Virginia's Precious Heritage

A Report on the Status of Virginia's Natural Communities, Plants and Animals, and a Plan for Preserving Virginia's Natural Heritage Resources

DCR
Department of Conservation & Recreation

Virginia Department of Conservation and Recreation
Natural Heritage Program

Virginia's Precious Heritage:

A Report on the Status of Virginia's Natural Communities, Plants, and Animals, and a Plan for Preserving Virginia's Natural Heritage Resources

A project of the Virginia Department of Conservation and Recreation

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Dear Fellow Virginians:

Most of us are familiar with Virginia's rich cultural heritage. But Virginia also has an incredibly diverse and precious natural heritage – a heritage that preceded and profoundly influenced our culture and is essential to our future.

We share the Old Dominion with more than 32,000 native species of plants and animals. They carpet our hills and valleys with green, they swim in our rivers and lurk in our deepest caves. A few play obviously important roles in our economy, such as the tree species that support our forest products industry, and the fishes and shellfish that are essential to the Chesapeake Bay's seafood businesses. Many more species are vital for clean air and water – indeed every green plant ensures our very existence by replenishing our supply of oxygen.

Virginia's vast array of species makes our lives rich in more subtle ways, too. Everyone who has ever savored a wild blackberry, enjoyed a Robin's song, inhaled the aroma of a water-lily blossom or feasted on the spectrum of red and gold of an autumn forest understands how natural diversity is vital to our souls. Natural diversity brings us satisfaction, often when we are unaware, and it is infused into our sense of place.

While most of us can name only a handful of species and identify how they serve our needs, it is important to remember that all life forms are interdependent. If we only focus on preserving the species that are pretty, or smell nice, or help us pay the bills, we may be dooming many of them to an unintended fate. It has been estimated that for every organism that becomes extinct, as many as 30 more, whose lives are intertwined, will follow. Because we may never understand all of the relationships between species, it is essential that we preserve all elements of our biodiversity and that we protect the land and waters that our native species require for survival.

Article XI of Virginia's constitution says state government is responsible for protecting our natural heritage:

> *"To the end that the people have clean air, pure water, and the use and enjoyment for recreation of adequate public lands, waters, and other natural resources, it shall be the policy of the commonwealth to conserve, develop and utilize its natural resources … to protect its atmosphere, lands and waters from pollution, impairment, or destruction, for the benefit, enjoyment and general welfare of the people of the commonwealth."*

We look to the Virginia Department of Conservation and Recreation and its Natural Heritage Program to lead the way in fulfilling this constitutional mandate as it pertains to preserving the Commonwealth's natural diversity of biological resources. However, we all must be informed and involved if we are to succeed. This report on the status and conservation needs of our natural heritage is intended to guide land conservation efforts and to safeguard Virginia's biodiversity.

This report is intended to give us – Virginia's government and citizens – some tools for better understanding and protecting our natural heritage. I encourage you to use this report. Mark it up. Copy it. And ask questions. Most of all, I urge you to get involved in natural resource conservation for the benefit of all present and future Virginians.

Please join me in protecting Virginia's precious natural heritage.

Sincerely,

W. Tayloe Murphy, Jr.
Secretary of Natural Resources
Commonwealth of Virginia

Preface

Joseph H. Maroon
Director, Virginia Department of Conservation and Recreation

It is no easy task to define the Virginia Department of Conservation and Recreation. Suffice it to say DCR's programs and activities – state parks, soil and water conservation, dam safety, land conservation, environmental education, and Virginia's Natural Heritage Program – touch virtually every Virginian.

It is also no easy task to quantify how biological diversity enhances our quality of life. True, we depend on biological resources for food, shelter and health. In addition, though we may be unaware, they have value for society's emotional and psychological well being. It would follow that understanding, quantifying and conserving these heritage resources enhances our lives. Failure to do so diminishes them. These resources need stewards. As they are better protected, their importance becomes much clearer to everyone – not just scientists and conservationists.

Virginians – all of us – "touch" virtually every species, habitat and natural community since our actions impact natural resources. Each organism has its own place in the scheme of the natural world and is valuable to and dependent upon the others. The most proactive approach to species conservation is assuring these organisms never become rare. We have benefited from them and we are entrusted with them. And our stewardship of them reflects our stewardship of creation.

In 1986 Virginia took a significant step toward conserving the state's heritage resources by establishing the Natural Heritage Program. In the 17 years since, that step has led to many advances in conservation as staff documented occurrences of more than 9,500 natural heritage resources, mapped 1,500 conservation sites, answered more than 35,000 information requests and established 38 natural area preserves totaling more than 35,000 acres. Much of the credit for this progress goes to Tom Smith, DCR's Natural Heritage director, and his dedicated, enthusiastic and ever-professional staff. We appreciate the many citizens, businesses and organizations that have made a difference in these endeavors.

The program has been named best in the Western Hemisphere by The Nature Conservancy; that is evidenced by the staff each day and through the compilation and production of this document. Almost daily, data contained within *Virginia's Precious Heritage* changes – we have more of it, we use it to answer questions or, perhaps, we protect an additional species or habitat. Almost daily, Virginia's biodiversity is better understood, quantified, monitored and protected.

I trust that you will find this document a useful tool for learning about, understanding or even becoming involved in conserving Virginia's rich natural heritage resources for our generation and the next.

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ACKNOWLEDGEMENTS

Virginia's Precious Heritage results from the work of many hands, feet, backs, ears, eyes and minds. It is the product of the scores of people who have contributed to the Natural Heritage Program over the course of its 14 years existence – the people who have braved hordes of hungry flies and ticks, struggled through miles of brambles, slithered into the deepest, darkest caves, dangled from mountainsides and waded through neck-deep muck, all in search of Virginia's rarest plants and animals. There are also those who have endured hours of tedium, carefully documenting minute and endless details and processing great volumes of data. And there are those who have labored to make sense of all that information, finding the patterns and asking fresh questions in order to develop some understanding of the condition of Virginia's precious natural heritage. Although space will not permit listing them all here by name, they are the people who created the foundation for this report.

Many individuals also contributed to the actual production of ***Virginia's Precious Heritage***, and hopefully we have named them all below. Unless otherwise noted, all contributed while employees of the Virginia Department of Conservation and Recreation's Natural Heritage Program. Tracey Tuberville and Irvine Wilson were the principal authors and project coordinators. Tom Smith, Steve Carter-Lovejoy, Gary Fleming, Chris Ludwig, Rick Myers, Wil Orndorff, Steve Roble, Megan Rollins, Larry Smith and Johnny Townsend made major contributions to the text. Mark Bradford served as the principal mapmaker and data-analyzer. Kevin Heffernan executed design and layout. Megan Rollins and private artist, Donna Smith, did the drawings. Gary Fleming, Curtis Hutto, Irvine Wilson, Rebecca Wilson and Claiborne Woodall provided photographs. Lois delBueno, Public Relations Specialist for the Virginia Department of Conservation and Recreation was the editor. Special thanks also go to the following individuals who provided vital input: Matthew Bley, Land Conservation Officer, Virginia Department of Conservation and Recreation; JoBeth Brown, Public Affairs Officer, George Washington and Jefferson National Forests; Mike Foreman, Stewardship Forester, Virginia Department of Forestry; Leslie Grayson, Director, Northern Virginia Office, Virginia Outdoors Foundation; Nancy J. Ross, Planning Team Leader, George Washington and Jefferson National Forests; Warren Wahl, Assistant Director, Virginia State Parks; and Daniel White, Director of Communications, Virginia Chapter of The Nature Conservancy.

A special thank you goes to NatureServe and the authors and editors of the book *Precious Heritage: The State of Biodiversity in the United States* (Stein, et al. 2000), whose work provided vital inspiration and information.

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Donna Smith: Figure 6.2

Executive Summary

In Virginia, pristine barrier islands line the Eastern Shore; expansive tidal marshes rim the Chesapeake Bay's creeks and rivers; dense blackwater swamps cover lowlands in the southeast; thousands of caves form secret chambers beneath western hills and valleys; and mile-high summits reach into the clouds in the southwest. From Brown Pelicans diving for mullet behind Atlantic breakers to Fraser firs swaying in the breeze at the top of Mount Rogers, a remarkable diversity of life occupies every conceivable niche across the state. These life forms, their natural communities and ecosystems are Virginia's very precious natural heritage - precious because they are unique and precious because, if not cared for, they may disappear. Furthermore, these natural treasures make Virginia a special place for people to call home.

Figure 1. Basic mesic forest, Stafford County.

Humans have an innate need for open space and natural diversity; almost any natural area that people consider beautiful or restful is a diversified, healthy system. When species are endangered, it is often an indicator that something is wrong with the quality of the environment. It is estimated that for every organism that becomes extinct, as many as 30 or more will follow because their lives are intertwined. There are many other reasons for protecting Virginia's biodiversity, but the most compelling justification for preserving the state's natural heritage may be simply the privilege of existing with a vast array of other living things.

The Virginia Natural Heritage Program, a component of the Virginia Department of Conservation and Recreation, is charged with preserving the Commonwealth's great diversity of biological resources, focusing specifically on natural heritage resources. These are defined as the habitats of rare, threatened or endangered plant and animal species, rare or state significant natural communities and similar features of scientific interest.

Virginia's Natural Heritage Program began in 1986 and is staffed by biologists, zoologists, ecologists, botanists, data managers and conservation professionals. Within ***Virginia's Precious Heritage*** their mission and methods are explained in detail, and their accomplishments are highlighted.

Virginia's Precious Heritage evaluates the current status of Virginia's natural heritage resources and identifies conservation targets for the upcoming decade. Among the major topics discussed are the collection, storage and analysis of natural heritage resource information, application of this information to the protection and management of significant natural areas in Virginia and development of new conservation initiatives. The many tables, maps and appendices in this publication display much of the data the program has collected to date.

Specific uses of ***Virginia's Precious Heritage*** include:

- Selection of local, regional and statewide land conservation priorities
- Selection of nodes in greenway and migration corridors
- Identification of mitigation sites
- Development project planning and site selection

- Outdoor recreational planning
- Prioritization of biological survey needs
- Local comprehensive planning
- Conservation biology reference

The Virginia Natural Heritage Program's systematic and scientific approach seeks answers to vital questions: What are the important elements of Virginia's natural heritage? What are the common and rare species and natural communities within the state's borders? Where do they occur, what is their conservation status, which are thriving and which are on the brink of extinction? Where are Virginia's best remaining natural areas and who owns them? Supplied with answers to these questions, the Natural Heritage Program seeks to protect the state's most significant habitats by educating landowners and policy-makers, by guiding land use decisions and by establishing a system of natural area preserves to provide permanent homes for many of the state's most imperiled species and natural communities.

The Natural Heritage Program staff evaluate information in several ways to focus their efforts and assign priorities for conserving Virginia's biological diversity. Using an internationally standardized methodology – which was developed and is maintained by NatureServe and the 75 member programs – they assess and rank the conservation needs of species and natural communities at a state and global level, the quality of individual natural heritage resource occurrences and the biodiversity significance of the areas that support one or more occurrences of rare species or natural community elements.

Each of the state's natural heritage resources is an element tracked by the Natural Heritage Program. An element's rarity status is described with a ranking system, which indicates its rarity and conservation status throughout its entire range – its G-rank – and within Virginia – its S-rank. For example the Shenandoah Salamander is ranked G1/S1. This Virginia endemic is known only from a single locality in Shenandoah National Park and is considered critically imperiled in the state and globally. Aside from ranking the status of each natural heritage resource, Natural Heritage Program staff scientists rank the quality, condition, viability and defensibility of each element occurrence. The occurrence is the area of land or water in which a species is, or was, present. Using both status ranks and occurrence ranks, it is possible to assess the biodiversity significance of conservation sites – areas that support one or more occurrences of rare species elements – across the state. By focusing on conservation sites that support the most viable occurrences of the rare elements in the state, an important part of the Commonwealth's conservation agenda can be established.

Another way to prioritize conservation actions is to concentrate on species and natural communities that are imperiled within the regions of the state that share common geology, landform and soils – areas referred to as physiographic provinces. Because plants, animals and natural communities are interdependent and are closely associated with the landscape, focusing on needs within physiographic provinces results in a systematic approach for determining conservation needs within the entire state. The physiographic provinces that occur, at least in part, within Virginia are: Cumberland Mountains, Ridge and Valley, Allegheny Mountains, Northern Blue Ridge, Southern Blue Ridge, Northern Piedmont, Southern Piedmont, Northern Coastal Plain, Southern Coastal Plain, and Outer Coastal Plain. The natural heritage resource elements found within each physiographic province have been reviewed to determine the most pressing needs for inventory, protection and stewardship and these highest priority elements are identified in this report for each physiographic province.

For all physiographic provinces ***Virginia's Precious Heritage*** contains information on a total of 6,289 element occurrences, 2,796 of which exist on protected lands, as of October 2003. These occurrences are located on approximately 1,800 conservation sites that occupy nearly 1,115,000 acres. Approximately one-third of the total conservation site acreage is currently protected in some fashion. Two-hundred-six rare species and natural communities are identified as top priorities for statewide inventory efforts. A total of 125 species and exemplary natural communities have been identified as likely to be lost from the state if specific conservation action is not taken in the next five to 10

years. The chapter detailing the provinces summarizes the natural heritage resources contained within each, as well as identifies elements that require immediate attention for inventory, protection and stewardship.

Virginia's biological diversity is subject to many significant threats. The greatest of these comes from habitat loss and habitat fragmentation as land is converted from agricultural, forest and open space uses to more intensive uses such as residential and commercial development, at the rate of 52,200 acres/year from 1982 to 1987 according to the USDA Natural Resources Inventory. Of the approximately 2,500 vascular plant species and nearly 740 vertebrate species native to Virginia, the Natural Heritage Program considers nearly a quarter of each to be rare. The program monitors the populations of these and more than 680 invertebrate species, as well as 145 natural community types. (Vascular plants include most green plants except the mosses; vertebrates include the fishes, amphibians, reptiles, birds and mammals; invertebrates include all other animal species – worms, mollusks, insects, spiders, etc.; and natural communities are assemblages of plants and animals living in close association with each other.) Only a fraction of the species considered rare by DCR has an official federal or state "threatened" or "endangered" species status. Natural Heritage Program staff help mitigate threats by sharing research and information on the locations of significant habitats, by participating in local and statewide land-use planning efforts, by educating the public and by intensively managing certain rare species habitats.

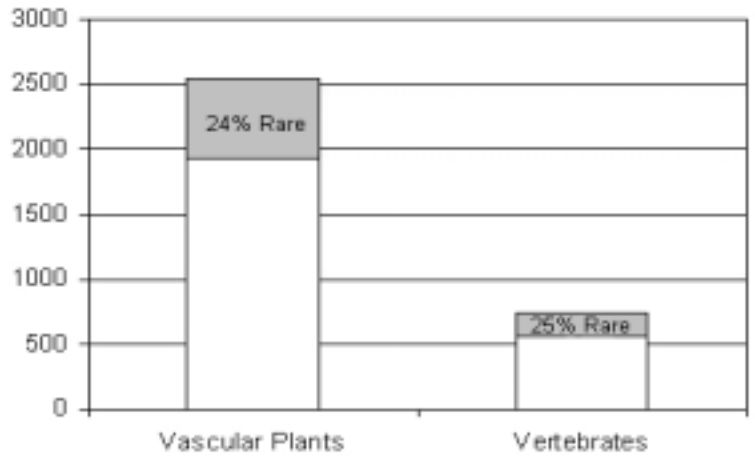


Figure 2. Numbers of vascular plant and vertebrate species in Virginia.

Data maintained by the Natural Heritage Program and contained within this document should interest anyone involved with land conservation, land planning or conservation biology, or who has an affinity for Virginia's rich natural history and the diversity of the living world. ***Virginia's Precious Heritage*** will serve as a valuable source for that information, but it is important to understand that natural heritage resource data are updated regularly and answers to conservation questions change with new information. This publication presents information at statewide and regional scales. Information at finer-than-regional scales, such as counties and individual sites, is available from the Natural Heritage Program upon request.

Natural heritage data can assist local, state and federal agencies, and private conservation organizations in identifying protection priorities and implementing policies to conserve the full range of natural biological diversity throughout the state. Data are also used to help educate the public about a wide range of topics including how and where to protect important watersheds, how to identify certain rare species and how to control invasive species.

To date, the Virginia Natural Heritage Program has accomplished a great deal, including developing the only comprehensive list of Virginia's rare, threatened and endangered vascular plants, vertebrates and major invertebrate groups. The current list totals more than 1,300 species, and directs major conservation action by the program and its partners. Program staff have documented the location and population status of almost 10,000 rare species and significant natural communities in Virginia through fieldwork, literature review, consulting with experts and museum research. Using data from more than 3,000 sampling sites across the state, Natural Heritage Program staff have classified 120 ecological community groups and related vegetation types occurring in the state. All the

while, they have furthered the understanding of Virginia's natural history, rare species and biodiversity with 253 technical reports, 125 scientific papers and a comprehensive web site.

Compared with other states, Virginia clearly stands out for its native species diversity – 10th for vertebrates and 13th for vascular plants. It ranks 8th in the U.S. for globally rare animals and 14th for globally rare plants. Unfortunately, it is the 8th state in the nation for plant and animal extinctions; 13 vertebrate (three bird, six mammal, four fish) and 13 mussel species are considered extirpated from Virginia. Of the several thousand species that occur naturally in the state, some occur only here - five vertebrate species, five vascular plants and a host of invertebrates. The Southern Appalachian Mountains, including Southwest Virginia, are one of six biodiversity hotspots in the country; within that, the nation's leading hotspot of aquatic diversity is the Clinch and Powell rivers. Virginia is also second in the U. S. for dragonfly diversity.

Funds and resources will always be limited for natural heritage inventory, information management, protection and stewardship work – therefore setting appropriate priorities is a key to success. Five key goals for conserving Virginia's biological diversity are set forth within *Virginia's Precious Heritage*. These are:

1. Secure a broad-based stable funding source for land conservation, including lands that support natural heritage resources.
    - ► Fully fund the Virginia Land Conservation Foundation.
    - ► Enhance the awareness of and delivery of conservation tools and tax incentives for private landowners who voluntarily conserve priority conservation sites or manage their land to benefit rare species and natural communities.
    - ► Expand efforts to encourage donations to the Conservation and Recreation Open Space Tax Check-off and Natural Area Preservation Fund to enhance natural area conservation efforts by localities and DCR.
2. Expand the existing network of conservation lands by securing more lands for natural area dedication, promoting more land conservation by local governments and encouraging greater investment by private conservation organizations.
    - ► Secure natural area preserve dedication and administrative public land designations for 200 high priority natural areas across Virginia by 2006.
    - ► Inform and promote land conservation at the local government level to meet the ever-increasing demand for open space lands.
    - ► Encourage increased investment in land protection by private conservation organizations.
3. Target conservation actions on the best opportunities and measure the success of the funds spent and actions taken.
    - ► Provide baselines which inform overall land conservation priorities and are a starting point to measure future progress.
    - ► Identify priority lands to meet current conservation needs.
    - ► Identify lands that meet multiple conservation goals.
    - ► Provide a continuous monitoring mechanism for re-evaluation of conservation needs.
    - ► Clearly and continuously track and document the progress of the Virginia Land Conservation Foundation.
4. Enhance natural resource information and expand the public awareness and understanding of natural resource conservation by expanding efforts to inventory natural heritage resources, enhancing cooperation with other conservation agencies and increasing the availability of natural heritage data for the general public, conservation organizations and government agencies.
    - ► Enhance and expand plant, animal and natural community inventory efforts across Virginia. There remains much to learn and the time to find and conserve these precious resources is rapidly dwindling.

- Work with localities to complete natural area inventories in regions of Virginia with high concentrations of natural heritage resources and/or high levels of threat. Such inventories will assist localities in their comprehensive planning and protection of natural areas.
- Enhance awareness of the importance of establishing natural areas to meet the needs of citizens.
- Create natural area conservation site information layers, which can be made available in a safe and informed manner to public and private conservation agencies and organizations at the local, regional and state level.
- Expand types of natural heritage information available to users via the Internet.
- Increase public awareness of significant karst (limestone regions with underground streams, sinkholes, and caves) features harboring natural heritage resources.
- Continue and enhance strong cooperation with the Virginia Department of Game and Inland Fisheries for efficient collection, exchange, and dissemination of information about Virginia's biological resources.

5. Promote more biodiversity-friendly resource management on Virginia's public and private lands.
   - Provide natural heritage resource management assistance to public and private land managers and owners with natural heritage resources on their properties and to DCR natural areas.
   - Write and implement management plans for public lands that set priorities for biodiversity conservation, expand the use of such common practices as prescribed burning, and provide alternative sites for conflicting land use issues.
   - Focus greater efforts on managing invasive alien species. These should include determining their distribution, status and effective control measures, and increasing public agency and private organizations' efforts to combat what has become a clear and present danger to native habitats throughout Virginia.

If these conservation goals are put into action, if individuals, agencies and organizations work together, and adjust their actions by objectively evaluating successes and failures, Virginia can meet its constitutional mandate to conserve its precious natural heritage for present and future generations.

Figure 3. American lotus (*Nelumbo lutea*).

Virginia Natural Heritage Program Mission:

Conserving Virginia's biodiversity through inventory, protection and stewardship.

Chapter 1

Overview of the Virginia Natural Heritage Program

In 1986 the Commonwealth of Virginia entered into a cooperative agreement with The Nature Conservancy to establish the Virginia Natural Heritage Program. This was the state's first step toward developing a comprehensive approach for conserving Virginia's rare plant and animal populations, and natural communities – what are referred to as natural heritage resources.

In July of 1988, the Virginia Natural Heritage Program came under the direction of the Department of Conservation and Recreation (DCR) and in 1989 the General Assembly passed the Virginia Natural Area Preserves Act, formally naming DCR the agency responsible for the program. The act (see Appendix B) charges DCR with the responsibilities of conserving the biological diversity of Virginia, inventorying natural heritage resources, maintaining a data bank of the information gathered through this inventory, and establishing a system of preserves dedicated to protecting natural heritage resources. Virginia's Natural Heritage Program has developed into one of the leading programs in the nation and supports as comprehensive approach to natural heritage conservation and management.

Strength of a Network

A key strength of the Virginia Natural Heritage Program is its participation in an international network of similar programs committed to preserving biodiversity. The Natural Heritage Network has members based in all 50 U. S. states, the Navajo Nation, most Canadian provinces, and 14 Latin American and Caribbean countries – a total of 75 independent member programs collecting, managing and sharing standardized biological data. Thus DCR's decisions are not based just upon Virginia data, but a global information system. A nonprofit organization called NatureServe (www.natureserve.org) acts as the hub of the network. NatureServe assists natural heritage programs by establishing standards for data collection and information management. Furthermore, NatureServe maintains a central database of information on rare species and natural communities, which has been compiled from existing sources (e.g., museum specimens, scientific publications) and from inventories conducted by natural heritage scientists throughout the network

The Fine and Coarse Filter Approaches to Biodiversity Protection

The Virginia Natural Heritage Program uses two approaches to protect the state's natural communities and plant and animal species. The more widely understood approach is to focus on protecting individual rare species. Sometimes referred to as the "fine filter" approach, it is effective in preserving biodiversity because often several rare species are found in close asso-

ciation with each other, plus many common species are protected with the rare ones. Another approach, which is considered the "coarse filter," is to protect the best-known examples of Virginia's natural community types. By protecting natural communities – such as oak forests, pine-scrub oak sandhills, bald cypress-tupelo swamps, and sea level fens – most of the state's flora and fauna will be protected, even species that are as yet undiscovered or not recognized as rare. The utility of the fine filter-coarse filter approach was succinctly stated in a motto by Robert Jenkins, The Nature Conservancy's first director of science and the individual responsible for creating the natural heritage network: "Protect the last of the least and the best of the rest."

Operational Structure

Since its inception, the Virginia Natural Heritage Program has been collecting, organizing, analyzing and providing information about the Commonwealth's natural heritage resources. The work of the program is carried out by staff organized in four sections: natural heritage inventory, information management, natural area protection and natural area stewardship. It is the day-to-day integration of these four sections that has made the Virginia Natural Heritage Program so successful at collecting data on natural heritage resources and using those data to provide recommendations and to develop strategies for the protection of Virginia's biodiversity. Responsibilities of each section are discussed below.

Natural Heritage Inventory

The Natural Heritage Program's inventory section is responsible for identifying, locating and assessing the status of the state's natural heritage resources. A dedicated team of botanists, zoologists and ecologists carries out this job, which requires systematically searching habitats across Virginia. Currently, natural heritage scientists collect site-specific information on 145 natural community types, 186 vertebrates, 682 invertebrates, and 641 plant species. The program maintains records on 9,735 rare species populations, significant natural communities and other significant biological and geological features that have been found in Virginia. (check numbers)

The inventory process begins by determining which species are rare and which natural communities are significant. This is an ongoing process, which relies on many informational sources for the status of each species and community type in the state and across their ranges. Those that are considered the most imperiled typically receive the highest priority for inventory. Scientists, using their knowledge of a species' or community's habitat requirements, rely on geologic maps, soils maps, topographic maps and aerial photographs to help focus their search. Once potential habitat is identified, landowner permission is secured and staff members conduct an inventory of the site. Because several rare species and communities may be found in association with each other, a thorough search may require visits at various times of the year by different staff representing a wide range of expertise.

Inventory staff conduct much of its work under contract to public and private organizations. One major client is the federal government. Recent inventories have included Virginia's National Park Service lands, the George Washington and Jefferson National Forests, and major Department of Defense facilities. Other inventories have been conducted along the entire Appalachian Trail and at selected state parks.

Inventory work is not finished with the completion of site visits. The location and condition of natural heritage resources must be thoroughly and consistently documented for uses both within and outside the Natural Heritage Program. Contract work usually requires detailed reports and staff make frequent contributions to scientific journals (see Appendix C for a list of reports and journal contributions). The inventory staff is also called upon to comment on potential impacts from proposed development projects and to re-

Natural Community Inventory
A natural community is an assemblage of co-existing, interacting species – considered together with the physical environment and associated ecological processes – that has undergone minimal human disturbance. The Virginia Natural Heritage Program collects and maintains information on the status, distribution and ecology of natural communities. Identifying and protecting excellent examples of all natural community types ensures the protection of the majority of native plant and animal species, including rare and poorly known species.

spond to queries from other scientists and the public.

Inventory ecologists are in the midst of a multi-year project to develop a hierarchical classification system for Virginia's natural communities. To date, descriptions of 120 natural community groups have been completed and published in Natural Heritage Technical Report 01-1. This report can be obtained by contacting the Virginia Natural Heritage Program or by visiting the website:

www.dcr.state.va.us/dnh.

Figure 1.1. Natural Heritage Program zoologist searching for rare insects.

Information Management

The Virginia Natural Heritage Program places great importance on having reliable, accurate and up-to-date information readily accessible for decision-making. The information management section is responsible for incorporating inventory data into a database system that maintains comprehensive data from a variety of sources on the location and condition of Virginia's plants, animals, natural communities and geological features, as well as on environmental, political and land ownership factors that influence biodiversity in Virginia.

Since 1987 Virginia has used the *Biological and Conservation Data System* (BCD) to maintain its natural heritage resources information. BCD is a data management application used by most members of the Natural Heritage Network. BCD maintains data in an integrated, accessible system of manual files, computer files, and a geographic information system (GIS). Since 2001 the Natural Heritage Program has been migrating from BCD to an integrated GIS data management system called the Biotics that will be used throughout the Natural Heritage Network. The system

Major Inventory Achievements

1. Developed the only comprehensive list of Virginia's rare, threatened and endangered vascular plants, vertebrates and major invertebrate groups. Currently including 641 plant and 868 animal species, these lists direct major conservation action by the Natural Heritage Program and its conservation partners.

2. Classified 120 ecological community groups and related vegetation types occurring in Virginia. This classification process is supported by comprehensive plot data collected at more than 3,000 sampling sites across the state.

3. Documented the location and population status of 9,735 rare species and significant natural communities in Virginia by gathering data through fieldwork, literature review, consultation with experts and museum research.

4. Mapped boundaries for 1,800 conservation sites and significant stream reaches that support natural heritage resources. These maps help direct development away from vital habitats and inform conservation partners about areas needing protection.

5. Furthered the understanding of Virginia's natural history, its rare species and significant natural communities, and the conservation needed to protect the state's biodiversity by preparing 261 technical reports, authoring 146 scientific papers and preparing a comprehensive web site.

currently contains Virginia's records for more than 7,797 elements of biodiversity, 9,735 natural heritage resources occurrences, 1,319 managed area properties, 1,828 conservation sites, 35,000 data requests and 20,045 separate information sources.

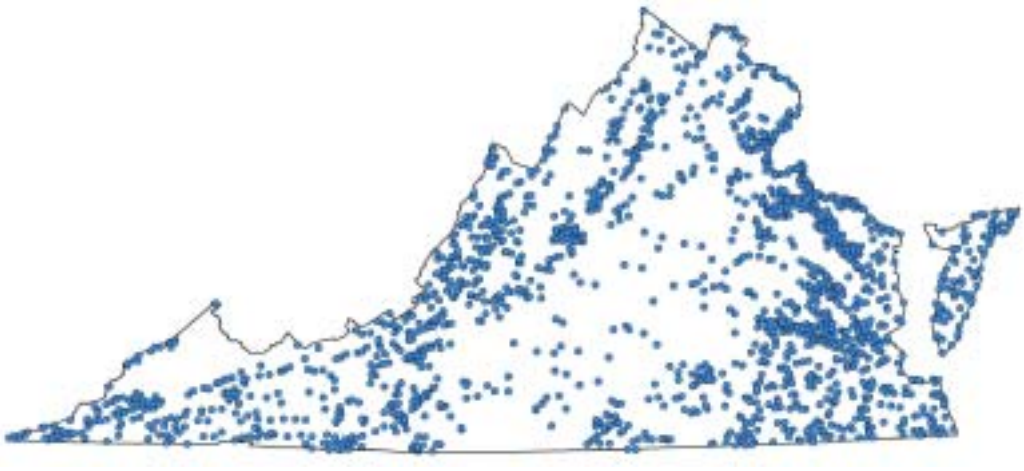


Figure 1.2. Locations of conservation sites and stream conservation units in Virginia.

This cache of data informs all of the work done by Natural Heritage staff – for example, determining rarity ranks, inventory needs and prospects, land protection priorities, potential conservation partners and stewardship needs. It is also a key resource for others – public and private land owners and land managers, researchers, conservation organizations, and students and teachers. Natural heritage resource data are especially useful for making land management decisions. Regulatory agencies such as the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers and the Virginia Department of Environmental Quality rely on natural heritage data in their permitting processes, and private developers and consultants and public development agencies such as the Virginia Department of Transportation use natural heritage resource data proactively in project planning to avoid or minimize negative environmental impacts. The Natural Heritage Program handles approximately 3,500 requests annually for information and project review.

Virginia Natural Heritage Program data *are widely used by program staff, other land and resource managers, and citizens in the Commonwealth to:*

- establish and refine the lists of Virginia's natural heritage resources
- set biological diversity protection priorities for 1,800 identified conservation sites
- assist public and private landowners and land managers to provide good stewardship for natural heritage resources on their lands
- review impacts on natural heritage resources of individual projects (about 3,500 requests per year) submitted by landowners, private consultants, and local, state and federal agencies
- provide scientific direction for local, regional and statewide land planning
- meet the research needs of scientists in government and academia
- fill requests for information from teachers and students, naturalists and other interested citizens
- be assembled with datasets from other states, through NatureServe, to meet regional and national natural heritage resource information needs

The Natural Heritage Program has recently created two new GIS coverages: the Conservation Lands Database and the Conservation Sites Database. The Conservation Lands Database includes boundaries and attributes for public and certain private lands in Virginia that have potential significance for serving a variety of conservation, recreation and open-space roles. Included are most federal and state lands, regional and interstate lands such as water and park authorities, parks and undeveloped lands owned by localities, lands owned as preserves by non-profit conservation organizations such as The Nature Conservancy and local land trusts, and conservation easements held by the Virginia Outdoors Foundation and other non-profit organizations. Public access to this da-

tabase will be provided through the DCR website in 2003.

Major Information Management Achievements

1. Collected, managed and made accessible in a variety of formats information for more than 9,600 occurrences of rare species and exemplary communities.

2. Identified, and made available as a GIS coverage, boundaries and conservation needs for 1,800 conservation sites containing one or more natural heritage resources.

3. Ensured the use of natural heritage resource data statewide as an integral part of environmental review processes, and responded to more than 35,000 requests for project reviews and natural heritage resource data.

4. Created and distributed Virginia's first comprehensive GIS database of public and private conservation lands.

5. Developed a long-term conservation plan for the Southern Watersheds of Virginia Beach and Chesapeake, identifying a range of options to maintain landscape connectivity through conservation corridors.

The Conservation Site Database holds information on key areas of the landscape worthy of protection and stewardship action because of the natural heritage resources and habitat they support. Each site has a boundary that encompasses one or more rare plant or animal population, or natural community and its associated habitat and other adjacent land thought necessary for the element's conservation. Conservation sites are ranked based on the rarity, quality and number of element occurrences they contain. This coverage will be made available to licensed users through password access to an Internet web site and will have two key uses: to identify priority lands for conservation actions, and to help with the design and review of development projects.

Natural Area Protection

Natural area protection staff select and implement strategies to protect the conservation sites identified through the inventory process. Natural area protection requires an understanding of the many factors that may affect the quality of a site, landowner attitudes and interests, which resource protection tools would be most appropriate and what may be accomplished with the resources available. The staff's primary responsibilities encompass three distinct roles: 1) natural area conservation planning; 2) natural area protection using a variety of tools; and 3) cave and karst protection.

Natural area conservation planning begins by gathering information about the site, including natural heritage resources, geology, hydrology, landscape features, ecological processes, threats, and economic and social factors influencing the site. After information is gathered and analyses are completed, site conservation boundaries are delineated. These boundaries are not regulatory zones or acquisition areas, but they guide protection and stewardship activities for natural areas and the natural heritage resources that they support. Conservation boundaries encompass areas within which land protection or landowner contacts are recommended. They may also address management needs such as areas required for the safe implementation of prescribed burns.

The ultimate goal of natural area protection is to secure habitats of natural heritage resources. The planning process guides the protection staff in determining which protection tools are most appropriate for a site. The most commonly used tools are:

- **The Virginia Registry of Natural Areas**, which encourages voluntary preservation of important natural lands in private and public ownership. This is a non-binding, non-regulatory program designed to recognize property owners who act voluntarily to safeguard natural areas.

- **Administrative designations** on federal lands such as special interest area, special management area and research natural area.

- **Conservation easements**, which allow landowners to protect land in perpetuity while re-

Virginia Conservation Lands Assessment

The Natural Heritage Program is taking a leading role in a new statewide project called the Virginia Conservation Lands Assessment (VCLA). This is a GIS-organized tool that models and maps priority conservation lands in the state. The VCLA is based on land use/land cover data derived from satellite imagery, augmented by such datasets as heritage conservation sites, existing public conservation lands, under-represented natural communities, unfragmented landscapes, natural floodplains and riparian forests, functional wetlands and significant viewsheds. The key use of the VCLA will be to direct land conservation toward the highest priorities, maximizing the achievement of multiple conservation goals, for

- biodiversity
- water quality
- recreation
- greenways
- agriculture
- historic/cultural resources

Other potential uses for this assessment include:

- Prioritize other resource management actions – e.g. invasive species control
- Identify priority potential restoration sites
- Provide data for local governments to use in planning for their future open space and growth needs

taining ownership. With a conservation easement, the landowner sells or donates certain rights for future land use. Easements are recorded on the deed and often landowners can benefit through local, state and federal tax incentives. The landowner retains rights to use the land in ways compatible with conservation goals.

- **Natural area dedication** as a state natural area preserve, which is the strongest protection tool available for natural areas, and involves the recording of a legally binding deed of dedication stating the intended use, management and development of the property. Dedicated natural area preserves may be owned by the Department of Conservation and Recreation, other state agencies, local governments, conservation organizations and private landowners.

The Natural Area Protection section, in addition to pursuing the protection of natural areas in general, plays an active role in protecting Virginia's karst areas. Karst is a landscape characterized by sinkholes, sinking streams, springs and caves that have formed in areas where mildly acidic groundwater has dissolved soluble rocks such as limestone. Virginia is rich in cave and karst resources, with more than 4000 known caves, located primarily west of the Blue Ridge Mountains. More than 150 cave organisms are tracked by the Virginia Natural Heritage Program due to their rarity – many are found in only one or two caves. Because of the abundance of karst areas in western Virginia, their importance as drinking water supplies, their sensitivity to environmental disturbance and their exceptional ecological diversity, karst areas warrant focused protection and pollution prevention efforts. The Virginia Natural Heritage Program is actively involved in the following cave and karst area protection initiatives:

Karst Groundwater Protection Program plays a leading role in cave and karst area education, monitoring and management in western Virginia. The program has developed forestry Best Management Practices (BMPs) for groundwater protection, BMPs for storm water management on karst areas and recommendations for preserve design in karst landscapes. In cooperation with other conservation organizations, the program has cleaned up of sinkhole dumps. The program also hosts training workshops and educational field trips. Program staff assist with project review and provide technical support to DCR's soil and water conservation division and other government agencies involved in groundwater protection and karst-related conservation issues. *Project Underground* is a national environmental education program on cave and karst resources. Project Underground provides lesson plans, games and hands-on projects to teach students in kindergarten

through high school about caves and karst ecology. The program is available through training workshops for teachers who wish to incorporate karst concepts into their curriculum. The *Project Underground* addresses many Standards of Learning across all grade levels.

The Virginia Cave Board, a collegial body of DCR, was established in 1979 to conserve and protect caves and karst lands of the Commonwealth and to advocate for the wise use of these resources. Eleven members of the 12-member board are appointed by the governor for four-year terms and are selected for their activity and knowledge in the conservation, exploration, study and management of caves. The Virginia Cave Board serves Virginia by advising agencies and private landowners on cave and karst-related matters, providing cave management expertise, preparing and presenting educational material, identifying significant caves, and recommending conservation and preservation measures for cave resources within the Commonwealth.

Figure 1.3. Gray's lily (*Lilium grayi*), a very rare species protected by Virginia's Natural Area Preserve System.

Stewardship

Conservation of natural areas does not end with land protection. After DCR acquires and/or dedicates natural areas of statewide significance, these areas are then actively managed to retain and enhance conservation values. *Natural area stewardship* is the long-term management of land and water to sustain natural heritage resources. The primary goals are (1) to restore and enhance habitat conditions suitable for rare species, and (2) to sustain the inherent biodiversity and beauty of natural communities. The Natural Heritage Program's Stewardship section focuses on maintaining the natural values of land areas and waterways to conserve biological diversity, both by managing state-owned lands as well as by advising public and private landowners about techniques for managing natural areas. The program's approach to natural area stewardship is summarized in the Natural Area Management Guidelines **(see Appendix D)**. Stewardship of dedicated natural area preserves in Virginia consists of six major components:

I . Management Planning. Natural Area Preserve Management Plans are developed to guide stewardship by establishing management goals for dedicated natural areas and formulating methods by which those goals will be achieved and management success measured. Plans include a wide array of supporting information and developed strategies for long-term protection, maintenance and enhancement of natural heritage resources supported on natural area preserves.

II. Biological Resource Management. 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 required processes or abating stresses. The primary objective is to restore ecosystem functions and maintain or enhance environmental conditions required to perpetuate rare species and natural communities. By taking actions

Major Protection Achievements

1. Oversaw establishment of 36 natural area preserves, totaling 27,899 acres.

2. Established the nation's only cave and karst protection program.

3. Secured $6.4 million in federal grants for the acquisition of natural area preserves.

4. Described for the U. S. Forest Service 174 conservation sites, encompassing 127,079 acres to be considered for special interest area designation.

5. Made direct contact with more than 100 private landowners of conservation sites to inform them of the significance of their property, to explain conservation measures that are appropriate for the natural heritage resources found there and to describe land protection options that may be available to them.

such as invasive species control or restoring natural hydrology, natural area stewards can improve habitat conditions for rare species and maintain the integrity (composition and structure) of natural communities.

Figure 1.4. Prescribed burn conducted on Cowbane Prairie Natural Area Preserve.

III. Operations Management. Site operations are a crucial aspect of natural areas stewardship. Especially on public lands, some recreational uses are compatible with the primary natural heritage resource management objectives while others are not. Natural area stewards design and maintain infrastructure such as trails, signs and observation areas in order to provide high quality visitor experiences while protecting natural heritage resources from adverse human effects. Routine management activities include boundary line and access road maintenance, site security, visitor safety and law enforcement. These actions all fall under the operations component of natural area stewardship.

IV. Fire Management. Prescribed burning is a specialized management activity that is essential in natural areas supporting occurrences of fire-maintained natural heritage resources. Prescribed fire is needed to perpetuate many species and communities that depend on fire but have become rare. Species rarity is often attributable to the fact that natural fire has been mostly eliminated as a landscape process by effective wildfire suppression and prevention programs. Prescribed fire is a unique component of steward-

Major Stewardship Achievements

1. Established five regional field offices across the state with full-time staff to provide effective, science-based stewardship for the natural area preserves in each region.

2. Established the Natural Heritage Fire Management Program with a full-time natural areas fire manager, rigorous training and performance standards, and a cache of specialized equipment – making fire a key tool of preserve management in Virginia.

3. Initiated invasive species control efforts on 16 preserves and ecological restoration projects on nine preserves. One major project underway is the restoration of more than one square mile of Piedmont grasslands and open woodlands at Difficult Creek Natural Area Preserve, featuring extensive habitat for the endangered smooth coneflower.

4. Developed strong alliances with conservation organizations, landowners and other agencies to restore vital habitats throughout Virginia. Partners include The Nature Conservancy, Virginia Native Plant Society, Old Dominion University, City of Newport News, City of Bedford, International Paper and Virginia Department of Forestry.

5. Developed public access facilities at 12 natural area preserves. Facilities include parking, trails, boardwalks, observation decks and interpretive signs.

ship, requiring expertise in biology, fire ecology and fire operations to safely and effectively mimic the process of natural fire under highly controlled conditions.

V. Research. Research to improve understanding of natural history, biology and population dynamics of rare species and ecosystem functions is needed for sound and defensible management planning. Scientific studies are conducted in-house or sponsored through funding support in order to inform stewardship decisions and actions.

VI. Monitoring. Natural area stewards use a variety of monitoring techniques to assess change in natural community composition and rare species population status. Monitoring can determine if natural processes essential to natural heritage resource health are occurring and whether or not management actions have been effective. Monitoring is also used to document and measure the effects of human activity on natural heritage resources protected within natural areas.

A Sound Investment

The Virginia Natural Heritage Program's efforts to identify and conserve Virginia's biological diversity represent a sound investment. In the 14 years since it became part of state government, the program has documented the occurrences of more than 9,500 natural heritage resources, mapped 1,500 conservation sites, answered more than 35,000 requests for information on rare species and established 36 natural area preserves, totaling nearly 28,000 acres. The State Natural Area Preserve System supports the greatest protected concentration of endangered species and exemplary natural communities in Virginia. The Nature Conservancy has recognized the Virginia Natural Heritage Program as the "Outstanding Natural Heritage Program in the Western Hemisphere" and it is regularly cited as a model in the International Natural Heritage Network. These accomplishments have been reached using only a minute fraction of the state government's total budget. Furthermore, the Natural Heritage Program's staff have raised approximately one third of the program's funding from sources outside state government through grants, contracts, donations and fees. Roughly half of the program's expenditures have gone toward the operation of the program – determining what the rare resources are, where they are, and working to conserve them – and half toward the acquisition of natural area preserves. A general breakdown of these two major expense categories follows.

Figure 1.5. Vegetation monitoring at Northwest River Natural Area Preserve.

Operational Funding

To date, the Natural Heritage Program has spent $14 million in state general funds for the overall operation of the program. Additionally, the staff have raised $6.4 million in non-general funds by winning competitive contracts and grants, and by charging nominal fees for some services. In effect, for every dollar invested by the state, an additional 46 cents have been brought to the program for conducting natural heritage resource inventories, for managing rare species habitats, for storing and retrieving vital data on rare species,

and for providing advice to the private and public sectors on how best to avoid impacts to rare species.

Much of the program's "soft money" is raised from a variety of sources to inventory natural communities and rare species populations. The largest outside funding support has come from the National Park Service, allowing Natural Heritage Program staff to conduct inventories in every National Park Service unit in Virginia. This funding has also allowed staff to provide various national parks with conservation planning products and detailed vegetation maps. The U.S. Forest Service has funded several major projects including inventories of forest districts and habitat types as well as a regional analysis and classification of vegetation types in Virginia's mountains. The Department of Defense has provided funding for inventories at almost all Virginia military bases, including the three largest, Fort A.P. Hill, Quantico and Fort Pickett. Other Federal partners, including the Environmental Protection Agency and the U.S. Fish and Wildlife Service, have provided major funding for a variety of projects such as inventory and recovery work on federal endangered species and regional vegetation mapping projects.

The Natural Heritage Program's project review function has drawn a small but steady stream of funding. One of the major external uses of the program's comprehensive databases is to identify potential impacts to natural heritage resources from proposed development projects and activities. Developers and consultants pay the program to review their projects and, when conflicts exist, to make recommendations on how to avoid or minimize impacts to natural heritage resources. The program's biggest project review client is the Virginia Department of Transportation, which has provided substantial funding assistance (from federal sources) for development of database enhancements.

Natural Area Preserve Funding

As of January 2003, $19.3 million have been invested in the State Natural Area Preserve System, which contains 36 preserves and totals 27,889 acres. From the very start, the Virginia Department of Conservation and Recreation recognized that to generate the funding required for natural area protection, a variety of public and private partnerships would be necessary. Natural area preserves have been purchased with general tax dollars, donations from private organizations and individuals, Virginia income tax check-off funds, federal grants and state bond funds. For each dollar of state funds that as been spent to purchase natural area preserve lands, an additional 40 cents has been raised from non-state funding sources.

In 1988, the General Assembly appropriated $1.5 million to be matched by $500,000 from The Nature Conservancy to create the Partners In Conservation Program, the first effort to acquire and dedicate lands to the Virginia Natural Area Preserve System. The Nature Conservancy, on behalf of the Department of Conservation and Recreation, purchased properties that became the first natural area preserves – North Landing River, Bethel Beach, Poor Mountain, Johnsons Creek, the Pinnacle and Big Spring Bog.

The Open Space Recreation and Conservation Fund is financed by Virginia tax payers who donate a portion of their state income tax refund for parks and natural areas protection and management. The fund does not receive large revenues annually but it has been used to purchase all or parts of properties at Bush Mill Stream, North Landing River and Poor Mountain natural area preserves. This fund has also been used to improve public access at a number of natural area preserves across the state.

Several Virginia landowners have made gifts of land or gifts of easements on dedicated natural area preserves. Some have been outright gifts of the natural area property; others have been partial gifts of land or donated easements. The value of gifts made to the Commonwealth for natural area dedication exceeds $1.2 million. Natural area preserves protected through gifts to the Commonwealth include Wm. B. Trower Bayshore, Grassy Hill, Folly Mills Fen and Grafton Ponds.

In 1992 Virginia voters approved the Parks and Recreational Facilities Bond. Included within this bond was $11.475 million for natural area acquisition and $675,000 for development of public access facilities on existing natural area preserves. Sixteen new preserves and additions to two existing preserves resulted from the expenditure of these general obligation bonds. These bond funds were used as match to leverage nearly $5 million in federal grants. Forty-four tracts, totaling 11,200 acres were purchased with these

bond and grant funds.

The Virginia Land Conservation Fund (VLCF) is a grant fund administered by DCR and the Virginia Land Conservation Foundation board. Grants have been given to private conservation organizations for a variety of land protection efforts including the purchase lands for natural areas and parks and for the preservation of open space, farmland, forestland and historic sites. One natural area preserve and additions to two existing preserves have been purchased with $661,000 of VLCF grants and an equal amount of private dollars. One additional VLCF funded natural area protection project in Northern Virginia is underway.

In November of 2002, Virginia voters, with a 69% majority, approved the passage of the Parks and Natural Areas Bond that will provide $13.2 million in funding for natural area preserve acquisition. These funds, plus an additional $6.8 million in bond funds approved by the Virginia General Assembly that same year, will result in substantive additions to the Virginia Natural Area Preserve System. As before, new preserves will be acquired, additions will be made to existing preserves and outside matching funds will be sought to increase the capacity of the department's land conservation effort. In the first few months since the passage of these bonds, the Natural Heritage Program secured two competitive federal grants, totaling $1 million, which will go to match the bond funds and negotiations are underway to purchase new preserves.

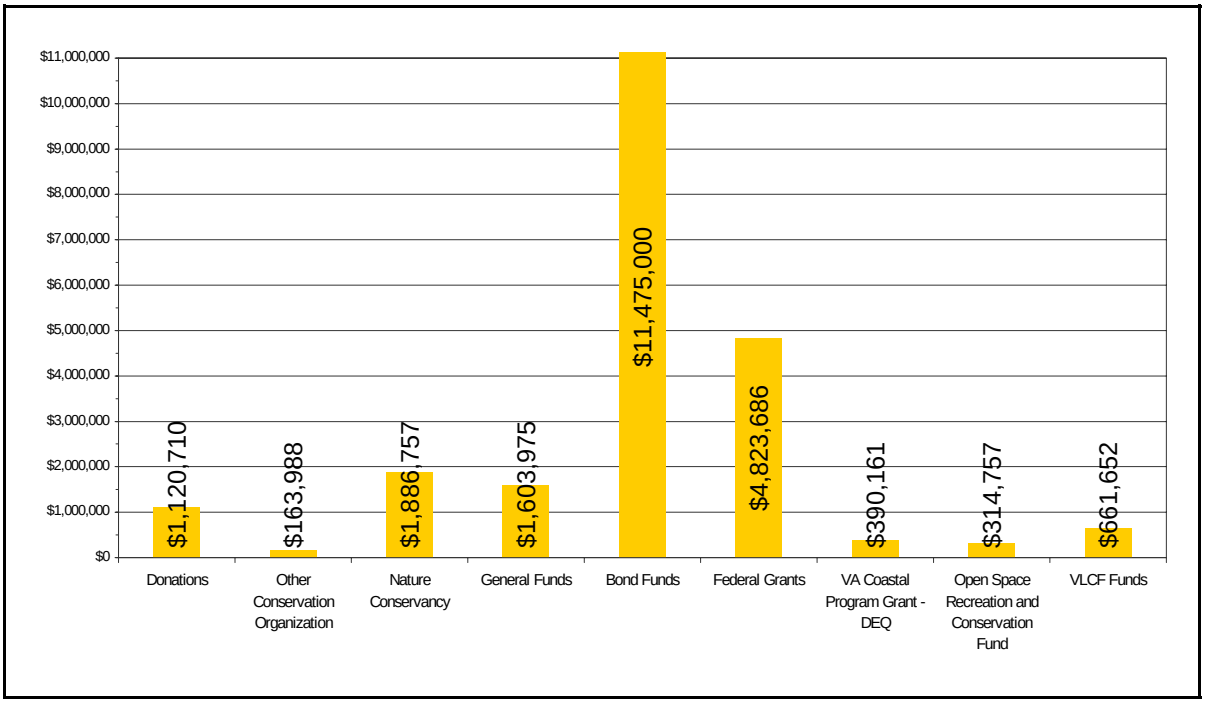


Figure 1.6. Expenditures by source for Natural Area Preserves.

Chapter 2

Virginia's Rich Natural Heritage

Virginia supports a rich diversity of plants, animals and natural communities. There are 2,546 species of vascular plants and 737 species of vertebrates known to be native to the state. While there is no accurate count of invertebrates, one conservative estimate places the number at 30,000 terrestrial and aquatic invertebrates species.

The exact number of natural communities is also unknown but the Virginia Natural Heritage Program has defined 120 broad ecological community groups, which are composed of several hundred community types. To comprehend the significance of this great biodiversity it is useful to see how Virginia compares with the rest of the nation and to understand some of the different ways of classifying rarity.

Virginia Compared with the Nation

When compared with other states in the U. S., Virginia is a clear standout for biodiversity. For overall native species diversity, the Commonwealth ranks 10th for vertebrates and 13th for vascular plants. Virginia ranks 8th in the U.S. for globally rare animals and 14th for globally rare plants. The Southern Appalachians, which includes southwest Virginia, was identified as one of six biodiversity hotspots in the United States by The Nature Conservancy and NatureServe in their joint publication *Precious Heritage: The Status of Biodiversity in the United States* (2000). The nation's leading hotspot of aquatic diversity is Virginia's Clinch and Powell rivers, and Virginia is ranked second in the U. S. for dragonfly diversity.

What the Virginia Natural Heritage Program Monitors

The Virginia Natural Heritage Program monitors the state's rare plants and animals and its recognized natural communities. Currently these total 1,660 elements – 186 vertebrates, 682 invertebrates, 609 vascular plants, 32 nonvascular plants, 145 natural community groups, and six other types of natural heritage resources. These numbers represent approximately a quarter of Virginia's known vascular plant and vertebrate species. Chapter 3 explains how species are selected for monitoring. For a complete list of natural communities, rare plants and rare animals tracked by the Virginia Natural Heritage Program see Appendix E.

Virginia's Endemic Species

Of the several thousand species that naturally occur in the state, some species have only been found in the Commonwealth—these are considered endemic to Virginia. Five vertebrate species and five vascular plant species are classified as such. Determining which of

the thousands of invertebrate species are endemic is a difficult endeavor, due to both the overwhelming task of surveying for them across the state and the varying levels of survey effort being conducted by other heritage programs in adjacent states. Currently, 129 invertebrate species have been documented only from Virginia, but this list will continue to be refined as inventory work continues. For a complete list of Virginia's endemic species, see Appendix F.

Figure 2.1. Addison's leatherflower (*Clematis addisonii*), a Virginia endemic.

Virginia's Lost Natural Heritage

Unfortunately, some species that were known to occur in Virginia can no longer be found in the state, despite intensive surveys. A species is considered extirpated from Virginia when it no longer exists in the wild within the Commonwealth. Some extirpated species are extinct, meaning there are none of its kind living anywhere, as is the case with the Passenger Pigeon and the Carolina Parakeet. Other species extirpated from Virginia still exist in the wild, but only outside of the Commonwealth, such as bison, elk, and gray wolf.

Distinguishing between species that have truly been extirpated and those that have simply not been observed for many years is sometimes difficult and uncertain. However, the Virginia Natural Heritage Program currently considers 26 vertebrate and mussel species or subspecies to be extirpated from the Commonwealth, including eight species and two subspecies that are also considered globally extinct. These animals have not been documented in recent years despite thorough inventories of their preferred habitat.

Species are classified as historic to Virginia when they have not been observed in the wild for an extended period of time – typically 15 to 20 years – but there remains some likelihood that it will be rediscovered. Species stay in this category until there is a documented occurrence in the wild, or sufficient evidence is found to consider the species extirpated. A total of 115 species are classified as historic to the state: five birds, one fish, one mammal, 39 invertebrates, and 67 plant species. For a complete summary of historic species, see Appendix H.

Some of Virginia's Endemic Species*

Plants

- Virginia round-leaf birch (*Betula uber*)
- Addison's leatherflower (*Clematis addisonii*)
- Virginia white-haired leatherflower (*Clematis coactilis*)
- Millboro leatherflower (*Clematis viticaulis*)
- Peter's Mountain-mallow (*Iliamna corei*)

Vertebrates

Fish

- Clinch sculpin (*Cottus sp 4*)
- roughhead shiner (*Notropis semperasper*)
- Roanoke logperch (*Percina rex*)

Amphibians

- Shenandoah salamander (*Plethodon shenandoah*)
- Peaks of Otter salamander (*Plethodon hubrichti*)

*There are 127 species of endemic invertebrates known for Virginia. For a complete list see Appendix F.

Threatened and Endangered Species Status

In the realm of conservation biology, the term "threatened and endangered species" typically refers to a formal legal status given to selected rare species and subspecies. Both the federal government and the Commonwealth of Virginia have enacted endangered species laws in an effort to save species from extinction and both entities maintain their own lists. Some Virginia species appear on the federal list, some only on the state list and some on both. "Endangered species" are considered more imperiled than "threatened species" but both groups have similar legal protection.

The U. S. Fish and Wildlife Service and the National Marine Fisheries Service have enforcement authority for the federal act. The Virginia Department of Game and Inland Fisheries has responsibility for all of the state's threatened and endangered animals, except insects. The Virginia Department of Agriculture is responsible for the state's threatened and endangered plants and insects. While the Virginia Natural Heritage Program data are often used for assigning threatened and endangered status, the agency is not responsible for making those determinations. Furthermore, only a fraction of the species considered rare by the Natural Heritage Program have threatened or endangered status. Appendix E shows the federal and state legal status of the plants and animals that are monitored by the Virginia Natural Heritage Program. The Virginia Endangered Species Acts are provided in Appendices I and J. The federal Endangered Species Act can be accessed on the web at:

http://endangered.fws.gov/esa.html

Vertebrate and mussel species believed to be extirpated from Virginia

Birds

Carolina Parakeet (*Conuropsis carolinensis*)*
Bachman's Warbler (*Vermivora bachmanii*)
Passenger Pigeon (*Ectopistes migratorius*)*

Mammals

bison (*Bos bison*)
eastern cougar (*Puma concolor couguar*)
gray wolf (*Canis lupus*)
red wolf (*Canis rufus*)
porcupine (*Erethizon dorsatum*)
wapiti or elk (*Cervus elaphus*)

Fish

blackside darter (*Percina maculata*)
harelip sucker (*Moxostoma lacerum*)*
shortnose sturgeon (*Acipenser brevirostrum*)
trout-perch (*Percopsis omiscomaycus*)

Mussels

acornshell (*Epioblasma haysiana*)*
Cumberland bean (*Villosa trabalis*)
Cumberland leafshell (*Epioblasma stewardsonii*)*
elephant ear (*Elliptio crassidens*)
forkshell (*Epioblasma lewisii*)*
green-blossom pearlymussel (*Epioblasma torulosa gubernaculum*)**
narrow catspaw (*Epioblasma lenior*)*
Ohio pigtoe (*Pleurobema cordatum*)
pink mucket (*Lampsilis abrupta*)
rayed bean (*Villosa fabalis*)
rough pigtoe (*Pleurobema plenum*)
sugarspoon (*Epioblasma arcaeformis*)*
yellow-blossom pearlymussel (*Epioblasma florentina florentina*)**

**Species is extinct*
***Subspecies is extinct*

Chapter 3

From Elements to Conservation Sites

Funds and resources will always be limited for natural heritage inventory, information management, protection and stewardship work, thus setting the proper priorities is a key to success. The methodology developed within the natural heritage network provides a framework to assess and rank the conservation needs of species and natural communities at a state and global level, the quality of individual natural heritage resource occurrences and the biodiversity significance of the conservation sites that support the rare elements of the state.

This chapter will summarize the methodology used to assess and prioritize the conservation needs for species and natural communities and conservation sites.

The Element Approach

Natural heritage resources are the individual elements tracked by the Natural Heritage Program. The term natural heritage resource is defined in the Natural Area Preserves Act as the habitat for the rare native plant and animal species in Virginia as well as rare or significant natural community types, biologically significant caves, and the other significant biological features such as great blue heron colonies or mussel concentration sites. For each natural heritage resource, or element, data are gathered on distribution, rarity, relevant threats, existing level of protection, and unmet protection and management needs. Standardized Natural Heritage Program methodology is used to determine the conservation status of each element, evaluate the quality and ecological significance of each of its occurrences, and rank elements in terms of their protection needs. The elements in greatest peril become the highest priorities for further inventory, protection and stewardship efforts.

Ranking Elements: Global and State Conservation Status

Each element is assigned a global and state rank, which relates to its conservation status on these levels (see **Definitions of Natural Heritage State Conservation Status Ranks** sidebar). The global rank, or G-rank, indicates the element's rarity and conservation status throughout its entire range, while the state rank, or S-rank, indicates the same within a particular state. In most cases, an element is ranked using a five-point scale that represents its conservation status (1 = critically imperiled, 5 = widespread and secure) based on the number of occurrences, total overall abundance of the element and degree of threat to the element. When a specific conservation status cannot be assigned or is uncertain for an element, a combination rank can be assigned, e.g., S1S2.

In some cases it may be necessary to use special ranks, such as when an element is believed to be extirpated or extinct. When a global rank is applied to a subspecies, the rank of the full species is noted along with that of the subspecies, e.g., G3T1.

Global and state conservation status ranks are used by

Definitions of Natural Heritage State Conservation Status Ranks (S-ranks)

S1 **Critically imperiled** with five or fewer occurrences or few remaining individuals in Virginia; or because of some factor(s) making it especially vulnerable to extirpation in Virginia.

S2 **Imperiled** with six to 20 occurrences or few remaining individuals in Virginia; or because of some factor(s) making it vulnerable to extirpation in Virginia.

S3 **Vulnerable** in Virginia with between 20 and 100 occurrences; may have fewer occurrences if found to be common or abundant at some of these locations; may be somewhat vulnerable to extirpation in Virginia.

S4 **Apparently secure,** uncommon but not rare with more than 100 occurrences; may have fewer occurrences with numerous large populations.

S5 **Secure,** very common and widespread in Virginia.

SX **Apparently extirpated** from Virginia with virtually no likelihood of rediscovery. **GX** the element is presumed extinct and has not been located despite intensive searches.

SH **Historically known** from Virginia with the expectation that it may be rediscovered. **GH** the element is possibly extinct but there still is some hope of rediscovery.

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

SZ **Regularly occurring migrants, transients or non-breeding seasonal residents** whose occurrences are too irregular, transitory and dispersed to be reliably identified, mapped and protected.

SA **Accidental** in the state.

SE **Exotic**; not native to Virginia.

Global Ranks: Global ranks (G-ranks) for conservation status are similar to state ranks, but refer to the status of a species throughout its entire range rather than just within a state.

Natural Heritage Program staff to identify the rarest species in Virginia, set conservation priorities and to plan status survey work. Elements with the highest conservation status ranks are given greatest priority. For example, the Shenandoah salamander (*Plethodon shenandoah*), a Virginia endemic known only from a single locality in the Shenandoah National Park, has a rank of G1/S1 and is critically imperiled in the state and globally. Although the pygmy salamander (*Desmognathus wrighti*) is imperiled in Virginia (ranked S2) it is apparently secure over its entire range (G4) and receives somewhat lower priority. The red-backed salamander (*Plethodon cinereus*) is demonstrably secure and common throughout its range (G5/S5). As such, this species is not actively monitored by the Virginia Natural Heritage Program.

Ranking Occurrences: Element Occurrence Ranks

In addition to ranking the conservation status of each natural heritage resource, staff scientists also rank the quality of each element occurrence (EO rank) on a qualitative scale that represents the quality and condition of the occurrence. An element occurrence is an area of land or water in which a species or natural community is currently, or was once, present. A rank is assigned to each element occurrence using the best and most current information available.

Element occurrences are ranked according to their quality (size, maturity and vigor of population or community), condition (natural quality of habitat), viability (likelihood of long-term survival of resource), and

Element Occurrence Ranks

A	excellent estimated viability
B	good estimated viability
C	fair estimated viability
D	poor estimated viability
E	verified as extant, still existing
H	historical
F	failed to find a previously documented occurrence but habitat still present
X	extirpated

defensibility (extent to which occurrence can be protected from anthropogenic damage). The Natural Heritage Network has developed criteria for ranking element occurrences for most elements. The criteria vary from element to element, but are used by all natural heritage programs, ensuring consistent ranking across the range of the element. By ranking both the element and each of its occurrences, protection efforts can be focused not only on the rarest natural heritage resources, but also the best examples of each.

Ranking Conservation Sites: Biodiversity Ranks

The Natural Heritage Program uses conservation status ranks (G-ranks and S-ranks) and element occurrence ranks (EO-ranks) to assess the biodiversity significance of conservation sites across the state. A conservation site is an area that supports one or more occurrences of rare species or natural community elements of the state. The biodiversity rank (B-rank) for a conservation site is based on the conservation status rank of the natural heritage resources found there and the quality rank of each occurrence. Biodiversity ranks establish the relative significance of conservation sites across the state. These ranks are used to help develop the conservation agenda of the Commonwealth by focusing efforts on conservation sites that support the most viable occurrences of the rarest elements in the state. Each conservation site is assigned a biodiversity rank on a five-point scale. (See the sidebars **Definitions of Biodiversity Ranks** and **Determining Biodiversity Ranks for Conservation Sites**.)

Conservation Site Boundaries

The Natural Heritage Program draws conservation site boundaries for occurrences of natural heritage resources that are found on land or small, confined water bodies. These areas, referred to as conservation sites, are designed to include the rare plant or animal population, or natural community, their associated habitats and additional lands judged necessary for the long-term viability of the elements present. The additional area around the natural heritage resource occurrences includes areas of water quality concern, water recharge zones and buffers to reduce threats from adjoining areas, and may include lands necessary to implement certain management actions such as prescribed burning. The boundaries of a conservation site may change over time as new information is gathered about the site, its natural heritage resources and the surrounding area. Figure 3.1 shows a typical conservation site.

Stream Conservation Units

A different approach is necessary to develop conservation boundaries for natural heritage resource elements that live in streams, rivers and other large bodies of water. For these aquatic elements it is unrealistic to draw boundaries that would encompass expansive uplands surrounding the aquatic elements to ensure their protection, since in some cases that boundary would include all or major portions of the watershed above the element occurrence. Instead, the conservation sites for rare plant and animal occurrences in streams and rivers are delineated on the stream reaches where they occur. Called a stream conservation unit, or SCU, each is drawn to include the waterway and its perennial tributaries two miles upstream and one mile downstream of the element occurrence. If two SCUs are within one stream mile of each other, the two units are joined together. B-ranks are assigned to stream conservation units using the methodology used for terrestrial conservation sites. The Virginia Natural Heritage Program monitors more than 240 species that occur in streams and rivers. These SCU species include mussels, fish, reptiles, amphibians, dragonflies, damselflies, other invertebrates and a few aquatic plants. Figure 3.2 shows a typical SCU.

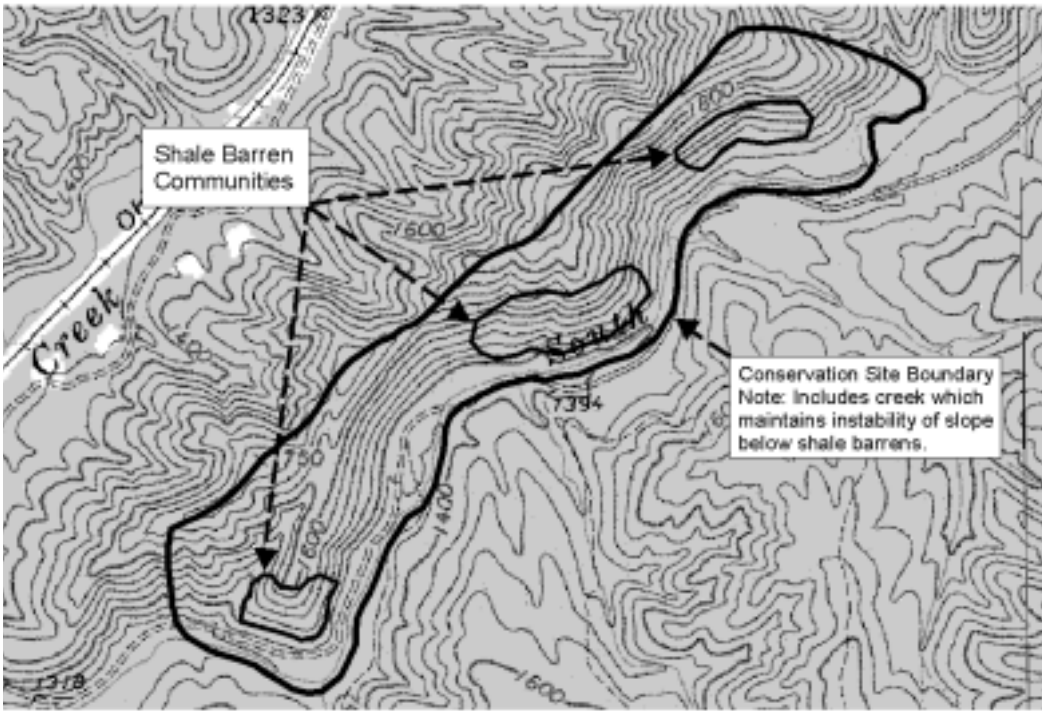


Figure 3.1. A typical conservation site boundary map.

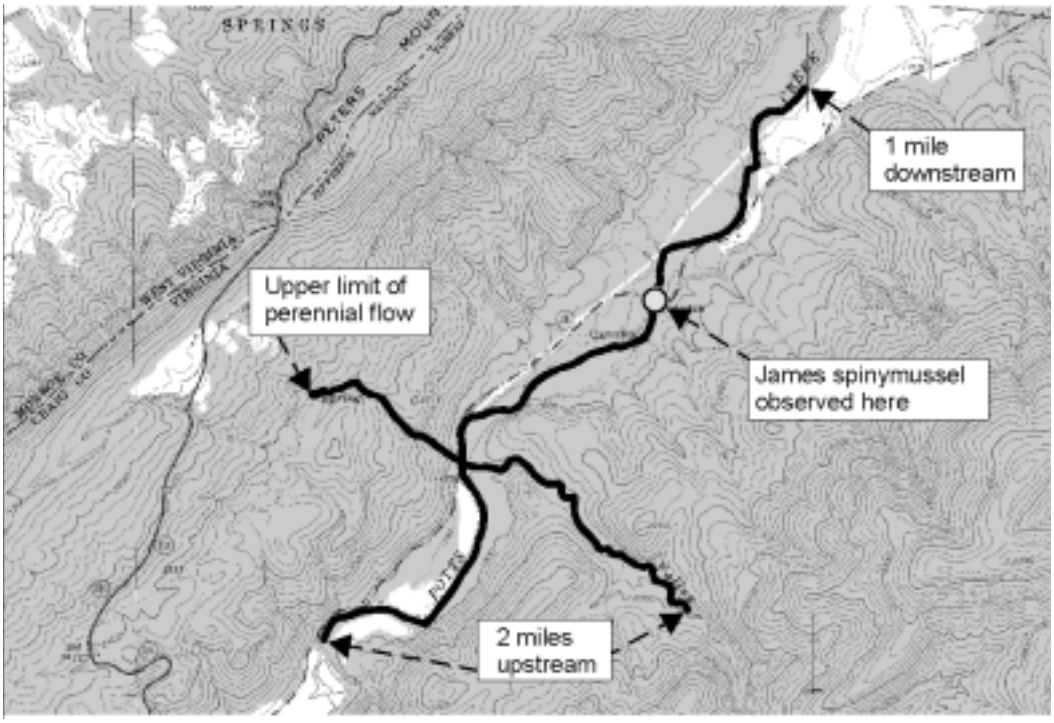


Figure 3.2. A typical stream conservation unit map.

Definitions of Biodiversity Ranks (B-ranks)

B1 Outstanding significance: only known site for a natural heritage resource or an excellent occurrence of a G1 species;

B2 Very high significance: the best example of any natural community type, a good occurrence of a G1 species, or an excellent occurrence of a G2 or G3 species;

B3 High significance: excellent example of any natural community type or a good occurrence of a G3 species;

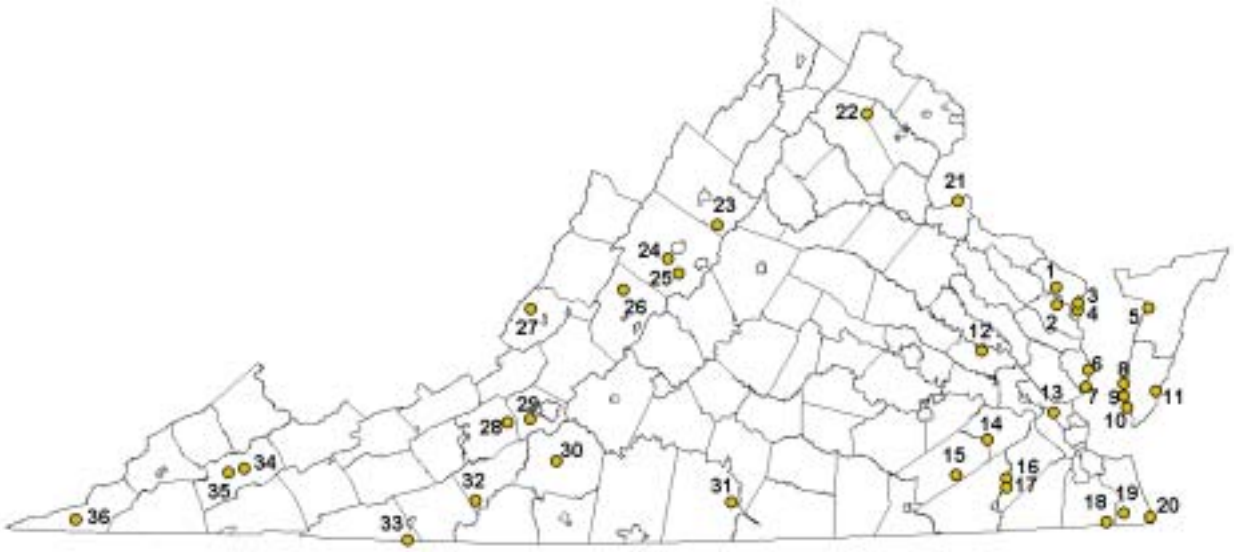
B4 Moderate significance: a good example of a rare natural community type, a fair occurrence of a G3 species, or an excellent or good occurrence of a S1 or S2 species;

B5 General significance: fair to poor occurrence of a rare natural community or an S1 or S2 species, any excellent or good occurrence of an S3 species, or any natural area of general biodiversity or open space interest.

Conservation sites that support four or more natural heritage resources may have their B-rank raised to a level higher than that which would be indicated by the presence of any one of the resources. For example, a natural area containing good occurrences of four different G3 species would be ranked B2, rather than B3.

Table 3.1. Determining Biodiversity Ranks for Conservation Sites.

ELEMENT OCCURRENCE RANKS	GLOBAL AND STATE RANKS							
	G1	G2	G3	G4/ S1	G5/ S1	G4 or G5/ S2	G4 or G5/ S3	Any community without a G-Rank
A	B1	B2	B2	B4	B4	B4	B5	B3
4 OR MORE w/ A RANK	B1	B1	B2	B3	B3	B4	B4	B2
B	B2	B2	B3	B4	B4	B5	B5	B4
4 OR MORE w/ B RANK	B1	B1	B2	B3	B3	B4	B5	B3
C	B2	B3	B4	B5	B5	B5		B5
4 OR MORE w/ C RANK	B2	B2	B3	B5	B5	B5		
D	B2	B3	B5	B5	B5	B5		



1 Bush Mill Stream
2 Hickory Hollow
3 Dameron Marsh
4 Hughlett Point
5 Parkers Marsh
6 Bethel Beach
7 New Point Comfort
8 Savage Neck Dunes
9 Cape Charles Coastal Habitat
10 William B. Trower Bayshore
11 Wreck Island
12 Cumberland Marsh
13 Grafton Ponds
14 Dendron Swamp
15 Chub Sandhill
16 Antioch Pines
17 Blackwater Ecological Preserve
18 Northwest River
19 North Landing River
20 False Cape State Park
21 Chotank Creek
22 Bull Run Mountains
23 Deep Run Ponds
24 Folly Mills Creek Fen
25 Cowbane Prairie
26 Goshen Pass
27 Johnsons Creek
28 Pedlar Hills
29 Poor Mountain
30 Grassy Hill
31 Difficult Creek
32 Buffalo Mountain
33 Big Spring Bog
34 Pinnacle
35 Cleveland Barrens
36 The Cedars

Figure 4.1. Locations of Virginia's Natural Area Preserves.

Chapter 4

Virginia's Natural Area Preserve System

The *Virginia Natural Area Preserves Act* authorizes the Virginia Department of Conservation and Recreation to acquire and manage a statewide system of natural area preserves. This system of protected lands includes some of the finest forests, barrens, natural ponds, swamps and marshes in Virginia. The first component of the system was 1,200 acres of wind-tide marsh and pocosin on the North Landing River, which was dedicated as a natural area preserve in October 1990. As of April 2003, the system includes a statewide network of 36 dedicated preserves covering 27,899 acres. The system is actively growing with new preserves and additions to existing preserves added each year.

Criteria for Establishing Natural Area Preserves

The public and private lands that have been dedicated as natural area preserves have been selected to protect some of the rarest and most threatened elements of Virginia's natural heritage. A basic requirement is that each natural area must support viable occurrences of natural heritage resources. Dedication is used only for those natural areas that support Virginia's most significant natural heritage resources. The criteria used to determine if a natural area qualifies for dedication include:

1. The natural heritage significance of the conservation site.
2. Whether the size and condition of the site are adequate to meet protection and management needs of the elements present.
3. The degree to which the elements present on the conservation site are adequately protected on other lands.
4. The number and quality of rare species populations.
5. The number and quality of exemplary natural communities.
6. The physical or functional proximity of the conservation site to other protected lands.
7. The potential costs of managing the site and of restoring conditions favorable for natural heritage resources.
8. The level of threats to natural heritage resources from invasive species and other factors.

By assigning scores to these attributes, conservation sites that are candidates for natural area dedication may be evaluated and compared. See Appendix X for the complete Conservation Site Scorecard.

Deed of Dedication

Natural area preserves are permanently protected through a legal instrument called a deed of dedication. The deed of dedication restricts certain uses and activities and allows others to occur depending on the management and protection needs for the natural area. Permissible activities would be those appropriate and compatible with the protection goals for the area. The protection offered to the property is perpetual. On

Table 4.1. Virginia Natural Area Preserve System. For map, see Figure 4.3.

NATURAL AREA PRESERVE	LOCALITY	ACRES	OWNER	NATURAL HERITAGE RESOURCE SIGNIFICANCE
Antioch Pines	Isle of Wight	400	DCR	Mature loblolly pine-turkey oak sandhills along the Blackwater River
Bethel Beach	Mathews	104	DCR	Rare plants, beach and marsh nesting birds and northeastern beach tiger beetle
Big Spring Bog	Grayson	50	DCR	Rare wetland community and pitch pine barrens; globally rare plants
Blackwater Ecological Preserve	Isle of Wight	318	ODU	One of Virginia's last longleaf pine-turkey oak barrens
Buffalo Mountain	Floyd	1,000	DCR	Balds, prairie-like openings, and magnesium rich seeps; 18+ rare species
Bull Run Mountains	Fauquier/ Prince William	2,486	VA Outdoors Foundation	Significant forest, cliff and swamp communities
Bush Mill Stream	Northumber-land	103	DCR	Mature hardwood forest and Great Blue Heron foraging area
Cape Charles Coastal Habitat	Northampton	29	Northamp-ton County	Coastal beach, dune and maritime forests; migratory songbird habitat
Chotank Creek	King George	1,108	Private	Coastal plain forest, swamp and tidal marsh systems, Bald Eagle nesting and feeding habitat
Chub Sandhill	Sussex	387	DCR	Rare sandhill community with five rare plants
Cowbane Prairie	Augusta	63	DCR	Wet prairie community with many rare plants
Cleveland Barrens	Russell	943	DCR & TNC	Limestone barrens with rare plants and animals
Cumberland Marsh	New Kent	1,193	TNC	Exemplary freshwater marsh, globally rare plants and animals
Dameron Marsh	Northumber-land	316	DCR	Exemplary Chesapeake Bay marsh and bird nesting area; fed-erally listed animal
Deep Run Ponds	Rockingham	668	DCR	Shenandoah Valley sinkhole ponds system
Dendron Swamp	Sussex	179	DCR	Old-growth bald cypress / tupelo swamp forest; state listed animal
Difficult Creek	Halifax	653	DCR	Piedmont pine-hardwood barrens
False Cape State Park	Virginia Beach	3,573	DCR	Five maritime community types, approx. 20 rare plants and 2 rare animals

dedicated natural area preserves that are not owned by the Commonwealth, the deed of dedication works very much like a conservation easement. Like an easement, certain uses and activities of the natural area are relinquished by the landowner and restricted forever. At this time, most of the natural area preserves are owned by the Virginia Department of Conservation and Recreation, but dedicated preserves can remain in private ownership by individuals, groups or corporations or in state or local government ownership. Federal lands cannot be dedicated as natural area preserves.

Preserve Management

All natural area preserves are managed to provide habitat for rare or declining species and to protect rare or exemplary natural communities. While every preserve requires some form of active management, the level of activity required to appropriately maintain and protect each preserve varies. At the minimum, preserve boundaries must be posted and the preserves must be monitored for encroachment from inappropriate human activities and for environmental changes that might adversely affect natural heritage resources. Some

Table 4.1. Virginia Natural Area Preserve System (continued from previous page). For map, see Figure 4.3.

NATURAL AREA PRESERVE	LOCALITY	ACRES	OWNER	NATURAL HERITAGE RESOURCE SIGNIFICANCE
Folly Mills Creek Fen	Augusta	29	Private	Calcareous wetland supporting many rare plants
Goshen Pass	Rockbridge	936	DCR	Chestnut forest community, several rare plants and a rare animal
Grafton Ponds	York	375	Newport News	Virginia's finest coastal plain sinkhole pond system; many rare plants and animals
Grassy Hill	Franklin	1,295	DCR	Grassland communities and rare species habitats
Hickory Hollow	Lancaster	254	Northern Neck Audubon	Seepage swamp community, rare plant
Hughlett Point	Northumber-land	204	DCR	Coastal marsh, beach, and dune system, northeastern beach tiger beetle
Johnsons Creek	Alleghany	99	DCR	Exemplary shale barren, shale barren rockcress, and several other rare plants
New Point Comfort	Mathews	95	TNC	Chesapeake Bay beach and northeastern beach tiger beetle
North Landing River	City of Vir-ginia Beach	3,441	DCR	Wind-tide marshes, swamp, and pocosin; 30+ rare animals and plants
Northwest River	City of Chesa-peake	2,418	DCR & TNC	Freshwater marsh, swamp, and upland forest; many rare animals and plants
Parkers Marsh	Accomack	759	DCR	Coastal marsh, beach, and dune system, northeastern beach tiger beetle
Pedlar Hills Glades	Montgomery	522	DCR	Dolomite glades, globally rare plants
Pinnacle	Russell	554	DCR	Limestone glades with state and globally rare plants and animals
Poor Mountain	Roanoke	925	DCR	Montane pine and hardwood forest; globally rare piratebush
Savage Neck Dunes	Northampton	299	DCR	Coastal beach, dune and maritime forest system; migratory songbird habitat; rare species
The Cedars	Lee	709	DCR	Caves and limestone glade and woodland communities; globally rare species
Wm. B. Trower Bayshore	Northampton	35	DCR	Coastal beach and dune system; state and globally rare plants and animals
Wreck Island	Northampton	1,380	DCR	Nesting habitat for endangered shorebirds, coastal grasslands
Total acres		27,899		

preserves require frequent, hands-on management because a variety of factors threaten the rare species and special communities the preserves were established to protect. (See Appendix D for complete Natural Area Preserve Management Guidelines.)

In some cases, the rare species populations and natural communities within preserves are declining and are mere vestiges of what once occurred at these sites. Often this is the result of decades or even centuries of previous land-use activities and steps must be taken to restore or mimic the original natural processes that once maintained these habitats. Some habitat restoration can be accomplished in a few seasons and at relatively small expense – such as by reseeding former agricultural fields with native grasses, or by plugging old drainage ditches to restore former wetlands. Other projects may be more long-term and labor intensive – such as using prescribed burns to re-establish fire-dependent communities.

Invasive exotic species are another significant management issue, which requires a great deal of stewardship attention. Preserves must be routinely monitored for the establishment and spread of invasive species. Controlling invasive species is often costly and labor-

Table 4.2 Natural Heritage Resources Protected on Virginia's Natural Area Preserves

Fish
Fundulus lineolatus (lined topminnow)
Percina rex (Roanoke logperch)

Amphibians
Ambystoma mabeei (Mabee's salamander)
Cryptobranchus alleganiensis (hellbender)
Necturus punctatus (dwarf waterdog)
Hyla gratiosa (barking treefrog)

Reptiles
Crotalus horridus atricaudatus (canebrake rattlesnake)
Ophisaurus ventralis (eastern glass lizard)
Tantilla coronata (southeastern crowned snake)

Birds
Ammodramus caudacutus (Saltmarsh Sharp-tailed Sparrow)
Ardea alba (Great Egret)
Charadrius melodus (Piping Plover)
Charadrius wilsonia (Wilson's Plover)
Egretta caerulea (Little Blue Heron)
Egretta thula (Snowy Egret)
Egretta tricolor (Tricolored Heron)
Eudocimus albus (White Ibis)
Haliaeetus leucocephalus (Bald Eagle)
Plegadis falcinellus (Glossy Ibis)
Rallus elegans (King Rail)
Rynchops niger (Black Skimmer)
Sterna nilotica (Gull-billed Tern)

Mammals
Corynorhinus rafinesquii macrotis (eastern big-eared bat)
Myotis austroriparius (southeastern myotis)
Sorex longirostris fisheri (Dismal Swamp southeastern shrew)

Insects
Basilia boardmanni (southeastern myotis bat fly)
Cicindela dorsalis dorsalis (northeastern beach tiger beetle)
Cicindela trifasciata (a tiger beetle)
Calopteryx angustipennis (Appalachian jewelwing)
Euchloe olympia (Olympia marble)
Puto kosztarabi (Buffalo Mountain mealybug)
Pyrgus wyandot (Appalachian grizzled skipper)
Telebasis byersi (duckweed firetail)

Millipedes
Brachoria cedra (cedar millipede)
Brachoria falcifera (Big Cedar Creek millipede)
Okeanobates americanus (a millipede)

Mussels
Fusconaia cuneolus (fine-rayed pigtoe)

Plants
Aeschynomene virginica (sensitive joint-vetch)
Arabis hirsuta var. *adpressipilis* (hairy rockcress)
Arabis serotina (shale-barren rockcress)
Astragalus neglectus (Cooper's milkvetch)
Buchnera americana (blue-hearts)
Buckleya distichophylla (piratebush)
Calycanthus floridus var. *floridus* (sweet-shrub)
Camassia scilloides (wild hyacinth)
Campanula rotundifolia (American harebell)
Carex buxbaumii (brown bog sedge)
Carex crawei (Craw's sedge)
[*continued on next pg*]

intensive. Some examples of invasive species control activities that are conducted within natural area preserves include aerial spraying to control gypsy moth infestations, manually cutting and spraying multiflora rose thickets, and reducing common reed populations with aerial application of herbicide followed by prescribed burning. Managing for invasive species is an ongoing process because it is usually impossible to completely eradicate their populations within and near preserves. Also, new invasive species arrive periodically, posing new management challenges.

Human activities within preserves also may pose significant threats to natural heritage resources. Impacts may result from deliberate destruction or theft of native plants, from poaching wildlife or from joy riding with off-road vehicles. Other impacts may result from legitimate activities and may be as innocent as the accidental introduction of invasive species brought into a preserve on the shoes of a hiker. Managing for human impacts, particularly from trespass, is a difficult task because most preserves are widely scattered and isolated and they lack full-time staff or residents. The stewardship staff must rely largely on volunteers and preserve neighbors to monitor for illegal activities. Impacts from law-abiding citizens can often be mitigated by educational efforts, signs, gates and carefully designed visitor use facilities.

Another aspect of natural area preserve management involves building a thorough understanding of the processes required to sustain the rare species and

Table 4.2 Natural Heritage Resources Protected on Virginia's Natural Area Preserves (continued from previous pg).

Plants (continued)

Carex cristatella (crested sedge)
Carex decomposita (epiphytic sedge)
Carex interior (inland sedge)
Carex prairea (prairie sedge)
Carex reniformis (reniform sedge)
Carex sterilis (sterile sedge)
Carphephorus bellidifolius (sandy-woods chaffhead)
Carphephorus tomentosus (wooly chaffhead)
Chamaesyce bombensis (southern beach spurge)
Chrysopsis gossypina (cottony golden-aster)
Cirsium carolinianum (Carolina thistle)
Cladium jamaicense (sawgrass)
Clematis addisonii (Addison's leatherflower)
Coreopsis falcata (pool coreopsis)
Crataegus pruinosa (a hawthorn)
Cyperus engelmannii (Engelmann's umbrella-sedge)
Cypripedium kentuckiense (Kentucky lady's slipper)
Desmodium sessilifolium (sessile-leaf tick-trefoil)
Desmodium strictum (pineland tick-trefoil)
Dichanthelium consanguineum (blood witchgrass)
Echinacea laevigata (smooth coneflower)
Echinodorus tenellus (dwarf burhead)
Eleocharis compressa (flat-stemmed spike-rush)
Eleocharis intermedia (matted spikerush)
Eleocharis halophila (salt-marsh spikerush)
Eleocharis melanocarpa (black-fruited spikerush)
Erigeron vernus (white-top fleabane)
Eriocaulon decangulare (ten-angle pipewort)
Eryngium yuccifolium var. *yuccifolium* (rattlesnake-master)
Erysimum capitatum var. *capitatum* (western wallflower)
Eupatorium incarnatum (pink thoroughwort)
Euphorbia purpurea (glade spurge)
Filipendula rubra (queen-of-the-prairie)
Fimbristylis perpusilla (Harper's fimbristylis)
Gentianella quinquefolia ssp occidentalis (western stiff gentian)
Helenium brevifolium (shortleaf sneezeweed)
Helenium virginicum (Virginia sneezeweed)
Helianthemum bicknellii (plains frostweed)
Hierochloe odorata ssp arctica (vanilla grass)
Hottonia inflata (featherfoil)
Houstonia canadensis (Canada bluets)
Huperzia appalachiana (Appalachian fir-clubmoss)
Hydrocotyle bonariensis (coastal-plain penny-wort)
Hypericum boreale (northern st. john's-wort)
Isoetes melanopoda (blackfoot quillwort)
Iva imbricata (sea-coast marsh-elder)
Juncus abortivus (pine-barren rush)
Juncus balticus var. *littoralis* (Baltic rush)
Juncus brachycephalus (small-head rush)
Juncus elliottii (bog rush)
Juncus megacephalus (big-head rush)
Juncus nodosus (knotted rush)
Kalmia angustifolia (sheep-laurel)
Kalmia carolina (Carolina sheep-laurel)
Lathyrus palustris (vetchling)
Lilaeopsis carolinensis (Carolina lilaeopsis)
Lilium grayi (Gray's lily)
Lipocarpha maculata (a lipocarpha)
Lithospermum caroliniense (golden puccoon)
Litsea aestivalis (pondspice)
Lobelia elongata (elongated lobelia)
Liparis loeselii (Loesel's twayblade)
Ludwigia alata (winged seedbox)
Ludwigia brevipes (Long Beach seedbox)
Lycopodiella inundata (northern bog clubmoss)

[*cont. on next pg*]

natural communities within each preserve. In many cases little is known about the biology of rare species, thus research and careful record keeping are important in order to develop successful management strategies and prescriptions.

Because each preserve is unique and must be managed with continuity over time, each natural area preserve must have a written management plan. The Natural Heritage Program staff prepare these plans with input from many organizations and agencies, including specialists in rare species biology, regulatory agencies and partners who have assisted with the establishment of the preserves. Each management plan spells out specific objectives and action recommendations, and addresses all aspects of preserve management, from habitat restoration to visitor use facilities to rare species monitoring.

Public Use of Natural Area Preserves

While natural area preserves are intended primarily for the protection of natural heritage resources, they may also meet other public needs such as for light recreation, nature study and environmental education. Technically, all natural area preserves that are owned by the Virginia Department of Conservation and Recreation are open for public visitation except for temporary closures to allow for management activities. However, each preserve is unique and the resources it supports can tolerate varying levels of hu-

Table 4.2 Natural Heritage Resources Protected on Virginia's Natural Area Preserves (continued from previous pg) .

Plants (continued)

Lysimachia quadriflora (four-flowered loosestrife)
Lythrum alatum (winged-loosestrife)
Malvastrum hispidum (hispid falsemallow)
Manfreda virginica (false aloe)
Marshallia obovata var. *obovata* (obovate marshallia)
Menyanthes trifoliata (buckbean)
Micranthemum umbrosum (shade mudflower)
Minuartia groenlandica (mountain sandwort)
Mitreola petiolata (lax hornpod)
Muhlenbergia glomerata (marsh muhly)
Oligoneuron rigidum var. *rigidum* (stiff goldenrod)
Onosmodium virginianum (Virginia false-gromwell)
Packera millefolia (yarrow-leaved ragwort)
Dichanthelium annulum (ringed panic grass)
Parnassia grandifolia (large-leaved grass-of-parnassus)
Paronychia virginica var. *virginica* (yellow nailwort)
Paspalum distichum (joint paspalum)
Paxistima canbyi (Canby's mountain-lover)
Pediomelum canescens (hoary scurfpea)
Phlox buckleyi (sword-leaved phlox)
Phyla nodiflora (common frog-fruit)
Physalis walteri (sticky ground-cherry)
Physostegia leptophylla (slender-leaved dragon-head)
Pinus palustris (long-leaf pine)
Poa palustris (fowl bluegrass)
Poa saltuensis (a bluegrass)
Polygonella polygama (October-flower)
Polygonum glaucum (sea-beach knotweed)
Porteranthus stipulatus (American ipecac)
Pycnanthemum setosum (awned mountain-mint)
Pyxidanthera barbulata var. *barbulata* (flowering pixie-moss)
Quercus incana (blue jack oak)
Quercus hemisphaerica (Darlington's oak)
Quercus laevis (turkey oak)
Ranunculus laxicaulis (Mississippi buttercup)
Rhamnus alnifolia (alderleaf buckthorn)
Rhamnus lanceolata var. *glabrata* (smooth lance-leaved buckthorn)
Rhynchospora alba (white beakrush)
Rhynchospora colorata (white-topped sedge)
Rhynchospora fascicularis var. *fascicularis* (fasciculate beak-rush)
Salix discolor (pussy willow)
Sanguisorba canadensis (Canada burnet)
Sarracenia purpurea ssp venosa (southern purple pitcher-plant)
Saxifraga caroliniana (carolina saxifrage)
Scleria verticillata (whorled nutrush)
Scutellaria parvula var. *parvula* (small skullcap)
Seymeria cassioides (seymeria)
Sibbaldiopsis tridentata (three-toothed cinquefoil)
Sisyrinchium albidum (white blue-eyed-grass)
Solidago randii (Rand's goldenrod)
Solidago uliginosa var. *uliginosa* (bog goldenrod)
Spartina pectinata (freshwater cordgrass)
Sphagnum macrophyllum var. *macrophyllum* (large-leaf peatmoss)
Sphagnum quinquefarium (five-rowed peatmoss)
Spiranthes lucida (shining ladies'-tresses)
Spiranthes magnicamporum (great plains ladies-tresses)
Sporobolus neglectus (small dropseed)
Stachys aspera (rough hedge-nettle)
Stillingia sylvatica ssp sylvatica (queen's delight)
Symphyotrichum elliottii (Elliott's aster)
Symphyotrichum pratense (barrens silky aster)
Talinum mengesii (Menge's fame-flower) [*cont. on next pg*]

man activity. Some preserves contain extremely fragile habitats and species that are damaged by even low levels of visitation; others are more resilient and may be capable of sustaining higher levels of public use. Also, the costs of providing for visitor access and visitor safety must be balanced with other stewardship needs.

Visitor activities within preserves fall into various categories of appropriateness. Activities that are sustainable at most preserves include birding, wildlife watching, wildflower and native plant observation, photography, hiking, ecological research and environmental education. Some preserves may sustain activities with slightly greater potential for impacts to natural resources such as picnicking, canoeing, fishing and hunting. Camping, swimming, and bicycling are permitted at False Cape State Park / Natural Area Preserve but not at other preserves. Some activities are normally inappropriate for all natural area preserves. These include horseback riding, rock climbing, caving, collecting plants, animals, minerals or artifacts, allowing pets to run loose within the preserve and operating vehicles off designated roadways. However, some of these activities may be allowed with special permission or during organized events.

Currently, 17 natural area preserves have facilities to accommodate public access. Generally, the access facilities are minimal and consist of a small gravel entrance road, parking area, trails and interpretive signs. Some preserves may be closed seasonally but open for

Table 4.2 Natural Heritage Resources Protected on Virginia's Natural Area Preserves (continued from previous pg) .

Plants (continued)
Tillandsia usneoides (Spanish moss)
Trifolium calcaricum (running glade clover)
Trillium pusillum var. *virginianum* (Virginia least trillium)
Utricularia purpurea (purple bladderwort)
Vaccinium crassifolium (creeping blueberry)
Vaccinium macrocarpon (large cranberry)
Veronica scutellata (marsh-speedwell)
Viola walteri (prostrate blue violet)
Vitis rupestris (sand grape)
Xyris caroliniana (Carolina yellow-eyed-grass)
Xyris laxifolia var. *iridifolia* (irisleaf yellow-eyed-grass)
Zigadenus leimanthoides (death-camass)
Zornia bracteata (viperina)

Communities
bald cypress - tupelo swamp
basic oak - hickory forest
calcareous spring marsh/muck fen
chestnut oak forest
central Appalachian shale barren
coastal plain/piedmont bottomland forest
coastal plain depression pond
high elevation outcrop barren
interdune pond
limestone/dolomite barren
low elevation basic outcrop barren
low elevation boulderfield forest/woodland
mafic fen/seep
mafic woodland seep
maritime dune grassland
maritime dune woodland
maritime evergreen forest
maritime mixed forest
maritime scrub
maritime swamp forest
maritime wet grassland
montane dry calcareous forest/woodland
peatland Atlantic white cedar forest
piedmont/mountain basic woodland
pine/scrub oak sandhill
pine-oak/heath woodland
pond pine woodland/pocosin
salt scrub
Shenandoah Valley sinkhole pond
tidal bald cypress forest/woodland
tidal mesohaline/polyhaline marsh
tidal oligohaline marsh
tidal shrub swamp
wet prairie/prairie fen
wind-tidal oligohaline marsh

Other Elements
bird nesting colony
mussel concentration site
significant great blue heron colony
significant karst area

visitor use at specific times of year. At others, visitation may be restricted to specific areas – such as along a designated trail or boardwalk. The owner controls access to preserves not owned by DCR. Some encourage visitation and provided public access facilities, while other, privately owned natural area preserves, are closed to the public.

What Preserves Protect

The purpose of the natural area preserve system is to protect natural heritage resources of Virginia. Except for national forest and national park lands in Virginia, natural area preserves support the greatest number of rare species and significant natural communities. Approximately 400 natural heritage resource occurrences fall within preserve boundaries. Of these, 265 different natural heritage resources are represented, including 151 rare plant and 37 rare animal species, 36 exemplary natural communities and four other natural heritage resources. Table 4.1 lists each natural area preserve, its location, ownership and the resources it protects. Table 4.2 lists all of the natural heritage resources currently protected by the natural area preserve system.

Chapter 5

Virginia's Partners in Land Management

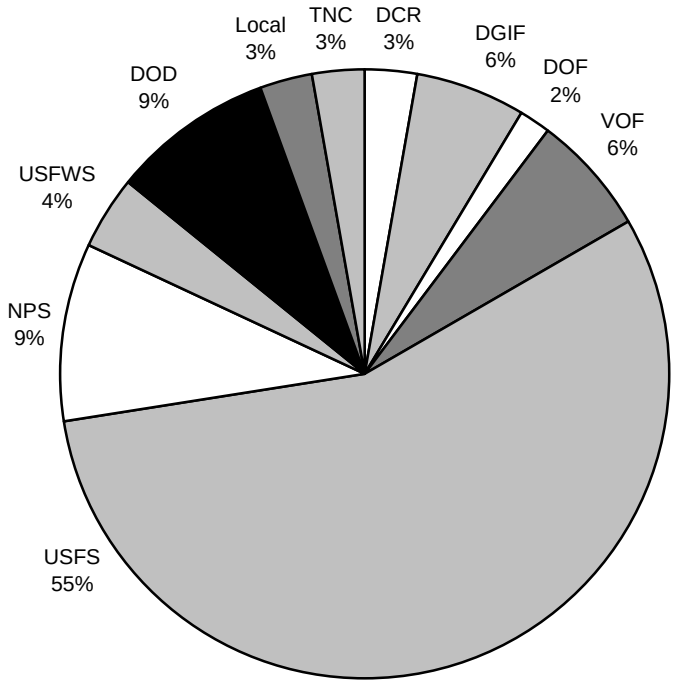
The previous chapter discussed Virginia's Natural Area Preserve System and the role it plays in protecting natural heritage resources. Natural area preserves alone, however, cannot ensure the long-term viability of the natural systems that sustain the state's biodiversity. This chapter describes the other major landholders in Virginia, how they contribute to natural resources conservation and how the Natural Heritage Program works in partnership with them. Numerous other conservation organizations and agencies play very significant roles in biodiversity conservation in Virginia.

Appendix L lists many of the land trusts that operate in Virginia and provides contact information for each. Additional information on land protection in Virginia can be found at the Virginia Department of Conservation and Recreation's land conservation web page at www.dcr.state.va.us/olc

This chapter provides for simple comparisons of Virginia's major landholders including DCR's Natural Area Preserve System. The figures provided here are approximate and are best used for relative comparisons because the acreages and number of elements known for these properties are subject to frequent revision. The primary purpose of the maps is to illustrate the regions of the state where the various organizations have properties. The boundaries of these properties are slightly enlarged in order to make small parcels visible at this scale. It is also important to note that there is some overlap in coverage because some properties fall under multiple jurisdictions – for example some properties shown as Natural Area Preserves also appear as properties for The Nature Conservancy, local governments, State Parks or the Virginia Outdoors Foundation.

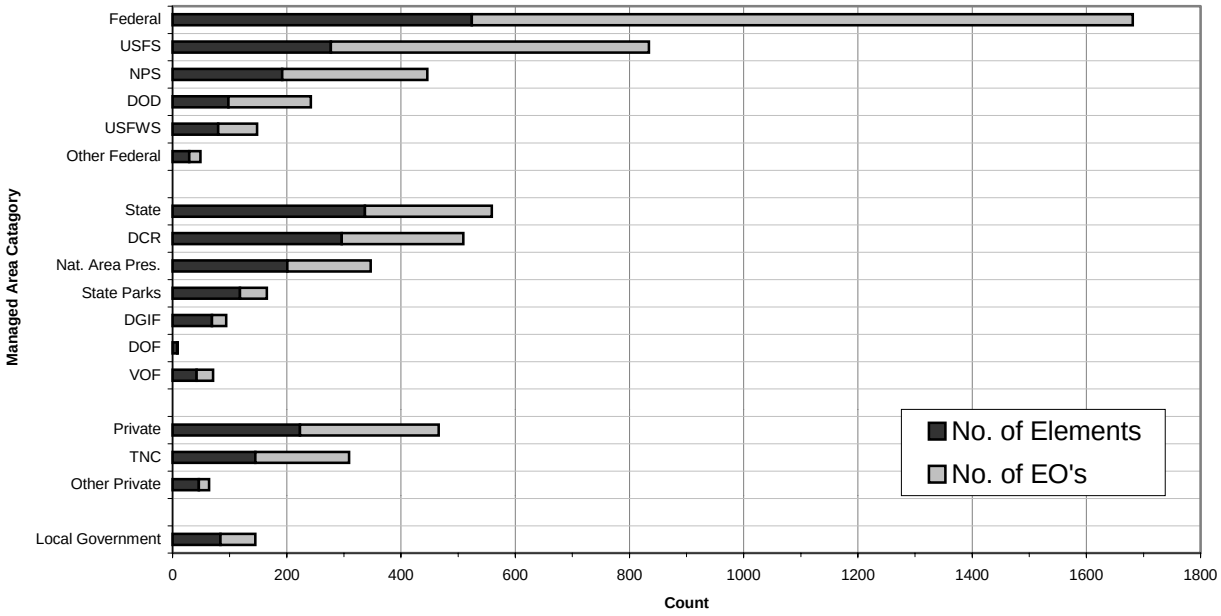
Figure 5.1. Pine-oak heath woodland, Blackwater Ecological Preserve.

Figure 5.2 shows the percentages of Virginia's conservation lands that are managed by the major agencies discussed in this chapter. Figure 5.3 illustrates the relative importance of these lands as places that support natural heritage resources.



DCR - VA Dept. of Conservation & Recreation
DGIF - VA Dept. of Game & Inland Fisheries
DOD - U. S. Department of Defense
DOF - VA Dept. of Forestry
Local - Local Governments
NPS - National Park Service
TNC - The Nature Conservancy
USFS - U. S. Forest Service
USFWS - U. S. Fish & Wildlife Service
VOF - VA Outdoors Foundation

Figure 5.2. Percent of managed conservation lands by agency.



Federal - all federal lands combined
USFS - U. S. Forest Service
NPS - National Park Service
DOD - U. S. Department of Defense
USFWS - U. S. Fish & Wildlife Service
State - all state lands combined
DCR - VA Dept. of Conservation & Recreation lands combined
Nat. Area - DCR natural area preserves
State Parks - DCR state park lands
DGIF - VA Dept. of Game & Inland Fisheries
DOF - VA Dept. of Forestry
VOF - VA Outdoors Foundation
Private - major private conservation lands combined
TNC - The Nature Conservancy
Local - Local Governments

Figure 5.3. Elements and element occurrences (EO's) on managed conservation lands in Virginia.

Figure 5.4. Dedicated Natural Area Preserves in Virginia.

Virginia Department of Conservation and Recreation, Natural Area Preserves

Acres – 27,899

Natural heritage resource occurrences - 401

Protection status of land – All dedicated natural area preserves have the highest degree of legal protection available for land in Virginia. Except to improve access, these properties may not be developed and are managed for the benefit of the natural heritage resources that they support.

Role in biodiversity protection – Natural area preserves are established with the expressed purpose of protecting, managing and restoring habitat for Virginia's rare plants and animals and the best examples of the state's natural communities. Only the national forests and national parks – which occupy approximately 70 and 10 times the land area, respectively – are known to host greater numbers of natural heritage resources.

Figure 5.5. Tidal flat and aquatic bed, Northwest River Natural Area Preserve.

Figure 5.6. Virginia State Parks.

Virginia Department of Conservation and Recreation, State Parks

Acres – 63,572

Natural heritage resource occurrences – 165

Protection status of land –State park lands are subject to limited development for outdoor recreational facilities. Some lands have special designations to protect natural heritage resources.

Role in biodiversity protection – Virginia's state parks are managed to preserve open space and to provide recreational opportunities in outdoor settings. The typical state park has its visitor use facilities concentrated in relatively small areas and is designed to minimize impacts to the surrounding landscape. Because state parks are somewhat evenly distributed across the state, they offer a degree of protection to a wide sampling of Virginia's habitat types and some state park lands are managed specifically to benefit the rare species and significant communities found there. State parks place a strong emphasis on environmental education and natural history interpretation, thus providing many opportunities for the public to learn about Virginia's natural heritage. State parks and natural heritage staff cooperate on many projects, including prescribed burns, invasive species control and public education efforts, which promote biodiversity protection in Virginia.

Figure 5.7. Maritime evergreen forest, False Cape State Park.

Figure 5.8. Virginia Department of Game and Inland Fisheries lands.

Virginia Department of Game and Inland Fisheries

Acres – 184,291

Natural heritage resource occurrences - 94

Protection status of land – These lands are protected from development and are managed primarily for game species and to provide public hunting and fishing opportunities. There are no specific designations to protect natural heritage resources.

Role in biodiversity protection – The Department of Game and Inland Fisheries (DGIF) plays a key role in biodiversity protection. It is charged with the mission of managing Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the Commonwealth. It is the state agency with statutory authority to protect Virginia's threatened and endangered fish and wildlife. DGIF conducts and supports research on many non-game and rare animal species; reviews and comments on development projects that might impact their populations; conducts many public outreach programs that promote the conservation of game and non-game species; and enforces state and federal laws that apply to threatened and endangered animals. DGIF also oversees Virginia's wildlife management areas, which provide the public with hunting and fishing opportunities. Because these lands are located across the state and are managed in various stages of natural succession, wildlife management areas provide habitats for a wide range of native species, including some natural heritage resources. DGIF and natural heritage staff routinely cooperate on projects such as species surveys and wetland restoration. DGIF game wardens and biologists assist natural heritage stewards with law enforcement and deer population control measures on natural area preserves.

Figure 5.9. Narrow-leaved spatterdock (*Nuphar sagittifolia*) on the Chickahominy River, Game Farm Marsh Wildlife Management Area.

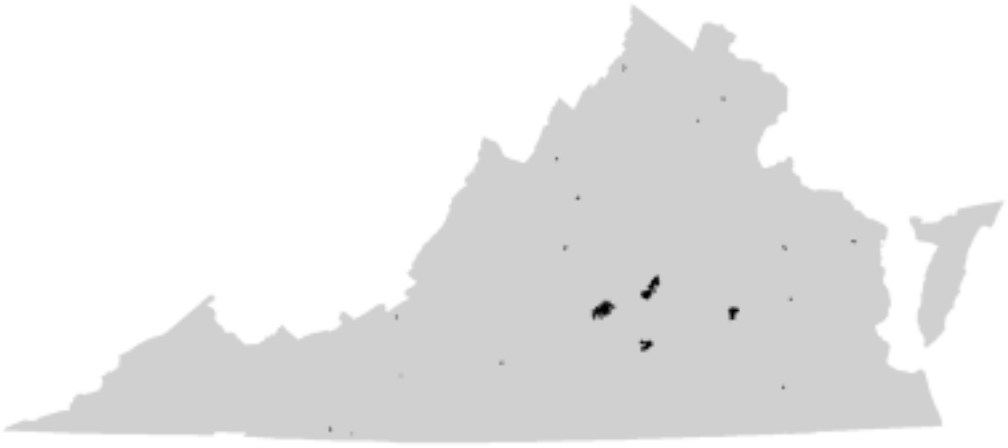


Figure 5.10. Virginia Department of Forestry lands.

Virginia Department of Forestry

Figure 5.11. Basic oak-hickory forest, Cumberland State Forest.

Acres – 55,442

Natural heritage resource occurrences - 9

Protection status of land – These lands are largely protected from development. They are managed primarily for application of sound forestry practices, research, watershed protection and outdoor recreation. There are no special designations to protect natural heritage resources.

Role in biodiversity protection – The Virginia Department of Forestry (DOF) is the lead agency for protecting the state's forest lands. State foresters work throughout the Commonwealth, providing advice and assistance to non-industrial private forest landowners. DOF directly manages 14 state forests and other state lands. State forests are known to support a few natural heritage resources. The agency coordinates the state's Forest Legacy Program, a federal/state partnership designed to protect environmentally sensitive forests through fee simple acquisition and purchased conservation easements. DOF and natural heritage staff cooperate on a variety of projects including prescribed burns, training and landowner contacts.

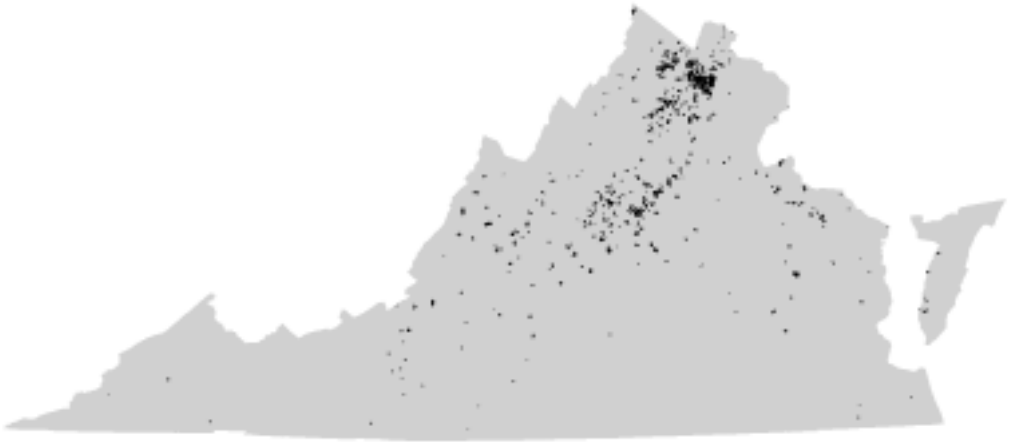


Figure 5.12. Lands protected by the Virginia Outdoors Foundation.

Virginia Outdoors Foundation

Acres – 196,889

Natural heritage resource occurrences - 72

Protection status of land – Lands protected by Virginia Outdoors Foundation easements allow little or no development but most permit the continuation of agricultural and forestal land uses. A few lands have restrictions designed to protect natural heritage resources.

Role in biodiversity protection – The Virginia Outdoors Foundation (VOF) was created by the General Assembly in 1966 to promote the preservation of the state's open space lands. It does this primarily through the use of conservation easements but it may also hold full title to properties. VOF currently holds easements on 193,379 acres, with most of this land remaining in private ownership. VOF owns approximately 3,510 acres, including the 2,486-acre Bull Run Mountains Natural Area Preserve. Some of the properties protected by VOF support natural heritage resources and two of these properties are dedicated natural area preserves. The Natural Heritage Program and VOF cooperate regularly on land protection projects, especially by sharing information on important areas to target for preservation.

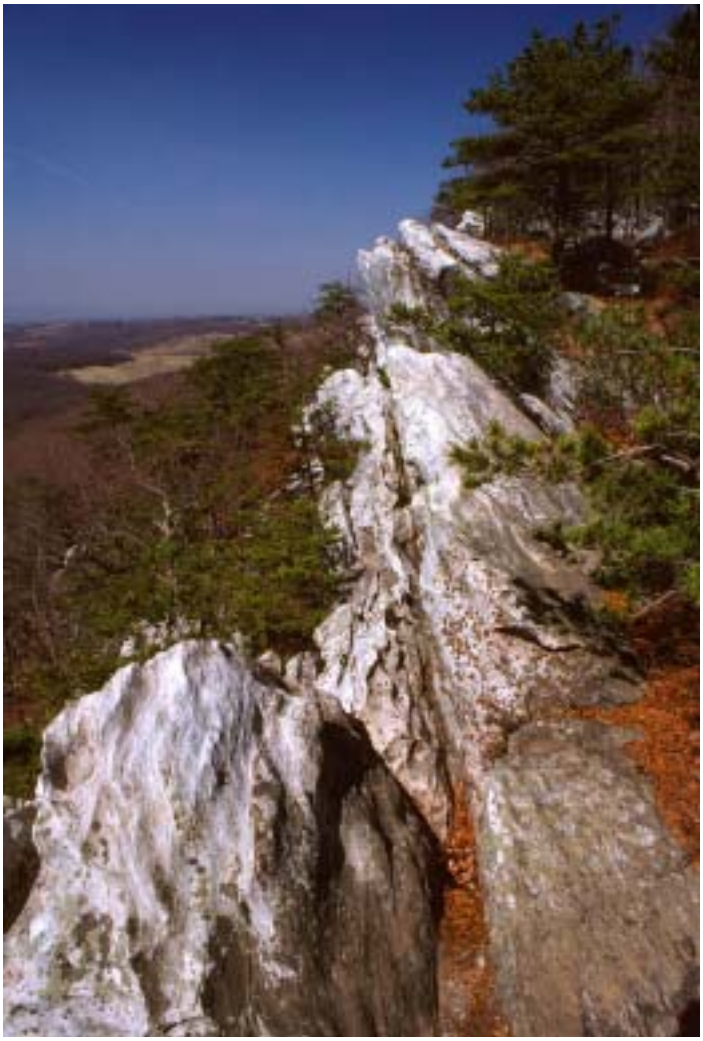


Figure 5.13. Pine-oak-heath woodlands, Bull Run Mountains

US Government Agencies

The federal government holds the most publicly owned land in Virginia – more than 2.3 million acres. These properties include lands managed as national forests, national parks, wildlife refuges and military bases. The vast majority of this land is maintained as open space, though the protected status of these properties varies with the mission of the agency.

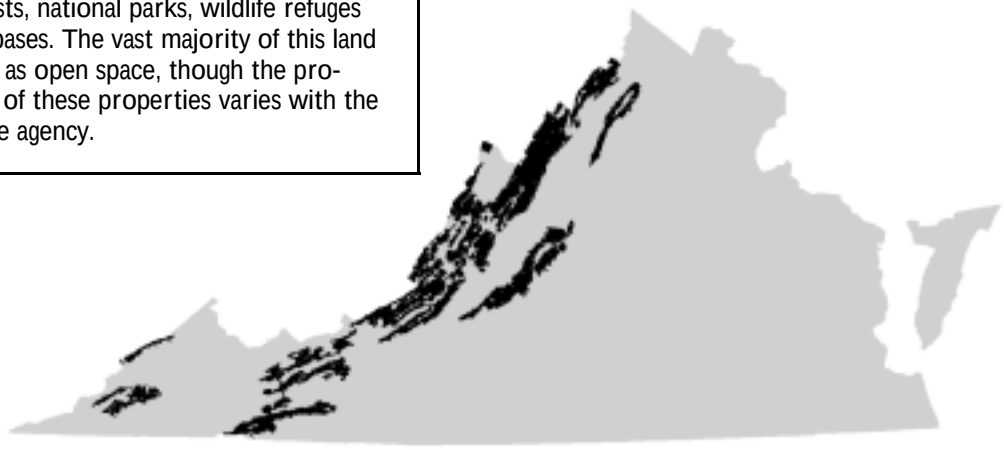


Figure 5.14. National forest lands in Virginia.

U. S. Department of Agriculture, Forest Service

Acres – 1,785,663

Natural heritage resource occurrences - 838

Protection status of land – This varies according to the administrative designation outlined in the forest plans for each forest. The George Washington Revised Forest Plan was approved in 1993. The Jefferson Forest Plan was approved in 1985 and is currently under revision. Most of the areas that support natural heritage resources have special protective designations or are being considered for special protection in the Jefferson Forest Plan Revision.

Role in biodiversity protection – The USDA Forest Service (USFS) is the caretaker of the largest resource landbase under one ownership in Virginia. While the agency maintains these lands for a variety of uses – including timber production, wildlife management, water quality protection, mineral extraction and outdoor recreation – it is a very important partner in biodiversity protection in the western third of the state. The forest service has contracted the Natural Heritage Program to conduct numerous surveys for rare plants and animals and significant communities in the George Washington and Jefferson National Forests. Much of the information provided by those surveys is used to guide activities in the forests. The George Washington National Forest used these surveys to designate 38 special biological areas encompassing approximately 60,000 acres. The national forest also provides large blocks of unfragmented habitat managed primarily by natural processes including roughly 44,000 acres of wilderness, 141,000 acres of remote highlands and an additional 60,000 acres in other special management designations. The Jefferson National Forest is also using the Natural Heritage Program surveys in the planning process and is considering the designation of 95 sites as rare communities (7,300 acres), old growth communities (29,000 acres), and special interest areas (46,000 acres). Jefferson National Forest currently includes almost 60,000 acres of wilderness and is considering recommendation of more than 24,000 additional acres, as well as almost 119,000 acres for backcountry recreation.

US Government Agencies

Figure 5.15. National park lands in Virginia.

U. S. Department of Interior, National Park Service

Acres – 299,642

Natural heritage resource occurrences - 449

Protection status of land – Most national park lands are protected from intensive development though many areas are managed to provide public recreational opportunities. There are no specific designations to protect natural heritage resources.

Role in biodiversity protection – Of the federal agencies, the National Park Service (NPS) manages land that supports the second largest number of natural heritage resources in Virginia. National park lands are managed to meet multiple public needs, with a strong focus on providing outdoor recreational opportunities. The National Park Service has a clear mandate to protect biodiversity. It has contracted with the Natural Heritage Program to locate natural heritage resources in all national parks in Virginia and seeks the staff's assistance with classifying and mapping natural communities, and managing rare species habitat. NPS also provides opportunities for the public to learn about the significance of biodiversity and other aspects of Virginia's natural heritage through interpretive programming offered in the national parks.

Figure 5.16. High-elevation outcrop barren, Shenandoah National Park.

Figure 5.17. Fish and Wildlife Service lands in Virginia.

U. S. Department of Interior, Fish and Wildlife Service

Acres – 128,310

Natural heritage resource occurrences - 156

Figure 5.18. Interdune pond, Chincoteague National Wildlife Refuge.

Protection status of land – Most of these lands are protected from development as national wildlife refuges. Some areas are subject to habitat manipulation for the benefit of wildlife and waterfowl species. There are no specific designations to protect natural heritage resources.

Role in biodiversity protection – As the agency with statutory authority for enforcement of the U. S. Endangered Species Act, the Fish and Wildlife Service (USFWS) has an essential role in protecting Virginia's biodiversity. In addition to enforcing the act, USFWS administers grants directed at protecting endangered and threatened species. Currently seven of Virginia's natural area preserves have been protected, at least in part, with USFWS grants. Another important role of the USFWS is to administer the National Wildlife Refuge System. The primary purpose of most national wildlife refuges in Virginia is to provide habitat for waterfowl. The refuges also are managed for passive outdoor recreation and environmental education, and they harbor a significant number of rare species and natural communities. USFWS has contracted with the Natural Heritage Program to conduct numerous surveys on their refuges in Virginia. The Natural Heritage Program and USFWS also cooperate on land management functions such as invasive species control and prescribed burning.

US Government Agencies

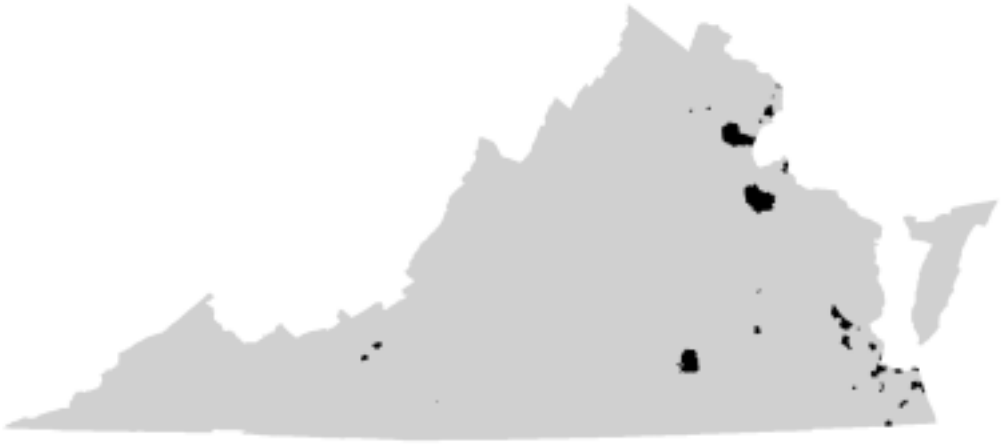


Figure 5.19. U.S. Department of Defense lands in Virginia.

U. S. Department of Defense

Acres – 271,535

Natural heritage resource occurrences - 249

Protection status of land – There is no formal protection for Department of Defense lands because these properties are intended to support national defense.

Role in biodiversity protection – The Department of Defense (DOD) plays a significant role in protecting Virginia's biodiversity in three important ways: First, DOD is a major landowner. Three military bases alone – Quantico, A. P. Hill and Pickett – cover more than 166,000 acres in the Piedmont and Northern Coastal Plain, and most of this land is open space. Because the military must have the flexibility to manage its properties in the interest of national defense, these lands cannot be counted as fully protected. Nevertheless, they remain important refuges for rare species and significant natural communities. Second, DOD actively seeks to understand the biodiversity significance of its lands and, when feasible, manages it in ways that benefit natural heritage resources. Natural Heritage Program staff have conducted inventories on all of the military bases in Virginia, as well as on lands around Kerr Reservoir, which are administered by the Army Corps of Engineers. As a result of these inventories, the Natural Heritage Program staff have provided management recommendations to the base managers. Third, the civilian arm of the Army Corps of Engineers has statutory authority to enforce the nation's wetland protection laws. This is a highly significant role because wetlands support not only many of the state's natural heritage resources, but are also essential to many common species of plants and animals.

Figure 5.20. Pine savanna, Fort Pickett Military Reservation.

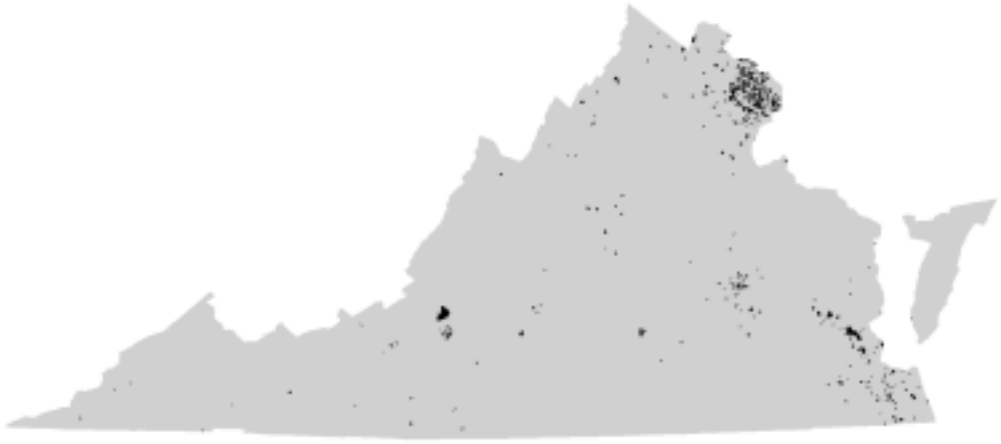


Figure 5.21. Lands owned by local governments in Virginia.

Local Governments

Acres – 92,074

Natural heritage resource occurrences - 146

Protection status of land – This varies considerably. Many local park lands are managed intensively to provide public recreation, some are managed as natural open space and a few are managed to protect natural heritage resources.

Figure 5.22. Piedmont/mountain basic woodland, Fairfax County Park Authority property.

Role in biodiversity protection – Localities, especially in and around major population centers, play an ever-increasing role in protecting biodiversity through zoning decisions, enforcement of environmental regulations, and acquisition and management of parks and natural areas. Natural Heritage Program staff assist local governments by conducting field surveys, helping with stewardship actions and by sharing data on the locations of natural heritage resources. Two localities currently each own dedicated natural area preserves.

Figure 5.23. The Nature Conservancy lands in Virginia.

The Nature Conservancy

Acres – 86,000

Natural heritage resource occurrences - 325

Protection status of land – All lands protected by The Nature Conservancy prohibit development. All lands that support natural heritage resources are managed to protect them. Some lands are in private ownership with conservation easements held by the conservancy.

Role in biodiversity protection – The Nature Conservancy's mission is "to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive." With a strong presence in Virginia, the conservancy clearly is a leader in protecting the state's biodiversity. The Natural Heritage Program partners with the conservancy in a wide array of projects including data sharing, natural area acquisitions, training and stewardship activities.

Figure 5.24. The Nature Conservancy's Fortunes Cove Preserve in Nelson County.

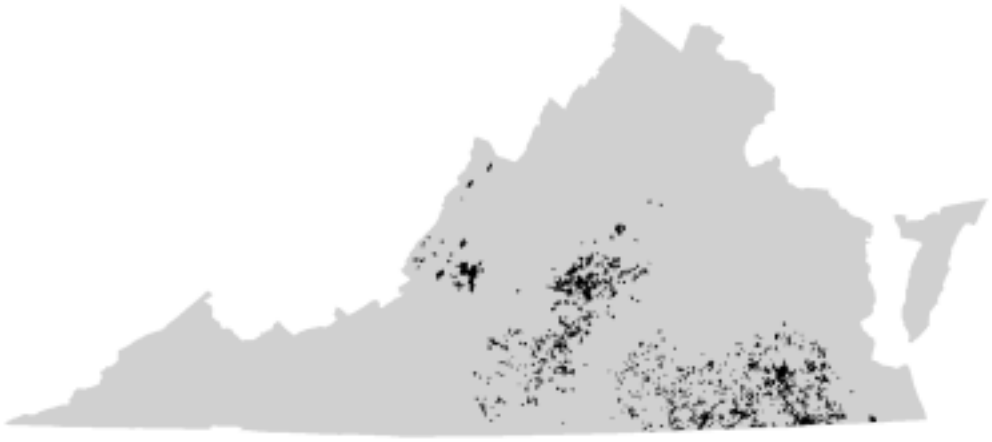


Figure 5.25. Some major corporate landholdings in Virginia.

Corporations

Acres – 442,048 (for the major corporate lands shown here)

Natural heritage resource occurrences – 157

Protection status of land – Most corporate lands are not protected from development.

Role in biodiversity protection – Timber companies manage much of Virginia's forestlands. While their activities on the land are by necessity profit-driven, they play an important role in protecting the state's biodiversity. Not only do corporate properties support many natural heritage resources, these forests are essential for supporting large populations of many common native plants and animals and for maintaining water quality. Several corporations have taken special steps to protect natural heritage resources on their properties. Two notable examples are Westvaco and International Paper, which have invited Natural Heritage Program staff to conduct field surveys and to provide management advice. One International Paper property, Cherry Orchard Bog in Sussex County, is on the Virginia Registry of Natural Areas and is cooperatively managed with DCR.

Figure 5.26. Long-leaf pine woodland, International Paper property.

Chotank Creek Natural Area Preserve: A Case Study in Partnerships

One great example of a broad-based cooperative effort to protect a highly significant conservation site is the story of Cedar Grove Farm in King George County. Stretching for two miles along the Potomac River, this 1,431-acre property has vast tidal marshes along Chotank Creek and supports hundreds of acres of mature upland and bottomland hardwood forests.

Many, including landowner James Nash, had long recognized the natural values of the property so it is not surprising that this protection project evolved into an eight-way partnership. The Trust for Public Land, a national nonprofit land conservation organization, took the lead role in bringing the parties together and negotiating the deal with Mr. Nash to purchase the development rights for the property. DCR secured the primary funding by applying for a grant from the U. S. Fish and Wildlife Service. Additional funds were provided by DCR, the Virginia Outdoors Foundation (VOF) and the Army Corps of Engineers' Wetlands Restoration Trust Fund. The Nature Conservancy agreed to oversee the restoration of approximately 35 acres of pasture back into wetland. VOF and the Chesapeake Bay Foundation, a regional nonprofit conservation organization, jointly hold the conservation easement on the farm, while the Department of Conservation and Recreation dedicated 1,107 acres of the property as the Chotank Creek Natural Area Preserve. Mr. Nash still owns the farm, and raises cattle and hay on portions of the property.

When combined with the adjoining Caledon Natural Area, this cooperative effort resulted in more than five and a half miles of continuous Potomac River shoreline, and more than 4,000 acres being protected from development. The properties support four different significant community types and eight bald eagle nests. The area is one of the most important summer gathering places for bald eagles on the East Coast, with more than 60 eagles spotted here at one time.

Figure 5.27. Depression pond, Chotank Creek Natural Area Preserve.

Chapter 6

Threats to Biodiversity

Virginia's biodiversity faces many threats. Some of these threats can be mitigated by actions of the Natural Heritage Program, while others are beyond the scope of the program. This chapter will discuss the greatest threats to Virginia's biodiversity and what the Natural Heritage Program is doing to address these threats.

Habitat Loss and Degradation

The greatest threat to Virginia's biodiversity comes from the loss and degradation of suitable habitat. Across the state, land is being converted to more intensive uses. In particular woodlands and pastures are being converted to subdivisions and shopping centers, and new roads and utility corridors are being constructed to service them. Current estimates indicate that over 93,000 acres of Virginia's open space lands are converted to non-renewable uses each year.

The Virginia Natural Heritage Program contributes in a number of ways to help protect sensitive habitats from these threats. The most direct method is through land acquisition for the Natural Area Preserve System. This is especially effective for rare species and communities – such as limestone barrens – that can persist in small isolated pockets and that are not greatly affected by activities beyond the boundaries of the preserve. Land acquisition is less effective for many aquatic and cave habitats because they are often affected by events throughout large watersheds. DCR's project review process plays an important role in protecting these and other sensitive habitats. By reviewing development proposals the Natural Heritage Program offers guidance on the location and design of projects to help avoid or minimize impacts to natural heritage resources. The program's karst protection staff help reduce impacts to cave systems by educating the public on the sensitive nature of these resources and by providing guidance to localities on matters such as storm water drainage systems.

Habitat Fragmentation

Development and the accompanying infrastructure, such as roads and power line rights-of-way, may threaten biodiversity through habitat fragmentation. Although suitable habitat may remain intact, the populations of some species such as forest nesting neotropical migrant birds will decline due to several factors. First, some species instinctively seek large undisturbed tracts for breeding – without large enough habitat, they simply will not breed. Second, when some plant and animal populations become isolated, they may suffer from problems associated with inbreeding. Third, the species that remain in small patches of habitat are often vulnerable to predation or invasion from "edge species." For example, opossums and raccoons that thrive at the edge of a forest may prey heavily on the eggs and nestlings of forest birds whose habitat has been reduced to small patches. And fourth, habitat fragmentation opens up new avenues

Figure 6.1. Aerial view of fragmented landscape at Cowbane Prairie Natural Area Preserve.

and opportunities for the introduction of invasive species.

The Virginia Natural Heritage Program plays a vital role in reducing the effects of habitat fragmentation. With its extensive database on the locations of critical habitats, its GIS capabilities, and the expertise of its staff, the Natural Heritage Program can help guide development and land protection efforts, in order to preserve the biological integrity of large areas. One recent example is the Natural Heritage Program's contribution to the Southern Watershed Area Management Program (SWAMP), which identified significant conservation corridors for the cities of Virginia Beach and Chesapeake.

Invasive Exotic Species

The second greatest threat to Virginia's natural heritage resources comes from invasive exotic species. New species have been arriving in Virginia from foreign lands since the settlement of Jamestown, and continue to arrive with the ongoing rise in global commerce.

Some exotic species were introduced into the state and spread intentionally, as with multiflora rose and autumn olive which have been used widely as wildlife plantings. Others were established by accident, as with Japanese stilt grass which probably arrived as packing material for porcelain from China. Most new introductions wither away unnoticed but some, in the absence of their native predators, diseases and competitors, rapidly exploit their new habitats. Exotic species may threaten the survival of native species in several ways. Some exotics, such as kudzu, out compete natives some, such as the gypsy moth, prey heavily on natives that have not evolved adequate defenses; and others, such as the Chinese chestnut, are seemingly harmless, but may be the source of disease (chestnut blight, in this case) that devastates native species.

Figure 6.2. Japanese honeysuckle (*Lonicera japonica*).

Slowing the introduction and spread of exotic species is a monumental task that far exceeds the scope of the Virginia Natural Heritage Program. However, the agency contributes to the process in several important ways. When invasive exotic species threaten natural heritage resources, steps are taken to control or eradicate them. With invasive plants, this typically involves using

herbicides, mechanical efforts and/or prescribed burning. The program's extensive data on the distribution of plants across the state are useful for analyzing the spread of exotic species. For example, information gathered in routine vegetation sampling has been used to identify some of Virginia's most invasive species. To help educate the public natural heritage staff, in cooperation with the Virginia Native Plant Society and others, have developed a list of invasive plant species (see Appendix H) and have published fact sheets on the 30 most invasive species. This list and the invasive fact sheets are available on the Natural Heritage website (http://www.dcr.state.va.us/dnh/pdflist.htm). Natural heritage scientists participate in numerous interagency efforts to better understand and control exotic species. One recent example is a symposium on common reed (*Phragmites australis*) co-hosted by DCR and the Chesapeake Bay Commission, in which experts were brought together from across the country to share information on this serious wetland invasive.

Figure 6.3. Prescribed burn at Blackwater Ecological Preserve.

Fire Exclusion

Prior to the 20th Century, fire occurred regularly in some parts of Virginia. Both Native Americans and settlers used fire to clear land and to improve habitat for game. Also there were fewer manmade firebreaks, such as roads and large agricultural fields, thus permitting accidental and lightning induced fires to sweep across large areas. Consequently, much of Virginia's original native flora and fauna were adapted to and often dependent upon fire. Since modern concerns require that wildfires be extinguished as rapidly as possible, many of Virginia's fire-adapted species and natural communities have declined.

The inventory process of the Natural Heritage Program has helped identify many of the remnant populations of fire-dependent species and communities. Some of these sites have been acquired for the Natural Area Preserve System and landowners of some other sites are cooperating to ensure their long-term protection. Natural heritage staff are using prescribed fire to restore these sites and are carefully monitoring the results.

Nonpoint Source Pollution

One particularly troublesome threat to biodiversity comes from nonpoint source pollution of surface waterways and groundwater. Nonpoint source pollution is basically pollution that doesn't come from the end of a pipe. Some examples are petroleum products and salts washed off roads, nutrients from excess fertilizers spread on lawns, soil particles eroded from agricultural fields and acid precipitation derived from the combustion of fossil fuels.

DCR is the lead state agency for nonpoint source pollution and the Natural Heritage Program works closely with DCR's soil and water conservation division to help address nonpoint source pollution threats. Natural heritage data are used to help identify high priority waterways to help direct state and federal funds, which are used to reduce nonpoint source pollution. Natural Heritage Karst Program staff work with industries and localities to address problems associated with cave and groundwater pollution and are especially active in public education efforts. Natural heritage staff members provide information to landowners on best management practices and on government cost-share programs that can help reduce pollution, which results from agricultural and timber harvesting activities.

Natural Heritage Program Leads Long-term Efforts in Lee County Cave Isopod Recovery

The Lee County cave isopod (*Lirceus usdagalun*) is a very rare crustacean that lives in streams within just a few caves in Virginia's most southwestern county. In the mid-1980s, scientists studying the isopod discovered a sawmill operation overlying one of the caves that was dumping sawdust into the cave's entrance sinkhole. Rain and surface water draining through the sawdust and into the cave was polluting the isopod's habitat and causing a steep decline in the population of this and other cave invertebrates. This event spurred the listing of the Lee County cave isopod as endangered under both the Virginia and Federal Endangered Species Acts.

The Virginia Cave Board worked with the sawmill operator to remove debris from the entrance sinkhole in the late 1980s, but toxic runoff from several hundred thousand cubic yards of sawdust continued and the isopod was not observed in the cave throughout the 1990s. From 1996 to 1998, Karst Program staff worked with the Virginia Water Resources Research Center to characterize the contamination of the cave and downstream springs in order to develop a remediation strategy for the site. This report, in combination with their own study, spurred the Virginia Department of Environmental Quality to enter into an agreement with the sawmill operator to begin cleanup efforts.

Figure 6.4. Lee County cave isopod (*Lirceus usdagalun*).

While the operator quickly found an economically viable way to dispose of newly generated sawdust, older material remained a problem. In fall 2000, Karst Program staff devised a plan to incorporate the decayed sawdust into coal mine reclamation soils. Through the generous support of the Cave Conservancy of the Virginias, the Tennessee Valley Authority and the U. S. Fish and Wildlife Service, the Natural Heritage Program was able to arrange for the transport of sawdust to mine sites in Lee County where it is used to enhance reclamation soil.

Renewed efforts at monitoring the cave have revealed a surprisingly resilient ecosystem. On Thanksgiving Day 2001, staff and volunteers entered the cave and discovered large populations of several cave species, but no Lee County cave isopods. The following February, however, a few of the isopods were observed in the cave, and in June more than 50 individuals were present. The return of the Lee County cave isopod to this cave suggests that long-term prospects for the species are good, assuming the cleanup of this site continues and the water quality can be maintained in the other caves where it occurs.

Figure 6.5. Natural areas steward girdling tree of heaven (*Ailanthus altissima*), a significant invasive species at Pedlar Hills Natural Area Preserve.

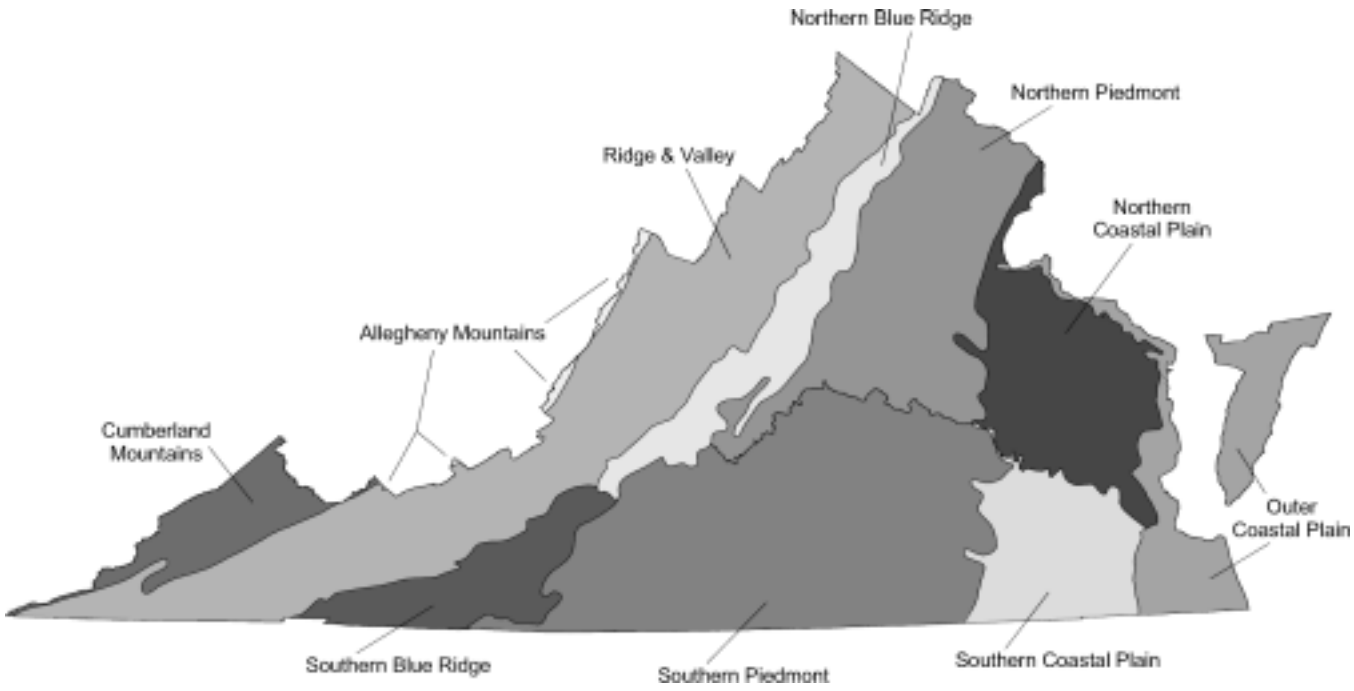


Figure 7.1. Virginia's physiographic provinces.

Chapter 7

Biodiversity Conservation Priorities by Physiographic Province

When considering the biodiversity conservation priorities for Virginia, it is useful to divide the state into physiographic provinces, which are land areas that share common geology, landform and soils. Because plants, animals and natural communities are interdependent and are closely associated with the soils and landforms of their native habitat, focusing on physiographic provinces helps direct conservation efforts towards keeping whole ecological systems intact. Geologists and ecologists have developed several variations of dividing the state into physiographic regions.

Chapter Overview

This chapter focuses on each physiographic province for the state and discusses the priorities for biodiversity conservation for each. Each section is divided as follows:

Description This section explains where the province is located in Virginia and describes its predominant geological and biological features.

Conservation Site Summary This section and an accompanying table provide statistics on the conservation sites and stream conservation units within the province. These statistics include total site acreage, the proportion that occurs on protected lands and the number of sites that occur under each of five biodiversity rankings.

Natural Heritage Resource Targets This section provides basic data on the natural heritage resources that are known to occur within the province. An accompanying table gives statistics on the total number of occurrences, the number of different kinds of elements, the number of populations of federal and state-listed species, and the number of populations of these elements that occur on protected land. Additional tables list the natural heritage resources most in need of inventory, habitat protection and stewardship attention. The inventory targets are determined by considering the elements' global and state rarity, past survey efforts and the presence or potential presence of appropriate habitat. The protection and stewardship targets are elements likely to disappear from the province within the next five to ten years if not given adequate attention for habitat protection and stewardship.

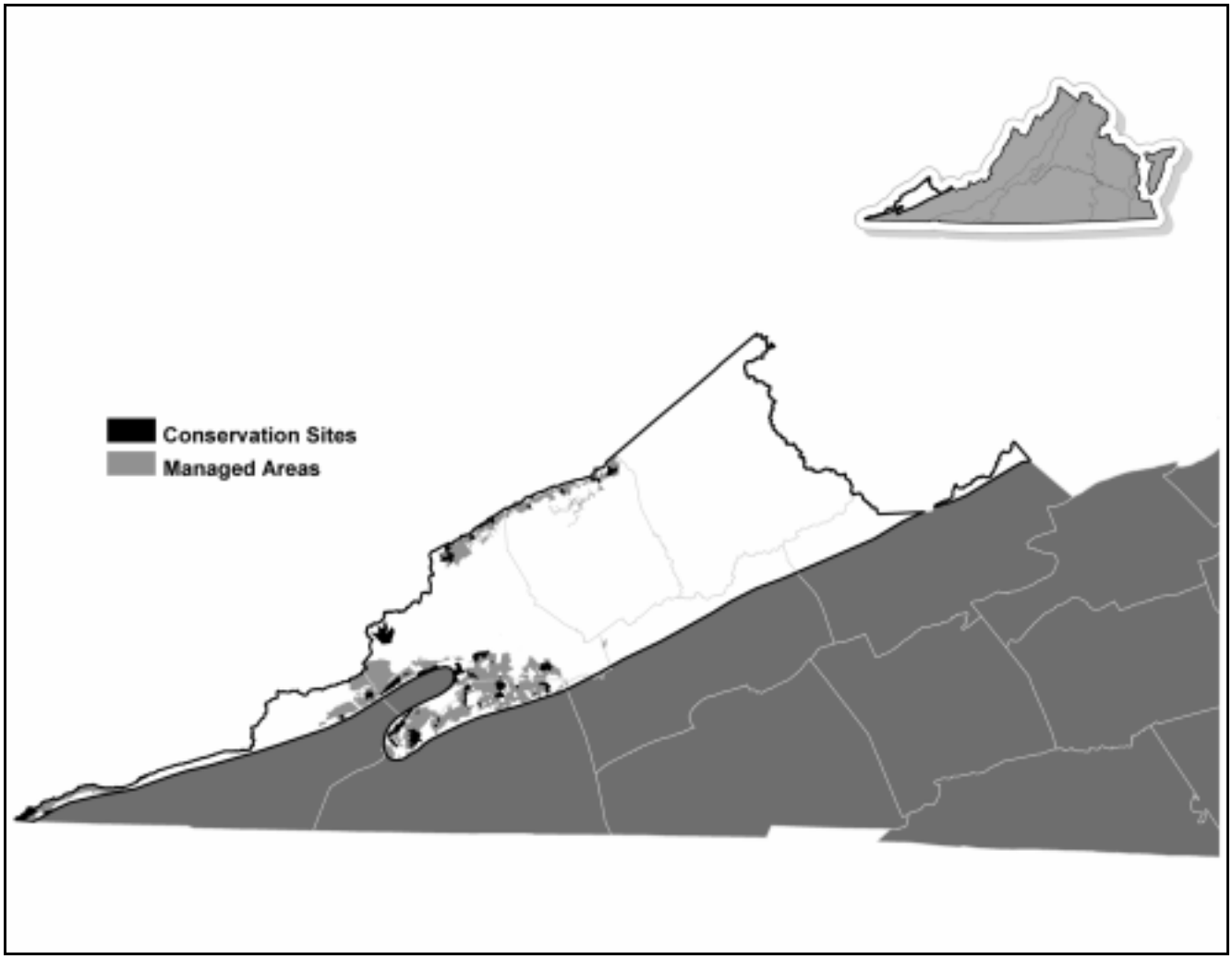


Figure 7.2. Cumberland Mountains Physiographic Province.

Cumberland Mountains Physiographic Province

Description

The Cumberland Mountains encompass the extreme southwestern portion of Virginia and are part of the Appalachian Plateaus, which extend from Alabama to northern Pennsylvania. Horizontal beds of sedimentary rocks – primarily sandstone and shale – and uniform summits indicate that the Cumberland Mountains were carved from a former a plateau. The landscape is intricately dissected by narrow, ever-branching valleys and elevations range from about 1,000 to more than 4,200 feet above sea level. Most of the region drains into the Clinch, Powell and Big Sandy rivers. This area of Virginia is rich in coal, natural gas and petroleum deposits.

The upland vegetation for the Cumberland Mountains is predominantly mixed mesophytic forest expressed as an intricate mosaic of rich cove forest, acidic cove forest and montane oak-hickory forest associations. These forests may have many tree species as co-dominants, including American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), eastern hemlock (*Tsuga canadensis*), tulip-poplar (*Liriodendron tulipifera*), basswood (*Tilia americana*), cucumber tree (*Magnolia acuminata*), yellow buckeye (*Aesculus flava*), white ash (*Fraxinus americana*), birches (*Betula* spp.), northern red oak (*Quercus rubra*), white oak (*Quercus alba*), and several hickories (*Carya* spp.). Small patches of northern hardwoods (beech-birch-maple) occur at the highest elevations, while linear patches of dry calcareous woodlands occupy a mid-slope band of Greenbrier limestone on Powell and Stone mountains. Oak/heath and pine-oak/heath vegetation types are generally restricted to shallow, rocky soils of caprock outcrops,

Table 7.1. Conservation site and stream conservation unit summary for the Cumberland Mountains Physiographic Province.

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks				
				B1	B2	B3	B4	B5
Conservation sites	52	24,910	60%	4	6	9	12	21
Stream conservation units	10	1,147	3%	2	1	3	4	0
Totals	**62**	**26,057**	**58%**	**6**	**7**	**12**	**16**	**21**

Table 7.2. Number and status of natural heritage resources found in the Cumberland Mountains Physiographic Province.

	No. of Elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	25	40	6	9	26
Plants	35	60	5	5	46
Communities	21	47	-	-	37
Biologically significant caves	1	12	-	-	5
Totals	**82**	**159**	**11**	**14**	**114**

ridge crests and upper south or west-facing slopes.

Conservation Site Summary

Current natural heritage data indicate that the Cumberland Mountains support 62 conservation sites and stream conservation units. The combined acreage for these sites is less than three percent of the land area of the Cumberland Mountains. Fifty-eight percent of the land area of these sites is on property that offers some level of natural resource protection – the majority being within the Jefferson National Forest. Table 7.1 gives an overview of the status of conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Cumberland Mountains Physiographic Province supports approximately 159 occurrences of 82 rare species and significant natural community types. Of these occurrences, 11 represent populations of federally threatened or endangered species and 14 are state-listed. A summary of these natural heritage resources is provided in Table 7.2 . The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.3 – 7.4.

Table 7.3. Natural heritage resource inventory targets for the Cumberland Mountains Physiographic Province.

Plants	
Botrychium jenmanii	Alabama grape-fern
Rudbeckia triloba var. *pinnatiloba*	pinnate-lobed coneflower
Silene ovata	ovate catchfly
Animals	
Cambarus veteranus	a crayfish
Erythroecia hebardi	Hebard's noctuid moth
Myotis grisescens	gray bat
Myotis sodalis	Indiana bat
Nannaria sp. 1	Roaring Branch Nannaria millipede
Paravitrea septadens	brown supercoil
Pseudotremia sp. 2	Roaring Branch pseudotremia millipede
Pyrgus wyandot	Appalachian grizzled skipper
Thryomanes bewickii altus	Appalachian Bewick's Wren
Natural Communities	
acidic cove forest	
eastern hemlock forest	
limestone and dolomite barren	
low-elevation acidic outcrop barren	
low-elevation boulderfield forest and woodland	
montane acidic woodland	
piedmont / low mountain alluvial forest	
pine – oak / heath woodland	
rich cove and slope forest	
Appalachian bog	
calcareous fens and seep	
mountain / piedmont acidic seepage swamp	
spray cliff	

Table 7.4. Natural heritage resource protection and stewardship targets for the Cumberland Mountains Physiographic Province.

Protection Targets	
Plants	
Spiraea virginiana	Virginia spiraea
Animals	
Myotis grisescens	gray bat
Myotis leibii	small-footed bat
Myotis sodalis	Indiana bat
Pseudanophthalmus cordicollis	Little Kennedy Cave beetle
Stewardship Target	
Plant	
Silphium terebinthinaceum	prairie rosinweed

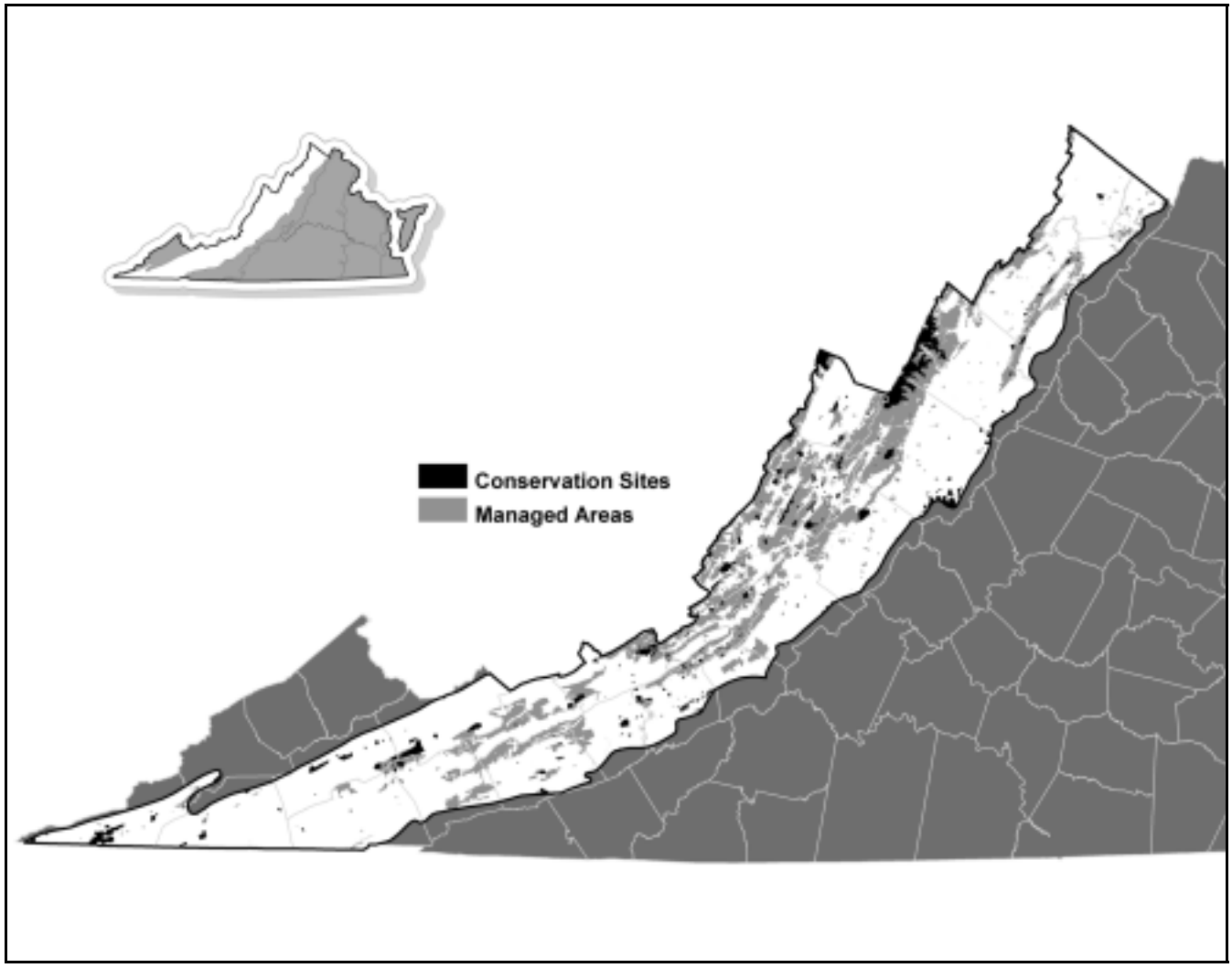


Figure 7.3. Ridge and Valley and Allegheny Mountains Physiographic Provinces.

Ridge and Valley and Allegheny Mountains Physiographic Provinces

Description

The Ridge and Valley Physiographic Province encompasses most of western Virginia and is composed of long parallel ridges and intervening valleys. Rivers in both the Atlantic and Gulf drainages cut transversely across the province to form "gaps" in the ridges. From south to north, the drainage systems are the upper Tennessee River system, New River, Roanoke River, James River and Shenandoah River. The sedimentary rocks that form the province are of the same origin as those forming the Cumberland Mountains, but in the Ridge and Valley, the rock layers have been folded and faulted. Differential rates of weathering of the rock layers determine local topographic relief. The linear ridges are usually underlain by more resistant sandstones and quartzites, while the valleys are typically underlain by less resistant shales and soluble, carbonate-rich limestone and dolomite. The carbonate-rich rocks are dissolved by groundwater to form a topography called karst, which is characterized by sinkholes, springs and caves. The Ridge and Valley has more than 4,000 caves, many of them significant for the biological features they contain.

The province is often subdivided into the eastern Great Valley of Virginia (or Shenandoah Valley), and the western Ridge and Valley, which has higher, more closely spaced ridges. Elevations in the province range from less than 1,000 feet in the Great Valley portion to more than 4,500 feet on a few of the higher ridges such as Clinch and Shenandoah mountains. The northern portion of the Great Valley is divided by the Massanutten Mountains, an isolated range with peaks

Table 7.5. Conservation site and stream conservation unit summary for the Ridge and Valley and Allegheny Mountains Physiographic Provinces.

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks					
				B1	B2	B3	B4	B5	B?
Conservation sites	394	272,248	53%	21	119	117	66	70	2
Stream conservation	87	5,638	4%	7	23	19	18	19	0
Totals	**481**	**277,886**	**52%**	**28**	**142**	**136**	**84**	**89**	**2**

Table 7.6. Number and status of natural heritage resources found in the Ridge and Valley and Allegheny Mountains Physiographic Provinces.

	No. of elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	239	1004	158	342	277
Plants	213	843	138	129	436
Communities	48	320	-	-	189
Biologically significant caves	1	200	-	-	26
Other	1	9	-	-	3
Totals	**503**	**2376**	**296**	**471**	**931**

that exceed 3,000 feet elevation.

The typical upland vegetation for the Ridge and Valley Physiographic Province is oak-dominated forest ranging from oak/heath communities characterized by chestnut oak (*Quercus prinus*), scarlet oak (*Quercus coccinea*), and heath-family shrubs to more mixed forests of white oak (*Quercus alba*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*) and various hickories (*Carya* spp.). Large patches of pine-oak/heath woodlands occur on dry spur ridges and cliff tops, while white pine-oak forests cover extensive areas on low shale knobs and slopes. At around 3,500 to 4,000 feet in elevation (varying with aspect) these communities tend to be replaced by forests dominated by northern red oak, black and yellow birches (*Betula lenta* and *B. alleghaniensis*) and sugar maple (*Acer saccharum*). On a few of the highest peaks, the vegetation takes on a boreal nature with red spruce (*Picea rubens*) dominating. Many significant plant and animal habitats occur in the Ridge and Valley Province. Among them are the significant mussel concentrations of the Upper Tennessee River drainage, red spruce forests, caves, limestone barrens, shale barrens, calcareous seepage wetlands and Shenandoah Valley sinkhole ponds.

To the west of the Ridge and Valley lies the Allegheny Mountains Physiographic Province. Like the Cumberland Mountains, the Allegheny Mountains are part of the Appalachian Plateaus region and constitute a plateau-like erosional landscape that is intricately dissected by streams. This province covers a very small land area in Virginia, where it is restricted to the eastern flank and summit of Allegheny Mountain in Alleghany, Bath and Highland counties. Elevations in this area range from about 2000 to more than 4,500 feet in Highland County. Vegetation of the Allegheny Mountains is predominantly mixed mesophytic forest at elevations below 3,200 feet and northern hardwood forest (beech-birch-maple-cherry) at elevations above 3,200 feet. Special small-patch communities of the province include red spruce forests, red spruce-hemlock swamps and bogs.

Table 7.7. Natural heritage resource inventory targets for the Ridge and Valley and Allegheny Mountains Physiographic Provinces.

Plants

Botrychium jenmanii	Alabama grape-fern
Carex juniperorum	juniper sedge
Carex roanensis	Roan Mountain sedge
Carex schweinitzii	Schweinitz's sedge
Corallorhiza bentleyi	Bentley's coralroot
Heuchera alba	white alumroot
Iliamna remota	Kankakee globe-mallow
Isoetes virginica	Virginia quillwort
Lycopodiella margueritiae	northern prostrate clubmoss
Napaea dioica	glade mallow
Paronychia virginica var. *virginica*	yellow nailwort
Platanthera leucophaea	prairie fringed orchid
Potamogeton hillii	Hill's pondweed
Potamogeton tennesseensis	Tennessee pondweed
Rudbeckia triloba var. *pinnatiloba*	pinnate-lobed coneflower
Scutellaria arguta	sharp-leaved skullcap
Sida hermaphrodita	Virginia mallow
Silene ovata	ovate catchfly
Vitis rupestris	sand grape

Figure 7.4. Indiana myotis (*Myotis sodalis*).

Animals

Etheostoma osburni	candy darter
Noturus flavipinnis	yellowfin madtom
Phoxinus tennesseensis	Tennessee dace
Pituophis melanoleucus	pine snake
Lanius ludovicianus	Loggerhead Shrike
Thryomanes bewickii altus	Appalachian Bewick's Wren
Corynorhinus townsendii virginianus	eastern big-eared bat
Myotis grisescens	gray myotis (bat)
Myotis sodalis	Indiana myotis (bat)
Fontigens morrisoni	Virginia springsnail
Helicodiscus diadema	shaggy coil
Helicodiscus lirellus	rubble coil
Holsingeria unthanksensis	an aquatic cavesnail
Polygyriscus virginianus	Virginia fringed mountain snail
Alasmidonta varicosa	brook floater
Fusconaia masoni	Atlantic pigtoe
Lampsilis cariosa	yellow lampmussel
Lexingtonia subplana	Virginia pigtoe
Pleurobema collina	James spinymussel
Caecidotea bowmani	Natural Bridge cave isopod
Lirceus culveri	Rye Cove isopod
Lirceus usdagalun	Lee County cave isopod
Cambarus jezerinaci	Powell River crayfish
Cambarus monongalensis	a crayfish
Brachoria sp. 1	Powell Mountain millipede sp. 1
Brachoria sp. 2	Powell Mountain millipede sp. 2
Calopteryx aequabilis	river jewelwing
Arigomphus furcifer	lilypad clubtail
Ophiogomphus alleghaniensis	Allegheny snaketail
Stylurus scudderi	zebra clubtail
Appalachia hebardi	Appalachian grasshopper
Isoperla major	big stripetail stonefly
Pseudanophthalmus deceptivus	deceptive cave beetle
Pseudanophthalmus longiceps	long-headed cave beetle
Pseudanophthalmus pontis	Natural Bridge cave beetle
Pseudanophthalmus praetermissus	overlooked cave beetle
Pseudanophthalmus quadratus	Straley's cave beetle
Pseudanophthalmus virginicus	Maiden Spring cave beetle
Callophrys irus	frosted elfin
Phyciodes batesii batesii	tawny crescentspot
Speyeria idalia	regal fritillary
Atrytone arogos arogos	arogos skipper

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Conservation Site Summary

Current natural heritage data indicate that the Ridge and Valley and Allegheny Mountains support 481 conservation sites and stream conservation units. The combined acreage for these areas is slightly more than four percent of the land area of the provinces. About 52 percent of the land area of these sites is on property with some level of natural resource protection. Table 7.5 gives an overview of the status of the conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Ridge and Valley Province and Allegheny Mountains support one of the highest concentrations of rare species and significant natural communities for the state. Natural Heritage data list 2,376 occurrences of 503 rare species and significant natural community types. Of these occurrences, 296 represent populations of federally threatened or endangered species and 471 are state-listed. A summary of these natural heritage resources is provided in Table 7.6. The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.7 – 7.9.

Table 7.7. Natural heritage resource inventory targets for the Ridge and Valley and Allegheny Mountains Physiographic Provinces (continued).

Animals—continued	
Erynnis persius persius	Persius duskywing
Pyrgus wyandot	Appalachian grizzled skipper
Apamea smythi	Smyth's Apamea moth
Erythroecia hebardi	Hebard's noctuid moth
Hypomecis buchholzaria	Buchholz's gray moth
Papaipema astute	yellow stoneroot borer moth
Papaipema duplicata	dark stoneroot borer moth

Natural Communities

southern Appalachian red spruce forest
central Appalachian red spruce forest
northern red oak forest
acidic cove forest
eastern hemlock forest
eastern arborvitae slope forest
acidic oak – hickory forest
montane oak – hickory forest
eastern white pine – hardwood forest
Carolina hemlock forest
montane acidic woodland
low-elevation acidic outcrop barren
low-elevation basic outcrop barren
limestone and dolomite barren
riverside outcrop barren
piedmont / mountain swamp forest
piedmont / low mountain alluvial forest
riverside prairie
river-scour woodland
mountain / piedmont acidic seepage swamp
Appalachian bog
high-elevation seep
calcareous fens and seep
mesic and wet-mesic prairie
wet prairie and prairie fen
calcareous spring marshes and muck fen
spray cliff
inland salt marsh

Table 7.8. Natural heritage resource protection targets for the Ridge and Valley and Allegheny Mountains Physiographic Provinces.

Plants	
Equisetum fluviatile	water horsetail
Helenium virginicum	Virginia sneezeweed
Iliamna remota	Kankakee globe-mallow
Scirpus ancistrochaetus	northeastern bulrush
Scutellaria galericulata	hooded skullcap
Animals	
Helicodiscus diadema	shaggy coil
Helicodiscus lirellus	rubble coil
Holsingeria unthanksensis	an aquatic cavesnail
Lirceus culveri	Rye Cove isopod
Lirceus usdagalun	Lee County cave isopod
Isoperla major	big stripetail stonefly
Pseudanophthalmus holsingeri	Holsinger's cave beetle
Pseudanophthalmus thomasi	Thomas' cave beetle

Natural Communities

rich cove and slope forest
Shenandoah Valley sinkhole pond
calcareous fens and seep
wet prairie and prairie fen
inland salt marsh

Table 7.9. Natural heritage resource stewardship targets for the Ridge and Valley and Allegheny Mountains Physiographic Provinces.

Plants	
Carex roanensis	Roan Mountain sedge
Desmodium sessilifolium	sessile-leaf tick-trefoil
Iliamna remota	Kankakee globe-mallow
Malvastrum hispidum	hispid falsemallow
Panicum hemitomon	maidencane
Animals	
Pseudanophthalmus holsingeri	Holsinger's cave beetle
Pseudanophthalmus thomasi	Thomas' cave beetle
Speyeria idalia	regal fritillary

Natural Communities

eastern hemlock forest
Carolina hemlock forest
piedmont / mountain bottomland forest
riverside prairie
calcareous fen and seep
wet prairie and prairie fen
inland salt marsh

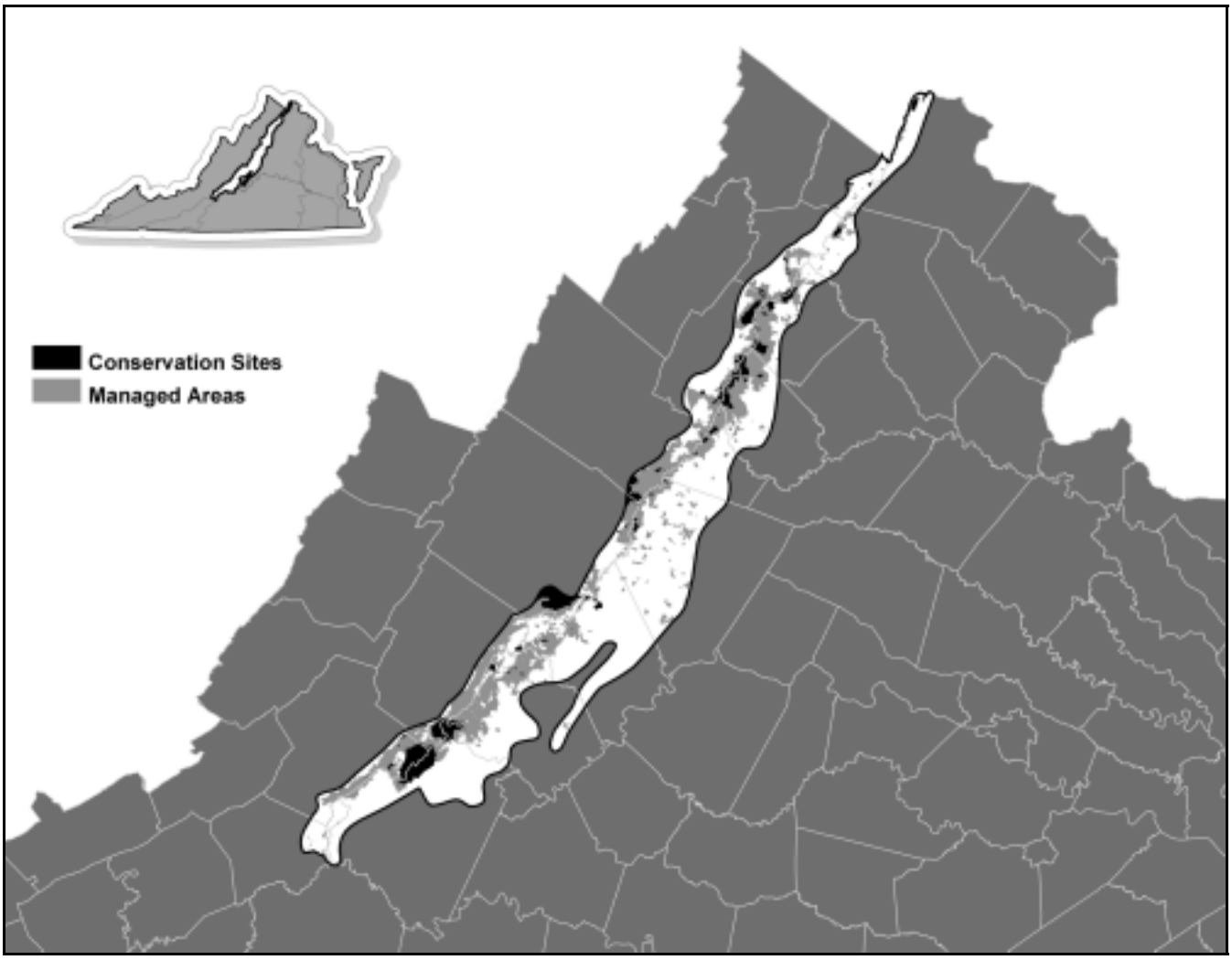

Figure 7.5. Northern Blue Ridge Physiographic Province.

Northern Blue Ridge Physiographic Province

Description

The Northern Blue Ridge Physiographic Province is located between the Ridge and Valley to the west and the Northern Piedmont to the east, and is the portion of the Blue Ridge Mountains occurring north of the Roanoke River. The Northern Blue Ridge is drained by fast-flowing headwater streams of the Atlantic drainage. Within the province, the Blue Ridge Mountains occur in a narrow (approximately five-mile-wide) chain of irregularly weathered, rugged peaks with steep slopes. Elevation ranges from about 1,000 feet to higher than 4,000 feet, with the highest peak at Apple Orchard Mountain (4,225 feet). The province is underlain by a core of resistant granites and metabasalts (greenstone), with resistant metasedimentary rocks exposed along the western flank.

The prevalent vegetation for this region is mixed oak and oak-hickory forest dominated by chestnut oak (*Quercus prinus*), white oak (*Quercus alba*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), tulip-poplar (*Liriodendron tulipifera*) and various hickories (*Carya* spp.). At higher elevations, chestnut oak drops out and northern red oak dominates the ridges exclusively. Xeric oak/heath and pine-oak/heath communities are more widespread on the metasedimentary bedrock areas, while rich cove forests, hemlock forests, northern hardwood forests and other mesophytic communities occupy smaller-scale niche habitats throughout. Some unusual and rare communities include mafic fens, various cliff and outcrop communities, seepage swamps and high-elevation boulderfields.

Table 7.10. Conservation site and stream conservation unit summary for the Northern Blue Ridge Physiographic Province

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks				
				B1	B2	B3	B4	B5
Conservation sites	107	97,067	82%	5	23	18	23	38
Stream conservation units	16	280	14%	0	12	2	2	0
Totals	**123**	**97,347**	**82%**	**5**	**35**	**20**	**25**	**38**

Table 7.11. Number and status of natural heritage resources found in the Northern Blue Ridge Physiographic Province

	No. of elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	21	62	19	24	45
Plants	79	201	13	17	185
Communities	29	124	-	-	107
Biologically significant caves	1	2	-	-	1
Totals	**130**	**389**	**32**	**41**	**338**

Conservation Site Summary

Current natural heritage data indicate that the Northern Blue Ridge supports 123 conservation sites and stream conservation units. The combined acreage for these areas is approximately six percent of the land area of the Northern Blue Ridge. Eighty-two percent of the land area of these sites is on property managed for conservation purposes – primarily on Shenandoah National Park. Table 7.10 gives an overview of the status of conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Northern Blue Ridge Physiographic Province supports approximately 389 occurrences of 130 rare species and significant natural community types. Of these occurrences, 32 represent populations of federally threatened or endangered species and 41 are state-listed. A summary of these natural heritage resources is provided in Table 7.11. The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.12 – 7.13.

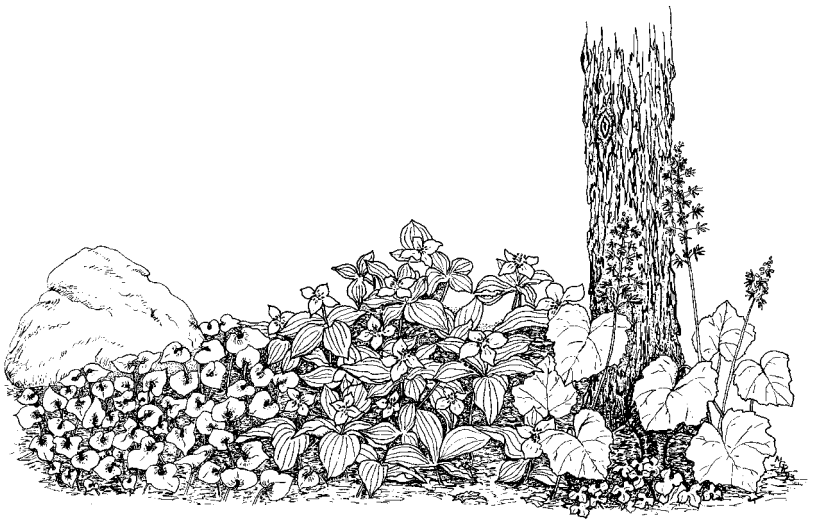

Figure 7.6. From left to right: wild ginger (*Asarum canadense*), bunchberry (*Cornus canadensis*), sharp-lobed hepatica (*Hepatica acutiloba*), and foamflower (*Tiarella cordifolia*).

Table 7.12. Natural heritage resource inventory targets for the Northern Blue Ridge Physiographic Province.

Plants	
Vitis rupestris	sand grape
Animals	
Plethodon shenandoah	Shenandoah salamander
Pituophis melanoleucus	pine snake
Lampsilis cariosa	yellow lampmussel
Pleurobema collina	James spinymussel
Stygobromus sp. 18	Big Levels spring amphipod
Calopteryx aequabilis	river jewelwing
Pyrgus wyandot	Appalachian grizzled skipper
Erythroecia hebardi	Hebard's noctuid moth
Papaipema astute	yellow stoneroot borer moth
Papaipema duplicata	dark stoneroot borer moth
Natural Communities	
eastern hemlock forest	
Carolina hemlock forest	
high-elevation seep	
mafic fen and seep	
spray cliff	

Table 7.13. Natural heritage resource protection and stewardship targets for the Northern Blue Ridge Physiographic Province.

Protection Target	
Animal	
Plethodon hubrichti	Peaks of Otter salamander
Stewardship Targets	
Plant	
Cornus canadensis	bunchberry
Natural Communities	
eastern hemlock forest	
piedmont / mountain bottomland forest	
riverside prairie	

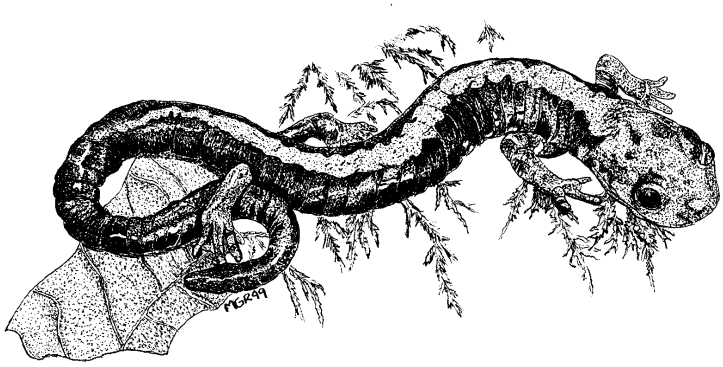

Figure 7.7. Shenandoah salamander (*Plethodon shenandoah*).

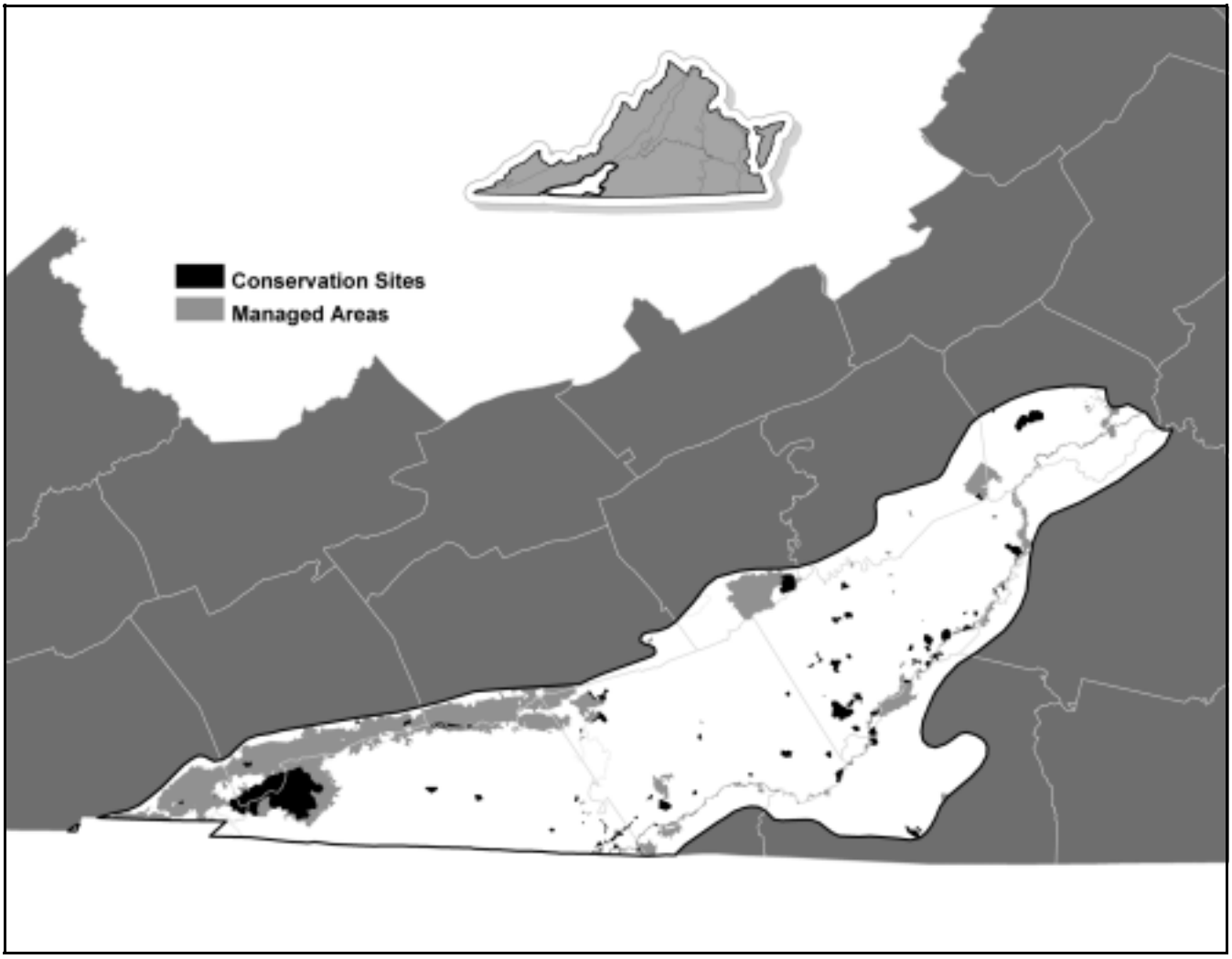

Figure 7.8. Southern Blue Ridge Physiographic Province.

Southern Blue Ridge Physiographic Province

Description

The Southern Blue Ridge physiographic province is the portion of the Blue Ridge Mountains occurring south of the Roanoke River at Roanoke Gap. The province is flanked by the Ridge and Valley to the west and the Southern Piedmont to the east. The geologic composition and history of the province is similar to that of the Northern Blue Ridge. However, the Southern Blue Ridge is wider – about 50 miles wide – and a significant portion of the province consists of a high plateau rather than mountainous terrain. Mostly lower gradient streams of the New River watershed drain the province. Elevations average 3,000 to 3,500 feet. However, the Balsam Mountains in Grayson, Smyth and Washington Counties constitute Virginia's highest landmass, lying almost completely above 4,000 feet and containing the state's two highest peaks – Mount Rogers (5,729 feet) and Whitetop Mountain (5,520 feet).

Because of variations in topography and elevation, vegetation of the Southern Blue Ridge is more complex than that of other provinces. Mixed oak, oak-hickory and mixed mesophytic communities form mosaics in the lower-elevation parts of the region. White pine (*Pinus strobus*) is the predominant early successional species at lower elevations and, in established forests, tends to dominate north slopes and mesic coves where soils are acidic. Very locally, ultramafic bedrock is exposed or close to the surface in this province, resulting in harsh soil that is high in magnesium and iron. The few plants that can survive in these conditions are often rare or disjunct species. Stunted woodlands and prairie-like openings typify mafic soils

Table 7.14. Conservation site and stream conservation unit summary for the Southern Blue Ridge Physiographic Province.

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks				
				B1	B2	B3	B4	B5
Conservation sites	93	42,180	58%	10	12	27	29	15
Stream conservation units	25	1,633	7%	0	5	2	10	8
Totals	**118**	**42,813**	**57%**	**10**	**17**	**29**	**39**	**23**

Table 7.15. Number and status of natural heritage resources found in the Southern Blue Ridge Physiographic Province.

	No. of elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	37	130	62	72	60
Plants	67	206	5	15	94
Communities	31	57	-	-	35
Biologically significant caves	1	4	-	-	1
Totals	**136**	**397**	**67**	**87**	**190**

under dry conditions. A complex of naturally rare mafic wetlands occurs in an area south of Galax known as The Glades. These wetlands support a large number of state-rare plants and provide habitat for the federally threatened bog turtle (*Glyptemys muhlenbergii*). Northern hardwood forests (birch-beech-maple-buckeye) form the matrix forest cover of the Balsam Mountains, which also support large relict stands of red spruce (*Picea rubens*) and Fraser fir (*Abies fraseri*) on the highest slopes and summits. Other rare, noteworthy communities of the Balsam Mountains include high-elevation boulderfields, grass and shrub balds and high-elevation bogs.

Conservation Site Summary

Current natural heritage data indicate that the Southern Blue Ridge Physiographic Province supports 118 conservation sites and stream conservation units. The combined acreage for these sites is approximately three percent of the land area of the province. Fifty-seven percent of the land area of these sites is on property currently managed for conservation. Table 7.14 gives an overview of the status of conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Southern Blue Ridge Physiographic Province supports approximately 397 occurrences of 136 rare species and significant natural community types. Of these occurrences, 67 represent populations of federally threatened or endangered species and 87 are state-listed. A summary of these natural heritage resources is provided in Table 7.15. The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.16 – 7.18.

Table 7.16. Natural heritage resource inventory targets for the Southern Blue Ridge Physiographic Province.

Plants	
Carex manhartii	Manhart's sedge
Scutellaria arguta	sharp-leaved skullcap
Animals	
Glyptemys muhlenbergii	bog turtle
Pituophis melanoleucus	pine snake
Fusconaia masoni	Atlantic pigtoe
Lampsilis cariosa	yellow lampmussel
Macromia margarita	mountain river cruiser
Ophiogomphus alleghaniensis	Allegheny snaketail
Stylurus amnicola	riverine clubtail
Stylurus scudderi	zebra clubtail
Taeniopteryx nelsoni	cryptic willowfly
Neonympha mitchellii francisci	Saint Francis' satyr
Phyciodes batesii batesii	tawny crescentspot
Erythroecia hebardi	Hebard's noctuid moth
Natural Communities	
high-elevation boulderfield forests and woodland	
northern red oak forest	
rich cove and slope forest	
acidic cove forest	
eastern hemlock forest	
Carolina hemlock forest	
pine – oak / heath woodland	
ultramafic woodland	
low-elevation boulderfield forests and woodland	
ultramafic barren	
piedmont / low mountain alluvial forest	
riverside prairie	
Appalachian bog	
high-elevation seep	
mafic fen and seep	
mafic woodland seep	
spray cliff	

Table 7.17. Natural heritage resource protection targets for the Southern Blue Ridge Physiographic Province.

Plants	
Fimbristylis puberula var. *puberula*	hairy fimbry
Glyceria laxa	northern mannagrass
Scleria verticillata	whorled nutrush
Tofieldia glutinosa	sticky false-asphodel
Animals	
Neonympha mitchellii francisci	Saint Francis' satyr
Natural Communities	
ultramafic barren	
mafic fen and seep	
mafic woodland seep	

Table 7.18. Natural heritage resource stewardship targets for the Southern Blue Ridge Physiographic Province.

Natural Communities
ultramafic barren
mafic fen and seep

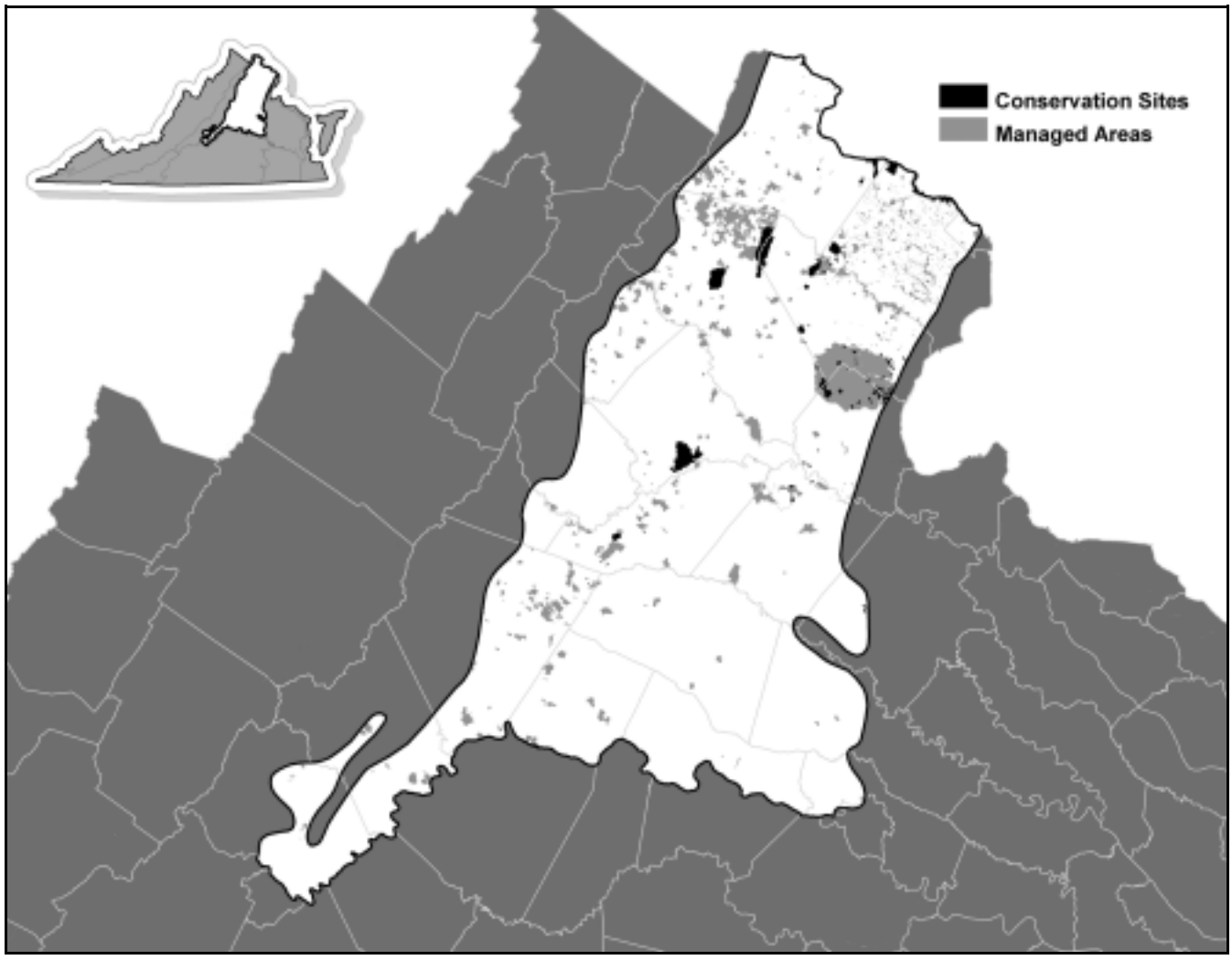

Figure 7.9. Northern Piedmont Physiographic Province.

Northern Piedmont Physiographic Province

Description

The Northern Piedmont is the portion of the Piedmont occurring north of the James River located between the Fall Line and the Blue Ridge escarpment. The province is dominated by rifted and folded metamorphic and igneous rock. Both elevation and topographic relief decrease across the Piedmont from west to east. Near the Blue Ridge escarpment, the base elevation is 1,000 feet, but isolated peaks called monadnocks of resistant rock may rise to 2,000 feet. The gently rolling topography in the east ranges from 200-300 feet and ends abruptly in a series of falls and rapids at the Fall Line. In the central portion, a large, nearly level Mesozoic basin (the Culpepper Basin) is underlain by metasedimentary rocks and intrusive diabase of Jurassic and Triassic age. There has been a long history of intensive farming in the Piedmont. As a result, much of the original vegetation cover has been removed and most of the topsoil eroded away.

When upland areas are left undisturbed, the natural vegetation in the Northern Piedmont tends to succeed to mixed oak or mixed hardwood forest, dominated by beech (*Fagus grandifolia*), white oak (*Quercus alba*), chestnut oak (*Quercus prinus*), northern red oak (*Quercus rubra*), tulip-poplar (*Liriodendron tulipifera*) and various hickories (*Carya* spp.). Locally, eastern hemlock forests are scattered on sheltered, north-facing stream bluffs and ravines. In the Culpeper Basin, the nearly flat landscape and clay-rich soils favor the formation of hardpans and the prevalence of drier, more stunted oak and oak-hickory-ash forests, as well as isolated upland depression wetlands. In the pre-settlement era, some of the region's hardpan soils may

Table 7.19. Conservation site and stream conservation unit summary for the Northern Piedmont Physiographic Province.

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks				
				B1	B2	B3	B4	B5
Conservation sites	88	44,011	28%	3	10	24	12	39
Stream conservation units	47	812	3%	0	21	19	2	5
Totals	**135**	**44,823**	**28%**	**3**	**31**	**43**	**14**	**44**

Table 7.20. Number and status of natural heritage resources found in the Northern Piedmont Physiographic Province.

	No. of elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	19	106	20	32	21
Plants	64	166	22	22	95
Communities	24	66	-	-	44
Biologically significant caves	2	2	-	-	0
Totals	**108**	**340**	**42**	**54**	**160**

have supported oak savannas and prairies. Very locally, diabase outcrops are exposed on monadnocks or stream-fronting slopes and support a rare barrens community characterized by prickly-pear cactus (*Opuntia humifusa*), fameflower (*Talinum teretifolium*), long-awn hairgrass (*Muhlenbergia capillaris*), Kate's-mountain clover (*Trifolium virginicum*), ninebark (*Physocarpus opulifolius*), eastern redcedar (*Juniperus virginiana*), and fragrant sumac (*Rhus aromatica*).

Conservation Site Summary

Current natural heritage data indicate that the Northern Piedmont Physiographic Province supports 135 conservation sites and stream conservation units. The combined acreage for these sites is approximately one percent of the land area of the province. Twenty-eight percent of the land area of these sites is on property currently managed for conservation. Table 7.19 gives an overview of the status of conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Northern Piedmont Physiographic Province supports approximately 340 occurrences of 108 rare species and significant natural community types. Of these occurrences, 42 represent populations of federally threatened or endangered species and 54 are state-listed. A summary of these natural heritage resources is provided in Table 7.20. The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.21-7.23.

Table 7.21. Natural heritage resource inventory targets for the Northern Piedmont Physiographic Province.

Plants	
Agalinis auriculata	earleaf foxglove
Baptisia cinerea	hairy wild-indigo
Sida hermaphrodita	Virginia mallow
Vitis rupestris	sand grape
Animals	
Bartramia longicauda	Upland Sandpiper
Alasmidonta heterodon	dwarf wedgemussel
Alasmidonta varicosa	brook floater
Elliptio lanceolata	yellow lance
Fusconaia masoni	Atlantic pigtoe
Lampsilis cariosa	yellow lampmussel
Pleurobema collina	James spinymussel
Stygobromus kenki	rock creek groundwater amphipod
Stygobromus phreaticus	northern Virginia well amphipod
Stygobromus sp. 21	Rappahannock spring amphipod
Enallagma weewa	blackwater bluet
Arigomphus furcifer	lilypad clubtail
Ladona exusta	white corporal skimmer
Acroneuria flinti	Manassas stonefly
Sigara depressa	Virginia piedmont water boatman
Euphyes bimacula	two-spotted skipper
Euphyes conspicua	black dash
Natural Communities	
basic oak-hickory forest	
piedmont / mountain basic woodland	
eastern hemlock forest	
piedmont hardpan forest	
coastal plain / piedmont bottomland forest	
floodplain pond and pool	
piedmont / mountain swamp forest	
piedmont / low mountain alluvial forest	
river-scour woodland	
upland depression swamp	

Table 7.22. Natural heritage resource protection targets for the Northern Piedmont Physiographic Province.

Plants	
Agalinis auriculata	earleaf foxglove
Animals	
Bartramia longicauda	Upland Sandpiper
Natural Communities	
basic oak-hickory forests	
piedmont / mountain basic woodlands	

Table 7.23. Natural heritage resource stewardship targets for the Northern Piedmont Physiographic Province.

Plants	
Agalinis auriculata	earleaf foxglove
Animals	
Bartramia longicauda	Upland Sandpiper
Natural Communities	
eastern hemlock forest	
piedmont / mountain basic woodland	
riverside prairie	
coastal plain / piedmont seepage bog	

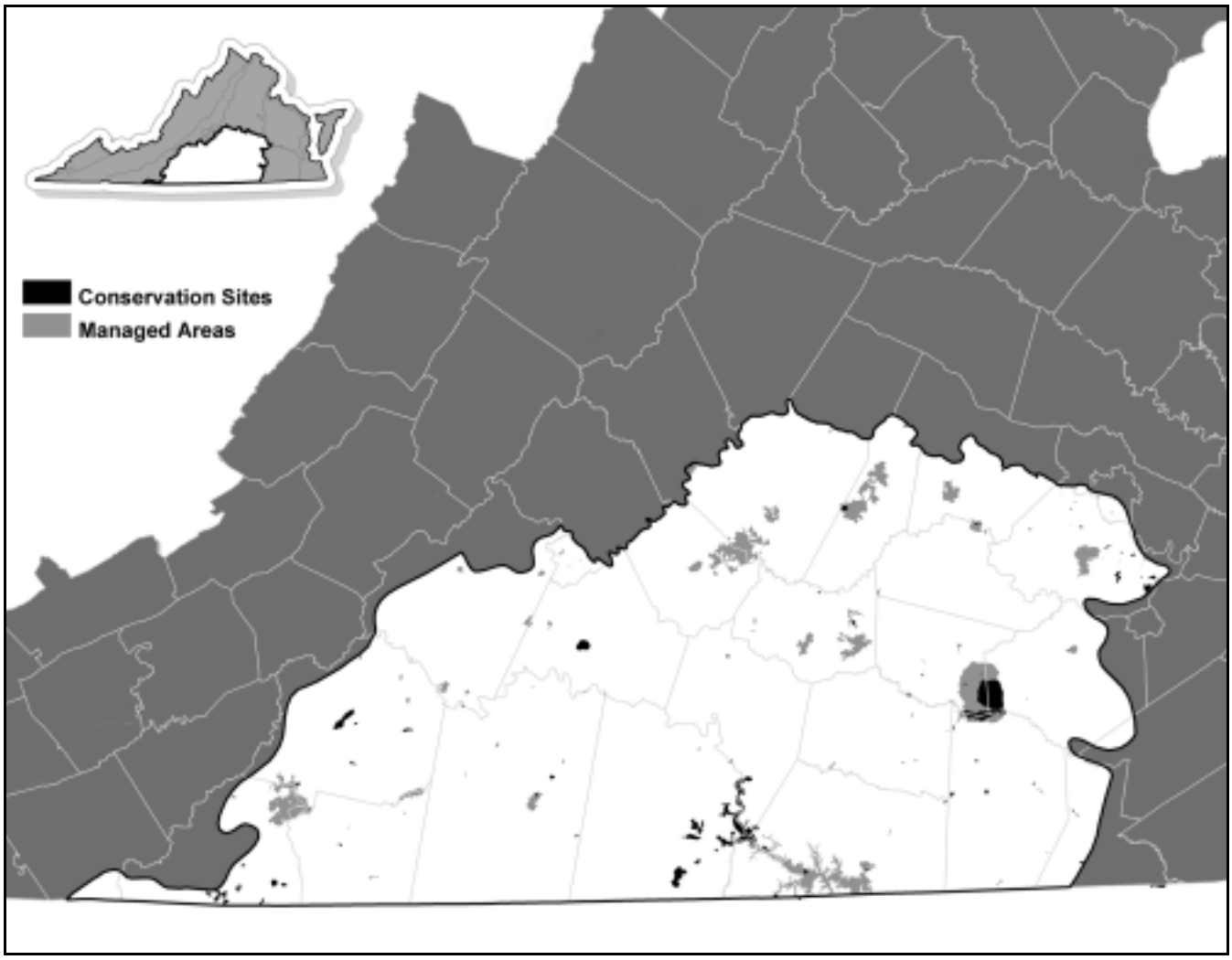

Figure 7.10. Southern Piedmont Physiographic Province.

Southern Piedmont Physiographic Province

Description

The Southern Piedmont is located between the Fall Line to the east and the Blue Ridge escarpment to the west and is the portion of the Piedmont occurring south of the James River. The Southern Piedmont is very similar to the Northern Piedmont in geologic and topographic characteristics. Many rivers and streams in the Southern Piedmont are bordered by habitats more typically associated with the Coastal Plain. The Southern Piedmont is drained by portions of the Roanoke, James and Chowan river system, which is composed of the Blackwater, Nottoway and Meherrin rivers.

The typical upland vegetation of the Southern Piedmont is mixed oak or mixed hardwood forest dominated by white oak (*Quercus alba*), black oak (*Quercus velutina*), southern red oak (*Quercus falcata*), northern red oak (*Quercus rubra*), beech (*Fagus grandifolia*), tulip-poplar (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*) and hickories (*Carya* spp.). Pines, especially shortleaf (*Pinus echinata*) and Virginia (*Pinus virginiana*), are abundant in early successional stands; loblolly pine (*Pinus taeda*) occurs naturally only in the easternmost counties but is extensively planted throughout the region. At scattered locations are some unusual plant communities, which are associated with stressful growing conditions. Among these are granite flatrock communities, Piedmont hardpan forests, mafic barrens and Piedmont savannas. Eastern hemlock forests occur on a few north-facing river bluffs and ravines across the Southern Piedmont.

Table 7.24. Conservation site and stream conservation unit summary for the Southern Piedmont Physiographic Province.

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks				
				B1	B2	B3	B4	B5
Conservation Sites	147	62,374	52%	8	18	23	40	58
Stream conservation units	39	1,750	14%	1	14	11	6	7
Totals	**186**	**63,123**	**51%**	**9**	**32**	**34**	**46**	**65**

Table 7.25. Number and status of natural heritage resources found in the Southern Piedmont Physiographic Province.

	No. of elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	33	121	35	69	19
Plants	88	201	25	4	62
Communities	25	93	-	-	47
Other	1	2	-	-	1
Totals	**147**	**417**	**60**	**73**	**129**

Conservation Site Summary

Current natural heritage data indicate that the Southern Piedmont Physiographic Province supports 186 conservation sites and stream conservation units. The combined acreage for these sites is less than one percent of the land area of the province. Fifty-one percent of the land area of these sites is on property currently managed for conservation. Table 7.24 gives an overview of the status of conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Southern Piedmont Physiographic Province supports approximately 417 occurrences of 147 rare species and significant natural community types. Of these occurrences, 60 represent populations of federally threatened or endangered species and 73 are state-listed. A summary of these natural heritage resources is provided in Table 7.25. The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.26-7.28.

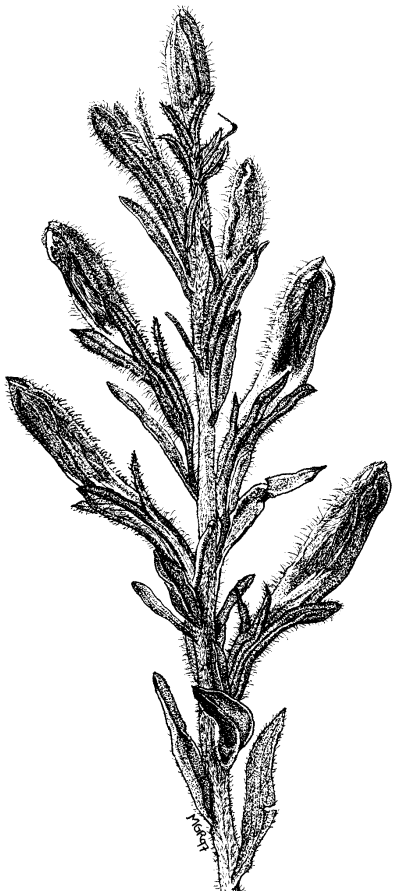

Figure 7.11. American chaffseed (*Schwalbea americana).*

Table 7.26. Natural heritage resource inventory targets for the Southern Piedmont Physiographic Province.

Plants	
Cardamine micranthera	small-anthered bittercress
Desmodium ochroleucum	creamflower tick-trefoil
Isoetes hyemalis	winter quillwort
Isoetes piedmontana	piedmont quillwort
Isoetes virginica	Virginia quillwort
Juncus caesariensis	New Jersey rush
Pycnanthemum clinopodioides	basil mountain-mint
Rhus michauxii	Michaux's sumac
Schwalbea americana	chaffseed
Sida elliottii	Elliott sida
Talinum mengesii	Menge's fame-flower
Animals	
Aimophila aestivalis	Bachman's Sparrow
Paravitrea hera	spirit supercoil
Alasmidonta heterodon	dwarf wedgemussel
Alasmidonta varicosa	brook floater
Elliptio lanceolata	yellow lance
Elliptio roanokensis	Roanoke slabshell
Fusconaia masoni	Atlantic pigtoe
Lampsilis cariosa	yellow lampmussel
Lexingtonia subplana	Virginia pigtoe
Pleurobema collina	James spinymussel
Orconectes virginiensis	Chowanoke crayfish
Siphloplecton costalense	Spieth's great speckled olive mayfly
Enallagma weewa	blackwater bluet
Gomphus apomyius	banner clubtail
Gomphus septima	Septima's clubtail
Somatochlora georgiana	coppery emerald
Sigara depressa	Virginia piedmont water boatman
Natural Communities	
eastern hemlock forest	
Carolina hemlock forest	
piedmont hardpan forest	
low-elevation basic outcrop barren	
granitic flatrock	
ultramafic barren	
coastal plain / piedmont bottomland forest	
floodplain ponds and pool	
piedmont / mountain swamp forest	
piedmont / low mountain alluvial forest	
upland depression swamp	

Table 7.27. Natural heritage resource protection targets for the Southern Piedmont Physiographic Province.

Plants	
Cardamine micranthera	small-anthered bittercress
Natural Communities	
low-elevation basic outcrop barren	
granitic flatrock	
ultramafic barren	
coastal plain/piedmont seepage bog	

Table 7.28. Natural heritage resource stewardship targets for the Southern Piedmont Physiographic Province.

Plants	
Aletris aurea	golden colicroot
Amphicarpum purshii	blue maiden-cane
Calamovilfa brevipilis var. *calvipes*	pine barrens reedgrass
Coreopsis linifolia	Atlantic tickseed
Ctenium aromaticum	toothache grass
Eriocaulon decangulare	ten-angle pipewort
Eryngium integrifolium	savanna eryngo
Eryngium yuccifolium var. *yuccifolium*	rattlesnake-master
Helenium brevifolium	shortleaf sneezeweed
Hypericum adpressum	creeping st. john's-wort
Hypericum setosum	a St. John's-wort
Juncus elliottii	bog rush
Lachnocaulon anceps	bog-buttons
Ludwigia hirtella	Rafinesque's seedbox
Mitreola sessilifolia	sessile-leaved hornpod
Paspalum praecox	early paspalum
Platanthera blephariglottis var. *conspicua*	large white fringed orchid
Pycnanthemum torrei	Torrey's mountain mint
Rhynchospora cephalantha var. *attenuata*	small capitate beakrush
Rhynchospora cephalantha var. *pleiocephala*	many-headed bunched beakrush
Rhynchospora perplexa var. *virginiana*	a beakrush
Sabatia campanulata	slender marsh rose-pink
Sarracenia flava	yellow pitcher-plant
Scleria minor	slender nutrush
Sporobolus junceus	purple dropseed
Tetragonotheca helianthoides	pineland squarehead
Tofieldia racemosa	coastal false-asphodel
Xyris difformis var. *curtissii*	Curtiss' yellow-eyed-grass
Zigadenus glaberrimus	large-flowered camas
Natural Communities	
eastern hemlock forest	
ultramafic barren	
piedmont / mountain bottomland forest	
riverside prairie	
coastal plain / piedmont seepage bog	

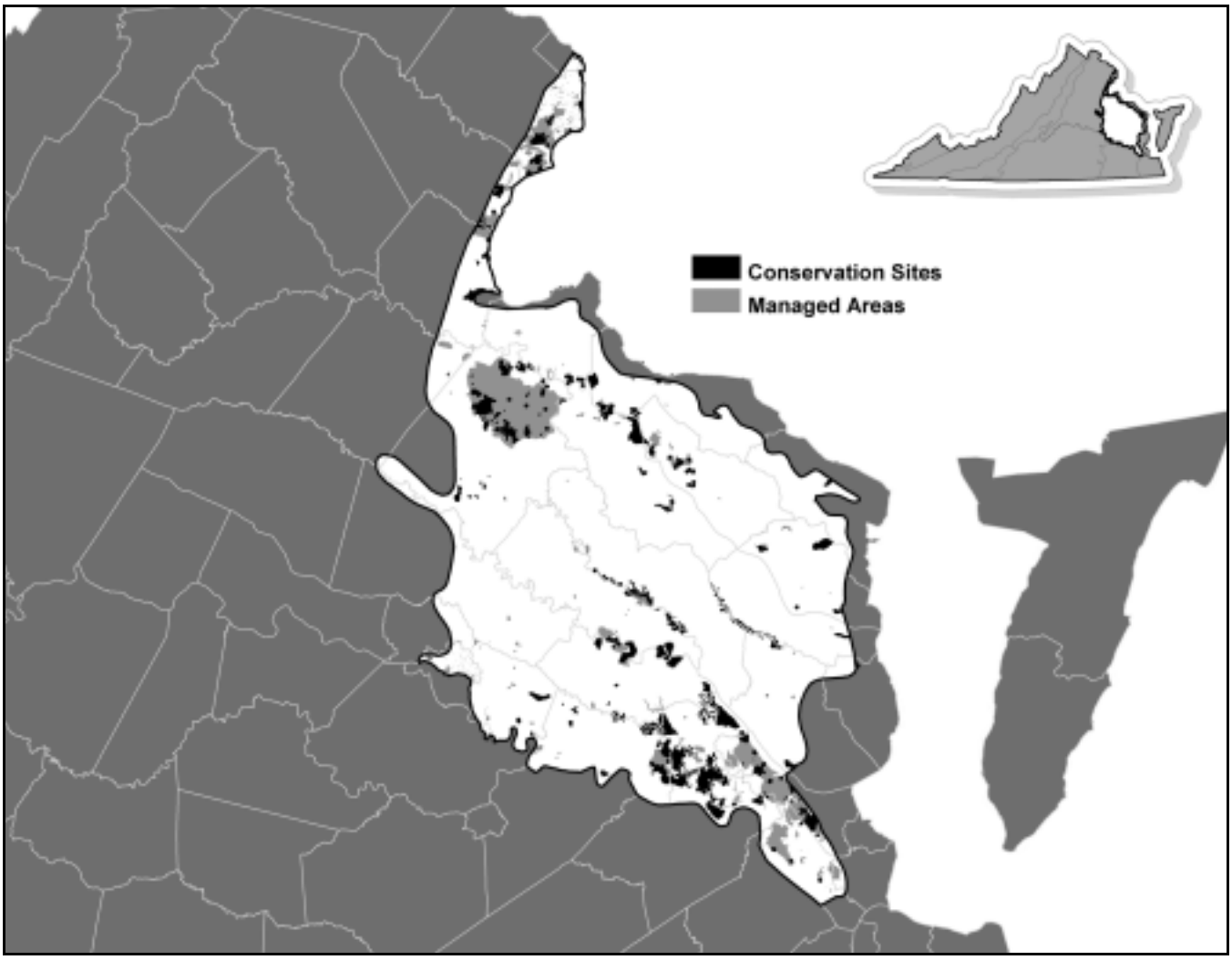

Figure 7.12. Northern Coastal Plain Physiographic Province.

Northern Coastal Plain Physiographic Province

Description

The Virginia Coastal Plain consists of a series of terraces sloping downward toward the coast, with each terrace or scarp representing a former shoreline. The Coastal Plain is the youngest physiographic region and consists of sedimentary deposits of sand, clay, marl and shell. In general, the Coastal Plain is characterized by low topographic relief, extensive marshes, and large, tidally influenced rivers. The Northern Coastal Plain Physiographic Province is bounded by the Fall Line to the west and the James River to the south. Topographic relief decreases from west to east and also from north to south. The boundary between the Northern Coastal Plain and the Outer Coastal Plain to the east is not very well defined but generally follows a change in elevation gradient along the outer terrace of the Northern Neck, the Middle Peninsula and the Lower Peninsula. The Northern Coastal Plain is entirely within the Chesapeake Bay watershed.

Most of the original upland vegetation of the Northern Coastal Plain was cleared for agriculture, and the remaining forests were cut repeatedly. Today, the natural upland vegetation of the Northern Coastal Plain varies from secondary mixed oak/heath forest on the ridges to mixed hardwood forest (beech-oak-tulip poplar) on mesic slopes and ravines. Pines, especially loblolly pine (*Pinus taeda*), are abundant in secondary succession and are also extensively planted. Steep, gravelly bluffs and ravine slopes are often dominated by oak-beech/heath forests with dense undergrowths of mountain-laurel (*Kalmia latifolia*). In very

Table 7.29. Conservation site and stream conservation unit summary for the Northern Coastal Plain Physiographic Province.

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks					
				B1	B2	B3	B4	B5	B?
Conservation sites	339	209,775	20%	1	16	54	23	244	1
Stream conservation	9	228	0%	0	1	2	2	4	0
Totals	**348**	**210,003**	**20%**	**1**	**17**	**56**	**25**	**248**	**1**

Table 7.30. Number and status of natural heritage resources found in the Northern Coastal Plain Physiographic Province.

	No. of elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	36	396	334	348	111
Plants	65	228	53	53	108
Communities	21	96	-	-	59
Other	3	8	-	-	7
Totals	**125**	**728**	**387**	**401**	**285**

local habitats where streams have downcut into Tertiary shell deposits or limesands, rare mesic and dry calcareous forest communities occur. A great variety of palustrine and estuarine wetlands occupy low-lying habitats of the province. Among the wetland communities of conservation concern are seepage swamps, seepage bogs, Coastal Plain depression ponds, tidal swamp forests and tidal freshwater marshes.

Conservation Site Summary

Current natural heritage data indicate that the Northern Coastal Plain Physiographic Province supports 348 conservation sites and stream conservation units. The combined acreage for these sites is approximately eight percent of the land area of the province. Twenty percent of the land area of these sites is on property currently managed for conservation. Table 7.29 gives an overview of the status of conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Northern Coastal Plain Physiographic Province supports approximately 728 occurrences of 125 rare species and significant natural community types. Of these occurrences, 387 represent populations of federally threatened or endangered species and 401 are state-listed. A summary of these natural heritage resources is provided in Table 7.30. The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.31-7.33.

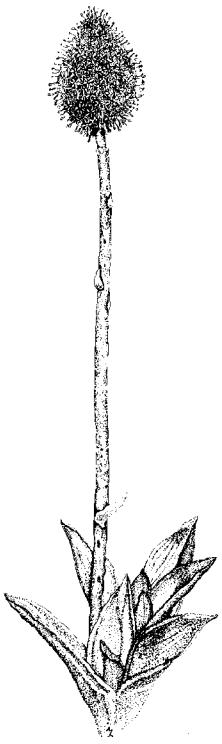

Figure 7.13. Swamp pink (*Helonias bullata*).

Table 7.31. Natural heritage resource inventory targets for the Northern Coastal Plain Physiographic Province.

Plants	
Aeschynomene virginica	sensitive joint-vetch
Cypripedium kentuckiense	Kentucky lady's-slipper
Desmodium ochroleucum	creamflower tick-trefoil
Hypericum adpressum	creeping St. John's-wort
Juncus caesariensis	New Jersey rush
Micranthemum micranthemoides	Nuttall's micranthemum
Animals	
Regina rigida	glossy crayfish snake
Myotis austroriparius	southeastern myotis (bat)
Alasmidonta heterodon	dwarf wedgemussel
Alasmidonta varicosa	brook floater
Elliptio lanceolata	yellow lance
Fusconaia masoni	Atlantic pigtoe
Lampsilis cariosa	yellow lampmussel
Crangonyx sp. 5	Lancaster County amphipod
Stygobromus phreaticus	northern Virginia well amphipod
Stygobromus sp. 21	Rappahannock spring amphipod
Enallagma weewa	blackwater bluet
Celithemis ornata	faded pennant
Ladona exusta	white corporal skimmer
Problema bulenta	rare skipper
Natural Communities	
coastal plain dry calcareous forest and woodland	
fluvial terrace woodland	
coastal plain / piedmont bottomland forest	
floodplain pond and pool	
coastal plain depression pond	
non-riverine wet hardwood forest	
coastal plain basic seepage swamp	
interdune pond	
tidal shrub swamp	
tidal bald cypress forest and woodland	
tidal hardwood swamp	

Table 7.32. Natural heritage resource protection targets for the Northern Coastal Plain Physiographic Province.

Plants	
Aeschynomene virginica	sensitive joint-vetch
Cypripedium kentuckiense	Kentucky lady's-slipper
Helonias bullata	swamp pink
Natural Communities	
coastal plain dry calcareous forest and woodland	
coastal plain depression pond	
tidal freshwater marsh	

Table 7.33. Natural heritage resource stewardship targets for the Northern Coastal Plain Physiographic Province.

Plants	
Hypericum setosum	a St. John's-wort
Juncus caesariensis	New Jersey rush
Mimosa quadrivalvis var. *angustata*	little-leaf sensitive-briar
Sabatia campanulata	slender marsh rose-pink
Stachys eplingii	Epling's hedgenettle
Natural Communities	
coastal plain / piedmont seepage bog	

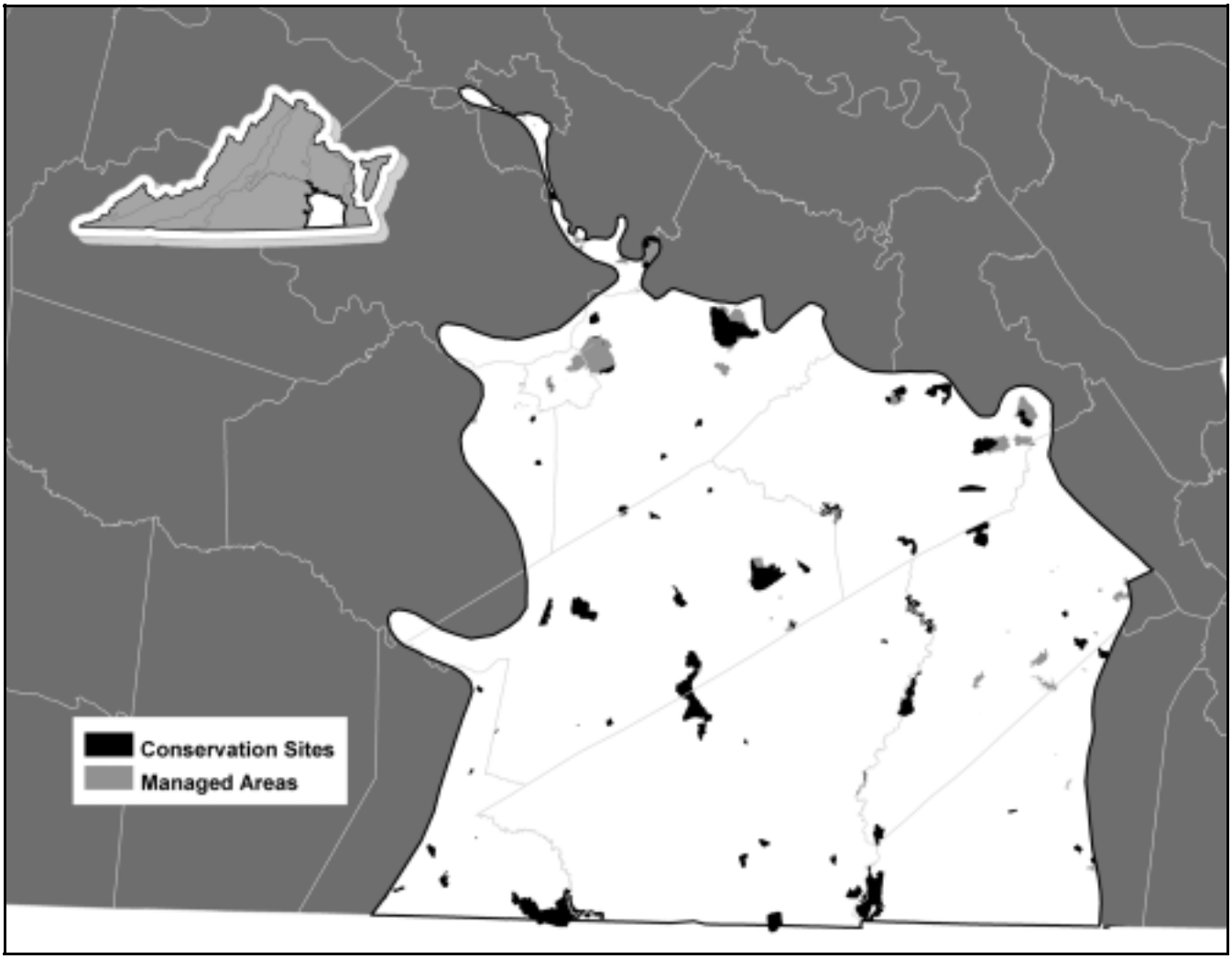

Figure 7.14. Southern Coastal Plain Physiographic Province.

Southern Coastal Plain Physiographic Province

Description

The Southern Coastal Plain is similar to the Northern Coastal Plain in geologic origin and composition but generally exhibits less topographic relief. Virginia's Southern Coastal Plain is bordered by the Fall Line to the west, the James River to the north, the Virginia-North Carolina state line to the south, and the Suffolk scarp to the east. The Suffolk scarp marks the boundary between the Southern Coastal Plain and the Outer Coastal Plain and runs along the western side of the Great Dismal Swamp.

Authors have identified the James River as a natural feature marking the transition between two great vegetational / climatic regions (Braun 1950). The potential natural vegetation of the Southern Coastal Plain is broadly referred to as the southeastern evergreen forest. Originally, fire-dependent longleaf pine (*Pinus palustris*) and pond pine (*Pinus serotina*) were dominant trees of the more level uplands, with mesophytic hardwoods (beech-oak-hickory) in ravines and a variety of baldcypress-tupelo swamps and other wetland communities in the bottomlands. Today, loblolly pine (*Pinus taeda*) is the dominant upland species, occurring both naturally and on tree farms. Bottomlands are still dominated by baldcypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), swamp black gum (*Nyssa biflora*) and other hardwoods. Special, small-patch communities include headwater seepage bogs, calcareous ravine forests, Coastal Plain depression ponds and remnant pine-scrub oak sandhills.

Table 7.34. Conservation site and stream conservation unit summary for the Southern Coastal Plain Physiographic Province.

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks				
				B1	B2	B3	B4	B5
Conservation sites	182	150,822	6%	0	9	20	33	120
Stream conservation units	23	400	2%	1	4	3	5	10
Totals	**205**	**151,222**	**6%**	**1**	**13**	**23**	**38**	**130**

Table 7.35. Number and status of natural heritage resources found in the Southern Coastal Plain Physiographic Province.

	No. of elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	35	166	83	119	30
Plants	123	338	1	0	56
Communities	14	38	-	-	14
Other	2	2	-	-	2
Totals	**174**	**544**	**84**	**119**	**102**

Conservation Site Summary

Current natural heritage data indicate that the Southern Coastal Plain Physiographic Province supports 205 conservation sites and stream conservation units. The combined acreage for these sites is approximately nine percent of the land area of the province. Six percent of the land area of these sites is on property currently managed for conservation. Table 7.34 gives an overview of the status of conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Southern Coastal Plain Physiographic Province supports approximately 544 occurrences of 174 rare species and significant natural community types. Of these occurrences, 84 represent populations of federally threatened or endangered species and 119 are state-listed. A summary of these natural heritage resources is provided in Table 7.35. The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.36-7.38.

Table 7.36. Natural heritage resource inventory targets for the Southern Coastal Plain Physiographic Province.

Plants	
Desmodium ochroleucum	creamflower tick-trefoil
Juncus caesariensis	New Jersey rush
Pycnanthemum clinopodioides	basil mountain-mint
Rudbeckia heliopsidis	sun-facing coneflower
Schwalbea americana	chaffseed
Scirpus flaccidifolius	reclining bulrush
Sida elliottii	Elliott sida
Tridens chapmanii	Chapman's redtop
Animals	
Bufo quercicus	oak toad
Deirochelys reticularia	chicken turtle
Picoides borealis	Red-cockaded Woodpecker
Myotis austroriparius	southeastern myotis (bat)
Alasmidonta heterodon	dwarf wedgemussel
Elliptio lanceolata	yellow lance
Elliptio roanokensis	Roanoke slabshell
Fusconaia masoni	Atlantic pigtoe
Lampsilis cariosa	yellow lampmussel
Caecidotea attenuatus	Dismal Swamp isopod
Caecidotea phreatica	phreatic isopod
Siphloplecton costalense	Spieth's great speckled olive mayfly
Enallagma weewa	blackwater bluet
Epitheca costalis	stripe-winged baskettail
Epitheca semiaquea	mantled baskettail
Epitheca spinosa	robust baskettail
Chlorochroa dismalia	Dismal Swamp green stink bug
Cicindela abdominalis	orange-bellied tiger beetle
Cicindela gratiosa	a tiger beetle
Calephelis virginiensis	little metalmark
Callophrys hesseli	Hessel's hairstreak
Problema bulenta	rare skipper
Papaipema sp. 3	southeastern cane borer moth
Natural Communities	
basic mesic forest	
coastal plain dry calcareous forest and woodland	
fluvial terrace woodland	
coastal plain / piedmont bottomland forest	
floodplain pond and pool	
coastal plain depression pond	
non-riverine wet hardwood forest	
coastal plain basic seepage swamp	
streamhead pocosin	
tidal shrub swamp	
tidal bald cypress forests and woodland	
tidal hardwood swamp	

Table 7.37. Natural heritage resource protection targets for the Southern Coastal Plain Physiographic Province.

Plants	
Chrysopsis gossypina	cottony golden-aster
Eleocharis melanocarpa	black-fruited spikerush
Eleocharis tricostata	Robbins spikerush
Animals	
Ambystoma maybeei	Mabee's salamander
Ambystoma tigrinum	tiger salamander
Hyla gratiosa	barking treefrog
Deirochelys reticularia	chicken turtle
Natural Communities	
coastal plain depression pond	
coastal plain / piedmont seepage bog	
streamhead pocosin	

Table 7.38. Natural heritage resource stewardship targets for the Southern Coastal Plain Physiographic Province.

Plants	
Aletris aurea	golden colicroot
Buchnera americana	blue-hearts
Calamovilfa brevipilis var. *calvipes*	pine barrens reedgrass
Cirsium virginianum	Virginia thistle
Cleistes divaricata	spreading pogonia
Coelorachis rugosa	wrinkled jointgrass
Ctenium aromaticum	toothache grass
Desmodium tenuifolium	slim-leaf tick-trefoil
Dichanthelium consanguineum	blood panic grass
Dichanthelium strigosum	rough-hair panic grass
Eriocaulon decangulare	ten-angle pipewort
Eryngium yuccifolium var. *yucci-folium*	rattlesnake-master
Gentiana autumnalis	pine-barren gentian
Helenium brevifolium	shortleaf sneezeweed
Hypericum setosum	a St. John's-wort
Lachnocaulon anceps	bog-buttons
Lilium catesbaei var. *longii*	southern red lily
Ludwigia ravenii	Raven's seedbox
Pediomelum canescens	hoary scurfpea
Platanthera blephariglottis var. *con-spicua*	large white fringed orchid
Prenanthes autumnalis	slender rattlesnake-root
Rhexia petiolata	ciliate meadow-beauty
Rhynchospora cephalantha var. *at-tenuata*	small capitate beakrush
Rhynchospora debilis	savannah beakrush
Rhynchospora fascicularis var. *distans*	fasciculate beakrush
Rhynchospora perplexa var. *virgin-iana*	a beakrush
Sabatia campanulata	slender marsh rose-pink
Saccharum brevibarbe var. *brevi-barbe*	short-beard plumegrass
Sarracenia flava	yellow pitcher-plant
Solidago gracillima	southern bog goldenrod
Trichostema setaceum	narrow-leaved blue-curls
Xyris platylepis	tall yellow-eyed-grass
Zigadenus densus	dense-flowered camas
Animals	
Picoides borealis	Red-cockaded Woodpecker
Natural Communities	
non-riverine pine – hardwood forests	
coastal plain / piedmont seepage bogs	

Figure 7.15. Red-cockaded Woodpecker (*Picoides borealis*).

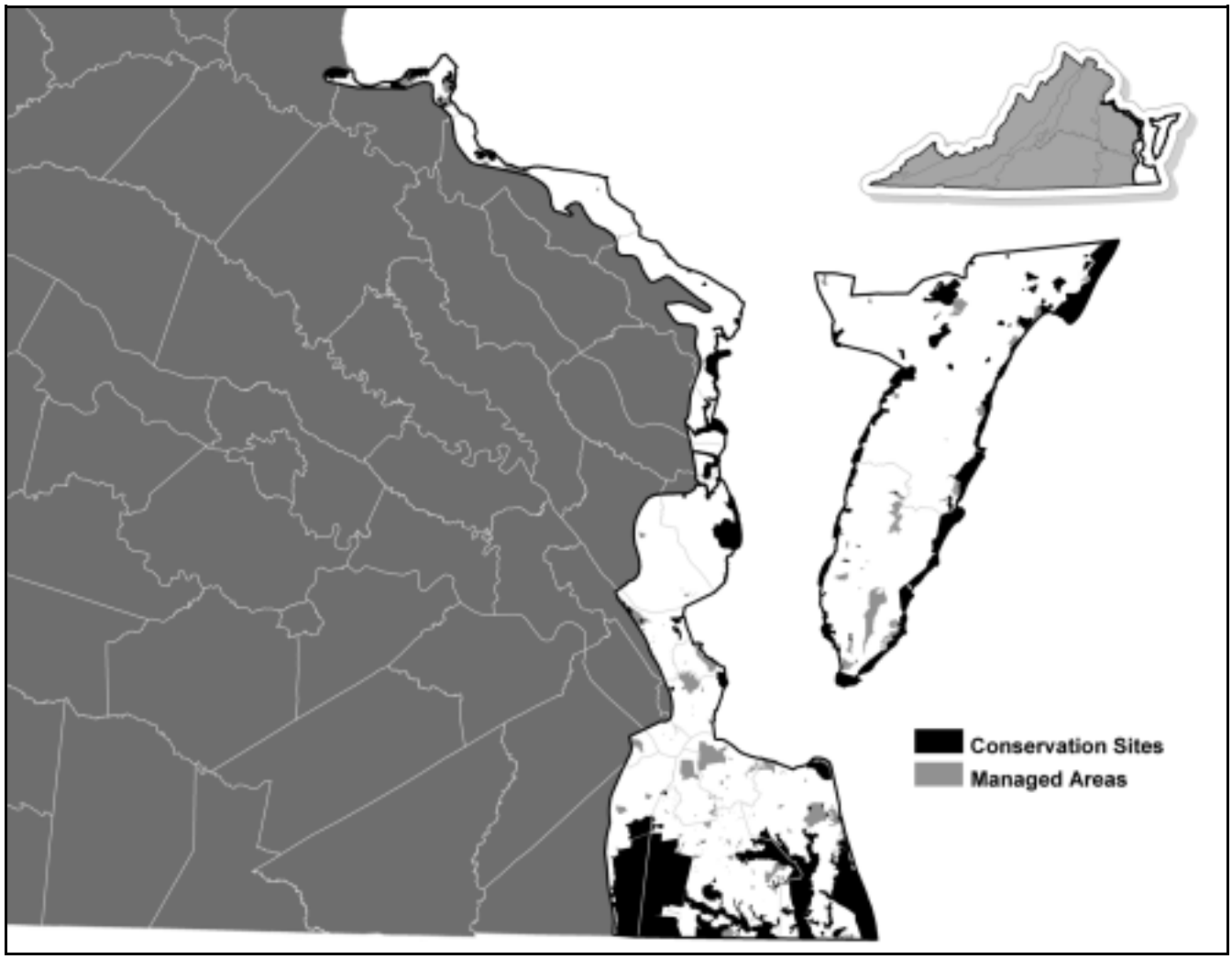

Figure 7.16. Outer Coastal Plain Physiographic Province.

Outer Coastal Plain Physiographic Province

Description

Virginia's Outer Coastal Plain encompasses the Eastern Shore, the outer terrace of the Northern Neck and the Middle and Lower Peninsulas, and lands east of the Suffolk Scarp in the southeast corner of the state. Unlike the higher and more dissected Northern and Southern Coastal Plain provinces, the Outer Coastal Plain has virtually no topographic relief and is dominated by flat-lying forests, salt marshes, barrier islands, beaches and dunes of the Chesapeake Bay and Atlantic Coast.

The natural vegetation types of the Outer Coastal Plain vary widely across the province, dependent largely upon the proximity to the shore, tidal influences and other hydrologic regimes. Maritime upland forests of the Chesapeake Bay and Eastern Shore are dominated by loblolly pine (*Pinus taeda*) or, on sheltered back dunes, by loblolly pine and deciduous oaks (*Quercus* spp.). Similar forests of Back Bay and the Atlantic shore are characterized by loblolly pine and live oak (*Quercus virginiana*). Occurring throughout the province and dominating the region around the Great Dismal Swamp are non-riverine wetland forests occupying large, saturated to seasonally flooded terraces. Tidal salt marshes border much of the Chesapeake Bay and its tributaries, as well as the areas between the barrier islands and the mainland of the Eastern Shore. High-energy beaches and coastal dunes form the eastern-most edge of the province along the Atlantic shore. Some notable rare communities of the province include Atlantic white cedar swamps, pocosins, wind-tidal marshes, interdune ponds and sea-level fens.

Table 7.39. Conservation site and stream conservation unit summary for the Outer Coastal Plain Physiographic Province.

Type	Count	Total acres	Proportion of conservation site land area protected	Site biodiversity ranks				
				B1	B2	B3	B4	B5
Conservation sites	231	382,587	23%	0	26	33	34	138
Stream conservation units	2	35	11%	0	0	0	1	1
Totals	**233**	**382,622**	**23%**	**0**	**26**	**33**	**35**	**139**

Table 7.40. Number and status of natural heritage resources found in the Outer Coastal Plain Physiographic Province.

	No. of elements	Element occurrences	Occurrences of federally listed species	Occurrences of state listed species	Occurrences on protected areas
Animals	62	544	300	266	261
Plants	88	241	1	2	178
Communities	38	115	-	-	85
Other	2	39	-	-	23
Totals	**190**	**939**	**301**	**268**	**547**

Conservation Site Summary

Current natural heritage data indicate that the Outer Coastal Plain Physiographic Province supports 233 conservation sites and stream conservation units. The combined acreage for these sites is approximately 22 percent of the land area of the province. Twenty-three percent of the land area of these sites is on property currently managed for conservation. Table 7.39 gives an overview of the status of conservation sites and stream conservation units for the province, including their biodiversity rankings.

Natural Heritage Resource Targets

The Outer Coastal Plain Physiographic Province supports approximately 939 occurrences of 190 rare species and significant natural community types. Of these occurrences, 301 represent populations of federally threatened or endangered species and 268 are state-listed. A summary of these natural heritage resources is provided in Table 7.40. The elements that require immediate attention for inventory, protection and stewardship are listed in Tables 7.41-7.43.

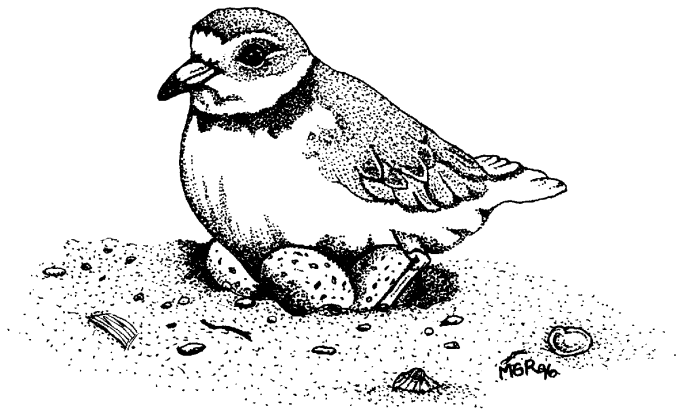

Figure 7.17. Piping Plover (*Charadrius melodus*).

Table 7.41. Natural heritage resource inventory targets for the Outer Coastal Plain Physiographic Province.

Plants	
Amaranthus pumilus	seabeach amaranth
Polygonum glaucum	sea-beach knotweed
Tridens chapmanii	Chapman's redtop
Animals	
Regina rigida	glossy crayfish snake
Laterallus jamaicensis	Black Rail
Myotis austroriparius	southeastern myotis (bat)
Sylvilagus floridanus hitchensi	Smith Island cottontail
Caecidotea attenuatus	Dismal Swamp isopod
Epitheca costalis	stripe-winged baskettail
Epitheca semiaquea	mantled baskettail
Epitheca spinosa	robust baskettail
Chlorochroa dismalia	Dismal Swamp green stink bug
Calephelis virginiensis	little metalmark
Callophrys hesseli	Hessel's hairstreak
Euphyes pilatka	saw-grass skipper
Problema bulenta	rare skipper
Apamea sp. 1	a noctuid moth
Papaipema sp. 3	southeastern cane borer moth
Natural Communities	
maritime dune woodland	
maritime evergreen forest	
coastal plain / piedmont bottomland forest	
floodplain ponds and pool	
coastal plain depression pond	
non-riverine wet hardwood forest	
maritime swamp forest	
interdune pond	
estuarine fringe pine forest	
tidal freshwater marsh	
tidal shrub swamp	
tidal bald cypress forest and woodland	
tidal hardwood swamp	
estuarine fringe swamp forest	
salt flat	

Table 7.42. Natural heritage resource protection targets for the Outer Coastal Plain Physiographic Province.

Plants	
Eleocharis equisetoides	horse-tail spikerush
Eriocaulon aquaticum	seven-angled pipewort
Nymphoides aquatica	big floating-heart
Animals	
Charadrius melodus	Piping Plover
Crotalus horridus atricaudatus	canebrake rattlesnake
Cicindela dorsalis dorsalis	northeastern beach tiger beetle
Natural Communities	
maritime dune woodland	
maritime mixed forest	
coastal plain depression pond	
sea-level fen	
tidal freshwater marsh	

Table 7.43. Natural heritage resource stewardship targets for the Outer Coastal Plain Physiographic Province.

Plants	
Amphicarpum purshii	blue maiden-cane
Helianthemum propinquum	low frostweed
Pycnanthemum setosum	awned mountain-mint
Rhynchospora cephalantha var. *pleiocephala*	many-headed bunched beakrush
Natural Communities	
non-riverine pine – hardwood forest	
coastal plain / piedmont seepage bog	
pond pine woodland and pocosin	
sea-level fen	

Chapter 8

Biodiversity Conservation Goals for the Next Decade

As documented throughout *Virginia's Precious Heritage*, Virginia is extremely rich in its diversity of life. The state's rare plants, animals and natural communities are declining but highly valued components of our native flora and fauna. Their condition serves as a direct measure of changes in the natural landscape and a barometer of the condition of open space across the state. Many of Virginia's elements of biodiversity have national or even international significance.

For example, the maritime resources of Virginia's seaside and Chesapeake Bay and the migratory neotropical songbird corridor on the Eastern Shore are systems vital to life throughout the western hemisphere. The rich slope forests and limestone barrens along the upper Tennessee River system in southwest Virginia are vitally important to the nationally significant mussel diversity and other freshwater fauna found there. Furthermore, protecting the plants, animals and natural communities found only in Virginia is only Virginia's responsibility. If not protected here, they will vanish from the earth.

Virginia ranks 12th in the United States for the number of native plant and animal species, and Virginia is second in the nation for the number of dragonfly species. The leading hotspot of aquatic diversity in the United States is found in the mist-shrouded Appalachian Mountains of southwestern Virginia. Virginians have inherited a tremendous wealth of natural resources, and with it a tremendous responsibility to pass on to future generations the same treasure chest of life.

The quality of life enjoyed by Virginia residents is directly tied to the quality of natural resources. Virginia ranked fourth in the nation in 2002 for being the most livable state, as rated by Morgan Quitno Press. Virginia has millions of acres of beautiful mountains, rivers and beaches and offers abundant outdoor opportunities in its many local, state, federal and privately protected parks, forests and natural areas. People gain great satisfaction by visiting healthy forests and clean rivers for bird watching, hiking, wildflower viewing, camping, hunting, fishing and other outdoor activities. An equal or greater number also benefit on a daily basis by simply knowing those resources are close at hand when they want to experience them.

Virginia's diversity of life and the outdoor opportunities are outstanding, however the challenges these resources and the current generation face are greater. Virginia is the eighth state in the nation for plant and animal extinctions. Recent analysis by the Virginia Department of Forestry and the U.S.D.A. National Resources Inventory show Virginia losing forestland at a rate of 49,000 acres per year, and developed land increasing at a rate of 52,200 acres per year. Alien in-

vasive species are the second leading threat to natural diversity. The best conservative estimate of costs to Virginians of alien invasive species is $1.4 - $3 billion per year. [Pimentel, D. et al. 2000. Environmental and Economic costs associated with non-indigenous species in the United States. Bioscience 50(1) 53-65 (15 Dec. 2000).] They threaten two-thirds of all endangered species, and literally know no boundaries. Invasive species such as garlic mustard, common reed, kudzu, Japanese stilt grass, Japanese honeysuckle, tree-of-heaven and many more have decimated Virginia's floodplains, forests and grasslands.

While natural resource land is being converted at a significant rate, there is strong citizen support for land conservation. A 2001 poll conducted by The Tarrance Group and The Kitchens Group found that 89% of Virginia's voters rate open space conservation a top priority, and that 82% of those polled believe that Virginia's natural areas soon will be lost forever unless there is immediate action to save them. In November 2002, 69% of the voters approved the $119 million Park and Natural Areas General Obligation Bond Referendum.

With such strong public support, Virginia can successfully protect its biological diversity. The following are some key goals that, if achieved, will help secure Virginia's rich natural heritage for future generations.

Goal 1: Secure a broad-based stable funding source for land conservation

A critical element in protecting land and the resources it supports is public funding for land conservation. Virginia has never had a dedicated and reliable state funding source for land conservation, and the state trails its East Coast neighbors. North Carolina devotes nearly $60 million annually to conservation efforts. In December 1999, Pennsylvania approved a five-year legislative package that will provide $645.9 million for natural resource protection and enhanced recreational opportunities. The Maryland state expenditure for public land preservation totaled more than $300 million for fiscal years 1992 through 1999. During the same eight-year period, Virginia expended $23.5 million in state funds, about eight percent of the Maryland total, for public land preservation efforts (Chesapeake Bay Commission and Trust for Public Land, 2001). Some steps to achieve this goal include:

- Fully fund the Virginia Land Conservation Foundation. In 1992, the Commonwealth established this foundation, a citizen appointed board whose mission is to serve as a coordinating and planning body for state land conservation interests and as a vehicle for state funding for a variety of related purposes. To date, the Virginia Land Conservation Foundation has awarded more than $10.5 million in state grants (matched by recipients) and protected an estimated 9,157 acres. Unfortunately, the foundation has not received any state funding for the last few years. When available, monies allocated to the foundation are spent according to the following formula: 25% is transferred to the Virginia Outdoors Foundation for providing landowner assistance grants and the remaining 75% is divided equally among (i) natural area protection; (ii) open spaces and parks; (iii) farmlands and forest preservation; and (iv) historic area preservation. At least one-third must be used to secure easements to be held or co-held by a public body.

- Enhance the awareness of and delivery of conservation tools and tax incentives for private landowners who voluntarily conserve priority conservation sites or manage their land to benefit rare species and natural communities.

- Expand efforts to encourage donations to the Conservation and Recreation Open Space tax check-off and Natural Area Preservation Fund to enhance natural area conservation efforts by localities and DCR.

Goal 2: Expand the existing network of conservation lands

Many of Virginia's rare species and significant community types are only known to exist on unprotected lands and probably very few of the other rarities have enough protected habitat to sustain them far into the future. Therefore all of the Commonwealth's partners in land conservation must work together to protect more vital habitat. And because not all elements of

biodiversity can be protected on a species-by-species basis, a special focus should be given to protecting healthy sustainable examples of all Virginia's natural community types. Some steps to achieve this goal include:

- Secure natural area preserve dedication and administrative public land designations for 200 high priority natural areas across Virginia by 2006.
- Inform and promote land conservation at the local government level to meet the ever-increasing demand for open space lands.
- Encourage increased investment in land protection by private conservation organizations.

Goal 3: Target conservation actions on the best opportunities and measure success of land conservation efforts

When Virginia moves forward with land conservation, it should have in place an objective, science-based analysis tool using the best statewide data currently available, or that can be developed in the next 12-18 months. This system would rank resources according to their ecosystem values, vulnerability, geographic distribution, and their relationship to resource-based land uses that have been identified in the Virginia Land Conservation Foundation Act as needing increased conservation attention. Statewide data would be collected or generated for resource types such as natural heritage conservation areas; significant viewsheds, greenways and conservation corridors; underrepresented natural communities; large relatively-unfragmented landscape areas; natural floodplains and riparian forests; surface waters; functional wetlands; natural resource-based recreation lands; significant archaeological and historic lands; sustainable forest lands; and significant agricultural lands. The geographic data for these resource types would be compared with existing public conservation lands and proposed conservation land acquisition projects to evaluate the protection status of these resource types and to guide decisions about future land conservation efforts. Such a system could be expanded from a project currently being developed by DCR called the Virginia Conservation Lands Assessment. (See the sidebar on Virginia Conservation Lands Assessment in Chapter 1.) Proposed outcomes of this assessment are:

- Provide baselines which inform overall land conservation priorities and are a starting point to measure future progress.
- Identify priority lands to meet current conservation needs.
- Identify lands that meet multiple conservation goals.
- Provide a continuous monitoring mechanism for re-evaluation of conservation needs.
- Clearly and continuously track and document the progress of the Virginia Land Conservation Foundation.

Goal 4: Enhance natural resource information and expand public awareness and understanding of natural resource conservation

Increasing the public's awareness and understanding of natural resources is essential for protecting biodiversity. This can be achieved, in part, by enhancing natural heritage resource information and making it available to more people. Some steps to help reach this goal include:

- Enhance and expand plant, animal and natural community inventory efforts across Virginia. There remains much to learn and the time to find and conserve these precious resources is rapidly dwindling.
- Work with localities to complete natural area inventories in regions of Virginia with high concentrations of natural heritage resources and/or high levels of threat. Such inventories will assist localities in their comprehensive planning and protection of natural areas.
- Enhance awareness of the importance of establishing natural areas to meet the needs of citizens.
- Create natural area conservation site information layers, which can be made available in a safe and in-

formed manner to public and private conservation agencies and organizations at the local, regional and state level.

- Expand types of natural heritage information available to users via the Internet.

- Increase public awareness of significant karst (limestone regions with underground streams, sinkholes, and caves) features harboring natural heritage resources.

- Continue and enhance cooperation with the Virginia Department of Game and Inland Fisheries for efficient collection, exchange, and dissemination of information about Virginia's biological resources.

Goal 5: Promote more biodiversity-friendly resource management

Maintaining Virginia's biodiversity requires protecting core significant natural areas and managing them appropriately. It must also include a broad range of conservation practices, land uses and management practices on public and private lands that make up the matrix of Virginia's natural and semi-natural landscape. Some steps to help achieve this goal include:

- Provide natural heritage resource management assistance to public and private land managers and owners with natural heritage resources on their properties and to DCR natural areas.

- Write and implement management plans for public lands that set priorities for biodiversity conservation, expand the use of such common practices as prescribed burning, and provide alternative sites for conflicting land use issues.

- Focus greater efforts on managing invasive alien species. These should include determining their distribution, status and effective control measures, and increasing public agency and private organizations' efforts to combat what has become a clear and present danger to native habitats throughout Virginia.

These are ambitious goals, outlining a path for the conservation of Virginia's precious natural heritage. Virginia can be successful if individuals, organizations and agencies work together, to put these goals into action and apply their collective conservation knowledge to today's conservation problems and challenges. Then, with open minds they should evaluate successes and failures, adjusting future actions accordingly. Considering the immense value of Virginia's natural heritage much will be lost if no action is taken now. Virginia must succeed for the sake of present and future generations.

Appendix A

Glossary

biodiversity (also called biological diversity): the full variety of species and habitats, their variability, and the processes affecting them

conservation site: an area that includes one or more viable occurrences of natural heritage resources and the land believed necessary to sustain them

conservation easement: a legal agreement recorded with the property deed that allows landowners to retain ownership while protecting land in perpetuity by agreeing to permanently restrict certain uses of the property

dedicated natural area: a natural area that has been formally placed into Virginia's Natural Area Preserve System; most dedicated natural areas are owned by the Virginia Department of Conservation and Recreation, but some are owned by other entities

dedication (natural area dedication): the strongest protection tool available for natural areas, which involves the recording of a legally binding agreement that states the intended use, management and development of the property, and designates oversight of these conditions to DCR; the landowner may elect to retain ownership, as well as the right to sell or transfer the property, but relinquishes specific rights to use the land in ways that are incompatible with the conservation goal of perpetuating occurrences of natural heritage resources

element: the individual natural heritage resource monitored by a natural heritage program; elements include native plant and animal species, natural community types, significant caves and other significant biological and geological features

element occurrence: single unit of a natural heritage resource; a specific location where a species' population or a natural community stand occurs

exotic species: also known as alien, non-native or non-indigenous species; species intentionally or accidentally introduced by human activity into a region in which they did not naturally occur

extirpated: no longer occurring in the wild within a specified region (e.g., extirpated from Virginia)

extinct: no longer occurring anywhere

Geographic Information System (GIS): a computer system capable of capturing, organizing, analyzing and displaying geographically referenced information

invasive species: a species which rapidly populates new areas and displaces other species; most invasive species are exotic and may spread unchecked by natural controls such as disease, predation and competition

karst: a landscape characterized by sinkholes, sinking streams, springs, and caves that have formed in areas where mildly acidic groundwater has dissolved soluble rocks such as limestone, dolostone, marble or gypsum

natural area: 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 (from *Code of Virginia*)

Natural Area Preserve System: the statewide network of dedicated natural areas

natural community: an assemblage of co-existing, interacting species, considered together with the physical environment and associated ecological processes, that has undergone minimal human disturbance

Natural Heritage Network: an international association of natural heritage programs dedicated to gathering, organizing and distributing high quality biodiversity information

Natural Heritage Plan: a statewide action plan for the protection, acquisition, and management of natural areas as mandated in the *Code of Virginia*

natural heritage resources: the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geological sites, and similar features of scientific interest benefiting the welfare of the citizens of the commonwealth (from *Code of Virginia*)

physiographic province: a large land area that shares common geologic history, landform and soil types

stewardship: long-term management of land to maintain or enhance natural heritage resources and conserve regional biodiversity

stream conservation unit (SCU): a section of a waterway with one or more viable occurrences of natural heritage resources and all stretches of that waterway and its tributaries for two miles upstream and one mile downstream from the known extent of the occurrence

Virginia Registry of Natural Areas: a non-binding, non-regulatory program that encourages voluntary preservation of important natural lands in private and public ownership; this program recognizes property owners who act voluntarily to safeguard natural areas

Appendix B

Virginia Natural Area Preserves 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 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 C

Natural Heritage Program Publications and Technical Reports

Peer-reviewed Publications

In the course of their conservation work, Natural Heritage Program scientists research a wide range of subjects in natural history. Some of these investigations produce data of interest to the scientific community, from the range of a dragonfly to the composition of prairie vegetation at Buffalo Mountain. To share the most significant research with the scientific community, staff biologists publish work in many peer-reviewed publications. There is limited time for publishing work through the office and many staff members will work nights and weekends to gather data and write-up results. Below is a list of the peer-reviewed papers and publications produced by Natural Heritage Program scientists and their co-authors. These are grouped by year of publication.

1987

Lipford, M. L., G. D. Rouse, and C. A. Clampitt. 1987. The Virginia Natural Heritage Program: monitoring rare species and communities. Virginia Journal of Science 38(4): 388-398.

1989

Buhlmann, K. A. 1989. Field notes: *Crotalus horridus atricaudatus* (Canebrake Rattlesnake). Catesbeiana 9(2): 34.

Buhlmann, K. A., and C. A. Pague. 1989. Field notes: *Hemidactylium scutatum* (Four-toed Salamander). Catesbeiana 9(2): 33.

Buhlmann, K. A., C. A. Pague, and J. C. Mitchell. 1989. Field notes: *Deirochelys reticularia reticularia* (Eastern Chicken Turtle). Catesbeiana 9(2): 35-36.

Lipford, M. L. 1989. The status of freshwater mussels (Unionidae) of Virginia. Sterkiana 72: 27-31.

Ludwig, J.C. 1989. The biological and legal status of Virginia's rare and uncommon vascular plants. Jeffersonia 20: 1-18.

1990

Buhlmann, K. A., and R. L. Hoffman. 1990. Geographic distribution: *Ambystoma tigrinum tigrinum* (Eastern Tiger Salamander). Herpetological Review 21(2):36.

1991

Buhlmann, K. A. 1991. Field notes: *Siren lacertina* (Greater Siren). Catesbeiana 11(1):19-20.

Buhlmann, K. A. 1991. Field notes: *Ambystoma mabeei* (Mabee's Salamander). Catesbeiana 11(1):20.

Buhlmann, K. A., and M. S. Hayslett. 1991. Herpetofauna of Chippokes Plantation State Park. Catesbeiana 11(2): 33-34.

Clampitt, C. A. 1991. White Mandarin, *Streptopus amplexifolius* (Linnaeus) DeCandolle. Pp. 435-436 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia

Clampitt, C. A. 1991. The upland plant communities of Seashore State Park, Virginia Beach, Virginia. Virginia Journal of Science 42(4): 419-436.

Gourley, E. V., and C. A. Pague. 1991. Shovel-nosed Salamander, *Leurognathus marmoratus* Moore. Pp. 435-436 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Lipford, M. L. 1991. Elephant-ear, *Elliptio crassidens* (Lamarck) Pp. 271-272, Sheepnose, *Plethobasus cyphyus* (Rafinesque) Pp. 280-281, Fanshell, *Cyprogenia stegaria* (Rafinesque) Pp. 291-292, Black Sandshell, *Ligumia recta* (Lamarck) Pp. 302-303, Deertoe, *Truncilla truncata* (Rafinesque) Pp. 304-305 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Ludwig, J. C. 1991. Epiphytic Sedge, *Carex decompotita* Muhlenberg Pp. 71-72, Toothed Sedge, *Cyperus dentatus* Torrey Pp. 74-75, Black-fruited Spikerush, *Eleocharis melanocarpa* Torrey Pp. 77-78, Robbins' Spikerush, *Eleocharis robbinsii* Oakes Pp. 78-79, Pine Barren Rush, *Juncus arbortivus* Chapman Pp. 84-85, Bog Rose, *Arethusa bulbosa* Linnaeus Pp. 90-91, White Fringed Orchid, *Habenaria blephariglottis* (Willdenow) Hooker Pp. 92-93, Large-leaf Grass-of-Parnassus, *Parnassia grandifolia* DeCandolle Pp. 14-115, Carolina Lilaeopsis, *Lilaeopsis carolinensis* Linnaeus Pp. 134-135, Fringed Gentian, *Gentiana crinita* Froelich Pp. 137-138, Buckbean, *Menyanthes trifoliata* Linnaeus Pp.138-139, Smooth Coneflower, *Echinacea laevigata* (Boynton and Beadle) Blake Pp. 144-145 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Ludwig, J. C., J. B. Wright, and N. E. Van Alstine. 1991. The rare plants of False Cape State Park, Virginia Beach City, Virginia. Pp. 249-256 in H. G. Marshall and M. D. Norman (eds.). Proceedings of the Back Bay Ecological Symposium. Old Dominion University, Norfolk, Virginia.

Mitchell, J. C., and K. A. Buhlmann. 1991. Eastern Chicken Turtle, *Deirochelys reticularia reticularia* (Latreille). Pp. 459-461 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Mitchell, J. C., K. A. Buhlmann, and C. H. Ernst. 1991. Bog Turtle, *Clemmys muhlenbergii* (Schoepf). Pp. 457-459 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Mitchell, J. C., and C. A. Pague. 1991. Ecology of freshwater turtles in Back Bay, Virginia. Pp. 183-187 in H. G. Marshall and M. D. Norman (eds.). Proceedings of the Back Bay Ecological Symposium. Old Dominion University, Norfolk, Virginia.

Mitchell, J. C., and C. A. Pague. 1991. Eastern Glass Lizard, *Ophisaurus ventralis* (Linnnaeus). Pp. 464-466 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Pague, C. A. 1991. Oak Toad, *Bufo quercicus* Holbrook Pp. 423-424, Carpenter Frog, *Rana virgatipes* Cope Pp. 426-427, Pygmy Salamander, *Desmognathus wrighti* King Pp. 433-435, Weller's Salamander, *Plethodon welleri* Walker Pp. 442-443, Hellbender, *Cryptobranchus alleganiensis alleganiensis* (Daudin) Pp. 443-445 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Pague, C.A., and K. A. Buhlmann. 1991. Rare animals of Back Bay, Virginia Beach, Virginia. Pp. 148-158 in H. G. Marshall and M. D. Norman (eds.). Proceedings of the Back Bay Ecological Symposium. Old Dominion University, Norfolk, Virginia.

Pague, C. A., and K. A. Buhlmann. 1991. Eastern Tiger Salamander, *Ambystoma tigrinum*

tigrinum (Green). Pp. 431-433 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Pague, C. A., K. A. Buhlmann, and J. C. Mitchell. 1991. Cow Knob Salamander, *Plethodon punctatus* Highton. Pp. 437-439 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Pague, C. A., and J. C. Mitchell. 1991. The amphibians and reptiles of Back Bay, Virginia. Pp. 159-166 in H. G. Marshall and M. D. Norman (eds.). Proceedings of the Back Bay Ecological Symposium. Old Dominion University, Norfolk, Virginia.

Pague, C. A., and J. C. Mitchell. 1991. Mabee's Salamander, *Ambystoma mabeei* Bishop Pp. 427-429, Mole Salamander, *Ambystoma talpoideum* (Holbrook) Pp. 429-431, Peaks of Otter Salamander, *Plethodon hubrichti* Thurow Pp. 436-437 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Pague, C. A., and D. F. Schweitzer. 1991. Butterflies and moths. Pp. 237-246 in K. Terwilliger (coordinator). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Pague, C. A., and D. A. Young. 1991. Barking Treefrog, *Hyla gratiosa* LeConte. Pp. 424-426 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

Van Alstine, N. E. 1991. White Buttons, *Eriocaulon septangulare* Withering. Pp. 83-84 in K. Terwilliger (coord.). Virginia's Endangered Species. McDonald and Woodward Publishing Company, Blacksburg, Virginia.

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Pague, C. A., and K. A. Buhlmann. 1992. Field notes: *Rana virgatipes* (Carpenter Frog). Catesbeiana 12(1): 9.

Pague, C. A., M. Hayslett, and P. Kramer. 1992. Field notes: *Plethodon hubrichti* (Peaks of Otter Salamander). Catesbeiana 12(1): 9-10.

1993

Buhlmann, K. A., J. C. Mitchell, and C. A. Pague. 1993. Amphibian and small mammal abundance and diversity in saturated forested wetlands and adjacent uplands of southeastern Virginia. Pp. 1-7 in S. D. Eckles, A. Jennings, A. Spingarn and C. Wienhold (eds.). Proceedings of a Workshop on Saturated Forested Wetlands in the Mid-Atlantic Region: The State of the Science. U. S. Fish and Wildlife Service, Annapolis, Maryland.

Buhlmann, K. A., A. H. Savitzky, B. A. Savitzky, and J. C. Mitchell. 1993. Geographic distribution: *Regina rigida* (Glossy Crayfish Snake). Herpetological Review 24(4): 156-157.

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saturated forested wetlands. Wetlands 13(2):130-136.

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Roble, S. M. 1994. Field notes: *Hyla cinerea* (Green Treefrog). Catesbeiana 14(2): 40.

Roble, S. M. 1994. Field notes: *Eumeces anthracinus anthracinus* (Northern Coal Skink). Catesbeiana 14(2): 40-42.

Roble, S. M. 1994. A preliminary checklist of the damselflies of Virginia, with notes on distribution and seasonality (Odonata: Zygoptera). Banisteria 4: 3-23.

Roble, S. M., and C. S. Hobson. 1994. Field notes: *Farancia erytrogramma* (Rainbow Snake). Catesbeiana 14(1): 15-16.

Roble, S. M., and P. H. Stevenson. 1994. Rediscovery of the dragonfly *Nannothemis bella* in Virginia (Odonata: Libellulidae). Banisteria 3: 27-28.

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Buhlmann, K. A. 1995. Habitat use, terrestrial movements, and conservation of the turtle, *Deirochelys reticularia* in Virginia. Journal of Herpetology 29(2): 173-181.

Erdle, S. Y. and J. F. Pagels. 1995. Observations on Sorex longirostris (Mammalia: Soricidae) and associates in eastern portions of the historical Great Dismal Swamp. Banisteria 6:17-23.

Hobson, C. S., and D. J. Stevenson. 1995. Field notes: *Thamnophis sirtalis sirtalis* (Eastern Garter Snake). Catesbeiana 15(1): 23.

Rawinski, T. J., and J. C. Mitchell. 1995. Field notes: *Cnemidophorus sexlineatus sexlineatus* (Six-lined Racerunner). Catesbeiana 15(1): 25.

Roble, S. M. 1995. Field notes: *Agkistrodon piscivorus piscivorus* (Eastern Cottonmouth). Catesbeiana 15(1): 24

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1998

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Hobson, C. S., A. C. Chazal, and S. M. Roble. 1998. The Virginia Piedmont water-boatman *Sigara depressa* (Heteroptera: Corixidae) rediscovered in Virginia. Banisteria 11: 37-40.

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Roble, S. M., and C. S. Hobson. 1998. Observations on nesting by a fence lizard, *Sceloporus undulatus hyacinthinus*, in Virginia. Banisteria 11: 47-49.

Roble, S. M., and C. S. Hobson. 1998. Records of amphibians and reptiles from Fort Lee, Prince George County, Virginia. Catesbeiana 18(2): 35-42.

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Roble, S. M., D. J. Stevenson, and A. C. Chazal. 1998. Field notes: *Eumeces anthracinus anthracinus* (Northern Coal Skink). Catesbeiana 18(2): 49-52.

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Technical Reports

Natural Heritage Program staff write numerous technical reports, which summarize their work and serve as guides for conservation activities. Many of these reports are produced for Natural Heritage Program clients and others are generated for internal use within the Virginia Department of Conservation and Recreation. These are listed here in the order in which they were completed. The first two digits of each report number represent the year it was produced. Reports produced for Natural Heritage Program clients may not be available for public distribution.

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89-1	A Natural Heritage Resources Inventory & Biological Assessment of the Elko Tract
90-2	An Inventory of the Natural Communities, and Rare, Threatened and Endangered Species of Seashore State Park and Natural Area, Virginia Beach, Virginia
90-3	An Inventory of the Rare, Threatened and Endangered Species of the Little Creek Amphibious Base
90-4	An Inventory of the Rare, Threatened, and Endangered Species of the NCS Cheatham Annex
90-5	An Inventory of the Rare, Threatened, and Endangered Species of the Naval Auxiliary Landing Field, Fentress
90-6	An Inventory of the Rare, Threatened, and Endangered Species of the Naval Air Station, Oceana
90-7	An Inventory of the Rare, Threatened, and Endangered Species of Camp Pendleton
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90-9	A Natural Areas Inventory of the City of Virginia Beach, Virginia, Phase I
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91-2	Distribution and Habitat of *Sorex longirostris fisheri*
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91-5	A Survey of the Freshwater Fishes at the Route 919 Crossing of the Blackwater River, Franklin County, Virginia
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91-8	A Natural Areas Inventory of the City of Virginia Beach, Virginia, Year 2
92-1	Natural Areas Inventory of the Lower Peninsula of Virginia
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92-3	Blue Ridge Interpretive Music Center and Fisher Peak - Rare, Threatened, and Endangered Species Assessment
92-4	A Natural Heritage Resources Inventory of Hunting Bay - Dyke Marsh, Alexandria City and Fairfax County, Virginia
92-14	Critical Natural Areas, Exemplary Wetlands, and Endangered Species Habitats in Southeastern Virginia

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92-15	1991 Final Report - Natural Heritage Inventory: *Gomphus septima*
92-16	Natural Heritage Inventory: *Cicindela dorsalis dorsalis* of the Chesapeake Bay Beaches of Virginia
92-18	A Natural Heritage Resources Inventory of the Naval Weapons Station Yorktown, York County, Virginia
92-19	A Natural Heritage Inventory for Unknown *Helenium virginicum* S.F. Blake Populations
92-20	An Inventory of *Clemmys muhlenbergii* in Southwestern Virginia
92-21	A Classification of Virginia's Indigenous Biotic Communities: Vegetated Terrestrial, Palustrine, and Estuarine Community Classes
92-22	Preliminary Survey of NH Resource Sites in Northampton and Accomac Counties, Virginia
92-23	An Inventory of Threatened and Endangered Species: Southeast TiSand Joint Venture, Greensville County, Virginia
92-24	Inventory for Rare, Threatened, and Endangered Plant and Animal Species: Route 600, Smyth County, Virginia
92-25	A Natural Heritage Resources Inventory of the Marine Corps Combat Development Command, Quantico, Virginia
92-26	A Natural Heritage Resources Inventory of the Naval Surface Warfare Center, Dahlgren Laboratory, Dahlgren, Virginia
92-27	A Rare Plant Inventory at Fort Belvoir, Virginia
92-29	Natural Heritage Inventory: Select Troglobitic Cave Beetles
92-30	A Natural Heritage Inventory of Seven Cave Beetles of the Genus *Pseudanophthalmus* and Assessment of their Respective Habitats
92-31	A Natural Heritage Inventory for *Ophiogomphus howei* in the New River, Virginia
92-32	Shenandoah Related Lands Study for National Park Service, Mid-Atlantic Service
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93-2	An Inventory of Rare, Threatened, and Endangered Plant Species and Significant Natural Communities of the Humpback Rocks Area, Blue Ridge Parkway
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93-12	A Natural Heritage Inventory of Mid-Atlantic Region National Parks in Virginia: Richmond National Battlefield Park
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93-14	A Natural Areas Inventory of the City of Virginia Beach, Virginia
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93-19	Conservation Strategies For Shale Barren Rock Cress *(Arabis serotina* Steele)
93-20	Classification and Mapping of Ecological Land Types on The James River Face Wilderness, Jefferson National Forest
93-21	An Inventory for *Isotria medeoloides* (Small Whorled Pogonia) at Two Sites on Quantico Marine Corps Base, Prince William County, Virginia
93-22	An Inventory for *Isotria medeoloides* (Small Whorled Pogonia) at The Ashland Property, Prince William County, Virginia
93-23	An Inventory for *Isotria medeoloides* (Small Whorled Pogonia) at Marine Corps Combat Development Command, Quantico, Stafford County, VA
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94-14	Forest Vegetation of the Ramsey's Draft and Little Laurel Run Res. N.A. Baseline Ecological Monitoring and Classification
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99-19	Preliminary Natural Heritage Inventory of Warm Springs Mountain, Bath County, Virginia
99-20	Fire Management for NLR Wetlands Restoration
99-21	Natural Heritage Locality Liaison Program – Final Report
99-22	Status Survey for the Rare Skipper *(Problema bulenta)* in Eastern Virginia, 1999
99-23	Status Survey for *(Cardamine micranthera)* Rollins (Small-Anthered Bittercress) in Virginia
99-24	Karst IV– Final Report
99-25	Conservation Status Assessment for the Regal Fritillary *(Speyeria idalia)* in Virginia, 1999
99-26	First Supplement to SBA's on the Jefferson National Forest

Number	Title
00-01	Surveys for Small Whorled Pogonia *(Isotria medeoloides)* in Timber Compartments 2, 11, 31, and 32 at Marine Corps Base, Quantico, Va.
00-03	A Natural Heritage Inventory of the Dragon Run Watershed
00-04	An Inventory of the Flora of the Fire-Maintained Grasslands and Woodlands at Marine Corps Base, Quanitco, Virginia
00-05	Zoological Surveys for the Dwarf Wedgemussel and Lepidoptera At Marine Corps Base, Quanitco, Virginia
00-06	Surveys for Rare Insects and Crustaceans in Manassas National Battlefield Park
00-07	Plant Communities and Ecological Land Units of the Peters Mountain Area, James River Ranger District, GW and JNF, Virginia
00-08	Ecological Communities of U. S. Army Garrison, Fort Belvoir
00-09	Natural Heritage Resources of Virginia: Rare Plants
00-10	Biological Diversity Protection on the George Washington National Forest – First Supplement
00-11	Special Biological Areas on the Jefferson National Forest – First Supplement
00-13	Spring Amphipods of the George Washington and Jefferson National Forests, Virginia
00-14	Pitcher Plant *(Sarracenia Spp)* Inventory of Fort A. P. Hill, Virginia
00-15	2000 Inventory for New Populations of *Aeschynomene virginica* (L.) BSP. in Virginia
00-16	Coalfields Expressway Small Whorled Pogonia *(Isotria medeoloides)* Survey 2000: A Preliminary Sampling
00-17	2000 Inventory for *Amaranthus pumilus* Raf. in Virginia
00-19	Current Status and Conservation Strataegy for the Eastern Small Footed Myotis *(Myotis leibii)*
00-20	Conservation Assessment of the Regal Fritillary *(Speyeria idalia) in* Virginia, 2000
00-21	Conservation status assessment of *Neonympha mitchellii* in Virginia, 1999.
00-22	Status survey for Saint Francis' Satyr, *Neonympha mitchellii francisci*, in Virginia, 2000.
01-01	An Updated Inventory of Rare, Threatened, and Endangered Species and Significant Natural Communities at the Naval Amphibious Base Little Creek South Virginia Beach Annex (Camp Pendleton)
01-02	An Updated Inventory of Rare, Threatened, and Endangered Species and Significant Natural Communities at the Naval Amphibious Base, Little Creek South Virginia Beach Annex (Camp Pendleton)
01-03	A Natural Heritage Inventory of the Dragon Run Watershed – Second Edition
01-04	Results of mist net surveys for the eastern small-footed myotis *(Myotis leibii)* at Turkey Run and Great Falls Parks, Virginia, 1999-2000
01-05	A Natural Heritage Inventory at Neck O Land, Colonial National Historical Park
01-06	A Natural Heritage Inventory of Philpott Lake
01-07	Status Survey for Rare Goundwater Amphipods (Genus *Stygobromus)* in Eastern Virginia

Number	Title
01-09	Biological Survey of the Coastal Plain Depression Ponds (Sinkholes) Of Colonial National Historical Park, Yorktown, Virginia – Final Report
01-10	A List of the Vascular Plants of Manassas National Battlefield Park
01-11	Natural Heritage Resources of Virginia: Rare Vascular Plants
01-12	Rare Fauna Inventory at Fort Pickett – Maneuver Training Center Blackstone, Virginia
01-13	Ranking Invasive Exotic Plant Species in Virginia
01-14	Ecological Communities of the George Washington and Jefferson National Forests, Virginia
01-15	A Status Survey and Assessment of Holsinger's Cave Beetle *(Pseudanophthalmus holsingeri)* at Young-Fugate Cave, Lee County, Virginia, 2000-2001
01-16	Natural Heritage Resources of Virginia: Rare Animals
01-18	Conservation Plan for the Saint Francis' Satyr *(Neonympha mitchellii francisci)* in Virginia
01-21	The Vascular Flora of John H. Kerr Reservoir, VA – Final Report
01-23	An Inventory for Rare, Threatened, and Endangered Species in the Jamestown Island 400 Project Area, Colonial National Historical Park
01-24	Status Survey for the Appalachian Grizzled Skipper *(Pyrgus wyandot)* in VA.
01-25	Status survey for Saint Francis' Satyr, *Neonympha mitchellii francisci*, in Virginia, 2001.
01-26	Surveys for Small Whorled Pogonia *(Isotria medeoloides)* in Timber Compartments 13, 15, 26, 27, 28, 29, 33, and 40 in 2000 and 2001 at Marine Corps Base, Quantico, Virginia
02-01	Plants and Animals Recorded from the Jamestown Island 400 Project Area, Colonial National Historical Park
02-02	A Natural Heritage Inventory of Rare, Threatened, and Endangered Species at Naval Air Station Oceana and Naval Auxiliary Landing Field Fentress Virginia Beach and Chesapeake, Virginia
02-03	An Inventory of Nocturnal Lepidoptera at Sharp Top Mountain, Peaks of Otter, Blue Ridge Parkway, Virginia
02-04	Coalfields Expressway Small Whorled Pogonia *(Isotria medeoloides)* Survey 2001: Final Report
02-06	Restoration of Habitat for Smooth Coneflower (*Echinacea laevigata*) in Virginia: Phase I – Population Surveys and Management Plan
02-07	Ecological Communities of the Jamestown Island 400th Anniversary Planning Project Area, Colonial National Historical Park, Virginia
02-09	A Natural Heritage Inventory of the Presquile and James River National Wildlife Refuges
02-10	Status Survey of the Regal Fritillary *(Speyeria idalia)* in Virginia, 2001
02-11	A Natural Heritage Inventory of Plant and Animal Species at Virginia Army National Guard OMS No. 1 and No. 2 near Sandston, Henrico County, Virginia
02-13	Natural Heritage Resources of Virginia: Rare Plants

Number	Title
02-14	Preliminary Classification of Piedmont and Inner Coastal Plain Vegetation Types in Virginia
02-15	Mosquito Control Guidelines for Virginia State Parks and Natural Area Preserves
02-16	Habitat Restoration for the Vaughan Tract at North Landing River Natural Area Preserve
02-17	Status Survey for the Appalachian Grizzled Skipper (*Pyrgus wyandot*) in Virginia
02-19	A Lepidopteran Survey of Turkey Run Park, George Washington Memorial Parkway
02-20	Status Survey of Regal Fritillary (*Speyeria idalia*) in 2002 on Radford Army Ammunition Plant
02-27	Status survey for and population monitoring of Saint Francis' Satyr (*Neonympha mitchellii francisci*) in Virginia, 2002.
03-04	Natural Heritage Resources of Virginia: Rare Animal Species.
03-05	An inventory for Natural Resources in the Chowan River Drainage Basin of Virginia.
03-06	Restoration of Habitat for Smooth Coneflower (*Echinacea laevigata*) in Virginia: Phase I I– Management and Monitoring
03-09	An inventory of rare, threatened, and endangered species and significant natural communities at the Naval Weapons Station Yorktown Complex, Yorktown, Virginia

Appendix D

Natural Area Preserve Management Guidelines

Overview

Natural area preserves in Virginia are managed for the objective of providing suitable habitat conditions for the continued existence of rare or declining species of plants and animals, and also to maintain rare and exemplary natural community types. Active management actions are often required to meet objectives, as is the case in many better known fields of natural resources management. For example, actions are taken in order to: (1) protect fragile and rare habitats from the potentially destructive impacts of human visitation while still allowing compatible and appropriate types of public use; (2) reinstate the natural process of fire through the use of prescribed burning to create and maintain habitat conditions required by fire-adapted and fire-dependant species and communities; (3) restore altered water flows and soil moisture regimes by blocking ditches or removing fill; (4) control invasive plants that rapidly usurp resources and occupy habitats of rare species while obliterating natural communities.

These management guidelines are intended to explain the general rationale for managing rare species and natural communities, to clarify the reasons for restricting public use and visitation, and to state principles and ideas that guide management of natural areas with the goal that they will perpetually sustain their valuable and vulnerable resources.

Introduction

The Virginia Natural Area Preserve System was established by law in 1989 to protect and conserve *natural heritage resources* (habitats of rare plants and animals; exemplary natural communities; other rare natural features) throughout the state. This system of protected lands is administered by the Virginia Department of Conservation and Recreation (DCR) and managed by the Division of Natural Heritage (DNH). Natural Area Preserve Dedication, in accordance with the Code of Virginia sections 10.1-209 - 217 (Virginia Natural Area Preserves Act), offers strong levels of protection by placing privately and publicly held natural areas into a legally established statewide preserve system with statutory protection against most forms of condemnation and conversion to other land uses.

These guidelines were developed by DCR–DNH to provide management direction for dedicated natural area preserves in Virginia. Natural area preserves may constitute a portion of larger conservation areas such as state parks, municipal watersheds, county parks, and privately-owned open spaces. Such areas often have recreation and/or commodity and income production as primary management objectives; thus, they nearly always have a broader set of compatible uses than is appropriate for natural area preserves.

Natural areas often support fragile habitats that are easily disturbed and sometimes destroyed by the presence of people. In a world dominated by humans, most natural areas have been modified to varying degrees by past and on-going land-use activities, and by introductions of non-indigenous species of plants and animals. The result, in some cases, has been the suppression or elimination of natural processes such as fire and flooding. These agents of disturbance are required to maintain successional stages that provide habitat for certain species or that result in the formation of distinct communities. Often, the introduction of exotic and invasive plants and animals poses a threat to native species and natural community integrity. For these reasons, a “hands-off” approach will usually not meet the objectives of natural areas stewardship. Natural area stewards must identify which processes are involved in maintaining communities and the habitats of rare species in order

to develop successful management strategies and prescriptions.

The primary and over-riding objective of natural areas stewardship is to provide for the continued presence of natural heritage resources. Attaining this objective may require management actions that result in perpetuation of a particular successional vegetative stage (habitat condition) required by a rare species or characterizing a natural community. Actions are taken that maintain, restore, or mimic natural processes and result in a particular desired vegetative structural and compositional condition. Thus, natural area stewards may work to prevent an unnatural, harmful disturbance (such as invasion by a non-native plant like kudzu) and allow or promote a natural, appropriate disturbance (such as fire) to maintain a rare grassland or prairie community in the Shenandoah Valley. By taking such actions, the natural processes and conditions that allowed the rare species or community to occur at the site are restored, to the extent possible.

Natural Area Preserve (NAP) Management Plans are written for all dedicated natural area preserves in Virginia. Plans are comprehensive and contain specific site and resource information plus management objectives and action recommendations that guide preserve stewardship and allow for management continuity over time. With assistance from various sources and organizations, DCR–DNH staff lead the assembly of information and development of management strategies aimed at enhancing, maintaining, and/or restoring the natural heritage resources for which the site was protected.

Public Use

Natural area preserves are acquired and managed primarily to perpetuate the long-term quality, condition, and viability of natural heritage resources contained or supported within their boundaries. Some natural area preserves can be managed to meet this objective while at the same time accommodating some level of public use. Compatible and appropriate types of uses for each preserve are identified through the management planning process. Visitor use is monitored by natural area stewards and data is used for refining public use and visitor access objectives. Some preserves contain extremely fragile habitats and species that are damaged by even low levels of visitation. Other preserves are more resilient and may be capable of sustaining higher levels of public use. Some preserves may be closed seasonally but open for visitor use at specific times of year. At others, visitation may be restricted to specific areas – such as along a designated trail or boardwalk.

Public use of natural area preserves can conflict with the primary natural heritage resource management and protection objective mandated by the Virginia Natural Area Preserves Act. The term "public use" as used here includes such activities as hiking, camping, biking, fishing, hunting, swimming, research, and education. It is a plain fact that human visitors often harm or threaten population viability of rare plants and animals, as well as their often-fragile habitats. The degree of damage depends on the frequency, intensity, and location of visitor activity. Some level of public use may be considered as appropriate if the characteristics of visitation and use are compatible with the resource protection priority and if such use does not threaten or degrade occurrences of natural heritage resources. Additionally, with the scarcity of funds to support natural areas management, costs to monitor and manage public use cannot be excessive.

Guidelines relating to specific types of public uses in the context of natural areas management follow. These are organized into three use categories, based on their appropriateness under normal circumstances and management situations.

Category 1: Normally Appropriate Uses

Birding, wildlife-watching, wildflower and native plant observation, photography. These non-consumptive uses by the public are often compatible with natural areas management. Populations of plants and animals are simply being observed, often at a distance, with no collection, disturbance, or resultant change in population condition. At some sites, trails or observation platforms may be beneficial for managing impacts of large groups or increased numbers of visitors participating in these activities. Particularly on fragile sites such as mountaintop balds, rock outcrops, and wetlands, repeated foot

travel can damage local habitats and trample rare plants. Visitation may, in some cases, need to be limited to specific seasons. Such is the case with preserves supporting populations of colonial beach nesting birds, so that nesting success is not decreased as a result of the presence of humans.

Hiking. Trails and vestiges of old roads nearly always exist as a result of land use prior to the establishment of a natural area preserve. Such trails may or may not be appropriate for public use by hikers, depending on factors such as proximity to occurrences of natural heritage resources, active erosion, wetland crossings, and other terrain features. New trails, if they are to be constructed, should be carefully located and maintained. All proposals for new trails in a natural area preserve, whether for recreation, research, or education, will be reviewed by the Natural Area Preserve Public Access Oversight Committee, co-chaired by the DCR–DNH Division Director and Stewardship Manager.

A map of existing and proposed trails will be included in the preserve Management Plan section on public access. This section will describe the purpose and physical characteristics of preserve trails. On most DCR-owned preserves, trail maintenance and use monitoring is the responsibility of the regional DNH Natural Area Operations Steward. Trail use monitoring assesses the number of trail users, the specific aspects of trail maintenance, and the extent to which users stay on designated trail routes. Careful attention is given to monitoring whether occurrences of natural heritage resources are being degraded by visitors using trails. It is notable that adverse effects from trail use are difficult to detect before damage has occurred and that once public use patterns are established, they are not easy to change. As needed, DNH staff will consult with Division of Planning and Recreation Resources and Division of State Parks staff to develop strategies to protect sensitive resources. Actions for reducing access to sensitive areas will include blocking roads and trails with gates and rocks, and installing interpretive signs explaining the purpose for access restrictions in natural area preserves.

Research. Numerous possibilities for research exist on natural area preserves. Baseline inventory work is often needed, such as floral, faunal, and community surveys. Research that increases knowledge about local microclimates, soils, geology, and hydrology of the area greatly benefits and informs preserve management decisions. To the extent possible, DNH will support scientific studies that show promise to fill knowledge gaps in natural area preserve and natural heritage resource management. Proposals for research funding support on natural area preserves will be reviewed on an individual basis. Studies to be conducted on preserves will require prior submission of a Research and Collecting permit application, review and approval by DNH staff, and issuance of a written permit. Research methods will be used that minimize adverse effects on natural heritage resources and physical features at the preserve. At project conclusion, researchers will be required to remove evidence of their work such as residue from destructive sampling techniques (clipped plots), temporary shelters for instrumentation, plastic flagging, and visual plot locators such as stakes, wire flags, or sampling station monuments

Teaching and interpretation. The use of natural area preserves for educational programs is highly appropriate. Natural areas present an opportunity to observe many rare forms of life as well as the natural processes that maintain them. Preserves are also ideal locations for introducing students to the concept and value of biodiversity and for educating people of all ages of the need for broad and comprehensive approaches to natural resource management. As with other public uses of natural areas, teaching and interpretation activities must be managed to prevent adverse impacts on natural heritage resources. DNH staff and/or responsible volunteer instructors should accompany all group field trips to natural area preserves.

Category 2: Conditionally Appropriate Uses

Fishing, picnicking, canoeing. Whether or not these activities constitute appropriate public uses depends on (1) the site-specific characteristics of a particular natural area and (2) the observed consequences of such uses. For example, circumstances may allow low

numbers of fishermen to use a beach that supports rare beach nesting birds and animals. At some preserves, however, there is clear justification for prohibiting these uses because they are known or expected to cause negative impacts to rare species. In all cases, where allowed, the effects of such uses will be monitored. If negative impacts to natural heritage resources are observed, the causative public use(s) will be discontinued.

Swimming. Swimming is not an authorized activity on DCR-owned natural area preserves, due primarily to the issue of public safety. With no lifeguards or patrols in place on public beaches or waterways, responsible landowning public agencies cannot officially sanction swimming. Rather, in nearly all cases, they must prohibit or actively discourage it. On privately-owned natural area preserves, decisions to allow swimming or to prohibit it are the responsibility of the landowner. In cases where beach uses such as sunbathing and beach-walking result in direct damage to fragile beach and dune habitats that support rare species, such impacts will be documented and the specific causative use(s) discontinued.

Hunting. As with fishing, hunting is not necessarily incompatible with natural area preserve management. Hunting may be both compatible and necessary for the purpose of controlling populations of animals that need to be limited such as white-tailed deer, nutria, snow geese, or resident Canada geese. However, hunting is an activity that can and often does result in conflicts between user groups. For example, public use by birders and wildlife watchers who visit a preserve to view migratory waterfowl is not compatible with concurrent waterfowl hunting. Likewise, use of a preserve by nature photographers or educators would not be a compatible use during periods when hunting activities to achieve control of the local deer population were taking place. In most instances, hunting on natural area preserves will be limited temporally and conducted specifically to meet the management objective of controlling animal populations that, if left unchecked, present a threat to natural heritage resources on site.

Category 3: Incompatible and Inappropriate Uses

Camping. Camping activities inevitably result in repeated localized intensive use and long-term degraded site effects. Even low-intensity camping styles cause some adverse impacts. And while "no trace" camping practices have much to recommend them, DCR–DNH does not have the capacity to monitor campers and ensure that they follow such practices. Additionally, if "no-trace" or other camping styles were allowed on state-owned preserves, increasing numbers of people would request camping access and many would not abide by "no trace" practices. Thus, permitting camping would lead to gradual habitat degradation and negative impacts on rare species. For these reasons, camping is considered incompatible with the objectives of the Virginia Natural Area Preserve System and is prohibited.

Bicycles. Except for accessing established parking areas and public access points designed for automobiles, use of bicycles in natural area preserves is prohibited. Mountain biking has become a popular outdoor activity that exerts increasing pressure on sensitive natural areas. If bicycle use has occurred in a preserve or if ready access exists, management actions will be taken to inform riders that biking is not permitted. If feasible or needed, access will be blocked with signs and/or barricades placed in strategic locations. Adverse effects from mountain bikes may be difficult to detect before damage has occurred. Given that bicycle riding patterns are difficult to change once established, it is imperative to quickly develop strategies to protect natural heritage resources from this incompatible use once such use is detected.

Horseback riding. This use is inappropriate for natural area preserves due to the well-documented negative impacts to soils and vegetation of concentrated and frequent passage of horses. Additionally, the introduction of invasive weeds from both manure and hoof-borne vectors is a documented negative aspect of horseback riding in areas managed for natural heritage resources. While infrequent use may cause minimal impacts, increased levels of use are inevitable on public lands. Thus, as with bicycles, horseback riding is nearly always an inappropriate

and incompatible use on lands managed as natural area preserves.

Rock climbing and caving. Rock outcrops, cliffs, and caves are among the most fragile of habitats and support some of the rarest occurrences of natural heritage resources in the state. The repeated presence of humans at these places often leads to habitat degradation and, if prolonged or chronic, is well-known to cause damage or extirpation of rare species of plants and animals. For this reason, access to most cliffs, rocky peaks, and caves on natural area preserves will be restricted to designated trails or observation points *only*, or to visitation during an organized field trip, or following issuance of a written Research and Collection or Special Use permit from DCR–DNH.

Off-road vehicles. Motorized all-terrain-vehicles including SUVs, "four-wheelers," and dirt bikes are prohibited within natural area preserves. These uses degrade trails and cause severe erosion requiring expensive repairs. Noise pollution from vehicle engines reduces the quality of the outdoor experience for other authorized user groups and constitutes harassment to wildlife. The use of such motorized vehicles is perhaps the most incompatible of all public use categories in natural area preserves.

Unleashed pets. Visitors are not prohibited from bringing pets with them when visiting natural area preserves. However, by regulation, pets must at all times remain under leash restraint while on DCR-owned lands. Unleashed dogs pose a particular threat to natural heritage resources and to various species of wildlife. Free-roaming dogs are known to cause nest abandonment in shore nesting bird colonies and to harm or destroy ground nesting bird eggs and young. Digging activity by dogs also causes habitat degradation on beaches protected for rare animals such as northeastern beach tiger beetles. For these reasons, all dogs or other domestic animals accompanying human visitors to natural areas preserves must be kept on leash at all times.

Collection of plants, animals, minerals, or artifacts. In order to protect occurrences of rare species, the collection and removal of plant material, animals, minerals (rocks), or artifacts is prohibited. The one exception to this guideline is the non-commercial, incidental gathering of common species (e.g., blackberries, blueberries, strawberries) for personal consumption. However, some rare species that produce an edible berry are native to Virginia and should not be picked. In such instances and locations, signs will be posted to inform the public in order to prevent negative effects to rare species from incidental collection. For legitimate research and education purposes, collection of specimens may be approved by DNH following submission and review of an application for a natural area preserve Research and Collection permit.

Site Operations Management

Roads

Many preserves have existing roads from previous land uses. Building new roads is nearly always inappropriate in natural area preserves and seldom is there sufficient justification to do so. Even roads outside of the preserve, especially along boundaries, may adversely affect resources within the preserve due to impacts such as introduction of invasive species, noise pollution, and alteration of local hydrology. Existing interior roads, skid trails, or historic traces will be mapped and described in Natural Area Preserve (NAP) Management Plans. Roads within preserves will be considered for closure or obliteration if they have no specific utility or function for preserve stewardship, or if such closure would reduce negative impacts to natural heritage resources or cause a decrease in vandalism to preserve facilities and infrastructure. Road maintenance schedules and costs will be included in NAP Management Plans.

Rights-of-way

Utility corridors such as powerline rights-of-way can and do exist in natural area preserves. Siting of new corridors within preserve boundaries is highly inappropriate and should be prevented by preserve Deed of Dedication language. Rights-of-way agreements or easements particular to a preserve will be appended to the NAP Management Plan, along with a list of contacts regarding agreements and corridor maintenance. All non-DCR entities (rights-of-way maintenance contractors, utilities,

municipalities, etc.) should be informed of the sensitivity and importance of natural heritage resources in the preserve. Frequency and methods for rights-of-way maintenance will be used that have the fewest negative effects on natural heritage resources. Such coordination will decrease adverse impacts to rare species and increase DCR inclusion in planning for expansion or improvement to utility corridors near or within natural area preserves.

Access Points

Public access facilities and points of entry to preserves will be designed so as to meet the primary objective of protecting natural heritage resources. Access designs will first and foremost function to restrict or direct visitor activity in ways that protect fragile habitats. Determining and mapping the location of sensitive areas within the preserve is essential so that threats can be abated and vulnerable resources protected. All proposed and existing structures and signs at preserve entrances will be described in NAP Management Plans. Additional needs for improved parking, interpretive signs, and trails will be discussed and approved by the NAP Public Access Oversight Committee prior to project implementation.

Facilities and Infrastructure

Guard rails, signs, fences, gates, trail steps, and other devices or measures may be installed as necessary for site security and visitor safety. Such infrastructure should be described and justified in each NAP Management Plan. Potentially dangerous conditions such as dead trees, branches, abandoned wells or pits, and similar hazards on trails or in authorized public use areas may be removed, cleared, filled in, or otherwise remedied. When in accordance with the NAP Management Plan, evidence of past human use such as fences, fence rows, culverts, trash dumps, and abandoned vehicles or structures (having no historic or scientific value) may be removed from the preserve.

Biological Resource Management

Prescribed Burning

Prescribed burns will be conducted to restore, enhance, and maintain fire-adapted natural communities, control invasive species, and accomplish various other objectives as identified in NAP Management Plans and in accordance with guidance from DNH fire managers and fire ecologists. DNH stewardship staff with training and experience in fire management that hold Virginia Prescribed Burn Manager Certification will, in conjunction with reviews and approval by other fire managers, prepare a written burn plan for each prescribed burn project. All required permits and approvals shall be obtained for each project. Burning shall not be attempted under conditions more hazardous than those specified in the prescribed burn plan. The use of equipment and motorized vehicles, size and roles of the burn crew, identity of the fire leader, time of year for the burn, frequency of burning, amount of area to be burned, and other detailed information pertinent for conducting a burn shall be specified in prescribed burn plans.

Prescribed burn plans shall be reviewed and approved by a DCR Fire Manager. The implementation of prescribed burn plans will require the concurrence of the Director of the Department of Conservation and Recreation, or his/her designee, and the Director of the Division of Natural Heritage. Stewardship objectives of prescribed burning shall be stated in NAP Management Plans. As appropriate and needed, monitoring of animal, plant, or community responses will be accomplished in order to determine efficacy of burn projects. Copies of unit burn prescriptions and monitoring reports will be completed and archived in the DNH NAP management files.

Restoration of Natural Hydrology

Hydrologic conditions altered by human activities such as drainage or fill placement may be restored, as appropriate, to create soil moisture regimes necessary for the benefit and enhancement of rare species and natural community occurrences. Stewardship actions that affect hydrology will be conducted for the purpose of meeting habitat maintenance and restoration objectives for which the preserve was established. Specific actions will be described in NAP Management Plans and be in accordance with local, state, and federal laws and regulations.

Erosion Control and Conservation Plantings

Control of erosion in natural area preserves that result from human disturbance may be accomplished through conservation plantings or by other means in order to meet natural heritage resource stewardship goals, to protect water quality, and to abate man-induced soil loss arising from previous land surface alterations. Species native to Virginia (and if possible, native to the specific region) will be used for conservation plantings to achieve soil stabilization. Planting non-native and/or invasive alien species is inappropriate on natural area preserves as well as in other natural settings, and such plantings are now widely discouraged for most natural resource conservation projects. In addition, erosion problems on adjacent or nearby lands that impinge on preserve stewardship issues may be addressed in cooperation with DCR's Division of Soil and Water Conservation and the landowner. Erosion mitigation plans will be developed as needed in cooperation with appropriate agencies, parties, and stakeholders

Invasive Species Control

Measures to control invasive plants and animals will be taken using accepted methods consistent with objectives stated in NAP Management Plans. The term "control of invasive species" may in some cases include the control of plant succession, even if targeted plants are native to Virginia. Actions recommended for the control of any plant or animal species, noxious or otherwise, will be described in NAP Management Plans.

Insect and Disease Control

Insect or disease control programs will be undertaken only if the infestation or outbreak (1) threatens adjacent natural areas, (2) will drastically alter natural ecological processes within the natural area preserve or cause adverse economic impacts on adjacent property, or (3) constitutes a public health emergency provided that such control programs are approved by the managing agency or are provided for by law.

Pesticide Use

The use of certain pesticides is one means by which natural area preserve stewards may accomplish specific management objectives. NAP Management Plans describe those situations under which pest management, such as invasive plant control programs, will be undertaken. Pesticide use in the context of natural area stewardship is mostly limited to herbicide applications for controlling (1) invasions of exotic vegetation that threaten on-site occurrence of rare species or natural communities or (2) weedy growth in public access facilities such as parking areas. Other use of pesticides should be made only with project review and approval by DNH staff or by consent of the managing entity or agency.

Forest Harvesting and Silviculture

The objectives of management for natural area preserves focus on (1) minimizing soil disturbance to retard or prevent invasive plant introductions, (2) retention and restoration of natural hydrological regimes and nutrient cycles, and (3) taking other actions to alter or maintain habitat conditions that favor the expansion of populations of rare species of plants and animals. Objectives of natural area preserve management do not include production of a continuous supply of forest products or income streams. Many silvicultural practices such as chemical and/or mechanical site preparation, fertilization, drainage, and plantation establishment are, in most instances, not compatible with protection and stewardship goals on natural areas as they can conflict with the goal of maintaining and enhancing natural plant communities and rare species habitats.

Nevertheless, actions such as cutting, deadening, or removing trees are not necessarily incompatible with natural areas management. Some silvicultural activities may be appropriate tools for natural area preserve management, but only when the objective is improvement or creation of habitat conditions for a targeted rare species or natural community. For example, thinning and burning a pine stand in order to favor shade-intolerant endangered plants such as smooth coneflower, or removing loblolly pine in order to restore a longleaf pine savanna may be high priorities requiring specialized forest harvesting plans for some natural area management programs. Such thinning and overstory removals may even, in some cases, best be accomplished through the process of conducting a timber sale.

When alterations to existing structure and composition of forest vegetation are appropriate and necessary to benefit natural heritage resources, natural area preserve stewards may make use of practices or treatments that closely resemble those of silviculture. Management plans for natural area preserves should clearly designate what vegetation management practices are to be used and for what objectives.

Traditional Wildlife and Fisheries Management

Natural area preserves are not purchased or managed for the objective of providing fishing, hunting, or trapping opportunities for the general public. It is therefore inappropriate to take management actions on preserves with the specific intent of improving consumptive recreation opportunities. However, certain types of hunting, fishing, or trapping activities may, at times, be considered compatible with preserve stewardship goals. For example, hunting may occur on some preserves under circumstances such as retained rights, conditions of transfer, traditional use, or to meet population reduction objectives. Hunting, fishing, and trapping activities for the purpose of protecting or enhancing natural heritage resources will be described in site-specific NAP Management Plans.

Rare Species Recovery

A primary objective of natural areas management is to conduct activities which provide or enhance habitats for plants and animals that have not benefited from common, traditional, or commercial land management regimes. Management of endangered, threatened, and special concern species of both plants and animals, plus non-listed species which may be of management concern on a particular natural area preserve, will receive close attention from natural area managers. Habitat manipulations and protective measures favoring a particular species will be undertaken as specified in NAP Management Plans. Monitoring of the target species will be undertaken in order to assess effectiveness of recovery or management actions.

Reintroduction as a means for rare species recovery will be considered only as a last resort and only when it is clear that reinstating natural processes and/or threat and stress mitigation will not result in population recovery. Intentional introductions of plant material of any type or kind of propagule (plant, cutting, seed, shoot, rhizome, rootstock, bulb, corm, etc.) or of any animal will be made only with review and approval, on a species by species and site by site basis, by a DNH oversight committee consisting of the Division Director, Stewardship Manager, and Chief Biologist.

Livestock Grazing and Crop Production

In nearly all cases, domestic livestock grazing is incompatible with the objectives of natural area preserve management. Concentrated grazing by cattle, horses, sheep, or other stock cannot be rationally argued to mimic a natural process; e.g., to simulate the effects once produced by native grazing animals such as bison or elk. Negative grazing effects commonly include degradation of stream banks and reduction of downstream water quality. Eliminating grazing and allowing or facilitating reestablishment of stream bank vegetation is one sound method of riparian buffer restoration.

However, certain exceptions are noteworthy of mention. Some natural area managers have experimented and seen positive results with grazing of goats in mountain bald communities for the control of invading woody species. Specialized circumstances may exist, such as retained rights or conditions of sale where grazing is continued for a specified time period. In such cases, detailed records will be kept on stock density, timing, and duration of grazing. A monitoring program will be designed and exclosures may be established to evaluate the effects of grazing. Management options for reducing negative grazing impacts to natural heritage resources should be developed under the guidance of the NAP Management Plan. These options may include shifting the season of grazing, providing resting periods, changing stocking levels, appropriately locating water, shelter, and mineral supplements, and rehabilitating soil.

As with grazing of stock, crop production for agricultural production purposes is not compatible with natural area preserve management. Except in the case of retained rights or short-term leases in specialized instances, the use of natural areas for

producing crops of any kind, including forages, grains, leaf, vegetables, or fruits is not consistent with the purpose and objectives for establishing and managing natural area preserves.

Archeological and Historic Resources

Archeological and historic resources on natural area preserves will be protected. Inventories for archeological and historic resources will be conducted and recommendations for conservation will be included in NAP Management Plans. Resources may be considered for interpretive and/or research value as identified and prescribed in the Plan. The collection of artifacts will be discouraged and only permitted for justified research studies approved by the Department of Historic Resources and the Department of Conservation and Recreation.

Eligible historic structures will be surveyed and nominated for placement on the Virginia Landmarks Register. Archeological research may vary, from recordation surveys where no collection or excavation is performed, to intensive excavations usually focused in a confined area. Consequently, compatibility of archaeological research and natural area preserve stewardship may vary and each proposed action should be assessed on an individual basis.

Certain resources are protected by established statutes, regulations, and guidelines. Activities which would in some way affect significant historic resources may require review and/or permitting by the Department of Historic Resources. Pertinent statutes to consider include the Virginia Antiquities Act, Virginia Cave Protection Act, Appropriations Act, and the National Historic Preservation Act.

Minerals

Mineral exploration and extraction are incompatible and inappropriate uses on natural area preserves, and are prohibited in all cases. Soil disturbance, especially at the scale necessary to remove mineral resources, is clearly at odds to the purposes and objectives of natural area preserve establishment and stewardship. Simply stated, dedicated natural area preserves will have no mineral exploration or exploitation. Collection of any surface mineral specimens for research or educational purposes requires the prior issuance of a Research and Collection permit by the Department of Conservation and Recreation.

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THESE GUIDELINES were approved by the Director of the Virginia Department of Conservation and Recreation on December 8, 2000 and by the Board of Conservation and Recreation on December 12, 2000. Modifications shall require the approval of the Director or his/her designee.

Appendix E

Virginia's Natural Heritage Resources

The following four tables provide a thumbnail sketch of the status of each plant, animal, natural community and other natural heritage resource monitored as part of the Natural Heritage Program. Each table provides the number of occurrences of each natural heritage resource and the number of occurrences that are on managed or protected lands. The plant and animal tables also provide global and state ranks, and federal and state endangered species status for each species. Data contained in these tables are essential for targeting species and community types for conservation.

KEY TO TABLES

Scientific Name

Names used here for plants and animals follow the nomenclature used by the Natural Heritage Program scientists. In most cases, the nomenclature for the vascular plants follows Kartesz, J.T. 1999. *A Synonymized Checklist and Atlas with Biological Attributes for the Vascular Flora of the United States, Canada, and Greenland.* First Edition. In: Kartesz, J.T., and C.A. Meacham. *Synthesis of the North American Flora, Version 1.0*. North Carolina Botanical Garden, Chapel Hill, NC. or A.S. Weakley *Flora of the Carolinas and Virginia* (In prep.). Animal names are derived from numerous sources but are typically the most scientifically accepted names for each taxonomic group. For brevity, species names are given here without the names or codes of their credited authors.

Common Name

Plant and animal common names are provided here for convenience. Standard common names have been developed and universally adopted for only a few animal groups and many taxa have no entirely satisfactory common name. Common names for birds, fishes, and a few selected aquatic invertebrate groups (e.g., mussels) are recognized as stable. Common names of plants vary widely. Some species lack common names and they are usually indicated in the tables as "a tiger beetle," "a sedge," etc. It is best to rely on scientific names whenever possible.

Community Name

Nomenclature used in the community list follows The Natural Communities of Virginia, Classification of Ecological Community Groups, Natural Heritage Technical Report 01-1. Most of these names are at the ecological community group level of classification. A few are at the finer scale, technically referred to as "community type."

Global Rank

Global ranks are assigned by a consensus of the network of natural heritage programs, scientific experts and NatureServe to designate a rarity rank based on the range-wide status of a species or variety. Ranks are assigned after considering a suite of factors, including number of occurrences, number of individuals and severity of threats. All plants and animals in the following tables have been assigned global ranks, but most communities and other natural heritage resource types have not.

G1 = Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.

G2 = Very rare and imperiled with 6 to 20 occurrences or few remaining individuals; or because of some factor(s) making it vulnerable to extinction.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range; or vulnerable to extinction because of other factors. Usually fewer than 100 occurrences are documented.
G4 = Common and apparently secure globally, though it may be rare in parts of its range, especially at the periphery.
G5 = Very common and demonstrably secure globally, though it may be rare in parts of its range, especially at the periphery.
GH = Formerly part of the world's biota with expectation that it may be rediscovered.
GX = Believed extinct throughout its range with virtually no likelihood of rediscovery.
GU = Possibly rare, but status uncertain and more data needed.
G? = Unranked, or, if following a ranking, rank uncertain (ex. G3?).
G_Q = the taxon has a questionable taxonomic assignment, such as a G3Q.
G_T_ = signifies the rank of a subspecies or variety. For example, a G5T1 would apply to a subspecies of a species that is demonstrably secure globally (G5) but the subspecies warrants a rank of T1, critically imperiled.
HYB = hybrid

State Rank

State ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Virginia. For example, whereas a plant endemic to Virginia (found nowhere else) will have the same global and state ranks, a plant that is common in the northeastern United States, but only known from a few occurrences in Virginia will have different global and state ranks. By comparing the global and state ranks, the status, rarity and the urgency of conservation needs can be ascertained. All plants and animals in the following tables have been assigned state ranks, but most communities and other natural heritage resource types have not.

S1 = Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals in Virginia; or because of some factor(s) making it especially vulnerable to extirpation in Virginia.
S2 = Very rare and imperiled with 6 to 20 occurrences or few remaining individuals in Virginia; or because of some factor(s) making it vulnerable to extirpation in Virginia.
S3 = Rare to uncommon in Virginia with between 20 and 100 occurrences; may have fewer occurrences if found to be common or abundant at some of these locations; may be somewhat vulnerable to extirpation in Virginia.
S4 = Common and apparently secure with more than 100 occurrences; may have fewer occurrences with numerous large populations.
S5 = Very common and demonstrably secure in Virginia.
SH = Formerly part of the Virginia biota with expectation that it may be rediscovered.
SX = Believed extirpated from Virginia with virtually no likelihood of rediscovery.
SE = Exotic; not believed to be a native component of Virginia's flora.
SR = Reported for Virginia, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.
SRF= Reported for Virginia, but with convincing evidence that the report was in error.
SU = Possibly rare, but status uncertain and more data needed.
S_?= Rank uncertain, for example a S2? denotes a species or variety which may range from S1 to S3, another example is SE?, meaning a taxon may or may not be native to Virginia.

Federal Status

The U. S. Fish and Wildlife Service determines federal status for plants and animals. This includes all species and varieties, which are listed as endangered or threatened by the U. S. government and receive protection under the federal Endangered Species Act.

The list also notes those taxa, which are proposed for listing or are candidates for listing. Communities and other natural heritage resources do not receive this type of federal designation.

LE = Listed Endangered. A taxon is threatened with extinction throughout all or a significant portion of its range.

LT = Listed Threatened. A taxon is likely to become endangered in the foreseeable future.

PE = Proposed Endangered. A taxon is proposed for listing as endangered.

PT = Proposed Threatened. A taxon is proposed for listing as threatened.

C = Candidate. There is enough available information to propose the taxon for listing, but listing is "precluded by other pending proposals of higher priority". The U. S. Fish and Wildlife Service is "directed to make prompt use of the emergency listing if the well-being of any such species is at significant risk."

_* = An * following the status denotes that the species or variety is possibly extinct.

State Status

State status indicates those plants and animals listed as state endangered or threatened. The status of plants and insects are determined under authority of the Virginia Department of Agriculture and Consumer Services, and the status of all other animals are determined by the Virginia Department of Game and Inland Fisheries. Communities and other natural heritage resources do mot receive this type of state designation.

LE = Listed Endangered

LT = Listed Threatened

PE = Proposed Endangered

PT = Proposed Threatened

C = Candidate for listing as threatened or endangered.

No. of Occurrences

This column contains the number of occurrences in Virginia for each natural heritage resource that is recorded in the Natural Heritage Program database. This column is blank for some elements. This is because there is no well-defined location for the known occurrences, former occurrences have been extirpated or location records have not yet been entered into the database.

Occurrences by Rank

This section is divided into five columns, with each column listing the number of occurrences of each species or community type with the corresponding element occurrence rank. These ranks reflect the quality, condition and defensibility of the occurrences with "A" representing excellent estimated viability, "B" good viability and "C" fair viability. The "H or X-Rank" column includes those occurrences for which there are only historic records or which are known to be extirpated from a site. Occurrences with poor viability or for which the viability is unknown are grouped in the "Other Rank" column. (For a more complete discussion of element occurrence ranks, see Chapter 3.)

Occurrences on Federal Lands

This section is divided into five columns, with each column listing the number of occurrences of each species or community type on land managed by a major federal government agency. Each entry has two numbers. The first is the number of occurrences fully contained within the boundaries of the federally managed property. The second number represents all occurrences, including those which extend beyond the federal property boundary. For example, if a cell contains "0/3," there are three occurrences of the element on that particular agency's lands, but no occurrence is fully contained within property managed by that agency. The agencies are abbreviated as follows:

USFS – U. S. Department of Agriculture, Forest Service, includes national forest lands

DOD – U. S. Department of Defense, includes military reservations and U. S. Army Corps of Engineers lands

USFWS – U. S. Department of Interior, Fish and Wildlife Service, includes National Wildlife Refuge System lands
NPS – U. S. Department of Interior, National Park Service, includes national parks

Occurrences on State Lands

This section is divided into six columns, with each column listing the number of occurrences of each species or community type on land managed by a major state government agency. As with the previous columns, each entry has two numbers. The first is the number of occurrences fully contained within the boundaries of the state managed property. The second number represents all occurrences, including those which extend beyond the state property boundary. Some occurrences may be counted twice in these columns, since some state lands are managed by multiple agencies. The abbreviations used here for the state agencies are:
DCR – Virginia Department of Conservation and Recreation, includes state parks and natural area preserves
DOF – Virginia Department of Forestry, includes state forests
DGIF – Virginia Department of Game and Inland Fisheries, includes wildlife management areas
EDU – Virginia educational institutions, includes university properties used for research
VOF – Virginia Outdoors Foundation, includes properties with full VOF ownership and lands with VOF conservation easements

Occurrences on Other Lands

This section is similar to the previous two sections, but includes data on occurrences on non-state and non-federal lands. Some occurrences may be counted here that were also counted in the state lands columns, since some natural area preserves (DCR) are owned by local governments, TNC and private individuals. The column headings used here are:
Locality – local government lands
TNC – The Nature Conservancy
Other Private – lands owned by other private conservation organizations and some private individuals

Table 1: Rare Plants

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	No. of Occurrences	Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands						Occ. on Other Lands		
							A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
Abies balsamea	balsam fir	G5	S1			3			3						3/3										
Abies fraseri	Fraser fir	G2	S1			1	1					1/1													
Adiantum capillus-veneris	southern maidenhair-fern	G5	SH																						
Aeschynomene virginica	sensitive joint-vetch	G2	S2	LT		32	1	3	9	11	8			0/1	1/1				0/1					0/2	
Agalinis auriculata	earleaf foxglove	G3	S1			5		1		3	1												0/1		
Agalinis paupercula	small-flower gerardia	G5	S1			1					1														
Aletris aurea	golden colicroot	G5	S1			11		1	1	6	3														
Alnus incana ssp. *rugosa*	speckled alder	G5 T5	S2			9	3	2	1	2	1				6/7										
Amaranthus pumilus	seabeach amaranth	G2	S1	LT		3				3															
Amphicarpum purshii	blue maiden-cane	G4	S1			2		1	1																
Anagallis minima	chaffweed	G5	SH																						
Anaphalis margaritacea	pearly everlasting	G5	S1			6			1	5		0/1													
Andropogon mohrii	Mohr bluestem	G4?	SH			2				2															
Anemone berlandieri	southern thimble-weed	G4?	S1			1		1																	
Anemone canadensis	Canada anemone	G5	S1			2					2				0/1									0/1	
Arabis glabra var. *glabra*	tower-mustard	G5 T5	S1			2				1	1	1/1													
Arabis hirsuta var. *adpressipilis*	hairy rockcress	G5 T4Q	S1 S2			12	1	2		3	6						2/4							1/1	
Arabis patens	spreading rockcress	G3	S2																						
Arabis serotina	shale-barren rockcress	G2	S2	LE	LE	59	3	11	16	1	28	30/47					2/4								
Arabis shortii	Short's rockcress	G5	S2			8		2	2	3	1				0/3								1/1		
Aralia hispida	bristly sarsaparilla	G5	S2			15	1	2	1	10	1	3/3			2/2										
Arctostaphylos uva-ursi	bearberry	G5	S1			1			1						1/1										
Arenaria lanuginosa ssp. *lanuginosa*	a sandwort	G5 T5	SH			1				1															
Arethusa bulbosa	dragon's mouth	G4	S1			1					1														
Arnoglossum muehlenbergii	great Indian-plantain	G4	S2			18		2	5	8	3	8/9													
Asclepias longifolia	long-leaf milkweed	G4 G5	S1			2					2														
Asclepias purpurascens	purple milkweed	G4 G5	S2			4			3		1		1/1		1/2								1/1		
Asclepias rubra	red milkweed	G4 G5	S2			27	1	4	6	4	12		1/1		0/2								0/1		

Table 1: Rare Plants

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	No. of Occurrences	Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands							Occ. on Other Lands		
							A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
Asplenium bradleyi	Bradley's spleenwort	G4	S2																						
Astomum phascoides	a moss	G3 G4	SU																						
Astragalus distortus var. *distortus*	bent milkvetch	G5 T5?	S1			8		1		7															
Astragalus neglectus	Cooper's milkvetch	G4	S2			10	1	6	1		2						0/2								
Bacopa caroliniana	Carolina water-hyssop	G4 G5	SH			2				2															
Bacopa innominata	tropical water-hyssop	G3 G5	S2		LE	15	1	3		5	6													0/1	1/1
Bacopa rotundifolia	round-leaved water-hyssop	G5	S1			2				1	1														
Baptisia albescens	prairie false-indigo	G4	S1			1					1														
Baptisia cinerea	hairy false-indigo	G3 G4	SH			3				3															
Bartonia verna	white screw stem	G5?	S1			1		1									1/1								
Betula cordifolia	mountain paper birch	G5 T5	S2			32		5	7	18	2	2/2			11/11										
Betula populifolia	gray birch	G5	S1			3		2		1					2/2										
Betula uber	Virginia round-leaf birch	G1Q	S1	LT	LE	1					1	0/1													
Bolboschoenus fluviatilis	river bulrush	G5	S1			10	2	3		1	4		1/2		0/1	0/1							0/1		
Botrychium jenmanii	Alabama grape-fer	G3 G4	SH			2				2															
Botrychium lanceolatum var. *angustisegmentum*	lance-leaf grape-fern	G5 T4	S1			4				3	1	0/1													
Botrychium multifidum	leathery grape-fern	G5	S1			3		1	1	1					2/2										
Botrychium oneidense	blunt-lobe grape-fern	G4Q	S2			1			1			1/1													
Botrychium simplex	least grape-fern	G5	S1			1				1															
Bromus ciliatus	fringed brome	G5	S1			4		1		2	1				1/1								0/1		
Bromus kalmii	wild chess	G5	S1			2		2				2/2													
Buchnera americana	blue-hearts	G5?	S1 S2			21	1	2	5	12	1				2/2		1/3								
Buckleya distichophylla	piratebush	G2	S2		LE	16	2	3	4		7	6/10					1/3								0/1
Burmannia biflora	northern burmannia	G4G5	SH			1				1															
Cabomba caroliniana	Carolina fanwort	G3 G5	S1			6		1		5			1/1												
Calamovilfa brevipilis	pine-barren reed-grass	G4	S1			7		1	1	1	4												0/1		
Calopogon pallidus	pale grass-pink	G4 G5	S1			4				4															

Table 1: Rare Plants

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	No. of Occurrences	Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands						Occ. on Other Lands		
							A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
Calopogon tuberosus var. *tuberosus*	tuberosus grass-pink	G5 T5	S2			3	1		1						0/1										
Calycanthus floridus var. *floridus*	sweet-shrub	G5 T4	S2?			9		2		4	2											1/1			
Camassia scilloides	wild hyacinth	G4 G5	S2			8		2	1	3	2	0/1					0/1		0/1						
Campanula rotundifolia	American harebell	G5	S1			6		2	1		3	1/1					0/2								
Cardamine clematitis	mountain bittercress	G2 G3	S1 S2			5		2	1		2	5/5													
Cardamine dissecta	divided toothwort	G4?	S1			2		1			1														
Cardamine flagellifera	a bittercress	G3	S1			4	1			2	1	0/1					0/1								
Cardamine micranthera	small-anthered bittercress	G1	S1	LE		13	2	5	2		4														
Cardamine pratensis	cuckooflower	G5	S1			4		1		3															
Carex aquatilis	aquatic sedge	G5	S1			1		1				1/1													
Carex arctata	black sedge	G5?	S1			3		3				3/3													
Carex atherodes	awned sedge	G5	S1			1			1																
Carex barrattii	Barratt's sedge	G4	S2			13	2	5	2	2	2	3/3													
Carex buxbaumii	brown bog sedge	G5	S2			19		10	4	2	3	3/4	1/1		2/3		1/2							0/1	
Carex conoidea	field sedge	G5	S1 S2			10		3	4		3				2/3										
Carex crawei	Craw's sedge	G5	S2			7	3	1	3								1/3							1/1	
Carex cristatella	crested sedge	G5	S2			10		2		3	5	0/1			0/1	0/1	0/1								
Carex crus-corvi	ravenfoot sedge	G5	S1 S2			11	1		4	4	2														
Carex decomposita	epiphytic sedge	G3	S2			11		1	1	8	1						0/1						0/1		
Carex flava	green sedge	G5	S1			3	1	2				3/3													
Carex interior	inland sedge	G5	S1			8	1	3	2		2						0/1							0/1	0/1
Carex juniperorum	juniper sedge	G2	S1			1		1																	
Carex lacustris	lake-bank sedge	G5	S1			6		4		2															
Carex lasiocarpa var. *americana*	slender sedge	G5 T5	S1			2		1			1	0/1													
Carex lupuliformis	false hop sedge	G4	S1			8	1			4	3												0/1		
Carex manhartii	Manhart sedge	G3	S1			1		1				1/1													
Carex oklahomensis	sooner sedge	G4	S1			1			1			1/1													
Carex ormostachya	a sedge	G4	SH																						
Carex pallescens	pale sedge	G5	S1			2				1	1						1/1								
Carex polymorpha	variable sedge	G3	S2		LE	15		4	5	1	5	7/7			2/2				1/1					2/2	

Table 1: Rare Plants

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	No. of Occurrences	Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands						Occ. on Other Lands		
							A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
Carex prairea	prairie sedge	G5?	S1			3		3									0/1							0/1	0/1
Carex purpurifera	purple sedge	G4?	S2			8	2	2	2	1	1	3/4			1/2										
Carex reniformis	reniform sedge	G4?	SH			6				6															
Carex roanensis	Roan Mountain sedge	G2	S2			1			1			1/1													
Carex schweinitzii	Schweinitz's sedge	G3	S1			6	2	1	2	1															
Carex silicea	sea-beach sedge	G5	S1			1					1			0/1	0/1										
Carex sp. *2*	a sedge	G1	S1			5	2		3																
Carex sp. *4*	a sedge	G?	S1			1		1																	
Carex sterilis	sterile sedge	G4	S1			1			1																0/1
Carex straminea	straw sedge	G5	S1			1			1						0/1										
Carex tenera	slender sedge	G5	S1?			1			1						0/1										
Carex utriculata	beaked sedge	G5	S1			2	1				1														
Carex vesicaria	inflated sedge	G5	S1 S2			9		3	2		4	2/3			1/1				0/1						
Carex vestita	a sedge	G5	S2			8		2	3	1	2		3/3		0/1										
Carex x aestivaliformis	a sedge	HYB	S1																						
Carphephorus bellidifolius	sandy-woods chaffhead	G4	S1			18	1		2	11	4						1/2					0/3			
Carphephorus tomentosus	wooly chaffhead	G4	S1			13			3	10												1/1			
Carya carolinae-septentrionalis	southern shagbark hickory	G5?	S1			1			1																
Cerastium arvense ssp. *velutinum*	a field chickweed	G5 T4?	S2?			3		3									0/1						0/1		
Chamaesyce bombensis	southern beach spurge	G4 G5	S2			15	1	4		6	4			2/3	1/1		1/2					0/1		2/4	
Cheilanthes alabamensis	Alabama lipfern	G4 G5	S1			2			1	1					1/1										
Cheilanthes eatonii	chestnut lipfern	G5?	S2			15		5	4		6	0/1					0/1							0/2	0/1
Cheilanthes feei	fee's lipfern	G5	S1			1		1									0/1								0/1
Chelone cuthbertii	Cuthbert turtlehead	G3	S2			33		5	5	8	15				2/4			0/1	0/1				1/2		
Chelone obliqua	red turtlehead	G4	S1			6	1			3	2														
Chrysopsis gossypina	cottony golden-aster	G5	S1			3	1		1	1							1/1								
Cicuta bulbifera	bulb-bearing water-hemlock	G5	SH																						
Cimicifuga rubifolia	Appalachian bugbane	G3	S2			15	2	1	2	6	4	0/1													
Cirsium altissimum	tall thistle	G5	SH			7				6															
Cirsium carolinianum	Carolina thistle	G5	S1			2		1			1						1/2								0/1
Cirsium nuttallii	Nuttall's thistle	G5	SH			2				2															
Cirsium repandum	coastal-plain thistle	G5	SH			2				2															

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Cirsium virginianum	Virginia thistle	G3	S2			25			3	16	6		0/1										0/1		
Cladium jamaicense	sawgrass	G5 T5	S2			4	1	1			2			1/1			0/2							0/1	
Cleistes bifaria	small spreading pogonia	G3 G4	S1			10			1	1	8	9/9							1/2						
Cleistes divaricata	spreading pogonia	G4	S1			14	1		1	4	8													1/1	
Clematis addisonii	Addison's leatherflower	G2	S2			34	8	6	8	9	3						0/1							0/3	
Clematis catesbyana	satin-curls	G4 G5	S1			3		1		1	1	1/1													
Clematis glaucophylla	white-leaved leatherflower	G4?	SH			3				3															
Clematis occidentalis var. *occidentalis*	purple clematis	G5 T5	S2																						
Clematis viticaulis	Millboro leatherflower	G2	S2			21	4	6	5	3	3	3/9													
Clinopodium glabellum	savory	G3Q	SH																						
Cocculus carolinus	red-berried moonseed	G5	S1																						
Coelorachis rugosa	wrinkled jointgrass	G5	S1			1		1																	
Collinsia verna	spring blue-eyed mary	G5	S1 S2			7		1	1	4	1								1/2						
Collinsonia verticillata	whorled horse-balm	G3	S1			2		1			1														
Conioselinum chinense	hemlock parsley	G5	S1			1			1						1/1										
Corallorhiza bentleyi	an orchid	G1?	S1																						
Corallorhiza maculata var. *occidentalis*	western spotted coralroot	G5T 3T5	S1			1			1						1/1										
Coreopsis falcata	pool coreopsis	G4 G5	S1			1		1									1/1								
Coreopsis linifolia	Texas tickseed	G4Q	S1			3		1			2														
Cornus canadensis	bunchberry	G5	S1			4			3	1		1/1			1/1									1/1	
Cornus rugosa	roundleaf dogwood	G5	S1			13		2	1	9	1				4/4										
Cornus sericea ssp. *sericea*	red-osier dogwood	G5 T5	S1			4				2	2				1/1										
Crataegus aestivalis	May hawthorn	G5	S1			1				1															
Crataegus calpodendron	pear hawthorn	G5	S1			4				4															
Crataegus mollis	a hawthorn	G5	S1			1					1				1/1										
Crataegus pruinosa	a hawthorn	G5	S2			15		3	1	10	1	2/4			1/1		0/1								
Crataegus spathulata	a hawthorn	G5	S1			1				1															
Crataegus succulenta	fleshy hawthorn	G5	S1			1				1															

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Crotalaria purshii	rattlebox	G5	S2																						
Crotalaria rotundifolia	prostrate rattle-box	G5	SH			5				5															
Ctenium aromaticum	toothache grass	G5	S1			5			2	2	1														
Cuscuta cephalanthi	button-bush dodder	G5	S1?			7				6	1													0/1	0/1
Cuscuta coryli	hazel dodder	G5	S2?			12	2	2	3	3	2	2/2			6/6				0/1						
Cuscuta indecora	pretty dodder	G5	S2?			8				4	4						0/2		0/1				0/2		
Cuscuta polygonorum	smartweed dodder	G5	S2?			7		1	1	5				1/1	1/1										
Cuscuta rostrata	beaked dodder	G4	S2			11	1	2	1	4	3	2/4					1/2								
Cuthbertia graminea	grass-like roselings	G5	S1			2		2																	
Cyperus acuminatus	short-point flatsedge	G5	SH																						
Cyperus dentatus	toothed sedge	G4	S1			2	1			1		0/1											0/1		
Cyperus diandrus	umbrella flatsedge	G5	S1			4		1	1	2				2/2	2/2										
Cyperus engelmannii	Engelmann's umbrella-sedge	G4Q	S1			1		1									1/1								
Cyperus granitophilus	granite-loving flatsedge	G3Q	S1			6	1	2	1	1	1													0/1	
Cyperus houghtonii	Houghton's umbrella-sedge	G4?	SH			2				2															
Cyperus plukenetii	a galingale sedge	G5	S2			3		1	2				1/1												
Cypripedium candidum	small white ladies-slipper	G4	S1																						
Cypripedium kentuckiense	Kentucky lady's slipper	G3	S1			2	1																		0/1
Cypripedium reginae	showy lady's-slipper	G4	S1			7			2	3	2	2/3													
Cystopteris fragilis	fragile fern	G5	S1?			2				2															
Cystopteris tennesseensis	Tennessee bladderfern	G5	S1			1		1																	
Dalibarda repens	robin runaway	G5	S1			3		1		1	1				1/1										
Dasistoma macrophylla	mullein foxglove	G4	S1																						
Deschampsia cespitosa ssp. *glauca*	tufted hairgrass	G5 T5	S1			2					2														
Desmodium canadense	showy tick-trefoil	G5	S1			4		2		2															
Desmodium cuspidatum	toothed tick-treefoil	G5	S2			3		1	1			2/2													
Desmodium ochroleucum	creamflower tick-trefoil	G2?	SH			5				4	1														
Desmodium sessilifolium	sessile-leaf tick-trefoil	G5	S2			9		2	1	3	3						0/2							0/1	

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Desmodium strictum	pineland tick-trefoil	G4	S2			16		1	6	5	4		1/1				1/2	1/1							
Desmodium tenuifolium	slim-leaf tick-trefoil	G4	S1			14			5	6	3				0/1										
Diamorpha smallii	Small's stonecrop	G4	S1			1	1																	0/1	
Diarrhena obovata	a beakgrain	G4 G5	S1			1					1												0/1		
Dichanthelium caerulescans	blue witch grass	G5T 4T5	S1			2		1	1								1/1								
Dichanthelium consanguineum	blood witchgrass	G5	S1?			2			1		1						0/1								
Dichanthelium ovale var. *ovale*	oval-fruited panic grass	G5 T5	S1?			1	1							0/1	0/1										
Dichanthelium strigosum var. *strigosum*	rough-hair witchgrass	G5 T5	S1?			1			1																
Dicliptera brachiata	wild mudwort	G5	S2			9	1	3	1	3	1						0/1		0/1				0/1		
Didiplas diandra	water-purslane	G5	S1			6		1		4	1														
Digitaria cognata	mountain hairgrass	G5	S2			6		2	2	1	1		1/1										0/1		
Digitaria serotina	dwarf crabgrass	G5?	SH			2				2															
Echinacea laevigata	smooth coneflower	G2	S2	LE		43	7	11	12	6	7	2/2					3/6							0/3	
Echinocystis lobata	wild mock-cucumber	G5	S1?			2				2															
Echinodorus tenellus	dwarf burhead	G5?	S1			6	1	1	1	2	1	0/1													
Elatine minima	small water-wort	G5	S1			3					3													0/2	1/3
Eleocharis baldwinii	Baldwin spikerush	G4 G5	S1			8		2	2	3	1		1/1						0/1						
Eleocharis compressa	flat-stemmed spike-rush	G4	S2			8	1	3	2	1	1	0/1			0/2		1/1								
Eleocharis equisetoides	horse-tail spikerush	G4	S1			2	1			1															
Eleocharis halophila	salt-marsh spikerush	G4	S1			3			1	2							0/1								
Eleocharis intermedia	matted spikerush	G5	S1			3		2			1	0/1					1/1							0/1	
Eleocharis melanocarpa	black-fruited spikerush	G4	S2			13	2	4	4	2	1	2/4					1/1						0/1		
Eleocharis radicans	rooted spikerush	G5	SH			1				1															
Eleocharis robbinsii	Robbins spikerush	G4 G5	S1			5	2	2	1			2/3											0/1		
Eleocharis tricostata	three-angle spikerush	G4	S1			5			1	3	1														
Eleocharis vivipara	viviparous spikerush	G5	S1			5	2	1	1	1			2/3												
Elymus canadensis	nodding wild-rye	G5	S2?			4		2		1	1	0/2													

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Elymus trachycaulus ssp. *trachycaulus*	slender wheatgrass	G5 T5	S2			8		1	3	1	3	4/4			2/3										
Enemion biternatum	false rue-anemone	G5	S1			2	1				1				0/1								0/1		
Epilobium leptophyllum	linear-leaved willow-herb	G5	S2			18	1	8	3	2	4	6/6			3/4		1/1								
Equisetum fluviatile	water horsetail	G5	S1			2		2																	
Equisetum sylvaticum	woodland horsetail	G5	S1			3				2	1														
Erigeron vernus	white-top fleabane	G5	S2			17	2	4	1	8	2		1/2	2/2			1/1								
Eriocaulon aquaticum	white buttons	G5	S1			6	2	1	2	1		4/4													
Eriocaulon decangulare	ten-angle pipewort	G5	S2			17		7	2	3	5			2/2			0/1						0/1		
Eriocaulon parkeri	parker's pipewort	G3	S2			31	2	4	4	10	11													0/1	1/1
Eryngium integrifolium	savanna eryngo	G5	S1			1			1																
Eryngium yuccifolium var. *yuccifolium*	rattlesnake-master	G5 T5	S2			23		2	2	17	2				0/1		0/3							0/1	0/2
Erysimum capitatum var. *capitatum*	western wallflower	G5 T5	S2			13	1	4	3		5	7/10					1/2								
Erythronium albidum	white trout-lily	G5	S2			11	1	1	2	2	5				0/6								1/3		0/1
Eupatorium glaucescens	wedge-leaf thoroughwort	G5	S1			4				4															
Eupatorium incarnatum	pink thoroughwort	G5	S2			8		3	2	2	1	1/1					2/2								
Eupatorium maculatum var. *maculatum*	spotted joe-pye weed	G5 T5	S2			6		2		2	2	0/1													
Euphorbia purpurea	glade spurge	G3	S2			18		6	9	1	2				4/4		2/4		0/1						
Eurybia radula	rough-leaved aster	G5	S1			3			2	1					1/1										
Eurybia surculosa	creeping aster	G4 G5	S1			4		2		2		1/1													
Filipendula rubra	queen-of-the-prairie	G4 G5	S2			20	1	4	6	2	7						0/3							0/1	0/1
Fimbristylis perpusilla	Harper's fimbristylis	G2	S1		LE	11	1	5	3		2												8/11		
Fimbristylis puberula var. *puberula*	hairy fimbristylis	G5 T5?	S1			1		1																	
Fragaria vesca ssp. *americana*	woodland strawberry	G5 T5	S2?																						
Fuirena breviseta	an umbrella sedge	G5	SH																						
Gaylussacia brachycera	box huckleberry	G3	S2			7	1	2	2	2		0/4													
Gentiana autumnalis	pine-barren gentian	G3	S1			6			3	2	1														

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Gentiana linearis	narrow-leaved gentian	G4 G5	S1?																						
Gentianella quinquefolia ssp. *occidentalis*	western stiff gentian	G5T 4T5	S1?			1		1									0/ 1								
Gentianopsis crinita	fringed gentian	G5	S1			3				1	2	1/1													
Geranium robertianum	herb-robert	G5	S2			6		5	1						5/5										
Geum aleppicum	yellow avens	G5	SH			4				4															
Geum laciniatum var. *trichocarpum*	rough avens	G5T ?	S2?			12		3	2	3	2				0/1	0/ 1							2/ 2		
Glyceria grandis var. *grandis*	American manna grass	G5T 5	S1			4		2	1	1		2/2													
Glyceria laxa	northern mannagrass	G5	S1?			2	1			1															
Gnaphalium helleri	catfoot	G4G 5	S1			1					1														
Gnaphalium macounii	winged cudweed	G5	S1			3			1	1	1	1/1													
Gnaphalium uliginosum	low cudweed	G5	S1			6		2		3	1	0/1					1/ 1								
Goodyera repens var. *ophioides*	dwarf rattlesnake plantain	G5 T?Q	S2?																						
Hasteola suaveolens	sweet-scented Indian-plantain	G3	S2			21	2	2	2	7	8				0/5								0/ 2		
Hedyotis nigricans	barren bluets	G5	S1			2	1	1																	
Helenium brevifolium	shortleaf sneezeweed	G3 G4	S2			13	3	3	2	2	3						0/ 1								
Helenium virginicum	Virginia sneezeweed	G2	S2	LT	LE	34	6	3	9	4	12	5/8					2/ 3						0/ 1		
Helianthemum bicknellii	plains frostweed	G5	S1			5		1		3	1	1/1					1/ 1								
Helianthemum propinquum	low frostweed	G4	S1			3		1		2															
Helianthus occidentalis	McDowell sunflower	G5	S1			2	1	1							0/2										
Heliopsis helianthoides var. *scabra*	smooth oxeye	G5 T5	S1																						
Heliotropium curassavicum	seaside heliotrope	G5	S1			7		1		6				1/1	1/1										
Helonias bullata	swamp-pink	G3	S2 S3	LT	LE	45	6	8	16	3	12	13/ 18	13/ 14		0/1										
Hemicarpha micrantha	dwarf bulrush	G4	S1			6	1	1	2	1	1		1/2				0/ 1						1/ 1		
Heteranthera multiflora	multiflowered mud-plantain	G4	S1																						
Heuchera alba	white alumroot	G2Q	S2?			9		2	2	2	3	5/5													
Hexastylis shuttleworthii var. *shuttleworthii*	large-flowered heartleaf	G4 T4	S2?			7		1		4	2	1/1			0/1										
Hierochloe odorata ssp. *arctica*	vanilla grass	G5	S1			1					1						1/ 1								

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Honckenya peploides ssp. *robusta*	sea-beach sandwort	G5 T4	SH			1				1															
Hordeum jubatum	fox-tail barley	G5	S1			1		1																	
Houstonia canadensis	Canada bluets	G4 G5	S2			16	3	5	2	4	2	0/1					1/3						0/1	0/3	0/1
Huperzia appalachiana	Appalachian fir-clubmoss	G4 G5	S2			11	3	5	2		1	0/1			8/8		1/1								
Huperzia porophila	rock clubmoss	G4	S1			1		1																	
Hydrocotyle bonariensis	coastal-plain penny-wort	G5	S1?			4		1	1	1	1		0/1	0/1			2/2								
Hypericum adpressum	creeping St. John's-wort	G2 G3	S1			2		1		1															
Hypericum boreale	northern St. John's-wort	G5	S2			19	2	4	3		10	6/7					4/5						0/1		
Hypericum denticulatum	coppery St. John's-wort	G5	SH																						
Hypericum ellipticum	pale St. John's-wort	G5	SH			1				1															
Hypericum setosum	a St. John's-wort	G4 G5	S1 S2			17		3	2	10	2												1/1		
Hypotrachyna oostingii	Oosting's loop lichen	G2?	SU																						
Hypoxis sessilis	glossy-seeded star-grass	G4	SH			1				1															
Ilex collina	long-stalked holly	G3	S2		LE	11		5	4	1	1	6/7					2/2								
Ilex coriacea	bay-gail holly	G5	S2			8	1	1		3	3			1/1			0/1							0/1	
Iliamna corei	Peter's Mountain mallow	G1Q	S1	LE	LE	1					1													1/1	
Iliamna remota	Kankakee globe-mallow	G1Q	S1			11		1	4	1	5	0/2			0/1										
Isoetes appalachiana	Engelmann's quillwort	G4	S2?			4	2	1			1				2/4										
Isoetes hyemalis	a quillwort	G2 G3	S1?			4	1	3					1/2												
Isoetes lacustris	lake quillwort	G5	S1?			1					1	1/1													
Isoetes melanopoda	blackfoot quillwort	G5	S1?			3			1	1	1														
Isoetes piedmontana	piedmont quillwort	G3	S1?			1					1														
Isoetes virginica	Virginia quillwort	G1	S1?			5		1		1	3	0/1	0/1												
Isotria medeoloides	small whorled pogonia	G2	S2	LT	LE	47		1	7	8	30	1/1	14/14		2/3	1/1				1/2					
Iva imbricata	sea-coast marsh-elder	G5?	S1 S2			10	2	3		5			0/2				0/2						1/1		
Juncus abortivus	pine-barren rush	G4 G5	S1			9				6	3											0/1			
Juncus articulatus	jointed rush	G5	S1 S2			4		1		1	2	0/1					0/1		0/1						
Juncus balticus var. *littoralis*	Baltic rush	G5 T5	S1			3		2	1								0/2							0/1	

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Juncus brachycephalus	small-head rush	G5	S2			11		3	3	2	3	2/3					0/1			0/1					0/1
Juncus brevicaudatus	narrow-panicled rush	G5	S2			4		2			2	4/4													
Juncus caesariensis	New Jersey rush	G2	S2			25		4	5	5	11		5/6												
Juncus elliottii	bog rush	G4 G5	S1 S2			8			3	4	1		1/1	0/1			1/1								
Juncus megacephalus	big-head rush	G4 G5	S2			11	1	4		2	4			0/4	0/1		0/2							3/4	
Juncus nodosus	knotted rush	G5	S1			5		1			4														0/2
Juncus pelocarpus	brown-fruited rush	G5	S1			4		1	2		1			1/1											
Juncus torreyi	Torrey's rush	G5	S2			15		1	1	8	5						1/1								
Juncus trifidus	highland rush	G5	S1			1	1								1/1										
Juniperus communis var. *depressa*	ground juniper	G5 T5	S1			8		1		4	3								2/2					1/1	
Kalmia angustifolia	sheep-laurel	G5	S2			12	1	5	2		4		4/5				1/1					0/1			
Kalmia carolina	Carolina sheep-laurel	G4	S2			10	2	2	2	2	2						1/2							0/1	
Lachnanthes caroliana	Carolina redroot	G4	SH			2				2															
Lachnocaulon anceps	bog-buttons	G5	S2			17	1	1	1	11	3														
Lathyrus palustris	vetchling	G5	S1			7	1	1		1	4		1/1				0/3							0/1	
Lechea intermedia var. *intermedia*	narrowleaf pinweed	G5T 4T5	S1?			1				1															
Leersia hexandra	club-head cutgrass	G5	SH			2				2															
Lejeunea ruthii	a liverwort	G3 G4	SU																						
Lemna trisulca	star duckweed	G5	S1			3		1		2															
Leucothoe fontanesiana	highland dog-hobble	G5	S1 S2			8			1	4	3	1/2			0/1									0/1	
Lilaeopsis carolinensis	Carolina lilaeopsis	G3 G5	S1			13	4	2	1	2	4			2/6			0/2						0/1		
Lilium catesbaei var. *longii*	southern red lily	G4 T?	S1			3			1	1	1														
Lilium grayi	Gray's lily	G3	S2			32		1	8	11	12	1/2			5/6		0/3								
Limosella australis	mudwort	G4 G5	SH																						
Liparis loeselii	Loesel's twayblade	G5	S2			18		3	4	7	4	3/4	2/2		2/3		1/1								
Lipocarpha maculata	a lipocarpha	G5	S1			4	1	2			1		2/2	1/1			1/1								
Lithospermum caroliniense	golden puccoon	G4 G5	S1			2		1		1							0/1	0/1							
Litsea aestivalis	pondspice	G3	S1			1					1												1/1		

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Lobelia elongata	elongated lobelia	G4 G5	S1			6	2	3		1							0/3						0/1	0/1	
Lotus helleri	Carolina prairie-trefoil	G5 T3	S1			7	1	2	2	2			3/4												
Ludwigia alata	winged seedbox	G4	S1			6		3		1	2			1/2			1/3						0/1	0/1	
Ludwigia brevipes	long beach seedbox	G4 G5	S2			17	2	3		5	7		3/3	1/4			0/2						0/1		
Ludwigia hirtella	hairy seedbox	G5	S1			6		2			4		1/1												
Ludwigia pilosa	hairy seedbox	G5	S1			6		2	1	1	2			1/2											
Ludwigia ravenii	Raven's seedbox	G2?	S1			9		1	2	5	1												0/1	0/1	
Ludwigia repens	creeping seedbox	G5	S1			3		1		1	1		1/1	0/1											
Ludwigia virgata	savanna seedbox	G5	SH			1				1															
Lycopodiella inundata	northern bog clubmoss	G5	S1			9		2		6	1	1/2					0/1								
Lycopodiella margueriteae	northern appressed clubmoss	G2	S1			1		1																	
Lysimachia hybrida	lance-leaf loosestrife	G5	S2			6	1	1	2		2														
Lysimachia quadriflora	four-flowered loosestrife	G5?	S1			6	1	1		1	3						0/2							0/1	0/1
Lysimachia radicans	trailing loosestrife	G4 G5	SH			4				4															
Lythrum alatum	winged-loosestrife	G5	S2			17	1	4	2	9	1						0/2							0/1	
Magnolia macrophylla	bigleaf magnolia	G5	S1			2	1			1															
Maianthemum stellatum	starflower false Solomon's-seal	G5	S2?																						
Malvastrum hispidum	hispid falsemallow	G3G5	S1			1			1								1/1								
Manfreda virginica	false aloe	G5	S2			11	2	1	5	1	2						0/2						0/1	0/2	0/1
Marshallia obovata var. *obovata*	obovate marshallia	G4G5T?	S2			11		4	2	4			1/1				1/2								
Matelea decipiens	old-field milkvine	G5	S1			5		1		3	1		2/2												
Matteuccia struthiopteris var. *pensylvanica*	ostrich fern	G5 T5	S1			4		1		1	2	0/1			0/2								0/2		
Melanelia culbersonii	Appalachian camouflage lichen	G2 G4	S2?																						
Melanelia stygia	alpine camouflage lichen	G4 G5	S2?																						
Melica nitens	three-flower melic grass	G5	S1 S2			4		2		1	1	1/1													
Menyanthes trifoliata	buckbean	G5	S1			3	1	1	1						1/1		0/1							0/1	0/1
Micranthemum micranthemoides	Nuttall's micranthemum	GH	SH			6				6															
Micranthemum umbrosum	shade mudflower	G5	S1			6	2	1		2	1											0/1			

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Mimosa quadrivalvis var. *angustata*	little-leaf sensitive-briars	G5 T5	S2			16			2	9	5														
Mimulus moschatus	muskflower	G4 G5	S1			3				2	1				1/1										
Minuartia caroliniana	pine-barren sandwort	G5	SH																						
Minuartia groenlandica	mountain sandwort	G5	S1			4	2	1	1			1/1			1/1		1/1								
Mitreola petiolata	lax hornpod	G5	S1			9	1		1	7					1/1		0/1					0/1			
Mitreola sessilifolia	a mitrewort	G4 G5	S1			1			1																
Moehringia lateriflora	grove sandwort	G5	S1			1					1														
Monotropsis odorata	sweet pine sap	G3	S2S3			18			1	9	2	1/1													
Morella pumila	southern bayberry	G5 T?	S1			2			1	1															
Muhlenbergia bushii	bush's muhly	G5	S1			5			1	4			1/1												
Muhlenbergia cuspidata	plains muhly	G4	S2			6		3			3														
Muhlenbergia expansa	cut-over muhly	G5 T5	SH			1				1															
Muhlenbergia glabrifloris	smooth-leaved muhly	G4?	SH			1				1															
Muhlenbergia glomerata	marsh muhly	G5	S2			12	2	4	4			1/2			4/5		0/1								
Myriophyllum humile	low water-milfoil	G5	S1			1					1														
Myriophyllum tenellum	slender water-milfoil	G5	S1																						
Napaea dioica	glade mallow	G3	S1?			1					1														
Nardia lescurii	a liverwort	G3?	SU																						
Neobeckia aquatica	lake cress	G4?	SH			1				1															
Nestronia umbellula	nestronia	G4	S1		LE	7	1	2	1	3									0/1						
Nuphar sagittifolia	narrow-leaved spatterdock	G2	S1			7	1	1	1	2	2								0/1						
Nymphoides aquatica	big floating-heart	G5	S1			2		1		1															
Oldenlandia boscii	Bosc's bluet	G5	S1			6			1	4	1		0/1												
Oligoneuron rigidum var. *rigidum*	stiff goldenrod	G5 T5	S2			19	3	6	3	4	3	2/2			2/3		1/1								
Onosmodium virginianum	Virginia false-gromwell	G4	S2			11		1	1	4	5	1/1			1/1		1/1						0/1		
Ophioglossum petiolatum	longstem adder's-tongue	G5	SH			1				1															
Ophioglossum pusillum	adder's-tongue	G5	S1			1				1															
Orbexilum onobrychis	French-grass	G5	S1																						

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Orthilia secunda	one-sided wintergreen	G5	SH			5				5															
Orthotrichum keeverae	Keever's bristle-moss	G1	S1			1					1														
Oryzopsis asperifolia	white-grained mountain-ricegrass	G5	S1			1					1	1/1													
Osmanthus americanus var. *americanus*	wild olive	G5 T5	S1			4			2	2			1/1				1/1								
Osmunda cinnamomea var. *glandulosa*	glandular cinnamon fern	G5 T?	S1			1		1				1/1													
Oxypolis ternata	a cowbane	G3	SH			1																			
Packera millefolia	yarrow-leaved ragwort	G2	S2			11	4	4	2		1						0/2								0/1
Panicum hemitomon	maidencane	G5?	S2			7	1	2	2	1	1	1/1												0/1	
Parnassia grandifolia	large-leaved grass-of-parnassus	G3	S2			21	4	7	3	6	1	0/1					0/3								0/1
Paronychia virginica var. *virginica*	yellow nailwort	G4T 1Q	S1			7		1	3	2	1	1/1					0/1							0/1	
Paspalum bifidum	pitchfork paspalum	G5	SH			2				2															
Paspalum dissectum	Walter paspalum	G4?	S2			9	2	3		3	1		0/1	0/1			0/1								
Paspalum distichum	joint paspalum	G5	S1			5	1			2	2			1/1	1/1		1/1								
Paspalum praecox	early paspalum	G4	S1			4			1	3															
Paxistima canbyi	Canby's mountain-lover	G2	S2			36	1	4	4	21	6				1/1		1/4								
Pediomelum canescens	hoary scurfpea	G3 G4	S1			1			1								1/1								
Penstemon australis	southern beardtongue	G5	S2																						
Penstemon calycosus	long-sepal beardtongue	G5	S1			1				1															
Penstemon hirsutus	hairy beardtongue	G4	S2			27	1	3	3	18	2				1/2								0/2		
Phacelia covillei	blue scorpion-weed	G2	S1			5	2			1	2				0/3								0/1		0/1
Phacelia fimbriata	fringed scorpion-weed	G4	S2			13	3	5		4	1	5/5							2/4						
Phalaris caroliniana	May grass	G5?	SH			1				1															
Phanopyrum gymnocarpon	clustered panic-grass	G5	S1			1					1														
Phlox amplifolia	large-leaved phlox	G3 G5	S2			6	1	1	1		3	2/3			1/1				0/3						
Phlox buckleyi	sword-leaved phlox	G2	S2			44		1	5	26	12	7/12			1/2		0/1								0/1
Phlox pilosa ssp. *pilosa*	downy phlox	G5 T5	S2			11	1		1	7	2		1/1										1/1		
Phyla nodiflora	common frog-fruit	G5	S1			3			1	1	1			0/1			0/1								

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Physalis walteri	sticky ground-cherry	G4	S2			12	2	6	2	1	1			0/1			3/3						0/1	1/5	
Physostegia leptophylla	slender-leaved dragon-head	G4?	S2 S3			5	3		1	1							0/2						0/1	0/1	
Pinus palustris	long-leaf pine	G5	S1			10			2	2	6						0/1					0/2			
Plagiothecium latebricola	lurking leskea	G3 G4	SU																						
Plantago cordata	heart-leaved plantain	G4	SH			5				5															
Plantago maritima var. *juncoides*	seaside plantain	G5 T5	S1			3	1		1	1				0/2	1/1										
Platanthera blephariglottis var. *conspicua*	large white fringed orchid	G4G 5T3 T4	S1			13			3	3	7														
Platanthera grandiflora	large purple-fringe orchis	G5	S1			12		4	3	4	1	2/2			5/5										
Platanthera leucophaea	prairie white-fringe orchis	G2	S1	LT		1					1														
Platanthera peramoena	purple fringeless orchis	G5	S2			4					4	0/1							0/1				0/1	0/2	
Poa paludigena	bog bluegrass	G3	S2			12	3	9				2/2			3/3				1/1						
Poa palustris	fowl bluegrass	G5	S1 S2			14		3		6	5	3/5					0/1							0/1	
Poa saltuensis	a bluegrass	G5	S2			12		5	1	1	5	5/5					1/3								
Polanisia dodecandra ssp. *dodecandra*	common clammy-weed	G5 T?	S2			13	3	2	3	1	4	0/2			0/1										
Polygala brevifolia	little-leaf milkwort	G4 G5	SH																						
Polygala ramosa	low pine-barren milkwort	G5	SH			3				3															
Polygonella polygama	October-flower	G4	S1			2	1				1						1/1					0/1			
Polygonum glaucum	sea-beach knotweed	G3	S1 S2			13	1		4	4	4			2/2	1/1		0/1							1/5	
Populus tremuloides	quaking aspen	G5	S2			3			1		2				1/2										
Porteranthus stipulatus	American ipecac	G5	S1			8		1	5		2	1/1					0/2								
Portulaca smallii	Small's purslane	G3	S1			6	1	2	1	1	1													0/1	
Potamogeton amplifolius	large-leaf pondweed	G5	S1 S2			10				5	4	0/2													
Potamogeton hillii	Hill's pondweed	G3	S1			1					1														
Potamogeton oakesianus	Oakes pondweed	G4	S2			11	2	3	1	5		1/2	2/2												
Potamogeton robbinsii	flatleaf pondweed	G5	SH			1				1															
Potamogeton spirillus	spiral pondweed	G5	S1			3				3															

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Potamogeton strictifolius	straight-leaf pondweed	G5	S1			1				1															
Potamogeton tennesseensis	Tennessee pondweed	G2	S1			3			1	2															
Potamogeton zosteriformis	flatstem pondweed	G5	S1			2		1		1															
Potentilla arguta	tall cinquefoil	G5	S1			2		2				1/1													
Prenanthes autumnalis	slender rattlesnake-root	G4 G5	S2			10			2	6	2														
Prunus maritima	beach plum	G4	S1																						
Prunus nigra	Canada plum	G4 G5	S1			4			2	1	1				1/1										
Prunus susquehanae	sand cherry	G5 T4	S1			4			1	2	1														
Pseudolycopodiella caroliniana	slender clubmoss	G5	SH			3				2	1														
Ptilimnium nodosum	harperella	G2	S1	LE																					
Puccinellia fasciculata	salt marsh goosegrass	G3 G5	S1			2				2															
Pycnanthemum clinopodioides	basil mountain-mint	G2	S1			2		1			1													1/1	
Pycnanthemum monotrichum	a mountain-mint	GHQ	SH			2				2															
Pycnanthemum montanum	single-haired mountain-mint	G3 G5	S2																						
Pycnanthemum setosum	awned mountain-mint	G3?	S1			3		1	1		1						2/2								
Pycnanthemum torrei	Torrey's mountain-mint	G2	S2?			14		1	8	5		1/1	1/1											1/1	
Pyrola chlorantha	greenish-flowered wintergreen	G5	SH			3				3															
Pyrola elliptica	shinleaf	G5	S2			13		1		9	3	1/1			1/1										
Pyxidanthera barbulata var. *barbulata*	flowering pixie-moss	G4 T4	S1			10		1	1	4	4											0/1			
Quercus hemisphaerica	Darlington's oak	G5	S1			4	1		1		2		0/2				1/2								
Quercus incana	blue jack oak	G5	S2			18	2	2	2	8	4		1/5				1/3								
Quercus laevis	turkey oak	G5	S2			17	3	4	3	3	4						1/1					0/1			
Quercus macrocarpa	bur oak	G5	S1			2				1	1														
Quercus prinoides	dwarf chinquapin oak	G5	S1			26		2		20	4							1/1							
Radula tenax	a liverwort	G3 G4	SU																						
Ranunculus ambigens	water-plantain spearwort	G4	S1			1		1					1/1												
Ranunculus hederaceus	long-stalked crowfoot	G5	SH			9				8	1														
Ranunculus laxicaulis	Mississippi buttercup	G5?	S1			4		1		2	1											1/1			

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Ranunculus longirostris	white water crow-foot	G5	S1			2				2															
Ranunculus trichophyllus var. *trichophyllus*	white water crowfoot	G5 T5	S1			2				1	1	0/1													
Rhamnus alnifolia	alderleaf buckthorn	G5	S1			6		3	2		1				1/1		0/2								
Rhamnus lanceolata var. *glabrata*	smooth lance-leaved buckthorn	G5T 4T5	S1			2			1		1						0/1								
Rhexia petiolata	ciliate meadowbeauty	G5?	S1			10		1	1	5	3														
Rhododendron arborescens	smooth azalea	G4 G5	S2			15	1	3	1	4	6	0/3			1/2		0/3			0/1					
Rhus michauxii	Michaux's sumac	G2	S1	LE		6	1	1	2		2		6/6												
Rhynchospora alba	white beakrush	G5	S2			10	3	3	3		1		1/1	1/1			1/2								
Rhynchospora capillacea	capillary beakrush	G5	S1			4		1	1	1	1														
Rhynchospora cephalantha var. *attenuata*	small capitate beakrush	G5 T3?	S2			23	1	11	5	4	2														
Rhynchospora colorata	white-topped sedge	G5	S1			4	1		1	2				1/1			0/1								
Rhynchospora debilis	savannah beakrush	G4?	S1			8		1		7															
Rhynchospora fascicularis var. *distans*	fasciculate beakrush	G5 T4?	S1?			11	1	1	3	3	3		2/3	0/2			0/1								
Rhynchospora filifolia	thread-leaved beakrush	G5	SH			1				1															
Rhynchospora grayi	Gray's beakrush	G4	SH																						
Rhynchospora harveyi	Harvey beakrush	G4	SH			2				2															
Rhynchospora macrostachya var. *macrostachya*	tall hornedrush	G4 T4	S2			1			1																
Rhynchospora miliacea	millet beakrush	G5	SH																						
Rhynchospora nitens	short-beaked baldrush	G4?	S1			3				2	1														
Rhynchospora oligantha	few-flowered beakrush	G4	S1			1		1						1/1											
Rhynchospora pallida	pale beakrush	G3	SH			1				1															
Rhynchospora perplexa var. *virginiana*	a beakrush	G5 T?	S1 S2			9	1	4		3	1														
Rhynchospora scirpoides	long-beaked baldrush	G4	S1			5	1		1	3							0/1								
Rhynchospora stenophylla	Chapman beakrush	G4	S1			1			1																
Rhynchospora wrightiana	Wright's beakrush	G5	SH																						

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Ribes americanum	wild black currant	G5	S1			3				2	1														
Ribes lacustre	bristly black currant	G5	S1?			1				1															
Rorippa sessiliflora	stalkless yellowcress	G5	S1			7		1	1	2	3		1/2				0/1						0/1		
Rosa setigera	prairie rose	G5	S1			7			2	3	2				0/1	0/1									
Rubus idaeus ssp. *strigosus*	red raspberry	G5 T5	S2			9	4	1	1	3		2/2			4/4										
Rudbeckia heliopsidis	sun-facing coneflower	G2	S1			1		1																	
Rudbeckia triloba var. *pinnatiloba*	pinnate-lobed black-eyed susan	G4G 5T2?	S1			4		1	1		2	0/1							0/1						
Sabatia campanulata	slender marsh pink	G5	S2			21	2	2	4	9	3	1/1			0/1							1/3			
Sabatia difformis	two-formed pink	G4 G5	S1			4			2	1	1														
Saccharum brevibarbe	short-beard plumegrass	G3 G5	S1?			7		1	2	4															
Saccharum coarctatum	bunched plume grass	G5?	S1?																						
Sagittaria calycina var. *calycina*	long-lobe arrowhead	G5 T5?	S1			4	1				2	0/1	1/2				0/1								
Sagittaria engelmanniana	Engelmann arrowhead	G5?	SH			1				1															
Sagittaria rigida	sessile-fruited arrowhead	G5	S1			3		1		2															
Salix discolor	pussy willow	G5	S1			1		1																	0/1
Salix exigua	sandbar willow	G5	S1			4				3	1				0/1										
Sanguisorba canadensis	Canada burnet	G5	S2			20	2	6	6	2	4				4/5		0/1								
Sarracenia flava	yellow pitcher-plant	G5?	S1			22			4	10	8		1/1												
Sarracenia purpurea ssp. *purpurea*	northern purple pitcher-plant	G5 T5?	S2?			43		7	8	7	21								0/1			1/1			0/1
Saxifraga careyana	Carey saxifrage	G3	S2?			7	2			2	3						0/2		0/1						
Saxifraga caroliniana	carolina saxifrage	G2	S2?			17	4	5	1	5	2	1/4					1/2								
Schizachne purpurascens	purple oat-grass	G5	S1			4	3		1			2/2							1/1						
Schoenoplectus acutus	hardstemmed bulrush	G5	S1			3				2	1														
Schoenoplectus etuberculatus	Canby's bulrush	G3 G4	SH			1				1															
Schoenoplectus smithii	Smith's bulrush	G5?	SH																						
Schoenoplectus subterminalis	water bulrush	G4 G5	S1 S2			6	4	1			1	2/2	3/4												
Schoenoplectus torreyi	Torrey's bulrush	G5?	S1			3	3																		
Schwalbea americana	chaffseed	G2	SH	LE		2				2															

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							A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
Scirpus ancistrochaetus	northeastern bulrush	G3	S2	LE	LE	8	4	1		1	2	2/2													
Scirpus flaccidifolius	reclining bulrush	G2	S1			5	1	2	1		1														
Scleria ciliata	fringed nutrush	G5	S1			2		1		1															
Scleria minor	slender nutrush	G4	S2			21	1	8	2	4	6														
Scleria pauciflora var. *caroliniana*	few-flowered nutrush	G5T 4T5	S1																						
Scleria verticillata	whorled nutrush	G5	S2			7	4	2			1			0/1	0/1		0/ 2							0/ 1	
Sclerolepis uniflora	one-flower sclerolepis	G4	S1			1		1																	
Scutellaria arguta	sharp-leaved skullcap	G2? Q	SH																						
Scutellaria galericulata	hooded skullcap	G5	S1			1		1																	
Scutellaria incana	hoary skullcap	G5	S2			9		2	3	1	3		1/1		1/1			1/ 1	1/ 1	1/ 1					
Scutellaria parvula var. *parvula*	small skullcap	G4 T4	S1			4	1			3							0/ 1						0/ 1	0/ 1	0/ 1
Seymeria cassioides	seymeria	G5	S1 S2			10	1		1	6	2											1/ 1		1/ 1	
Sibbaldiopsis tridentata	three-toothed cinquefoil	G5	S2			8	3	1	2	1	1	2/2			3/3		1/ 1								
Sida elliottii	Elliott sida	G4G 5	S1			4			2	2															
Sida hermaphrodita	Virginia mallow	G2	S1			7				4	3	0/1			0/1										0/ 1
Silene nivea	snowy campion	G4?	S1			6				5	1														
Silene ovata	ovate catchfly	G2 G3	S1			4				2	2														
Silene rotundifolia	roundleaf catchfly	G4	S2			9	1		2	1	5	1/4			0/1		0/ 2								
Silphium terebinthinaceum	prairie rosinweed	G4 G5	S1			1			1						1/1										
Sisyrinchium albidum	white blue-eyed-grass	G5?	S2			16	4	3	7		2	1/1					0/ 3						0/ 1	0/ 2	0/ 1
Smilax ecirrata	upright greenbrier	G5?	S1			1					1														
Smilax smallii	Small's greenbrier	G5?	SH																						
Solidago gracillima	a goldenrod	G4?	S2			3		1	1		1														
Solidago latissimifolia	Elliott goldenrod	G5	S2			11		3	1	1	6			1/3					0/ 1					0/ 1	
Solidago patula var. *strictula*	round-leaved goldenrod	G5 T5	S1			2		1		1															
Solidago racemosa	sticky goldenrod	G5 T4?	S1			24	6	8	8	1	1				0/2										
Solidago rupestris	rock goldenrod	G4?	S1			7	1	1	1	4		0/1			0/1										
Solidago tortifolia	a goldenrod	G4 G5	S1			9		1		8															
Solidago uliginosa var. *uliginosa*	bog goldenrod	G4G 5T?	S2			12	3	2	1	6		1/1	1/1				0/ 1								
Sparganium androcladum	branching burreed	G4 G5	SH			1					1														

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Sparganium chlorocarpum	narrow-leaf burreed	G5	S1			10	1	1	3	4	1	4/5													
Spartina pectinata	freshwater cordgrass	G5	S2			16	1	2	4	3	6	0/4			0/3		0/2								
Spermacoce glabra	smooth buttonweed	G4 G5	S1			1					1	0/1													
Spermolepis divaricata	rough-fruit spermolepis	G5	S1?			1			1																
Sphagnum angustifolium	narrowleaf peatmoss	G5	S1 S2			4					4	1/1					2/2								
Sphagnum capillifolium	pom-pom peatmoss	G5	S1 S2			2					2	0/2					0/1								
Sphagnum carolinianum	carolina peatmoss	G3	S2			5				1	4												0/1		
Sphagnum cyclophyllum	circular-leaved peatmoss	G3	S1 S2			2				2															
Sphagnum fimbriatum	a peatmoss	G5	S1			1					1	0/1													
Sphagnum flavicomans	a peatmoss	G3	SU			1					1														
Sphagnum flexuosum	flexuose peatmoss	G5	S1 S2			3				2	1	1/1													
Sphagnum fuscum	brown peatmoss	G5	S1			2				2															
Sphagnum girgensohnii	Girgensohn's peatmoss	G5	S1 S2			3				2	1														
Sphagnum inundatum	inundated peatmoss	G4	S1 S2			2				1	1														
Sphagnum macrophyllum var. *macrophyllum*	large-leaf peatmoss	G3 T3?	S2			3				1	2												1/1		
Sphagnum molle	soft peatmoss	G4	S2			4				3	1						0/1					0/1			
Sphagnum portoricense	Puerto Rico peatmoss	G5	S1 S2			1					1														
Sphagnum quinquefarium	five-rowed peatmoss	G5	S2S3			7				3	4	1/3					0/1								
Sphagnum rubellum	red peatmoss	G5	S2			4				1	3	3/3					1/1								
Sphagnum russowii	Russow's peatmoss	G5	S1 S2			2					2	1/2					0/1								
Sphagnum strictum	straight peatmoss	G5	S2			2				1	1		1/1												
Sphagnum subsecundum	subsecund peatmoss	G5	S1																						
Sphagnum subtile	delicate peatmoss	G5? Q	S1 S2			2				2															
Sphagnum torreyanum	Torrey's peatmoss	G3 G4	S2			6				1	5						0/1		0/1			0/1			
Sphagnum trinitense	Trinidad peatmoss	G4	S2 S3			5	1			1	3		2/2												
Sphenopholis filiformis	long-leaf wedgescale	G4?	S1			2				2															
Spiraea virginiana	Virginia spiraea	G2	S1	LT	LE	6	2	2	2			0/4					0/2								

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Spiranthes lucida	shining ladies'-tresses	G5	S1			6		1		1	4	0/1					0/1								0/1
Spiranthes magnicamporum	great plains ladies'-tresses	G4	S1			3		1	1		1						0/1								
Spiranthes ochroleuca	yellow nodding ladies'-tresses	G4	S1			5				3	2	0/1													
Sporobolus compositus var. *compositus*	longleaf dropseed	G5 T5	S1 S2			10	1	5	2		2				0/1		0/1								0/1
Sporobolus heterolepis	northern dropseed	G5	S1			1		1																	
Sporobolus junceus	a dropseed	G5	S1			2		1		1															
Sporobolus neglectus	small dropseed	G5	S2			12		1	2	6	3	0/1					0/1								
Stachys aspera	rough hedge-nettle	G5 T4?	S2			1	1										1/1								
Stachys eplingii	Epling's hedge-nettle	G5	S1			4			3	1															
Stachys pilosa var. *arenicola*	marsh hedgenettle	G5 T4?	S1			9	1	3	2	3					3/4										
Stachys sp. *1*	Vadkin hedgenettle	G?	S1			3		1	1		1		0/2									0/1			
Steinchisma hians	gaping panic grass	G5	S1			5			1	4					1/1										
Stewartia ovata	mountain camellia	G4	S2			14	1	1	1	10	1		2/2		1/1		1/1								
Stillingia sylvatica ssp. *sylvatica*	queen's delight	G5 T5	S1			5			1	2	2						1/1	0/1							
Stipulicida setacea var. *setacea*	pineland scaly-pink	G4G5T4T5	S1			2		1			1		0/1				0/1								
Streptopus amplexifolius	white mandarin	G5	S1			2			2						2/2										
Stylophorum diphyllum	celandine poppy	G5	S2			16	1	1	4	4	6								0/1					0/1	0/1
Sullivantia sullivantii	sullivantia	G4	S1			4	1		2		1														
Symphoricarpos albus var. *albus*	snowberry	G5T4	S2			4			1		1	0/2													
Symphyotrichum elliottii	Elliott's aster	G5T3T4	S1			4		1		2	1						0/1								
Symphyotrichum ericoides	white heath aster	G5	S1			11		3	1	2	5					0/1							0/2		
Symphyotrichum praealtum var. *angustior*	willow aster	G5 T4	S1			1		1																	
Symphyotrichum pratense	barrens silky aster	G?	S1			7	1	1	3		2	1/1					1/3							0/1	
Symphyotrichum shortii	short's aster	G4 G5	S1			3			1	1	1				0/1										
Synandra hispidula	gyandotte beauty	G4	S2			13		5	3	4	1													0/1	
Talinum mengesii	Menge's fame-flower	G3	S1			3	1		2								1/1								

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Tetragonotheca helianthoides	pineland squarehead	G5	S1			5		1		4															
Thalictrum macrostylum	piedmont meadow-rue	G3 G4	S1			4			1	3															
Thelypteris simulata	bog fern	G4 G5	S1 S2			5	1	3		1			2/2												0/1
Tillandsia usneoides	Spanish moss	G5	S2			19	1	2	2	7	7		1/2	1/1			1/2						1/1	0/1	
Tofieldia glutinosa	sticky false-asphodel	G5	S1			1			1																
Tofieldia racemosa	coastal false-asphodel	G5	S1			4			1	2	1														
Toxicodendron rydbergii	western poison ivy	G5	S1			2				2															
Triadenum fraseri	Fraser's marsh St. John's-wort	G4 G5	S1			2				1	1													1/1	
Triadenum tubulosum	large marsh St. John's-wort	G4?	S1			6		2		1	3		2/2						0/1						
Trichomanes boschianum	bristle-fern	G4	S1			1			1																
Trichostema setaceum	narrow-leaved blue-curls	G5	S2			12		3	3	6		2/2							0/1				0/1		
Tridens chapmanii	Chapman's redtop	G?	SH																						
Trifolium calcaricum	running glade clover	G1	S1			2	2										1/2						0/1	0/1	0/1
Trifolium reflexum	buffalo clover	G5	S1			10			1	6	3				1/1										
Trillium cernuum	nodding trillium	G5	S2			7	1	2	1	1	2								1/1						
Trillium flexipes	nodding trillium	G5	S1			6				5	1														
Trillium nivale	snow trillium	G4	S1																						
Trillium pusillum var. *virginianum*	Virginia least trillium	G3 T2	S2			33	2	3	4	13	11	2/2	0/1	0/1					0/1			1/1		1/1	0/1
Triphora trianthophora	nodding pogonia	G3 G4	S1			7	1		1	2	3	1/2					1/1								
Trisetum spicatum	narrow false oats	G5	S1			1	1								1/1										
Utricularia juncea	southern bladderwort	G5	S2			11		1	3	7				1/1											
Utricularia olivacea	minute bladderwort	G4	S1			1				1															
Utricularia purpurea	purple bladderwort	G5	S2			11	1	2		3	5		3/5				1/2		0/1						
Utricularia striata	fibrous bladderwort	G4 G5	S1			4		1		3			0/1		0/1										
Vaccinium crassifolium	creeping blueberry	G4 G5	S1			8			1	5	2											1/1			
Vaccinium macrocarpon	large cranberry	G4	S2			18	1	5	3	6	3	2/2		2/2	1/2		0/1								
Vaccinium myrtilloides	velvetleaf blueberry	G5	S1 S2			6		2		2	2				2/2				0/1						
Vaccinium virgatum	swamp blueberry	G4	SH																						
Valeriana pauciflora	valerian	G4	S2			8	1	2		3	2				0/2								1/2		
Verbena scabra	sandpaper vervain	G5	S2			9		1		7	1				1/2										

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Veronica scutellata	marsh-speedwell	G5	S1			10		1	2	2	5						0/1							0/1	0/1
Viburnum lentago	nannyberry	G5	S1			1				1															
Vicia americana ssp. *americana*	American purple vetch	G5 T5	S1 S2			9		2		7		0/2													
Viola esculenta	salad violet	G4 G5	S1			5	1			2	2						0/1	0/1							
Viola walteri	prostrate blue violet	G4 G5	S2			18	3	4	4	5	2						0/6			0/1				0/1	
Vitis rupestris	sand grape	G3	S1?			9		3	1	4	1	0/1			0/2		0/1								
Wisteria frutescens	American wisteria	G5	S2			8		2	1	4	1		1/1												
Wolffia columbiana	Columbia water-meal	G5	S1			5				4	1														
Xyris caroliniana	Carolina yellow-eyed-grass	G4 G5	S1			13		1		10	2						0/1					1/2			
Xyris difformis var. *curtissii*	Curtiss' yellow-eyed-grass	G5 T5	S1			2			1		1														
Xyris fimbriata	fringed yellow-eyed-grass	G5	S1			5		1		3	1			1/2											
Xyris laxifolia var. *iridifolia*	irisleaf yellow-eyed-grass	G4G 5T4 T5	S1			5		1	2		2						3/3								
Xyris platylepis	tall yellow-eyed-grass	G5	S2			6		1	4		1														
Zenobia pulverulenta	dusty zenobia	G4?	S1			6		1		5															
Zigadenus densus	black snakeroot	G5	S1			3		1	1	1															
Zigadenus glaberrimus	large-flowered camass	G5	S1			9			1	4	4				0/1										
Zigadenus leimanthoides	death-camass	G4Q	S1			4	1	1	2								0/1								
Zornia bracteata	viperina	G5?	S1			6		2		3	1											1/1			

Table 2: Rare Animals

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Vertebrates																									
Fish																									
Acipenser brevirostrum	shortnose sturgeon	G3	SX	LE	LE																				
Acipenser oxyrinchus	Atlantic sturgeon	G3	S2		SC																				
Ameiurus brunneus	snail bullhead	G4	S2			2				1	1														
Ammocrypta clara	western sand darter	G3	S1		LT	6				3	1														
Aplodinotus grunniens	freshwater drum	G5	S2			7				7															
Cottus baileyi	black sculpin	G4Q	S2			35				22	13	0/5													
Cottus cognatus	slimy sculpin	G5	S2			7				3	4														0/1
Cottus sp. *1*	bluestone sculpin	G2	S2			1																			
Cottus sp. *4*	Clinch sculpin	G1 G2	S1 S2			4					4														
Cottus sp. *5*	Holston sculpin	G2	S2																						
Cyprinella labrosa	thicklip chub	G4	SH																						
Cyprinella monacha	turquoise shiner	G2	S1	LT	LT	16				2	14													0/1	
Cyprinella whipplei	steelcolor shiner	G5	S1		LT																				
Enneacanthus chaetodon	blackbanded sunfish	G4	S1		LE	5		1		1	3								0/1					0/1	0/1
Erimystax cahni	slender chub	G1	S1	LT	LT	3				1	2													0/1	
Erimyzon sucetta	lake chubsucker	G5	S2			12				4	8													0/1	0/1
Etheostoma acuticeps	sharphead darter	G3	S1		LE	3			2		1														
Etheostoma caeruleum	rainbow darter	G5	S2																						
Etheostoma camurum	bluebreast darter	G4	S2		SC	29		2		12	15													0/1	
Etheostoma chlorobranchium	greenfin darter	G4	S1		LT	3					3	0/2													
Etheostoma cinereum	ashy darter	G2 G3	S1			2				1	1														
Etheostoma collis	Carolina darter	G3	S2		LT	3		1		1	1														
Etheostoma denoncourti	golden darter	G2	S1		LT	10		1	1	3	5						0/1							0/1	
Etheostoma jessiae	blueside darter	G4Q	S1		LE	1				1															
Etheostoma meadiae	bluespar darter	G4	S2			11		3		6	2														
Etheostoma osburni	candy darter	G3	S1		SC	21				14	3	0/1													
Etheostoma percnurum	duskytail darter	G1	S1	LE	LE	4			2	2															

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Etheostoma swannanoa	Swannanoa darter	G4	S2			5				3	2														
Etheostoma variatum	variegate darter	G5	S1		LE																				
Etheostoma vulneratum	wounded darter	G3	S2 S3			1					1														
Fundulus lineolatus	lined topminnow	G5	S2 S3			24			1	5	18						1/2		0/1					0/1	0/1
Fundulus rathbuni	speckled killifish	G4	S2		SC	7			1	4	2														
Hybopsis hypsinotus	highback chub	G4	S2			3					3														
Ichthyomyzon bdellium	Ohio lamprey	G3 G4	S2			4				2	2														
Ichthyomyzon greeleyi	mountain brook lamprey	G3 G4	S2			1					1														
Labidesthes sicculus	brook silverside	G5	S2		SC	7				5	2														
Lythrurus lirus	mountain shiner	G4	S2 S3			2				1	1														
Moxostoma carinatum	river redhorse	G4	S2 S3		SC	19				4	15													0/1	
Notropis alborus	Whitemouth shiner	G4	S1		LT	4					4														
Notropis ariommus	popeye shiner	G3	S2 S3		SC	32	2	4	2	6	18								0/2						
Notropis atherinoides	emerald shiner	G5	S1 S2		LT	2				1	1														
Notropis bifrenatus		G5	S2		SC																				
Notropis semperasper	roughhead shiner	G2 G3	S2 S3		SC	34		1		29	4	0/4													
Notropis spectrunculus	mirror shiner	G4	S2		SC	2				1	1														
Notropis stramineus	sand shiner	G5	S2																						
Noturus eleutherus	mountain madtom	G4	S2 S3			1				1															
Noturus flavipinnis	yellowfin madtom	G1	S1	LT	LT	12			1	6	5														
Noturus flavus	stonecat	G5	S2		SC	14				5	9														
Noturus gilberti	orangefin madtom	G2	S2		LT	22	1	1	1	1	18	0/4													
Noturus insignis ssp. *1*	spotted margined madtom	G5 T1Q	S1																						
Percina aurantiaca	tangerine darter	G4	S2 S3			33		2	1	21	9								0/2					0/1	
Percina burtoni	blotchside logperch	G2	S1		SC	34				17	17														
Percina copelandi	channel darter	G4	S2		SC	14				9	5														
Percina crassa	Piedmont darter	G4	S1			1				1															
Percina evides	gilt darter	G4	S2			13				7	6						0/1								
Percina macrocephala	longhead darter	G3	S1 S2		LT	13				8	5														
Percina maculata	blackside darter	G5	SX																						

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Percina rex	Roanoke logperch	G1 G2	S1 S2	LE	LE	43	1	1	2	6	31		1/2				0/3						0/1		
Percina sciera	dusky darter	G5	S1 S2			2				1	1						0/1								
Percopsis omiscomaycus	trout-perch	G5	SX																						
Phenacobius crassilabrum	fatlips minnow	G3 G4	S2		SC	3				1	2														
Phenacobius mirabilis	suckermouth minnow	G5	S1 S2																						
Phenacobius teretulus	Kanawha minnow	G3 G4	S2 S3			47				35	8				1/1		0/1								
Phoxinus cumberlandensis	blackside dace	G2	S1	LT																					
Phoxinus saylori	laurel dace	G1																							
Phoxinus tennesseensis	Tennessee dace	G3	S1		LE	4				2	2														
Pimephales vigilax	bullhead minnow	G5	S1			2				1	1														
Polyodon spathula	paddlefish	G4	S1		LT	1				1															
Scartomyzon sp. *1*	brassy jumprock	G4	S1 S2																						
Stizostedion canadense	sauger	G5	S2 S3		SC	8				2	6														
Thoburnia hamiltoni	rustyside sucker	G3	S2		SC	5				2	3				0/1										
Amphibians																									
Ambystoma mabeei	Mabee's salamander	G4	S1 S2		LT	13	1	1	7	2	2		1/1		1/1							0/1	1/3		
Ambystoma talpoideum	mole salamander	G5	S1 S2		SC	2			1		1														
Ambystoma tigrinum	tiger salamander	G5	S1		LE	5		1	2	1	1	0/1													
Bufo quercicus	oak toad	G5	S1 S2		SC	8				7	1														
Cryptobranchus alleganiensis	hellbender	G3 G4	S2 S3		SC	46	2	3	2	32	7						0/2								
Desmognathus marmoratus	shovel-nosed salamander	G4	S2		SC	7	1	1		3	2	2/2													
Desmognathus wrighti	pygmy salamander	G3 G4	S2		SC	4		1	1		2	1/2													
Eurycea wilderae	Blue Ridge two-lined salamander	G5	S2																						
Hyla gratiosa	barking treefrog	G5	S1		LT	11	1	3	2	3	2												1/2		
Necturus maculosus	mudpuppy	G5	S2			9	1	2		3	3													0/1	
Necturus punctatus	dwarf waterdog	G4	S2 S3			9	2	1		6							0/1								
Plethodon hubrichti	Peaks of Otter salamander	G2	S2		SC	12	8	1	1	1	1	3/7			3/8										
Plethodon punctatus	Cow Knob salamander	G3	S2		SC	13	10		1	1		6/8													

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Plethodon shenandoah	Shenandoah salamander	G1	S1	LE	LE	5	4	1							3/4										
Plethodon ventralis	southern zigzag salamander	G4	S1			2				2															
Plethodon virginia	Shenandoah Mountain salamander	G2 G3Q	S2																						
Plethodon welleri	Weller's salamander	G3	S2		SC	3		2			1	2/2													
Siren intermedia	lesser siren	G5	S2			5	1	2	1		1		0/1												
Reptiles																									
Apalone spinifera	spiny softshell	G5	S2			7	2			1	4					0/1	0/1								
Caretta caretta	loggerhead (sea turtle)	G3	S1B, S1N	LT	LT	3				1	1														
Crotalus horridus atricaudatus	canebrake rattlesnake	G4 TUQ	S1		LE	23	2	1	1	7	12		1/1	1/1			1/5						1/6	0/5	
Deirochelys reticularia	chicken turtle	G5	S1		LE	2			1		1		0/1				0/1								
Eumeces anthracinus	coal skink	G5	S2			9	3	1	1	4		5/5													
Glyptemys insculpta	wood turtle	G4	S2		LT	27	1	4	3	7	12	1/1	1/2		1/2								0/2	1/1	0/1
Glyptemys muhlenbergii	bog turtle	G3	S1 S2	LT	LE	65	4	16	10	3	32				3/17	0/1	0/2	0/1	0/1						0/2
Graptemys geographica	northern map turtle	G5	S2 S3			19		7		8	4								0/2						0/1
Lampropeltis getula nigra	eastern black kingsnake	G5 T5	S2			5					5						1/1								
Lepidochelys kempii	Kemp's ridley (sea turtle)	G1	S1N	LE	LE																				
Ophisaurus ventralis	eastern glass lizard	G5	S1		LT	3				1	2						1/2						0/1	0/1	
Pituophis melanoleucus	pine snake	G4	S1 S3			10		1		9		1/1													
Regina rigida	glossy crayfish snake	G5	S1			1		1																	
Sternotherus minor	loggerhead musk turtle	G5	S2			7	2	2	1		2														
Tantilla coronata	southeastern crowned snake	G5	S2			5	1		1	3												0/1			
Trachemys scripta troostii	Cumberland slider	G5T 3T4	S1			4	1				3														
Virginia valeriae pulchra	mountain earthsnake	G5T 3T4	S1		SC	1			1																
Birds																									
Actitis macularia	Spotted Sandpiper	G5	S2B, SZN			1					1														
Aegolius acadicus	Northern Saw-whet Owl	G5	S1B, S1N		SC	6			3		3	1/4					1/1		0/1						
Aimophila aestivalis	Bachman's Sparrow	G3	S1B		LT	12		2	2		8		3/3												

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Ammodramus caudacutus	Saltmarsh Sharp-tailed Sparrow	G4	S2B, S3N		SC	5	1	3			1			1/1			0/2		1/1						
Ammodramus henslowii	Henslow's Sparrow	G4	S1B		LT	6			2		4		1/1												
Anas discors	Blue-Winged Teal	G5	S1B, S2N																						
Anas strepera	Gadwall	G5	S2B, S3N			2	1		1															2/2	
Aquila chrysaetos	Golden Eagle	G5	SHB ,S1N																						
Ardea alba	Great Egret	G5	S2B, S3N		SC	12	1	6	2		3			2/2	0/1		1/1						0/1	1/1	
Asio flammeus	Short-eared Owl	G5	S1B, S3N			2					2								0/1						
Asio otus	Long-eared Owl	G5	S1		SC																				
Bartramia longicauda	Upland Sandpiper	G5	S1B, SZN		LT	4			1	2	1								0/1						
Botaurus lentiginosus	American Bittern	G4	S1B, S2N			1					1												0/1		
Carpodacus purpureus	Purple Finch	G5	S1B, S5N		SC	6				1	5	2/5													
Catharus guttatus	Hermit Thrush	G5	S1B, S5N		SC	7	1	2	2	1	1	3/4					0/1		1/1						
Catharus ustulatus	Swainson's Thrush	G5	S1B, SZN			1		1				1/1													
Charadrius melodus	Piping Plover	G3	S2B, S1N	LT	LT	30	7	5	12		6		0/1	2/5	0/2		0/2						0/1	4/18	
Charadrius wilsonia	Wilson's Plover	G5	S1B, SZN		LE	17	1	5	5		6			2/4	1/1		0/1							3/11	
Chondestes grammacus	Lark Sparrow	G5	SHB SZN																						
Circus cyaneus	Northern Harrier	G5	S1S2B,S3S4		SC	6	1	1	1		3			1/1					1/1					0/3	
Cistothorus platensis	Sedge Wren	G5	S1B, S1S2N		SC	2				2															
Contopus cooperi	Olive-sided Flycatcher	G4	SHB ,SZN																						
Dendroica fusca	Blackburnian Warbler	G5	S2B, SZN			8		2			6	3/5			1/1										
Dendroica magnolia	Magnolia Warbler	G5	S2B, SZN		SC	10	1	2	2		5	4/7					0/1		3/3						
Egretta caerulea	Little Blue Heron	G5	S2B, S3N		SC	5	1		4					1/1			1/1							1/1	
Egretta thula	Snowy Egret	G5	S2B, S3N			8	1	5			2			1/1			1/1							1/2	
Egretta tricolor	Tricolored Heron	G5	S2B, S3N		SC	5	2	2	1					1/1			1/1							1/1	
Empidonax alnorum	Alder Flycatcher	G5	S1B, SZN		SC	3		1	1		1	0/2					0/1							0/1	
Empidonax flaviventris	Yellow-bellied Flycatcher	G5	S1B, SZN		SC	1					1	1/1													

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Eudocimus albus	White Ibis	G5	S1B, SAN			2			1		1			1/1			1/1								
Falco peregrinus	Peregrine Falcon	G4	S1B, S2N		LT	25	4	4	2	1	14		0/1	1/4	1/4		0/1						0/3	2/4	0/1
Fulica americana	American Coot	G5	S1B, S5N																						
Gallinula chloropus	Common Moorhen	G5	S1B, S1N		SC	1					1		0/1										0/1		
Haliaeetus leucocephalus	Bald Eagle	G4	S2 S3B, S3N	LT	LT	574	1	12	6		555	1/1	27/30	12/20	6/10		7/11		4/8			0/2	1/5	2/5	4/8
Himantopus mexicanus	Black-necked Stilt	G5	S1B			1		1					0/1												
Lanius ludovicianus	Loggerhead Shrike	G4	S2B, S3N		LT	25		6	1	6	12	0/3	1/1												
Laterallus jamaicensis	Black Rail	G4	S2B, S2N			1	1												1/1						
Limnothlypis swainsonii	Swainson's Warbler	G4	S2B, SZN		SC	7		2	5			5/5		0/1											
Loxia curvirostra	Red Crossbill	G5	S1B, SZN		SC	4					4	1/3												0/1	
Melospiza georgiana	Swamp Sparrow	G5	S1B, S4S 5N																						
Mergus merganser	Common Merganser	G5	S1B, S4N																						
Nyctanassa violacea	Yellow-crowned Night-heron	G5	S2B, S3N		SC	9					9		0/1	1/1									0/1	1/1	
Oporornis philadelphia	Mourning Warbler	G5	S1B, SZN		SC	4		1			3	1/4													
Pelecanus occidentalis	Brown Pelican	G4	S1B, S3N		SC	3		2	1					0/1										0/2	
Picoides borealis	Red-cockaded Woodpecker	G3	S1	LE	LE	11			6	1	4													0/2	
Plegadis falcinellus	Glossy Ibis	G5	S2B, S1N		SC	5	2	1			2			1/1			1/1							1/1	
Podilymbus podiceps	Pied-billed Grebe	G5	S2B, S3N			1					1		0/1										0/1		
Porzana carolina	Sora	G5	S1B, S2N			2			2										1/1						
Rallus elegans	King Rail	G4 G5	S2B, S3N			8		2	1		5		0/2	1/2			0/1						0/2	0/1	
Rallus limicola	Virginia Rail	G5	S2B, S3N			4		1	3										1/1					0/1	
Regulus satrapa	Golden-crowned Kinglet	G5	S2B, S5N		SC	9	4	2			3	4/7					1/2		1/1						
Rynchops niger	Black Skimmer	G5	S2B, S1N			22	3	14	5					0/1			0/1						0/1	3/10	
Seiurus noveboracensis	Northern Waterthrush	G5	S1B, SZN			1					1	0/1							0/1						
Sitta canadensis	Red-breasted Nuthatch	G5	S2B, S4N		SC	9		3	1		5	4/5			1/1		1/1		0/1						

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Sphyrapicus varius	Yellow-bellied Sapsucker	G5	S1B, S4N			7			1	4	2	0/3													
Sterna antillarum	Least Tern	G4	S2B, SZN		SC	22	1	12	1		8		0/3	1/4									0/1	3/12	
Sterna caspia	Caspian Tern	G5	S1B, S2N		SC	5					5													1/3	
Sterna dougallii	Roseate Tern	G4	SHB ,SZN	LE	LE																				
Sterna maxima	Royal Tern	G5	S2B, SZN			2	1		1															0/1	
Sterna nilotica	Gull-billed Tern	G5	S2B, SZN		LT	19	2	7	6		4			0/1			0/1							2/7	
Sterna sandvicensis	Sandwich Tern	G5	S1B, SZN		SC	2		1			1													0/1	
Thryomanes bewickii altus	Appalachian Bewick's Wren	G5 T2Q	S1B, SZN		LE	21				12	5														
Troglodytes troglodytes	Winter Wren	G5	S2B, S4N		SC	8	1	3	1		3	3/5			3/4										
Vermivora ruficapilla	Nashville Warbler	G5	S1B, SZN																						
Mammals																									
Corynorhinus rafinesquii macrotis	eastern big-eared bat	G3G4T?	S2		LE	29		1	3	1	24			1/1			1/2							0/2	
Corynorhinus townsendii virginianus	Virginia big-eared bat	G4 T2	S1	LE	LE	13	2		2	6	3	0/1													
Glaucomys sabrinus coloratus	northern flying squirrel	G5 T1	S1	LE	LE	6	2	1	1		1	3/3													
Lepus americanus	snowshoe hare	G5	S1		LE	1					1	1/1													
Martes pennanti	fisher	G5	S1			1					1														
Microtus chrotorrhinus carolinensis	southern rock vole	G4 T3	S1		LE	5		1			2	0/2													
Myotis austroriparius	southeastern myotis	G3 G4	S1 S2			5		1	2		2			3/3			1/1							1/1	
Myotis grisescens	gray bat	G3	S1	LE	LE	10		2	1	2	4														
Myotis leibii	eastern small-footed bat	G3	S1			24		2	5	1	16	4/5			1/1										
Myotis sodalis	Indiana bat	G2	S1	LE	LE	20	3	4	3	4	6	4/6			2/2										
Puma concolor couguar	eastern cougar	G5 TH	SX	LE	LE																				
Sciurus niger cinereus	Delmarva fox squirrel	G5 T3	S1	LE	LE	2		1			1			0/1	0/1										
Sorex longirostris fisheri	Dismal Swamp southeastern shrew	G5 T4	S2		LT	10	1	1	3	3	2		0/1	1/1			1/1						0/1		
Sorex palustris punctulatus	southern water shrew	G5 T3	S1 S2		LE	4			1		2	1/2													
Sylvilagus floridanus hitchensi		G5 THQ	SH			3				3															

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Invertebrates Turbellaria (flatworms)																									
Geocentrophora cavernicola	a cave planarian	G3 G4	S1			1			1																
Procotyla typhlops	a groundwater planarian	G1 G2	S1 S2			2				1															
Sphalloplana chandleri	Chandler's planarian	G1 G3	S1			1				1															
Sphalloplana consimilis	Powell Valley planarian	G2 G3	S1			6	2			3	1														
Sphalloplana holsingeri	Holsinger's groundwater planarian	GH	SH			1				1															
Sphalloplana hypogea	a groundwater planarian	G1 G2	S1 S2																						
Sphalloplana subtilis	Bigger's groundwater planarian	GH	SH			1				1															
Sphalloplana virginiana	Rockbridge County cave planarian	G1	S1			1				1															
Gastropoda (snails)																									
Anguispira jessica	mountain disc	G3 G4	S1																						
Catinella hubrichti	Snowhill ambersnail	G3	S1 S3																						
Discus nigrimontanus	black mountain disc	G4	S1 S3																						
Euchemotrema leai	lowland pillsnail	G5	S1 S3																						
Fontigens bottimeri	Appalachian springsnail	G2	S1 S2																						
Fontigens morrisoni	Virginia springsnail	G1	S1																						
Fumonelix wheatleyi clingmanicus	Clingman covert	G4T 3T4	S1 S2																						
Gastrocopta clappi	bluegrass snaggletooth	G5	S1 S2																						
Gastrocopta pellucida	slim snaggletooth	G4 G5	S1 S3																						
Gastrodonta fonticula	Appalachia bellytooth	G3 G4	S1 S3																						
Glyphyalinia picea	rust glyph	G3	S1 S3			1				1															
Glyphyalinia praecox	brilliant glyph	G4	S1 S3																						
Glyphyalinia raderi	Maryland glyph	G2	S1 S2		SC	3				1															
Glyphyalinia sculptilis	suborb glyph	G4	S1																						
Glyphyalinia virginica	depressed glyph	G3	S2 S3			5				5															

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Helicodiscus diadema	shaggy coil	G1	S1		LE	4				2	2	0/2													
Helicodiscus lirellus	rubble coil	G1	S1		LE	2					2														
Helicodiscus multidens	twighlight coil	G2	S2																						
Helicodiscus shimeki	temperate coil	G4	S1																						
Helicodiscus triodus	tallus coil	G2	S1 S2			1					1	0/1													
Holsingeria sp. *1*	Skyline Caverns snail	G1Q	S1																						
Holsingeria unthanksensis	an aquatic cavesnail	G1	S1		LE	5		1			4													0/1	
Inflectarius kalmianus	brown globelet	G3	S1 S3																						
Io fluvialis	spiny riversnail	G2	S2		LT	20	2	1	3	6	6						0/1							0/2	
Leptoxis praerosa	onyx rocksnail	G5	S1 S3			11					11														
Megapallifera wetherbyi	blotchy mantleslug	G2 G3	S1?																						
Mesodon andrewsae	balsam globe	G3	S1																						
Mesodon christyi	glossy covert	G3	S1																						
Mesodon elevatus	proud globe	G5	S2			1					1													0/1	
Mesodon panselenus	Virginia bladetooth	G2	S2																						
Mesomphix subplanus	flat button	G3	S2			1				1															
Millerelix plicata	Cumberland liptooth	G3 G4	S1 S3																						
Oxyloma subeffusum	Chesapeake ambersnail	G3	S1																						
Pallifera hemphilli	black mantleslug	G3	S1																						
Pallifera varia	variable mantleslug	G2 G4	S2?			4				4															
Paravitrea blarina	shrew supercoil	G2	S1																						
Paravitrea calcicola	pearl supercoil	G1	SR																						
Paravitrea dentilla	comb supercoil	G1	S1			1				1															
Paravitrea hera	spirit supercoil	G1	S1		LE	1					1														
Paravitrea mira	funnel supercoil	G2	S2			3				3															
Paravitrea placentula	glossy supercoil	G3	S1 S3																						
Paravitrea pontis	Natural Bridge supercoil	G3	S2																						
Paravitrea reesei	round supercoil	G2	S2																						
Paravitrea septadens	brown supercoil	G1	S1		LT	2				1	1	0/1					0/1								

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Paravitrea seradens	barred supercoil	G3	S1 S3																						
Paravitrea subtilis	slender supercoil	G2	S1 S2																						
Polygyriscus virginianus	Virginia fringed mountain snail	G1	S1	LE	LE	1			1																
Pomatiopsis cincinnatiensis	brown walker	G4	S2																						
Pupilla muscorum	widespread column	G5	S1																						
Somatogyrus virginicus	pandhandle pebblesnail	G1 G2	S1 S2			1				1															
Stagnicola neopalustris	Piedmont pondsnail	GH	SH																						
Stenotrema altispira	highland slitmouth	G2	S1																						
Stenotrema pilula	pygmy slitmouth	G3 G4	S1																						
Stenotrema spinosum	carinate slitmouth	G3 G4	S2																						
Striatura exigua	ribbed striate	G4 G5	S2			2				2															
Striatura milium	fine-ribbed striate	G4	S1 S3			1				1															
Triodopsis anteridon	Carter threetooth	G2 G3	S2 S3																						
Triodopsis messana	pinhole threetooth	G4	S1 S3																						
Triodopsis pendula	hanging rock three-tooth	G3	S1 S3																						
Triodopsis picea	Spruce Knob three-tooth	G3	S1																						
Vallonia parvula	trumpet vallonia	G4	S1																						
Ventridens coelaxis	bidentate dome	G3	S2																						
Ventridens decussatus	crossed dome	G2 G3	S1																						
Ventridens lawae	rounded dome	G3 G4	S1 S3																						
Ventridens pilsbryi	yellow dome	G4	S2?																						
Vertigo bollesiana	delicate vertigo	G3	S1 S3																						
Vertigo clappi	cupped vertigo	G1 G2	S1 S2																						
Vertigo oralis	palmetto vertigo	G5	S1 S3																						
Vertigo teskeyae	swamp vertigo	G4	S1 S3																						
Vertigo ventricosa	five-tooth vertigo	G3 G4	S1 S3																						
Vitrinizonites latissimus	glassy grapeskin	G4	S2?																						

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Bivalvia (mussels & clams) Mussels																									
Alasmidonta heterodon	dwarf wedgemussel	G1 G2	S1	LE	LE	16			2	6	7		0/1										0/1		
Alasmidonta marginata	elktoe	G4	S2		SC	21				15	6						0/1							0/5	
Alasmidonta varicosa	brook floater	G3	S1		LE	21				12	9														
Alasmidonta viridis	slippershell mussel	G4 G5	S1		LE	13				9	4														
Cumberlandia monodonta	spectacle case	G2 G3	S1		LE	5					5													0/1	
Cyprogenia stegaria	fanshell	G1	S1	LE	LE	4			1		3													0/2	0/1
Dromus dromas	dromedary pearlymussel	G1	S1	LE	LE	11		1	3	3	4													0/2	
Elliptio crassidens	elephant ear	G5	SX		LE	8				5	3														
Elliptio lanceolata	yellow lance	G2 G3	S2 S3		SC	110	9	18	26	9	46	0/14	0/1						0/2				0/2		
Elliptio roanokensis	Roanoke slabshell	G2 G3	S1		SC	3		1	1		1		1/1												
Epioblasma brevidens	Cumberland combshell	G1	S1	LE	LE	12			2	2	8													0/4	0/1
Epioblasma capsaeformis	oyster mussel	G1	S1	LE	LE	15			3	7	5													0/2	0/1
Epioblasma florentina walkeri	tan riffleshell	G1 T1	S1	LE	LE	5	1		1	3															
Epioblasma torulosa gubernaculum	green-blossom pearlymussel	G2 TX	SX	LE	LE	4				4															
Epioblasma triquetra	snuffbox	G3	S1		LE	3					3													0/2	0/1
Fusconaia barnesiana	Tennessee pigtoe	G2 G3	S2 S3		SC	148	5	17	20	35	71	0/1					0/2							0/5	
Fusconaia cor	shiny pigtoe	G1	S1	LE	LE	28		1	6	13	8								0/1					0/4	0/1
Fusconaia cuneolus	fine-rayed pigtoe	G1	S1	LE	LE	13			1	8	4													0/3	0/1
Fusconaia masoni	Atlantic pigtoe	G2	S2		LT	40		6	7	3	19	0/4	1/2										0/1		
Hemistena lata	cracking pearlymussel	G1	S1	LE	LE	6				4	2													0/1	
Lampsilis abrupta	pink mucket	G2	SX	LE	LE																				
Lampsilis cariosa	yellow lampmussel	G3 G4	S2		SC	29	1	2	4	3	19														
Lampsilis radiata	eastern lampmussel	G5	S2		SC	16		2	1	1	12														
Lasmigona holstonia	Tennessee heelsplitter	G3	S1		LE	32				22	9	0/1													
Lasmigona subviridis	green floater	G3	S2		SC	73	1	6	9	26	23	1/1	0/1				0/2								

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Lemiox rimosus	birdwing pearlymussel	G1	S1	LE	LE	15			2	10	3													0/3	0/1
Leptodea fragilis	fragile papershell	G5	S2		LT	31		1	14	12	4													0/4	0/1
Lexingtonia dolabelloides	slabside pearlymussel	G2	S2	C	LT	28		1	3	7	17													0/4	0/1
Lexingtonia subplana	Virginia pigtoe	G1Q	S1			9				9															
Ligumia recta	black sandshell	G5	S2		LT	29		1	14	4	10													0/4	0/1
Pegias fabula	little-winged pearlymussel	G1	S1	LE	LE	18			2	15	1														
Plethobasus cyphyus	sheepnose	G3	S1		LT	20	1	1	4	4	10						0/1							0/2	0/2
Pleurobema collina	James spinymussel	G1	S1	LE	LE	47	4	8	18	5	12	1/9													
Pleurobema cordatum	Ohio pigtoe	G3	SX		LE	3				3															
Pleurobema oviforme	Tennessee clubshell	G3	S2 S3			124	1	27	30	21	45				0/1		0/1							0/2	
Pleurobema plenum	rough pigtoe	G1	SH	LE	LE	1				1															
Pleurobema rubrum	pyramid pigtoe	G2	S1		LE	2					2													0/1	
Ptychobranchus subtentum	fluted kidneyshell	G2 G3	S2	C		13			4	2	7													0/2	
Quadrula cylindrica strigillata	rough rabbits foot	G3 T2	S2	LE	LE	16		1	3	2	9													0/3	0/1
Quadrula intermedia	Cumberland monkeyface	G1	S1	LE	LE	14			5	4	5													0/2	
Quadrula pustulosa	pimple back	G5	S2		LT	10			1	2	7													0/2	
Quadrula sparsa	Appalachian monkeyface	G1	S1	LE	LE	8			2	2	4													0/3	0/1
Toxolasma lividus	purple liliput	G2	S1		LE	3				1	2														
Truncilla truncata	deertoe	G5	SH		LE	17		3	3	7	4													0/3	0/1
Villosa fabalis	rayed bean	G1 G2	SX																						
Villosa perpurpurea	purple bean	G1	S1	LE	LE	10			2	5	3													0/2	
Villosa trabalis	Cumberland bean	G1	SX	LE	LE	5				5															
Clams																									
Pisidium equilaterale	round peaclam	G5	S2																						
Annelida (segmented worms)																									
Spelaedrilus multiporus	a cave lumbriculid worm	G1 G2	S1			1				1															
Stylodrilus beattiei	a cave lumbriculid worm	G2 G3	S1			1				1															

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Arachnida (spiders, pseudoscorpions & relatives) Spiders																									
Agelenopsis kastoni	a funnel-web spider	G4?	S4			2					2		1/1				0/1								
Amaurobius borealis	an amaurobiid spider	G4	S1 S3																						
Anahita punctulata	southeastern wandering spider	G4	S1 S3			1					1	0/1					0/1								
Anthrobia mammouthia	a cave spider	G3 G4	S1			4				4															
Antrodiaetus robustus	robust trapdoor spider	G3?	S2																						
Barronopsis jeffersi	a funnel-web spider	G3	S1 S3			1					1						1/1								
Bathyphantes weyeri	a cave spider	G3 G4	S1			1				1															
Castianeira trilineata	a two-clawed hunting spider	G4?	S1 S3			1					1						1/1								
Clubiona spiralis	a two-clawed hunting spider	G4	S1 S3																						
Drassylus louisianus	a gnaphosid spider	G4?	S1 S3			1					1						1/1								
Hypochilus pococki	Pocock's lampshade-web spider	G4 G5	S2																						
Hypochilus thorelli	Thorell's lampshade-web spider	G4	S1																						
Islandiana muma	a cave spider	G2 G3	S1			1				1															
Nesticus holsingeri	Holsinger's cave spider	G2 G3	S1 S2			11				10	1														
Nesticus mimus	a cave spider	G2	S1			4				2	2														
Nesticus paynei	a cave spider	G2 G3	S1			1				1															
Nesticus tennesseensis	a cave spider	G2 G4	S2			15		2		13															
Pisaurina dubia	a nursery-web spider	G4	S1 S3			1					1						1/1								
Xysticus emertoni	Emerton's crab spider	G5	S1 S3																						
Mites																									
Foveacheles paralleloseta	a cave mite	G1	S1			1				1															
Poecilophysis extraneostella	a cave mite	G2?	S1			1				1															
Poecilophysis weyerensis	a cave mite	G3?	S1			2				2															
Rhagidia varia	a cave mite	G3	S2?			3				3															

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Pseudoscorpions																									
Apochthonius coecus	a cave pseudoscorpion	G1	S1			2				2															
Apochthonius holsingeri	a cave pseudoscorpion	G1 G2	S1			2				2															
Chitrella sp. *1*	a cave pseudoscorpion	G1	S1			1					1														
Chitrella superba	a cave pseudoscorpion	G1	S1			1				1															
Kleptochthonius anophthalmus	a cave pseudoscorpion	G1	S1			1				1															
Kleptochthonius binoculatus	a cave pseudoscorpion	G1	S1			1				1															
Kleptochthonius gertschi	Gertsch's cave pseudoscorpion	G1	S1			1				1															
Kleptochthonius lutzi	Lutz's cave pseudoscorpion	G1	S1			1				1															
Kleptochthonius polychaetus	Shaenadoah pseudoscorpion	G1 G3	S1 S3																						
Kleptochthonius proximosetus	a cave pseudoscorpion	G1	S1			1				1															
Kleptochthonius regulus	a cave pseudoscorpion	G1	S1			1		1																	
Kleptochthonius similis	a cave pseudoscorpion	G1	S1			1				1															
Kleptochthonius sp. *1*	a cave pseudoscorpion	G1	S1			2		1			1						0/ 1								
Microcreagris valentinei	Valentine's cave pseudoscorpion	G1 G3	S1			1				1															
Mundochthonius holsingeri	a cave pseudoscorpion	G1	S1			1	1																		
Scorpions																									
Vaejovis carolinianus	Carolina scorpion	G5	S1			1					1														
Crustacea (amphipods, isopods & decapods) Amiphipods																									
Bactrurus angulus	Cumberland Gap cave amphipod	G1	S1			1		1																	
Crangonyx gracilis	an amphipod	G4	S1 S3																						
Crangonyx sp. *3*	Bland County amphipod	G1?	S1																						
Crangonyx sp. *5*		G1?	S1?																						
Stygobromus abditus	James cave amphipod	G2	S2			7		1	2		4		1/1												
Stygobromus baroodyi	Rockbridge County cave amphipod	G2	S1 S2			7	1	1		2	3														
Stygobromus biggersi	Bigger's cave amphipod	G2 G4	S1 S2			3	1			1	1														

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Stygobromus conradi	Burnsville Cove cave amphipod	G1 G3	S1 S2			7			3		4								0/2						
Stygobromus cumberlandus	Cumberland cave amphipod	G2 G3	S1 S2			5		1		3	1						0/1								
Stygobromus ephemerus	ephemeral cave amphipod	G1	S1		SC	3		1		1	1														
Stygobromus estesi	Craig County cave amphipod	G1 G2	S1 S2			6		1		1	4	1/2													
Stygobromus fergusoni	Montgomery County cave amphipod	G1 G2	S1			3				2	1														
Stygobromus finleyi	Finley's cave amphipod	G1 G3	S1			3					3						0/1								
Stygobromus gracilipes	Shenandoah Valley cave amphipod	G2 G4	S2 S3		SC	10				6	4	1/1													
Stygobromus hoffmani	Alleghany County cave amphipod	G1	S1			2				1	1	1/1													
Stygobromus interitus	New Castle murder hole amphipod	G1	S1			1				1															
Stygobromus kenki	Rock Creek groundwater amphipod	G1 G3	SH			1				1															
Stygobromus leensis	Lee County cave amphipod	G1	S1			4		1	2		1														
Stygobromus morrisoni	Morrison's cave amphipod	G2 G3	S1 S2		SC	5				1	4														
Stygobromus mundus	Bath County cave amphipod	G2 G3	S1 S2		SC	4				2	2														
Stygobromus obrutus	Pittsylvania well amphipod	G1	SH			1				1															
Stygobromus phreaticus	Northern Virginia well amphipod	G1	S1			3	1			2			1/1												
Stygobromus pizzinii	Pizzini's amphipod	G2 G4	S1 S2		SC	5		2		3					1/2										0/1
Stygobromus pseudospinosus	Luray Caverns amphipod	G1	S1			1		1																	
Stygobromus sp. *10*	a cave amphipod (Botetourt Co.)	G1	S1																						
Stygobromus sp. *11*	a cave amphipod (Nelson Co.)	G1	S1																						
Stygobromus sp. *12*	a cave amphipod (Rockbridge Co.)	G1	S1																						
Stygobromus sp. *15*	a groundwater amphipod	G1	S1			2	1		1						1/2										0/1
Stygobromus sp. *16*	Helsley's cave amphipod	G1	S1																						
Stygobromus sp. *17*	Massanutten spring amphipod	G2	S2																						
Stygobromus sp. *18*	Big Levels spring amphipod	G1?	S1?																						
Stygobromus sp. *19*	a cave amphipod (Scott Co.)	G1	S1																						

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Stygobromus sp. *20*	a cave amphipod (Bath and Highland Cos.)	G1	S1																						
Stygobromus sp. *21*	Rappahannock spring amphipod	G1 G2	S1 S2			2	1				1								1/1					1/1	
Stygobromus sp. *23*	Shenandoah Mountain spring amphipod	G1?	S1?																						
Stygobromus sp. *7*	Sherando spinosoid amphipod	G2	S2			3		2			1	1/3			0/2										
Stygobromus sp. *8*	a groundwater amphipod	G2 G3	S2 S3			2					2	1/2													
Stygobromus sp. *9*	a cave amphipod (shenandoah county)	G1	S1			3					3														
Stygobromus stegerorum	Madison cave amphipod	G1	S1		LT	2	1	1																	
Isopods																									
Amerigoniscus henroti	Powell Valley terrestrial cave isopod	G1 G2	S1 S2			9	1	1		6	1														
Antrolana lira	Madison cave isopod	G2	S2	LT	LT	8	2				6														
Caecidotea attenuatus	Dismal Swamp isopod	G1?	S1?																						
Caecidotea bowmani	Natural Bridge cave isopod	G1	S1			1				1															
Caecidotea cumberlandensis	Cumberland cave isopod	G1	S1			1					1				1/1										
Caecidotea henroti	Henrot's cave isopod	G2 G3	S1 S2			3				3															
Caecidotea holsingeri	Greenbriar Valley cave isopod	G3	S1			5				1	4								0/1						
Caecidotea incurva	incurved cave isopod	G2 G3	S1 S2			4				2	2	1/1													
Caecidotea phreatica	phreatic isopod	G1 G2	S1			3					3														
Caecidotea pricei	Price's cave isopod	G3 G4	S2 S3			19		1	1	12	5													1/1	
Caecidotea richardsonae	Tennessee Valley cave isopod	G3 G5	S2			15	1	1		11	2														
Caecidotea vandeli	Vandel's cave isopod	G2 G3	S1 S2			9				6	3														
Ligidium elrodii leensis	Lee County terrestrial cave isopod	G4G 5T1 T2	S1 S2																						
Lirceus culveri	Rye Cove isopod	G1	S1		SC	1	1																		
Lirceus usdagalun	Lee County cave isopod	G1	S1	LE	LE	6	2	2	1	1															
Miktoniscus racovitzai	Racovitza's terrestrial cave isopod	G3 G4	S2			6		1		4	1														

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Decapods																									
Cambarus buntingi	Bunting's crayfish	G4	S2																						
Cambarus jezerinaci	Powell River crayfish	G1 G2	S1 S2			4					4														
Cambarus monongalensis	a crayfish	G5	S1?																						
Cambarus parvoculus	a crayfish	G4	S2?																						
Cambarus sciotensis	Scioto crayfish	G5	S2 S3																						
Cambarus veteranus	a crayfish	G3 G4	S1 S2																						
Macrobrachium ohione	Ohio River shrimp	G4	S1			1				1															
Orconectes virginiensis	Chowanoke River crayfish	G3	S2 S3			6				3	3		0/2												
Diplopoda (millipedes)																									
Abacion tesselatum	a millipede	G5	S2																						
Aniulus orientalis	a millipede	G2	S1																						
Aniulus sp. *1*	a millipede (Elm Hill)	G?	S1																						
Auturus erythropygos	a millipede	G3	S1			1					1														
Boraria infesta	a millipede	G4	S2																						
Brachoria cedra	cedar millipede	G1 G2	S1			2	1		1								0/1							0/1	
Brachoria dentata	a millipede	G1	S1			1					1	0/1													
Brachoria ethotela	Hungry Mother millipede	G3	S3			1				1															
Brachoria falcifera	Big Cedar Creek millipede	G1	S1			1					1						1/1								
Brachoria hoffmani	Hoffman's xystodesmid millipede	G2	S2			1					1	0/1					0/1								
Brachoria insolita	a millipede	G1	S1																						
Brachoria laminata	Keeton's millipede	G1	S1																						
Brachoria mendota	Collinwood millipede	G1	S1																						
Brachoria separanda hamata	a millipede	G2 T?	S2			4	1			1															
Brachoria sp. *1*	Powell Mountain millipede sp. a	G1?	S1?			1					1														
Brachoria sp. *2*	Powell Mountain millipede sp. b	G1?	S1?			1					1														
Brachoria turneri	Turner's millipede	G1	S1																						
Buotus carolinus	a millipede	G1	S1			1					1	0/1													
Chaetaspis albus	a millipede	G4	S2																						

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Cherokia georgiana latassa	a millipede	G4 T?	S1			1				1															
Cleidogona fidelitor	faithful millipede	G1	S1																						
Cleidogona hoffmani	Hoffman's cleidogonid millipede	G2	S2			2				2															
Cleidogona lachesis	a millipede	G2	S1			1				1															
Cleidogona medialis	Blowing Rock millipede	G1	S1																						
Conotyla aeto	aeto millipede	G1	S1																						
Conotyla celeno	celeno millipede	G1	S1																						
Conotyla melinda	Melinda millipede	G2	S2																						
Conotyla sp. *1*	a millipede (burkes garden)	G1	S1																						
Conotyla venetia	venetia millipede	G2	S2			1				1															
Desmonus earlei	a millipede	G5	S1			1				1															
Dixioria brooksi	Brooks millipede	G1	S1																						
Dixioria coronata	a millipede	G2	S2			1				1															
Dixioria fowleri	a millipede	G2	S2			1				1															
Euryurus leachi fraternus	a millipede	G4 T?	S1																						
Gyalostethus monticolens	a millipede	G4	S2																						
Nannaria conservata	Duke Forest xystodesmid	G1	S1																						
Nannaria ericacea	McGraw Gap xystodesmid	G2	S2			1				1															
Nannaria laminata	Smith Creek xystodesmid	G1	S1																						
Nannaria shenandoah	Shenandoah Mt xystodesmid	G1	S1			1				1															
Nannaria simplex	a millipede	G1	S1																						
Nannaria sp. *1*	Roaring Branch nannaria millipede	G1?	S1?			1					1	0/1													
Okeanobates americanus	a millipede	G4	S1			1				1															
Onomeris underwoodi	a millipede	G5	S1																						
Orinisobates nigrior	a millipede	G4	S1																						
Polyzonium rosalbum	a millipede	G5	S2																						
Polyzonium strictum	a millipede	G5	S1																						
Pseudopolydesmus paludicolous	a millipede	G3?	S2			2				2															
Pseudotremia alecto	a millipede	G1	S1			2					2	1/1													
Pseudotremia armesi	a millipede	G2	S2			1		1																	

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Pseudotremia cavernarum	Ellett Valley pseudotremia millipede	G2 G4	S1		LT	5	1			1	3														
Pseudotremia momus	a millipede	G2	S2			2				2															
Pseudotremia princeps	South Branch Valley cave millipede	G1	S1			1				1															
Pseudotremia sp. *2*	Roaring Branch pseudotremia millipede	G1?	S1?			1					1	0/1													
Pseudotremia sp. *3*	a cave millipede	G1	S1																						
Pseudotremia sublevis	a millipede	G1	S1			4		1		3															
Pseudotremia tuberculata	a millipede	G2	S1 S2			5		1		4															
Rudiloria trimaculata tortua	a millipede	G5 T2	S2			1				1															
Semionellus placidus	a millipede	G3	S2			6	1		1	3	1				3/3										
Sigmoria whiteheadi	Laurel Creek xystodesmid millipede	G1	S1		LT	1					1				0/1										
Striaria causeyae	a millipede	G1	S1																						
Striaria columbiana	a millipede	G2	S2			1				1															
Striaria granulosa	a millipede	G2	S1																						
Striaria sp. *1*	a millipede	G1	S1			1				1															
Thalassisobates littoralis	a millipede	G5	S1																						
Trichomeris sinuata	a millipede	G5	S1																						
Trichopetalum dux	a millipede	G1	S1																						
Trichopetalum lunatum	a millipede	G5	S2																						
Trichopetalum packardi	Packard's blind cave millipede	G4	S2			16				16															
Trichopetalum weyeriensis	Grand Caverns blind cave millipede	G3	S2			7				6	1	1/1													
Trichopetalum whitei	Luray Caverns blind cave millipede	G3 G4	S2			9				9															
Uroblaniulus canadensis	a millipede	G5	S2																						
Uroblaniulus jerseyi	a millipede	G3	S2																						
Uroblaniulus sp. *1*	a millipede (Burkes Garden)	G?	S1																						
Virgoiulus minutus	a millipede	G5	S2																						
Chilopoda (centipedes)																									

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Escaryus cryptorobius	montane centipede	G2	S2			3					3	0/2					0/1								
Escaryus orestes	Whitetop Mountain centipede	G1 G2	S1 S2			1					1	0/1													
Nampabius turbator	a cave centipede	G1 G2	S1			2				2															
Collembola (springtails)																									
Arrhopalites caedus	a cave springtail	G1 G2	S1			2					2	1/1													
Arrhopalites carolynae	a cave springtail	G2 G3	S1			7					7	1/1							0/1						
Arrhopalites clarus	a cave springtail	G2 G4	S1			2				2															
Arrhopalites commorus	a cave springtail	G1 G2	S1			4					4														
Arrhopalites lacuna	a cave springtail	G1 G2	S1 S2			1					1														
Arrhopalites marshalli	a cave springtail	G3	S2			2					2														
Arrhopalites pavo	a cave springtail	G1 G2	S1			2					2														
Arrhopalites sacer	a cave springtail	G1 G2	S1			2					2	1/1													
Arrhopalites silvus	a cave springtail	G1 G2	S1			2					2														
Oncopodura hubbardi	a cave springtail	G1	S1			3					3														
Pseudosinella bona	a cave springtail	G1 G2	S1 S2			2				1	1														
Pseudosinella erehwon	a cave springtail	G1	S1			1					1														
Pseudosinella extra	a cave springtail	G1	S1			2					2														
Pseudosinella gisini virginia	a cave springtail	G3 G4 T1	S1			1					1														
Pseudosinella granda	a cave springtail	G3	S2			1					1														
Pseudosinella hirsuta	a cave springtail	G2 G4	S1			3				3															
Schaefferia hubbardi	a cave springtail	G3	S2			1					1														
Typhlogastrura valentini	a cave springtail	G1	S1			2					2														
Diplura (diplurans)																									
Litocampa cookei	Cooke's cave dipluran	G4 G5	S2			8				7	1														
Litocampa sp. *1*	a cave dipluran (Salamander Cave)	G1	S1			1					1														
Litocampa sp. *2*	a cave dipluran	G1	S1			4	1	1		2															
Litocampa sp. *3*	a cave dipluran	G2	S2			7				7															

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Litocampa sp. *4*	a cave dipluran	G2	S1 S2			3				3															
Ephemeroptera (mayflies)																									
Ameletus cryptostimulus	Allegheny mayfly	G4	S1 S3																						
Ameletus tarteri	Tarter's ameletus mayfly	G1	S1																						
Baetisca rubescens	a mayfly	G2	S1																						
Barbaetis benfieldi	Benfield's bearded small minnow mayfly	G2	S1			1				1															
Ephemerella berneri	Berner's ephemerella mayfly	G3	S1 S3																						
Ephemerella inconstans	a mayfly	G3	S1 S3																						
Habrophlebiodes celeteria	a mayfly	G2	S1?																						
Isonychia arida	a mayfly	G5	S1 S3																						
Isonychia georgiae	Georgia isonychia mayfly	G3	S1 S3																						
Isonychia hoffmani	Hoffman's isonychia mayfly	G1	S1																						
Isonychia serrata	a mayfly	G4	S1 S3																						
Isonychia tusculanensis	a mayfly	G3	S2																						
Leptophlebia johnsoni	Johnson's pronggill mayfly	G4	S1			1					1	1/1													
Paraleptophlebia assimilis	a mayfly	G3	S1 S3																						
Paraleptophlebia jeanae	a mayfly	G3	S1 S3																						
Pseudiron centralis	a mayfly	G5	S1																						
Rhithrogena anomala	a mayfly	G2	S1?																						
Siphloplecton costalense	Spieth's great speckled olive mayfly	G2	SH			2				2															
Odonata (damselflies & dragonflies) Damselflies																									
Calopteryx aequabilis	river jewelwing	G5	S2?																						
Calopteryx amata	superb jewelwing	G4	S1			3		1		1	1	1/1													
Calopteryx angustipennis	Appalachian jewelwing	G4	S2			8		3		1	4	1/1					0/1		0/1						
Enallagma cyathigerum	northern bluet	G5	S1			1			1			1/1													
Enallagma dubium	burgundy bluet	G5	S2			4		1		1	2		3/3												

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Enallagma ebrium	marsh bluet	G5	S1																						
Enallagma hageni	Hagen's bluet	G5	S2			7	1	1	1	3	1	3/4													
Enallagma pallidum	pale bluet	G4	S1			3		1		1	1			1/1									0/1		
Enallagma weewa	blackwater bluet	G5	S2			2			1		1		0/1												
Lestes disjunctus disjunctus	northern common spreadwing	G5 T5	S1 S2			6	2			2	2	2/2			1/1									1/1	
Lestes dryas	emerald spreadwing	G5	S1																						
Lestes vidua	Carolina spreadwing	G5	SH																						
Nehalennia gracilis	sphagnum sprite	G5	S2			3	1				2		2/2												
Nehalennia integricollis	southern sprite	G5	S2			6		2		1	3		4/5												
Nehalennia irene	sedge sprite	G5	S1			2		1			1	1/1			1/1										
Telebasis byersi	duckweed firetail	G5	S3			2		1			1						1/1						1/1		
Dragonflies																									
Aeshna canadensis	Canada darner	G5	S1			1			1																
Aeshna constricta	lance-tipped darner	G5	S1			2				2															
Aeshna mutata	spatterdock darner	G3 G4	S2			5	1	1	3			1/1													
Aeshna tuberculifera	black-tipped darner	G4	S2 S3			12		3	5	1	3	3/3	1/1						1/1					1/1	
Aeshna verticalis	green-striped darner	G5	S1			1			1			1/1													
Aphylla williamsoni	two-striped forceptail	G5	S1			1				1															
Arigomphus furcifer	lilypad clubtail	G5	SH			2				1	1														
Celithemis martha	Martha's pennant	G4	S2			1				1															
Celithemis ornata	faded pennant	G5	SH			1				1															
Cordulegaster diastatops	delta-spotted spiketail	G5	S1			2				1	1														
Cordulia shurtleffii	American emerald	G5	S2			8	1	2	3	1	1	1/2							1/1						
Coryphaeschna ingens	regal darner	G5	S1			1				1															
Dythemis velox	swift setwing	G5	S2 S4			1					1		1/1												
Epitheca canis	beaverpond baskettail	G5	S1			2			1		1	1/1													
Epitheca costalis	stripe-winged baskettail	G4	S2			4			1	3				1/1											
Epitheca semiaquea	mantled baskettail	G4	S1			1				1															
Epitheca spinosa	robust baskettail	G4	S2			5	1	1		1	2						0/1					0/1			1/1
Gomphus abbreviatus	spine-crowned clubtail	G3 G4	S2 S3			9			2	6	1														

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Gomphus adelphus	moustached clubtail	G4	S1			11				2	9						0/3								
Gomphus apomyius	banner clubtail	G4	S1			1				1															
Gomphus borealis	beaverpond clubtail	G4	S1			1			1																
Gomphus consanguis	Cherokee clubtail	G2 G3	S2			9	1	2	6																
Gomphus descriptus	harpoon clubtail	G4	S1			2				1	1								0/1						
Gomphus fraternus	midland clubtail	G5	S1			3				3															
Gomphus parvidens	Piedmont clubtail	G4	S1			2		2																	
Gomphus quadricolor	rapids clubtail	G3 G4	S1			5				2	3														
Gomphus septima	Septima's clubtail	G2	SR			1				1															
Gomphus ventricosus	skillet clubtail	G3	S1			3				2	1								0/1						
Gomphus viridifrons	green-faced clubtail	G3	S2			10		3	3	2	2	0/2													
Helocordulia selysii	Selys' sundragon	G4	S2			9				7	2														1/1
Ladona exusta	white corporal skimmer	G4	S1			1				1															
Ladona julia	chalk-fronted corporal skimmer	G5	S1			1		1				1/1													
Lanthus parvulus	northern pygmy clubtail	G4	S2			7		4	2		1	1/2			1/1				1/1						
Leucorrhinia frigida	frosted whiteface	G5	SH			2			1		1														
Leucorrhinia hudsonica	hudsonian whiteface	G5	S1			1		1																	
Leucorrhinia intacta	dot-tailed whiteface	G5	S2 S3			8		1		5	1	2/2													
Leucorrhinia proxima	red-waisted whiteface	G5	SH			1				1															
Macromia alleghaniensis	Allegheny river cruiser	G4	S2																						
Macromia margarita	mountain river cruiser	G3	S1			1		1																	
Nannothemis bella	elfin skimmer	G4	S1			3			2	1			2/2												
Neurocordulia virginiensis	cinnamon shadowdragon	G4	S1			1				1															
Neurocordulia yamaskanensis	stygian shadowdragon	G5	S2			7				6	1	0/1													
Ophiogomphus alleghaniensis	Allegheny snaketail	G3Q	S1			2			1		1														
Ophiogomphus aspersus	brook snaketail	G3 G4	S1			3				2	1														
Ophiogomphus carolus	riffle snaketail	G5	S1			2				2															
Ophiogomphus howei	pygmy snaketail	G3	S1 S2			5	1	1		2	1														
Ophiogomphus incurvatus	Appalachian snaketail	G3	S1			2		1	1																

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Ophiogomphus mainensis	maine snaketail	G4	S1			2				2															
Somatochlora elongata	ski-tailed emerald	G5	S1 S2			5	1	2	1	1		2/3													
Somatochlora filosa	fine-lined emerald	G5	S2			8		1	2	4	1						2/2								
Somatochlora georgiana	coppery emerald	G3 G4	S1			1		1																	
Somatochlora provocans	treetop emerald	G4	S2			3			1	1	1														
Somatochlora williamsoni	Williamson's emerald	G5	SH			1			1																
Stylurus amnicola	riverine clubtail	G4	S1			2				2															
Stylurus laurae	Laura's clubtail	G4	S2			9			1	7	1														
Stylurus notatus	elusive clubtail	G3	S1			1			1																
Stylurus scudderi	zebra clubtail	G4	S1 S2			2				1	1														
Sympetrum corruptum	variegated meadowhawk	G5	S1			1				1															
Sympetrum janeae	Jane's meadowhawk	G5	SH			1				1															
Sympetrum obtrusum	white-faced meadowhawk	G5	S1			5		2	1	2		2/2													
Orthoptera (grasshoppers, katydids, crickets & relatives)																									
Appalachia hebardi		GH	SH																						
Melanoplus pachycercus		G2 G3	S1 S3																						
Melanoplus sp. *55*		G1 G2	S1 S2																						
Melanoplus sp. *59*		G1 G2	S1 S2																						
Scudderia septentrionalis	northern bush katydid	G3?	S1 S3																						
Plecoptera (stoneflies)																									
Acroneuria flinti	Manassas stonefly	GH	SH			1				1															
Acroneuria kosztarabi	Virginia stonefly	G1	S1			1					1														
Allocapnia fumosa	Smokies snowfly	G2	S1 S2																						
Allocapnia illinoensis	Illinois snowfly	G3	S1 S3																						
Allocapnia simmonsi	spatulate snowfly	G2	S1 S2			1					1														
Allocapnia stannardi	Blue Ridge snowfly	G3	S1 S3																						
Alloperla banksi	tufted sallfly	G4	S1 S3																						

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Alloperla biserrata	dusky sallfly	G3	S2 S3																						
Alloperla idei	vernal sallfly	G3	S1 S3																						
Alloperla nanina	Swannanoa sallfly	G4	S1 S3																						
Alloperla neglecta	Tennessee sallfly	G3	S1 S2																						
Bolotoperla rossi	smoky willowfly	G4	S1 S3																						
Cultus decisus isolatus	southern springfly	G4 T2	S1 S2																						
Diploperla kanawholensis	kanawhole springfly	G3	S1 S3			1																			
Diploperla morgani	Virginia springfly	G2	S2																						
Hansonoperla appalachia	Appalachian stonefly	G3	S1 S3																						
Isogenoides varians	Rock Island springfly	G3	S1 S3																						
Isoperla major	big stripetail stonefly	G1	S1			1					1														
Leuctra mitchellensis	Mitchell needlefly	G3	S1 S2																						
Leuctra monticola	montane needlefly	G1Q	S1																						
Megaleuctra flinti	Shenandoah needlefly	G2	S2																						
Megaleuctra williamsae	Smokies needlefly	G2	S2			3																			
Ostrocerca complexa	notched forestfly	G4	S1 S3																						
Ostrocerca prolongata	bent forestfly	G3	S1 S3																						
Paragnetina ichusa	widecollar stonefly	G3	S1 S3																						
Perlesta frisoni	Blue Ridge stonefly	G3	S1 S2																						
Perlesta teaysia	Teays stonefly	G3	S1 S3																						
Prostoia hallasi	swamp forestfly	G3	S1 S3			2					2			0/1											
Pteronarcys comstocki	spiny salmonfly	G3	S1 S3																						
Pteronarcys scotti	Carolina salmonfly	G4	S1 S3																						
Remenus kirchneri	Blue Ridge springfly	G2	S2																						
Strophopteryx limata	newfound willowfly	G3	S1 S2																						
Sweltsa holstonensis	Holston sallfly	G1	S1																						
Sweltsa voshelli	Virginia sallfly	G3	S2			2					2				0/1										

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Taeniopteryx nelsoni	cryptic willowfly	G1	S1			1				1															
Tallaperla cornelia	southeastern roachfly	G4	S1 S3																						
Tallaperla lobata	lobed roachfly	G2	S1 S2			1				1															
Yugus arinus	highlands springfly	G3	S1 S3																						
Heteroptera (true bugs)																									
Acantholomidea denticulata	a shield bug	G?	SH																						
Allopodops mississippiensis	Mississippi turtle bug	G2 G3	SH																						
Bothynotus johnstoni	a mirid bug	G3	S1 S3			1					1						1/ 1								
Botocudo modestus	a seed bug	G5	S1 S3																						
Chelinidea vittiger	opuntia squash bug	G3 G5	SR																						
Chlorochroa dismalia	Dismal Swamp green stink bug	GU	S1 S3			1				1															
Ctenotrachelus shermani	combneck assassin bug	G3	S1 S3			1					1						1/ 1								
Elasmostethus atricornis	Hercules club stink bug	G3?	S1 S3																						
Eurygaster alternata	a shield bug	G5	SH																						
Galgupha denudata	a shield bug	G3	S1 S3																						
Isthmocorius piceus	black stalk-eyed bug	G5	S1 S2																						
Limnoporus dissortis	a water strider	G5	S1																						
Melanaethus cavicollis	a burrower bug	G4	S1 S3			1					1						1/ 1								
Oncozygia clavicornis	a turtle	G3	SH																						
Ploiaria carolina	Carolina thread-legged bug	G4?	S1 S3			1					1						1/ 1								
Ploiaria hirticornis	an assassin bug	G3?	S1 S3			2		1			1		1/1				1/ 1								
Pnirontis brimleyi	an assassin bug	G2	S1 S3			1					1						1/ 1								
Pycnoderiella virginiana	seashore mirid bug	GU	SU			1	1																		
Ramphocorixa acuminata	acuminate water boatman	G4	S1																						
Ranatra drakei	Drake's water scorpion	G4	S1 S3																						
Sigara depressa	Virginia Piedmont water boatman	G1 G3	S1 S3			4		1		3															

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Stachyocnemus apicalis	sandpit alydid bug	G4	SH																						
Stenocoris tipuloides	neotropical rice bug	G5	S1 S3			1					1														
Homoptera (cicadas, leafhoppers & relatives)																									
Puto kosztarabi	Buffalo Mountain mealybug	G1	S1			1	1										1/1								
Coleoptera (beetles																									
Arianops jeanneli	a cave pselaphid beetle	G1	S1			1				1															
Atheta annexa	a rove beetle	G2 G4	S2			5				5															
Atheta troglophila	a rove beetle	G1	S1			3				3															
Calligrapha pnirsa	a leaf beetle	G3?	S1 S3																						
Cicindela abdominalis	orange-bellied tiger beetle	G5	S1			1				1															
Cicindela ancocisconensis	a tiger beetle	G3	S2			6				2	4	1/2							1/1						
Cicindela dorsalis dorsalis	northeastern beach tiger beetle	G4 T2	S2	LT		123	6	20	29		67			0/2			1/13		0/1				0/5	0/2	0/4
Cicindela formosa generosa	a tiger beetle	G5 T5	SH			4				4															
Cicindela gratiosa	a tiger beetle	G5	S1																						
Cicindela lepida	spectral tiger beetle	G4	S1			1					1			1/1											
Cicindela limbalis	a tiger beetle	G5	SH			1				1															
Cicindela patruela	barrens tiger beetle	G3	S2			2	1				1	1/1													
Cicindela trifasciata	a tiger beetle	G5	S1			5			2	1	2		2/2				0/1								
Cyclotrachelus incisus	a ground beetle	G2	S1			1					1	0/1					0/1								
Dryobius sexnotatus	six-banded longhorn beetle	G?	S1 S3			1					1	0/1					0/1								
Hydraena appalachicola	minute moss beetle	G?	SU			1				1															
Hydraena maureenae	Maureen's shale stream beetle	G1 G3	S1 S3			2					2														
Laccophilus schwarzi	Schwarz' diving beetle	G?	S1 S3			2				2															
Lordithon niger	black lordithon rove beetle	GU	SH			4					2														
Nicrophorus americanus	American burying beetle	G2 G3	SH	LE																					
Pentagonica picticornis	a ground beetle	G?	S1 S3																						
Phloeoxena signata	a ground beetle	G3?	S1 S3			1			1																

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Pseudanophthalmus avernus	avernus cave beetle	G1	S1			1					1														
Pseudanophthalmus cordicollis	Little Kennedy Cave beetle	G1	S1			1					1														
Pseudanophthalmus deceptivus	deceptive cave beetle	G1	S1			1					1														
Pseudanophthalmus delicatus	delicate cave beetle	G2	S2			13				13															
Pseudanophthalmus egberti	New River Valley cave beetle	G1	S1			2				1	1														
Pseudanophthalmus gracilis	a cave beetle	G1 G2	S1 S2			4				3	1														
Pseudanophthalmus hirsutus	Cumberland Gap cave beetle	G1	S1			2				1	1				1/1										
Pseudanophthalmus hoffmani	Hoffman's cave beetle	G1 G2	S1 S2			7		1		6															
Pseudanophthalmus holsingeri	Holsinger's cave beetle	G1	S1	C		1			1																
Pseudanophthalmus hortulanus	Burkes Garden cave beetle	G1	S1			1				1															
Pseudanophthalmus hubbardi	Hubbard's cave beetle	G1	S1			1					1														
Pseudanophthalmus hubrichti	Hubricht's cave beetle	G1	S1			1					1														
Pseudanophthalmus intersectus	Crossroads cave beetle	G1	S1			2				1	1														
Pseudanophthalmus limicola	mud-dwelling cave beetle	G1	S1			3				3															
Pseudanophthalmus longiceps	long-headed cave beetle	G1	S1			1				1															
Pseudanophthalmus nelsoni	Nelson's cave beetle	G1	S1			2			1	1															
Pseudanophthalmus parvicollis	thin-neck cave beetle	G1	S1			1				1															
Pseudanophthalmus petrunkevitchi	Petrunkevitch's cave beetle	G1 G2	S1			2				2															
Pseudanophthalmus pontis	Natural Bridge cave beetle	GH	SH			1					1														
Pseudanophthalmus potomaca potomaca	South Branch Valley cave beetle	G2 T2	S2			3					3	2/2													
Pseudanophthalmus praetermissus	overlooked cave beetle	G1	S1			1				1															
Pseudanophthalmus punctatus	spotted cave beetle	G1	S1			5		1		3	1														
Pseudanophthalmus pusio	a cave beetle	G3	S1 S2			9		1		6	2														
Pseudanophthalmus quadratus	Straley's cave beetle	G1	S1			1					1														
Pseudanophthalmus rotundatus	rotund cave beetle	G1 G3	S1			3				3															
Pseudanophthalmus sanctipauli	Saint Paul cave beetle	G1	S1			2				1	1														

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Pseudanophthalmus seclusus	a cave beetle	G1	S1			7				7															
Pseudanophthalmus sericus	silken cave beetle	G1	S1			1					1														
Pseudanophthalmus sp. *10*	a cave beetle	G1	S1			1				1															
Pseudanophthalmus sp. *11*	a cave beetle	G1	S1			1				1															
Pseudanophthalmus sp. *12*	Catawba cave beetle	G1	S1																						
Pseudanophthalmus sp. *13*	McMullan cave beetle	G1	S1																						
Pseudanophthalmus sp. *14*	Karl's Pit cave beetle	G1	S1																						
Pseudanophthalmus sp. *4*	a cave beetle	G1	S1			1				1															
Pseudanophthalmus sp. *5*	a cave beetle	G1	S1			1				1															
Pseudanophthalmus sp. *6*	a cave beetle	G1	S1			3				3															
Pseudanophthalmus sp. *7*	a cave beetle	G1	S1			1				1															
Pseudanophthalmus sp. *8*	a cave beetle	G1	S1			2				2															
Pseudanophthalmus sp. *9*	a cave beetle	G1	S1			1				1															
Pseudanophthalmus thomasi	Thomas' cave beetle	G1	S1			2				1	1														
Pseudanophthalmus vicarius	vicariant cave beetle	G1 G2	S1 S2			6	1		1	2	2														
Pseudanophthalmus virginicus	Maiden Spring cave beetle	GH	SH			1					1														
Pseudaptinus lecontei	a ground beetle	G?	S1 S3			1					1						1/ 1								
Rybaxis sp. *1*	a pselaphid beetle	GU	SU			1					1														
Sosylus costatus	a beetle	G?	S1 S3																						
Sphaeroderus schaumi	Schaum's ground beetle	G4	S2			1					1				1/1										
Stenelmis gammoni	Gammon's riffle beetle	G1 G3	S1																						
Stenocorus schaumi	Schaum's longhorn beetle	G?	S1 S3																						
Thalpius pygmaeus	a ground beetle	G?	S1																						
Mecoptera (scorpionflies)																									
Boreus nivoriundus	a snow scorpionfly	G4	S1 S2																						
Brachypanorpa jeffersoni	Jefferson's short-nosed scorpionfly	G2	S1 S2			3				2	1	1/1													
Trichoptera (caddisflies)																									

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Anabolia apora	a limnephilid caddisfly	G1 G3	S1 S3																						
Nemotaulius hostilis	a limnephilid caddisfly	G5	S1			1		1																	
Rhyacophila appalachia	appalachian rhyacophilid caddisfly	G3?	S1 S3																						
Rhyacophila tricornuta	a rhyacophilid caddisfly	G1 G3	S1 S3																						
Wormaldia thyria	a philopotamid caddisfly	G3?	S1 S3																						
Lepidoptera (butterflies, skippers, moths) Butterflies																									
Anaea andria	goatweed butterfly	G5	S1			1					1						1/ 1								
Boloria selene	silver-bordered fritillary	G5	S2			10		3		6	1	2/2													
Calephelis borealis	northern metalmark	G3 G4	S2 S3			1					1	0/1													
Calephelis virginiensis	little metalmark	G4	SH			6				6															
Callophrys hesseli	Hessel's hairstreak	G3 G4	S1																						
Callophrys irus	frosted elfin	G3	S2			15				14	1														
Callophrys polios	hoary elfin	G5	S1 S3			2				2															
Colias interior	pink-edged sulphur	G5	S1 S2			1		1				1/1													
Euchloe olympia	Olympia marble	G4 G5	S2 S3			5			1	2	2	2/2					0/ 1								
Lycaena hyllus	bronze copper	G5	S1																						
Neonympha areolata areolata	Georgia satyr	G4T 3T4	S2 S3			6		2	1	3															
Neonympha mitchellii francisci	Saint Francis' satyr	G1 G2 T1	S1	LE																					
Phyciodes batesii batesii	tawny crescentspot	G4 T1	SH			5				5															
Phyciodes cocyta	northern pearly crescentspot	G5	S1 S3			3					3	1/2													
Satyrium caryaevorum	hickory hairstreak	G4	S1 S3			1				1															
Satyrium kingi	King's hairstreak	G3 G4	S2 S3			4		1		2	1	0/1					1/ 1		0/ 1						
Speyeria atlantis	Atlantis fritillary	G5	S2			7	2	1	1	2	1	3/3													
Speyeria idalia	regal fritillary	G3	S1			48			1	8	3	0/1	1/1												
Skippers																									
Amblyscirtes alternata	dusky roadside-skipper	G3 G4	S1																						

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Atrytone arogos arogos	arogos skipper	G3 G4T 1T2	SH			1				1															
Erynnis lucilius	columbine duskywing	G4	S1 S3			5				5															
Erynnis martialis	mottled duskywing	G3 G4	S1 S3			19				18	1	0/1													
Erynnis persius persius	persius duskywing	G5T 2T3	S1			7				7															
Euphyes bimacula	two-spotted skipper	G4	S2			2				1	1														
Euphyes conspicua	black dash	G4	S1 S3			3				3															
Euphyes dukesi	scarce swamp skipper	G3	S2			9	1	1	2	3	2												2/2	0/2	
Euphyes pilatka	saw-grass skipper	G3 G4	SH			2				2															
Hesperia attalus slossonae	dotted skipper	G3G 4T3	SH			2				2															
Megathymus yuccae	yucca giant skipper	G5	SH																						
Polites mystic	long dash	G5	S1?																						
Problema bulenta	rare skipper	G2 G3	S1			2		1			1				0/1										
Pyrgus wyandot	Appalachian grizzled skipper	G2	S1 S2			28				20	3	1/1					0/1							0/1	
Moths																									
Acherdoa ferraria	chocolate moth	G5	S1 S2																						
Acrapex relicta	cane boring moth	G4	S1 S3																						
Acronicta albarufa	barrens dagger moth	G3 G4	S1 S3																						
Acronicta brumosa	a dagger moth	G4?	S1																						
Anaplectoides brunneomedia	brown-lined dart moth	G4	S1 S3			1					1	1/1													
Apamea smythi	Smyth's apamea moth	GH	SH			1																			
Apamea sp. *1*	cane apamea moth	G3 G4	S1 S2																						
Aplectoides condita	a noctuid moth	G4	S1 S3			1					1													1/1	
Argillophora furcilla	a noctuid moth	G2 G4	S1 S3			1					1						1/1								
Argyrostrotis deleta	a noctuid moth	G4 G5	S1 S3																						
Argyrostrotis sylvarum	a noctuid moth	G4	S1 S3																						
Arugisa watsoni	Watson's arugisa moth	G4	S1 S3																						
Brachionycha borealis	boreal fan moth	G4	S1 S3																						

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Callosamia securifera	sweetbay silkmoth	G4	S1 S2			1					1														
Catocala consors sorsconi	consort underwing	G4T 2T4	SH																						
Catocala dulciola	sweet underwing	G3	S1 S3			1				1															
Catocala herodias gerhardi	herodias underwing	G3 T3	S2 S3			4				1	3	0/1							0/ 1					1/ 1	
Catocala marmorata	marbled underwing	G3 G4	S2			1					1	0/1													
Catocala messalina	messalina underwing	G4	SH			1				1															
Catocala pretiosa pretiosa	precious underwing	G4T 2T3	SH																						
Catocala ulalume	ulalume underwing	G4	S1 S3			1			1				1/1												
Crambidia cephalica	yellow-headed lichen moth	G4	S1 S2																						
Cymatophora approximaria	a geometrid moth	G4 G5	S1 S3																						
Drasteria graphica atlantica	Atlantic graphic moth	G4 T4	S2 S3																						
Dysstroma citrata	a geometrid moth	G5	S1 S3																						
Emarginea percara	a noctuid moth	G4	S1 S3																						
Erythroecia hebardi	Hebard's noctuid moth	GU	SH			1				1															
Euchlaena milnei	Milne's euchlaena moth	G2 G4	S2			11				3	8	0/1												0/ 1	
Euxoa immixta	mixed dart moth	G4	SH																						
Faronta rubripennis	pink-streak moth	G3 G4	S1 S3																						
Franclemontia interrogans	a cane moth	G3 G4	S1 S3																						
Hadena ectypa	a noctuid moth	G3 G4	S1 S3			1					1				1/1										
Heterocampa astarte	a prominent moth	G4 G5	S1 S2																						
Hypomecis buchholzaria	Buchholz's gray moth	G3 G4	S1 S3																						
Hyppa contrasta	a noctuid moth	G4	S1 S3																						
Idaea tacturata	a geometrid moth	G?	S1 S2																						
Itame ribearia	currant spanworm moth	G4	S1 S3																						
Itame sp. *1*	barrens itame	G3	S1 S3																						
Leucania calidior	a noctuid moth	GU	S1 S3			1					1						1/ 1								
Lithacodia sp. 1	a noctuid moth	G4	S1 S2																						

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Lithophane lemmeri	Lemmer's pinion moth	G3 G4	S1 S3																						
Lithophane lepida adipel	a pinion moth	G4 T4	S1 S3																						
Lophosis labeculata	a geometrid moth	GU	S1 S3																						
Lytrosis permagnaria	a geometrid moth	G3 G4	S1 S3			1					1	0/1												0/1	
Merolonche dolli	Doll's merolonch	G3 G4	S1 S3			1					1								0/1						
Meropleon cosmion	a noctuid moth	G4	S1 S3																						
Meropleon titan	a noctuid moth	G2 G4	S1 S3																						
Metarranthis sp. *1*	a geometrid moth	G3	S1 S3																						
Metria amella	a noctuid moth	G5	S1 S2																						
Nemoria elfa	elfin emerald moth	G?	S1 S3			1					1						1/1								
Nemoria tuscarora	an emerald moth	GU	S1 S3																						
Oxycilla mitographa	a noctuid moth	G4	SH																						
Paectes abrostolella	a noctuid moth	G4	S1 S2			2					2						2/2								
Panopoda repanda	orange panopoda moth	G5	S1 S2																						
Papaipema astuta	yellow stoneroot borer moth	G3 G4	S1 S3			1					1													1/1	
Papaipema duovata	seaside goldenrod stem borer	G4	S1 S3																						
Papaipema duplicata	dark stoneroot borer moth	G2 G4	S1 S3			1	1																	1/1	
Papaipema sp. *3*	southeastern cane borer moth	G4	S2 S3			3					3		2/2				0/1								
Papaipema speciosissima	osmunda stem borer moth	G4	S1 S3																						
Papaipema stenocelis	chain fern borer moth	G4	S1 S3																						
Polychrysia morigera	a noctuid moth	G4	S2 S3			1					1						1/1								
Properigea sp. *1*	a noctuid moth	G2 G3Q	S1 S3																						
Ptichodis bistrigata	southern ptichodis moth	G3	S1 S3																						
Pygarctia abdominalis	yellow-edged pygarctia moth	G3 G4	S1 S2																						
Richia grotei	a noctuid moth	G4	S1 S3																						
Schinia siren	a flower moth	G?	S1 S2																						
Semiothisa distribuaria	a geometrid moth	G4	S1 S2																						

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Sphinx franckii	Franck's sphinx	G4	S2 S3																						
Synanthedon castaneae	chestnut clearwing moth	G3 G5	SH																						
Syngrapha rectangula	salt-and-pepper looper moth	G5	S1 S3																						
Tischeria perplexa	chestnut leaf-mining moth	GHQ	SH																						
Xanthorhoe iduata	a geometrid moth	G4	S1 S3																						
Zale curema	a noctuid moth	G3 G4	S1 S3			1					1		1/1												
Zale sp. *1 nr lunifera*	pine barrens zale	G3 G4	S1 S3																						
Zale sp. *3 nr buchholzi*	maritime zale moth	G3?	S2																						
Zale sp. 2 near squamularis		G4Q	S1 S3																						
Zanclognatha gypsalis	a noctuid moth	G4	S1 S3			1		1																	
Diptera (true flies																									
Basilia boardmanni	southeastern myotis bat fly	G3	S1 S2			2			1		1						1/1							1/1	
Fletcherimyia fletcheri	pitcher plant fly	G5	S1 S2																						
Metriocnemus knabi	pitcher plant midge	G5	S2																						
Spelobia tenebrarum	a cave fly	G4 G5	S1			2				2															
Wyeomyia haynei	southern pitcher plant mosquito	G4	S2			1					1														

Table 3: Significant Natural Communities

Community Name	Global Rank	State Rank	No. of Occurrences	Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands						Occ. on Other Lands		
				A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
acidic cove forest			8	3	4	1			5/7													
acidic oak - hickory forest			1		1																0/1	
acidic oak - hickory woodland/savanna		S1	4	3	1					4/4												
Andropogon gerardii - Liatris spicata - Carex buxbaumii saturated herbaceous vegetation	G2?	S1	3			2																
Appalachian bog			17	3	8	3	3		8/ 10					2/2		1/1						
Appalachian cave drip pool/epikarstic community	G2	S2	3	3																		
Appalachian cave stream community	G2	S2	11	11																	0/1	
Appalachian edaphobitic/epikarstic terrestrial cave community	G1	S1	2	2																		
Appalachian karst phreatic community	G1	S1	1	1																		
Appalachian terrestrial dung/transitory organic matter cave community	G2	S2	7	6				1														
Appalachian terrestrial riparian cave community	G2	S2	6	6																	0/1	
arborvitae slope forest			3		2	1			1/1													
bald cypress - tupelo swamp			4	3	1									0/1							0/2	
basic mesic forest			28	7	16	5			1/2	3/5		1/3		0/3				0/1		0/2		0/1
basic oak - hickory forest			18	2	12	4						2/4			0/1			1/2		0/1	0/2	0/1
basic oak - hickory woodland/savanna		S1	2	1	1					2/2												
calcareous fen / seep			12	3	6	3			4/4					1/1								
calcareous spring marsh/muck fen			6	2	3	1			1/1													0/1
Carolina hemlock forest			1		1				1/1													
central Appalachian northern hardwood forest			3		2	1			2/2					1/1								
central Appalachian red spruce forest			7	2	3	2			0/2							3/3						
central Appalachian shale barren			60	32	24	4			26/ 46					0/1							0/2	
chestnut oak forest			19	7	8	4			7/ 10			2/2		2/3				0/1				
coastal plain / piedmont acidic seepage swamp			16	3	9	4				10/ 10		0/1										
coastal plain / piedmont bottomland forest			5	1	3	1				0/1				0/2	0/1							1/2
coastal plain / piedmont seepage bog			10	2	8					9/9												
coastal plain basic seepage swamp			6	3	2	1				2/3		3/4	1/1	1/1								
coastal plain depression pond			39	6	29	2		2				4/7								9/ 18		1/1
coastal plain dry calcareous forest/woodland			4		3	1				0/1		1/2										
coastal plain semipermanent impoundment			3	1	2					2/2												
Danthonia compressa - Sibbaldiopsis tridentata - Carex brunnescens herbaceous vegetation	G1	S1	2		1				1/1													
dry-mesic calcareous forest			5	1	3	1			3/3													
eastern hemlock forest			22	3	10	7	2			0/1		0/2	0/1									
eastern white pine - hardwood forest			2	1		1			1/1			1/1										

Table 3: Significant Natural Communities																							
				Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands						Occ. on Other Lands		
Community Name	Global Rank	State Rank	No. of Occurrences	A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
estuarine fringe pine forest																						
estuarine fringe swamp forest		S1S2																				
floodplain pond / pool			1		1																	
fluvial terrace woodland			4		3	1										0/1						
Fraser fir - spruce forest			1		1				1/1													
granitic flatrock			15	1	8	6				2/2										0/1	0/1	
high-elevation boulderfield forest/woodland			9	4	3	2			3/3			5/5				1/1						
high-elevation cove forest			10	3	5	2			7/7					1/1		2/2						
high-elevation outcrop barren	G1	S1	22	6	10	5			4/5			11/11		5/5								
high-elevation seep			1		1							1/1										
high-elevation seepage swamp			5	1	2	2			3/3			1/1										
interdune pond			11	5	4	1		1		2/3	7/7	6/6		1/2								
interdune wet pine woodland			1			1					1/1	1/1										
limestone/dolomite barren			62	19	28	15								3/14							1/3	0/3
loblolly pine savanna			3	2	1					3/3												
longleaf pine / mixed pine flatwoods																						
low-elevation acidic outcrop barren			5	3	2				2/3			1/1										
low-elevation basic outcrop barren	G1	S1	37	17	13	5		1	2/4	3/4		12/14		2/3								
low-elevation boulderfield forest/woodland			12	5	5	2			5/6			2/2		0/1				0/1				
mafic fen / seep	G1	S1	12	1	8	1								0/1								
mafic woodland seep	G1	S1	5	1	1	2																
maritime dune grassland			6	2	4					0/1	0/2			0/4								
maritime dune woodland	G2	S1	8	2	5	1					0/2	0/2		0/1								
maritime evergreen forest		S1	2	2						0/1	0/1			0/2								
maritime loblolly pine forest			2	1	1						0/2	0/2										
maritime mixed forest		S1	5	3	2						0/1	0/1		2/4								
maritime scrub			10	5	5					0/3	0/3	0/1		1/6							1/1	
maritime shrub swamp																						
maritime swamp forest			3	1	2									2/3								
maritime wet grassland			5	3	2						2/5	2/3		0/1								
mesic calcareous cliff			4	3				1	1/1													
mesic mixed hardwood forest			20	2	14	2		2		4/5				1/1		0/1	1/1	0/2				
mixed oak/heath forest			6		3	3			2/3			0/1										
montane acidic woodland			12	2	5	5			5/6											0/1		
montane alluvial forest																						
montane basic seepage swamp			10	3	7				1/3			3/3				1/1						
montane dry calcareous forest/woodland			17	6	8	3			8/10			1/1										
montane oak - hickory forest			12	4	1	7			3/7			3/3									1/1	

Table 3: Significant Natural Communities

Community Name	Global Rank	State Rank	No. of Occurrences	Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands						Occ. on Other Lands		
				A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
montane pine barren			1	1																	1/1	
moss/lichen boulderfield			1		1							1/1										
mountain / piedmont acidic seepage swamp			15	4	8	2		1	2/3			1/3	0/1			0/1		1/2				
mountain pond			14	5	7	1		1	10/11													
natural lake draw-down shore																						
non-riverine pine - hardwood forest			2	1		1																
non-riverine swamp forest			1	1																		
non-riverine wet hardwood forest		S2	2			1		1				1/1										
northern red oak forest			4	2	2				2/2			1/1										
peatland Atlantic white cedar forest		S1	3	1		1		1			0/1			0/1								
piedmont / low mountain alluvial forest																						
piedmont / mountain bottomland forest			6		4	2			0/1							0/1				0/1		0/1
piedmont / mountain semipermanent impoundment	G?	S1?	3	2					0/1	1/1						0/1						
piedmont / mountain swamp forest			8	1	6	1				4/5		0/1										
piedmont hardpan forest			7		3	4				0/4				0/1	1/1							
piedmont prairie			5	1	4					3/3												
piedmont/coastal plain oak - beech/heath forest			1		1																	
piedmont/mountain acidic cliff			4	4					1/1									0/1				
piedmont/mountain basic cliff			2		2															0/1		
piedmont/mountain basic woodland	G1Q	S1	29	17	9	2			4/6			9/10		1/1		0/1					1/2	
pine/scrub oak sandhill		S1	9	2	3	2	1	1						2/2					1/2			
pine-oak/heath woodland			10	5	3	2			4/6			1/1		1/1				0/1				
Pinus rigida - Quercus stellata /Andropogon gerardii - Senecio pauperculus woodland	G1	S1	3		2																	
pond pine woodland / pocosin		S1	4	1	1	1		1			0/1			2/2							0/1	
rich cove/slope forest			19	3	11	3	1	1	3/8	0/1		6/6				0/1						
riverine aquatic bed																						
river-scour woodland			1			1						0/1										
riverside outcrop barren			2	1	1							0/1										
riverside prairie			9	1	2	5		1	0/4			0/1										
rocky bar and shore			1			1								0/1								
salt flat			3	2	1						0/1			0/1								
salt scrub			2		2																	1/1
sand / gravel / mud bar and shore			4	2	1	1				2/4				0/2								
Scirpus robustus - Juncus gerardii - Hordeum jubatum - Atriplex patula seasonally flooded herbaceous vegetation	G1	S1	2			1																
sea level fen		S1	4	1	3						1/1											
Shenandoah Valley sinkhole pond			40	11	23	4		1	10/14			0/1		3/5						0/1		
southern Appalachian northern hardwood forest			5	3	2				1/3					1/2		1/1						

Table 3: Significant Natural Communities

Community Name	Global Rank	State Rank	No. of Occurrences	Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands						Occ. on Other Lands		
				A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
southern Appalachian red spruce forest			5	2	3				3/3							2/2						
southern Appalachian shrub bald			2	1		1			2/2													
spray cliff			1		1																	
streamhead pocosin			1	1																		
tidal bald cypress forest / woodland			5	2	2			1			0/1			1/1								
tidal baldcypress woodland / savanna																						
tidal freshwater and oligohaline aquatic bed																						
tidal freshwater marsh			22	14	8					1/1	0/2					0/2				0/1		0/1
tidal hardwood swamp			1		1																	
tidal mesohaline / polyhaline marsh			6	4	2									0/3								
tidal mesohaline and polyhaline aquatic bed																						
tidal oligohaline marsh			9	2	4	2		1			0/1	1/2										0/1
tidal shrub swamp			1	1										0/1							0/1	
ultramafic barren	G1	S1	2	1	1																	
upland depression swamp			8	1	4	3				0/1		0/1			0/1							
upper beach/overwash flat			1	1																	0/1	
wet prairie / prairie fen			5		4	1								0/2							0/1	0/1
wind-tidal oligohaline marsh		S1	9	5	3	1					0/2			0/3		2/2				0/1	0/1	
xeric calcareous cliff			6	2	3	1			1/2					0/1								

Table 4: Other Natural Heritage Resources

Name	Global Rank	State Rank	No. of Occurrences	Occurrences by E. O. Rank					Occurrences on Federal Lands					Occurrences on State Lands						Occ. on Other Lands		
				A-Rank	B-Rank	C-Rank	H- or X-Rank	Other Rank	USFS	DOD	USFWS	NPS	Other Federal	DCR	DOF	VDGIF	EDU	VOF	Other State	Locality	TNC	Other Private
Bald Eagle roost			2	1				1			0/1			1/1								
bird nesting colony			39	10	5	7		17		1/1	1/4			1/2							2/17	
mussel concentration site			14	2	4	3		5						0/1						0/1	0/3	0/1
significant cave			232				21	211	0			1		2/2		0/3				0/2	0/1	2/3
significant Great Blue Heron colony	G3G5		7	2	1			4		1/1	0/1	1/2		0/2					0/1	0/2		
significant karst area			7					7	0/2					0/2		0/2					0/1	0/1

Appendix F

Virginia's Endemic Species

The following is a list of Virginia's endemic species, those found only within the borders of the state. For a discussion on endemics, see Chapter 2.

Plants

Betula uber	Virginia round-leaf birch
Clematis addisonii	Addison's leatherflower
Clematis coactilis	Virginia white-haired leatherflower
Clematis viticaulis	Millboro leatherflower
Iliamna corei	Peter's Mountain-mallow

Animals

Vertebrates

Fish

Cottus sp 4	Clinch sculpin
Notropis semperasper	Roughhead shiner
Percina rex	Roanoke logperch

Amphibians

Plethodon shenandoah	Shenandoah salamander
Plethodon hubrichti	Peaks of Otter salamander

Invertebrates

Turbellaria (flatworms)

Sphalloplana hypogea	a groundwater planarian
Sphalloplana subtilis	Bigger's groundwater planarian
Sphalloplana virginiana	Rockbridge County cave planarian

Gastropoda (snails)

Fontigens morrisoni	Virginia springsnail
Holsingeria unthanksensis	an aquatic cavesnail
Holsingeria sp 1	Skyline Caverns snail
Helicodiscus diadema	shaggy coil
Helicodiscus lirellus	rubble coil
Paravitrea hera	spirit supercoil
Paravitrea septadens	brown supercoil
Pleurocera gradata	bottle hornsnail
Polygyriscus virginicus	Virginia fringed mountain snail
Stagnicola neopalustris	piedmont pondsnail

Bivalvia (mussels & clams)

Lexingtonia subplana	Virginia pigtoe

Annelida (segmented worms)

Spelaedrilus multiporus	a cave lumbriculid worm

Arachnida (spiders & pseudoscorpions)

Apochthonius coecus	a cave pseudoscorpion
Apochthonius holsingeri	a cave pseudoscorpion
Chitrella superba	a cave pseudoscorpion
Foveacheles paralleloseta	a cave mite
Kleptochthonius regulus	a cave pseudoscorpion
Kleptochthonius anophthalmus	a cave pseudoscorpion
Kleptochthonius binoculatus	a cave pseudoscorpion
Kleptochthonius gertschi	a cave pseudoscorpion
Kleptochthonius lutzi	a cave pseudoscorpion
Kleptochthonius proximosetus	a cave pseudoscorpion
Kleptochthonius similis	a cave pseudoscorpion
Kleptochthonius polychaetus	a cave pseudoscorpion
Microcreagris valentinei	a cave pseudoscorpion
Mundochthonius holsingeri	a cave pseudoscorpion
Nesticus holsingeri	Holsinger's cave spider

Crustacea (amphipods & isopods)

Amerigoniscus henroti	Powell Valley terrestrial cave isopod
Caecidotea bowmani	Natural Bridge cave isopod
Caecidotea henroti	Henrot's cave isopod
Caecidotea phreatica	phreatic isopod
Caecidotea vandeli	Vandel's cave isopod
Crangonyx sp 5	an amphipod
Lirceus culveri	Rye Cove isopod
Lirceus usdagalun	Lee County cave isopod
Stygobromus abditus	James cave amphipod
Stygobromus baroodyi	Rockbridge County cave amphipod
Stygobromus conradi	Burnsville Cove cave amphipod

Stygobromus cumberlandus	Cumberland cave amphipod
Stygobromus ephemerus	ephemeral cave amphipod
Stygobromus estesi	Craig County cave amphipod
Stygobromus fergusoni	Montgomery County cave amphipod
Stygobromus hoffmani	Alleghany County cave amphipod
Stygobromus interitus	New Castle Murder Hole amphipod
Stygobromus leensis	Lee County cave amphipod
Stygobromus mundus	Bath County cave amphipod
Stygobromus obrutus	Pittsylvania well amphipod
Stygobromus phreaticus	northern Virginia well amphipod
Stygobromus pseudospinosus	Luray Caverns amphipod
Stygobromus spinosus	Blue Ridge Mountain amphipod
Stygobromus stegerorum	Madison cave amphipod
Stygobromus sp 16	Helsley's cave amphipod
Stygobromus sp 17	Massanutten Mountain spring amphipod
Stygobromus sp 18	Big Levels spring amphipod
Stygobromus sp 19	a cave amphipod (Scott Co.)
Stygobromus sp 20	a cave amphipod (Bath and Highland Cos.)
Stygobromus sp 21	Rappahannock spring amphipod

Diplopoda (millipedes)

Brachoria cedra	cedar millipede
Brachoria falcifera	Big Cedar Creek millipede
Brachoria laminata	Keeton's millipede
Brachoria turneri	Turner's millipede
Nannaria sp 1	Roaring Branch nannaria millipede
Pseudotremia cavernarum	Ellett Valley pseudotremia millipede
Pseudotremia tuberculata	a millipede
Pseudotremia sp 2	Roaring Branch pseudotremia millipede
Pseudotremia sp 3	a cave millipede
Sigmoria whiteheadi	a millipede

Chilopoda (centipedes)

Nampabius turbator	a cave centipede

Collembola (springtails)

Arrhopalites caedus	a cave springtail
Arrhopalites carolynae	a cave springtail
Arrhopalites commorus	a cave springtail
Arrhopalites lacuna	a cave springtail
Arrhopalites marshalli	a cave springtail
Arrhopalites pavo	a cave springtail
Arrhopalites sacer	a cave springtail
Arrhopalites silvus	a cave springtail
Oncopodura hubbardi	a cave springtail
Pseudosinella bona	a cave springtail
Pseudosinella erehwon	a cave springtail
Pseudosinella extra	a cave springtail
Pseudosinella granda	a cave springtail
Schaefferia hubbardi	a cave springtail
Typhlogastrura valentini	a cave springtail

Diplura (diplurans)

Litocampa pucketti	a cave dipluran

Coleoptera (beetles)

Pseudanophthalmus avernus	avernus cave beetle
Pseudanophthalmus cordicollis	Little Kennedy cave beetle
Pseudanophthalmus deceptivus	deceptive cave beetle
Pseudanophthalmus delicatus	delicate cave beetle
Pseudanophthalmus egberti	New River Valley cave beetle
Pseudanophthalmus gracilis	a cave beetle
Pseudanophthalmus holsingeri	Holsinger's cave beetle
Pseudanophthalmus hortulanus	Burkes Garden cave beetle
Pseudanophthalmus hubbardi	Hubbard's cave beetle
Pseudanophthalmus hubrichti	Hubricht's cave beetle
Pseudanophthalmus hoffmani	Hoffman's cave beetle
Pseudanophthalmus intersectus	Crossroads cave beetle
Pseudanophthalmus limicola	mud-dwelling cave beetle
Pseudanophthalmus nelsoni	Nelson's cave beetle
Pseudanophthalmus parvicollis	thin-neck cave beetle
Pseudanophthalmus petrunkevitchi	Petrunkevitch's cave beetle
Pseudanophthalmus pontis	Natural Bridge cave beetle
Pseudanophthalmus praetermissus	overlooked cave beetle
Pseudanophthalmus punctatus	spotted cave beetle
Pseudanophthalmus pusio	a cave beetle
Pseudanophthalmus quadratus	Straley's cave beetle
Pseudanophthalmus sanctipauli	Saint Paul cave beetle
Pseudanophthalmus seclusus	a cave beetle
Pseudanophthalmus sericus	silken cave beetle
Pseudanophthalmus thomasi	Thomas' cave beetle
Pseudanophthalmus vicarius	vicariant cave beetle
Pseudanophthalmus virginicus	Maiden Spring cave beetle

Plecoptera (stoneflies)

Acroneuria flinti	Manassas stonefly
Isoperla major	big stripetail stonefly
Perlesta teaysia	Teays stonefly
Remenus kirchneri	Blue Ridge springfly
Sweltsa holstonensis	Holston sallfly
Sweltsa voshelli	Virginia sallfly
Taeniopteryx nelsoni	cryptic willowfly

Tallaperla lobata	lobed roachfly
Heteroptera (true bugs)	
Sigara depressa	Virginia piedmont water boatman
Pycnoderiella virginiana	seashore plant bug
Homoptera (cicadas & leaf hoppers)	
Puto kosztarabi	Buffalo Mountain giant mealybug
Orthoptera (grasshoppers)	
Melanoplus sp 55	a spur-throat grasshopper
Melanoplus sp 59	a spur-throat grasshopper

Appendix G

Virginia's Historic, Extirpated and Extinct Species

The following table lists the plants and animals that are known to have occurred within Virginia in the past but now have no known populations within the state. The date and location of the last observation of each species is provided for those species for which there are records. The terms used in the status column can be briefly defined as follows:
Extinct: no longer alive anywhere in the world
Extirpated: no longer found in the wild in Virginia
Historic: no known wild populations but there is some possibility that the species may be found

For a more detailed discussion see Virginia's Lost Natural Heritage in Chapter 2.

Scientific name	Common name	Date last seen	Location last seen	Status
Plants				
Adiantum capillus-veneris	southern maidenhair-fern			Historic in VA
Anagallis minima	chaffweed			Historic in VA
Andropogon mohrii	Mohr bluestem	1938	Dinwiddie & Prince George	Historic in VA
Arenaria lanuginosa ssp lanuginosa	a sandwort	1936	City of Virginia Beach	Subspecies historic in VA
Bacopa caroliniana	Carolina water-hyssop	1970	Prince George	Historic in VA
Baptisia cinerea	hairy false-indigo	1969	Halifax	Historic in VA
Botrychium jenmanii	Alabama grape-fern	1942	Wise	Historic in VA
Burmannia biflora	northern burmannia	1938	Greensville	Historic in VA
Carex ormostachya	a sedge			Historic in VA
Carex reniformis	reniform sedge	1973	Greensville	Historic in VA
Cicuta bulbifera	bulb-bearing water-hemlock			Historic in VA
Cirsium altissimum	tall thistle	1949	Shenandoah	Historic in VA
Cirsium nuttallii	Nuttall's thistle	1938	Southampton	Historic in VA
Cirsium repandum	coastal-plain thistle			Historic in VA
Clematis glaucophylla	white-leaved leatherflower	1968	Lee	Historic in VA
Clinopodium glabellum	savory			Historic in VA (taxonomy uncertain)
Crotalaria rotundifolia	prostrate rattle-box	1967	City of Suffolk	Historic in VA
Cyperus acuminatus	short-point flatsedge			Historic in VA
Cyperus houghtonii	Houghton's umbrella-sedge	1966	Botetourt	Historic in VA
Desmodium ochroleucum	creamflower tick-trefoil	1988	Chesterfield	Historic in VA
Digitaria serotina	dwarf crabgrass	1942	Southampton	Historic in VA
Eleocharis radicans	rooted spikerush	1934	City of Virginia Beach	Historic in VA
Fuirena breviseta	an umbrella sedge			Historic in VA
Geum aleppicum	yellow avens	1945	Rockingham	Historic in VA
Honckenya peploides ssp robusta	sea-beach sandwort	1898	City of Virginia Beach	Subspecies historic in VA

Scientific name	Common name	Date last seen	Location last seen	Status
Hypericum denticulatum	coppery St. John's-wort			Historic in VA
Hypericum ellipticum	pale St. John's-wort	1971	Amherst	Historic in VA
Hypoxis sessilis	glossy-seeded star-grass	1934	City of Virginia Beach	Historic in VA
Lachnanthes caroliana	Carolina redroot	1966	Augusta	Historic in VA
Leersia hexandra	club-head cutgrass	1939	Essex	Historic in VA
Limosella australis	mudwort			Historic in VA
Ludwigia virgata	savanna seedbox	1970-	City of Suffolk	Historic in VA
Lysimachia radicans	trailing loosestrife	1940-	Augusta	Historic in VA
Lythrum lanceolatum	lance-leaved loosestrife	1940	York	Historic in VA
Micranthemum micranthemoides	Nuttall's micranthemum	1941	Charles City	Globally historic
Minuartia caroliniana	pine-barren sandwort			Historic in VA
Muhlenbergia expansa	cut-over muhly	1941	Greensville	Historic in VA
Muhlenbergia glabrifloris	smooth-leaved muhly	1942	Brunswick	Historic in VA
Neobeckia aquatica	lake cress	1936	Southampton	Historic in VA
Ophioglossum petiolatum	longstem adder's-tongue	1979	City of Virginia Beach	Historic in VA
Orthilia secunda	one-sided wintergreen	1941	Prince William	Historic in VA
Oxypolis ternata	a cowbane			Historic in VA
Paspalum bifidum	pitchfork paspalum	1970	Southampton	Historic in VA
Phalaris caroliniana	May grass			Historic in VA
Plantago cordata	heart-leaved plantain	1924	Fairfax	Historic in VA
Polygala brevifolia	little-leaf milkwort			Historic in VA
Polygala ramosa	low pine-barren milkwort	1949	Greensville	Historic in VA
Potamogeton robbinsii	flatleaf pondweed	1915	Fairfax	Historic in VA
Pseudolycopodiella caroliniana	slender clubmoss	1985	Sussex	Historic in VA
Pycnanthemum monotrichum	a mountain-mint	1936	Sussex	Globally historic (taxonomy uncertain)
Pyrola chlorantha	greenish-flowered wintergreen	1929	Madison	Historic in VA
Ranunculus hederaceus	long-stalked crowfoot	1984	Westmoreland	Historic in VA
Rhynchospora filifolia	thread-leaved beakrush	1945	Sussex	Historic in VA
Rhynchospora grayi	Gray's beakrush			Historic in VA
Rhynchospora harveyi	Harvey beakrush	1941	Sussex	Historic in VA
Rhynchospora miliacea	millet beakrush			Historic in VA
Rhynchospora pallida	pale beakrush	1939	City of Suffolk	Historic in VA
Rhynchospora wrightiana	Wright's beakrush			Historic in VA
Sagittaria engelmanniana	Engelmann arrowhead	1941	City of Chesapeake	Historic in VA
Schoenoplectus etuberculatus	Canby's bulrush			Historic in VA
Schoenoplectus smithii	Smith's bulrush			Historic in VA
Schwalbea americana	chaffseed	1938	Greensville & Sussex	Historic in VA
Scutellaria arguta	sharp-leaved skullcap			Historic in VA (taxonomy uncertain)
Smilax smallii	Small's greenbrier			Historic in VA
Sparganium androcladum	branching burreed	1988	City of Virginia Beach	Historic in VA
Tridens chapmanii	Chapman's redtop			Historic in VA
Vaccinium virgatum	swamp blueberry		Southampton	Historic in VA
Vertebrates				
Fish				
Acipenser brevirostrum	shortnose sturgeon	1876	Chesapeake estuaries	Breeding population extirpated from VA
Cyprinella labrosa	thicklip chub	1933	Peedee River	Historic in VA
Moxostoma lacerum	harelip sucker	1888	N. Fork Holston R.	Extinct
Percina maculata	blackside darter	1937	Big Sandy R.	Extirpated from VA

Scientific name	Common name	Date last seen	Location last seen	Status
Percopsis omiscomaycus	trout-perch	1911	Potomac R.	Extirpated from VA
Birds				
Aquila chrysaetos	Golden Eagle			Breeding population historic in VA
Chondestes grammacus	Lark Sparrow	1937	Rockingham	Breeding population historic in VA
Contopus cooperi	Olive-Sided Flycatcher	1938	Highland	Breeding population historic in VA
Conuropsis carolinensis	Carolina Parakeet	ca. 1865		Extinct
Ectopistes migratorius	Passenger Pigeon	1874	Nelson	Extinct
Sterna dougallii	Roseate Tern	pre-1927	Eastern Shore	Breeding population historic in VA
Vermivora bachmanii	Bachman's Warbler	1958	Fairfax	Extirpated from VA, globally historic
Mammals				
Bos bison	bison	ca. 1790		Extirpated from VA
Canis lupus	gray wolf	ca. 1910	Tazewell	Extirpated from VA
Canis rufus	red wolf			Extirpated from VA
Cervus elaphus	wapiti or elk	ca. 1855	Clarke	Native population extirpated from VA
Erethizon dorsatum	porcupine			Extirpated from VA
Puma concolor couguar	eastern cougar	ca. 1880		Extirpated from VA
Sylvilagus floridanus hitchensi	Smith Island cottontail	1911	Northampton	Subspecies globally historic (taxonomy uncertain)
Invertebrates				
Turbellaria (flatworms)				
Sphalloplana holsingeri	Holsinger's groundwater planarian	1973	Fairfax	Globally historic
Sphalloplana subtilis	Bigger's groundwater planarian	1973	Fairfax	Globally historic
Gastropoda (snails)				
Stagnicola neopalustris	piedmont pondsnail			Globally historic
Bivalvia (mussels & clams)				
Elliptio crassidens	elephant ear	1996	Lee	Extirpated from VA
Epioblasma arcaeformis	sugarspoon			Extinct
Epioblasma florentina florentina	yellow-blossom pearlymussel			Subspecies extinct
Epioblasma haysiana	acornshell			Extinct
Epioblasma lenior	narrow catspaw			Extinct
Epioblasma lewisii	forkshell			Extinct
Epioblasma stewardsonii	Cumberland leafshell			Extinct
Epioblasma torulosa gubernaculum	green-blossom pearlymussel	1999	Scott	Subspecies extinct
Lampsilis abrupta	pink mucket			Extirpated from VA
Pleurobema cordatum	Ohio pigtoe	1988	Scott	Extirpated from VA
Pleurobema plenum	rough pigtoe	1984	Scott	Extirpated from VA
Villosa fabalis	rayed bean			Extirpated from VA
Villosa trabalis	Cumberland bean	1988	Scott	Extirpated from VA
Truncilla truncata	deertoe			Historic in VA
Crustacea (amphipods, isopods & decapods)				
Stygobromus kenki	Rock Creek groundwater amphipod	1973	Fairfax	Historic in VA
Stygobromus obrutus	Pittsylvania well amphipod	1948	Pittsylvania	Historic in VA
Ephemeroptera (mayflies)				
Siphloplecton costalense	Spieth's great speckled olive mayfly	1935	Southampton	Historic in VA

Scientific name	Common name	Date last seen	Location last seen	Status
Odonata				
Dragonflies				
Arigomphus furcifer	lilypad clubtail	1973	Highland	Historic in VA
Somatochlora williamsoni	Williamson's emerald	1973	Highland	Historic in VA
Sympetrum janeae	Jane's meadowhawk	1978	City of Suffolk	Historic in VA
Orthoptera (grasshoppers & relatives)				
Appalachia hebardi	Appalachian grasshopper		Bath	Globally historic
Plecoptera (stoneflies)				
Acroneuria flinti	Manassas stonefly	1962	Fairfax	Globally historic
Heteroptera (true bugs)				
Allopodops mississippiensis	a turtle bug	1943	Fairfax	Historic in VA
Eurygaster alternata	a shield bug	1948	Montgomery	Historic in VA
Oncozygia clavicornis	a turtle bug	1891	Hampton	Historic in VA
Stachyocnemus apicalis	sandpit alydid bug	1920	Chesterfield	Historic in VA
Coleoptera (beetles)				
Cicindela formosa generosa	a tiger beetle	1948	Lee & Fairfax	Historic in VA
Cicindela limbalis	a tiger beetle		City of Alexandria	Historic in VA
Lordithon niger	black lordithon rove beetle	pre-1982	Fairfax & Stafford	Historic in VA
Nicrophorus americanus	American burying beetle	1955	Montgomery	Historic in VA
Pseudanophthalmus pontis	Natural Bridge cave beetle	1959	Rockbridge County	Globally historic
Pseudanophthalmus virginicus	Maiden Spring cave beetle	1966	Tazewell	Globally historic
Lepidopera (butterflies & moths)				
Butterflies				
Phyciodes batesii batesii	tawny crescentspot	1940	Giles	Historic in VA
Skippers				
Atrytone arogos arogos	arogos skipper	pre-1950	Montgomery	Historic in VA
Euphyes pilatka	saw-grass skipper	1971	City of VA Beach	Historic in VA
Hesperia attalus slossonae	dotted skipper	1940	Loudon	Historic in VA
Megathymus yuccae	yucca giant skipper	1957	City of VA Beach	Historic in VA
Moths				
Apamea smythi	Smyth's apamea moth	1907	Montgomery	Globally historic
Catocala agrippina	agrippina underwing			Historic in VA
Catocala consors sorsconi	consort underwing	ca. 1960	City of Danville	Historic in VA
Catocala messalina	messalina underwing	ca. 1990	Montgomery	Historic in VA
Catocala pretiosa	precious underwing	ca. 1990	Montgomery	Historic in VA
Erythroecia hebardi	Hebard's noctuid moth	1916	Bath	Historic in VA
Euxoa immixta	mixed dart moth			Historic in VA
Leucorrhinia frigida	frosted whiteface	1978	Highland	Historic in VA
Leucorrhinia proxima	red-waisted whiteface	1978	Highland	Historic in VA
Oxycilla mitographa	a noctuid moth		Giles	Historic in VA
Synanthedon castaneae	chestnut clearwing moth		Fairfax	Historic in VA
Tischeria perplexa	chestnut leaf-mining moth			Globally historic (taxonomy uncertain)

Appendix H

Invasive Alien Plant Species of Virginia

About the List

This list was developed as a cooperative project between Virginia Department of Conservation and Recreation's Natural Heritage Program and the Virginia Native Plant Society. It is intended to inform land managers of potential risks associated with certain plant species known to exhibit invasive behavior in some situations. This list is not regulatory in nature, thus does not prohibit the use of the listed plant species.

The Natural Heritage Program and Virginia Native Plant Society use detailed criteria to assess the invasiveness of a plant. Factors used to rank each species include: cumulative impacts on natural areas; potential to disperse and invade natural landscapes; distribution and abundance; difficulty to manage; and impacts on other species.

Invasiveness Ranking

Each species on the list is assessed according to its cumulative effects on natural areas and native plant habitats where it typically occurs.

Highly invasive species exhibit the most invasive tendencies in natural areas and native plant habitats. They may disrupt ecosystem processes and cause major alterations in plant community composition and structure. They establish readily in natural systems and spread rapidly.

Moderately invasive species exhibit moderate invasiveness in natural areas. They may have minor influence on ecosystem processes, alter plant community composition and affect community structure in at least one layer. They may become dominant in the understory layer without threatening all species found in the community. These species usually require a minor disturbance to become established.

Occasionally invasive species generally do not affect ecosystem processes but may alter plant community composition by out-competing one or more native plant species. They often become established in severely disturbed areas. The disturbance may be of natural or human origin, such as ice storm damage, wind-throw or road construction. These species spread slowly or not at all from disturbed sites.

Regions

For purposes of this list, the state has been divided into three regions. Coastal Plain and Piedmont follow conventional boundaries. Blue Ridge, Ridge and Valley and Cumberland Mountains are grouped together into one region called Mountain.

Habitat Requirements

The categories for light and soil moisture requirements are very broad and are meant only to give general indication of habitat adaptations for these plants.

Key		
M = Mountains	F = Full sun	H = Hydric (wet)
P = Piedmont	P = Partial sun	M = Mesic (moist)
C = Coastal	S = Shade	X = Xeric (dry)

Common name	Scientific name	Region			Light			Moisture		
		M	P	C	F	P	S	H	M	X
Highly invasive species										
Ailanthus altissima	tree-of-heaven	●	●	●	●	●			●	
Alliaria petiolata	garlic mustard	●	●		●	●	●		●	
Alternanthera philoxeroides	alligator weed			●	●	●		●		
Ampelopsis brevipedunculata	porcelain-berry		●		●	●	●		●	
Carex kobomugi	Asiatic sand sedge			●	●	●				●
Celastrus orbiculata	oriental bittersweet	●	●	●		●	●		●	
Centaurea dubia	short-fringed knapweed	●			●	●			●	●
Centaurea maculosa	spotted knapweed	●	●	●	●	●				●
Cirsium arvense	Canada thistle	●	●	●	●				●	
Dioscorea oppositifolia	Chinese yam	●	●	●		●	●		●	
Elaeagnus umbellata	autumn olive	●	●	●	●	●			●	
Euonymus alata	winged burning bush		●			●	●		●	
Hydrilla verticillata	hydrilla			●	●	●		●		
Imperata cylindrica	cogon grass			●		●	●		●	
Lespedeza cuneata	Chinese lespedeza	●	●		●				●	
Ligustrum sinense	Chinese privet	●	●	●		●	●		●	
Lonicera japonica	Japanese honeysuckle	●	●	●	●	●	●		●	
Lonicera morrowii	Morrow's honeysuckle	●	●		●	●	●		●	
Lonicera standishii	Standish's honeysuckle	●	●			●	●		●	
Lythrum salicaria & L. virgatum	purple loosestrife	●	●	●	●			●	●	
Melilotus alba	white sweet clover	●	●	●	●	●			●	
Melilotus officinalis	yellow sweet clover	●	●	●	●	●			●	
Microstegium vimineum	Japanese stilt grass	●	●	●	●	●	●	●	●	
Murdannia keisak	aneilema		●	●	●	●		●		
Myriophyllum aquaticum	parrot feather	●	●	●	●			●		
Myriophyllum spicatum	European water-milfoil	●	●	●	●			●		
Phragmites australis	common reed		●	●	●	●		●	●	
Polygonum cuspidatum	Japanese knotweed	●	●	●	●	●			●	
Polygonum perfoliatum	mile-a-minute		●		●	●	●		●	
Pueraria lobata (*P. montana*)	kudzu vine	●	●	●	●	●	●		●	
Ranunculus ficaria	lesser celandine			●		●	●		●	
Rosa multiflora	multiflora rose	●	●	●	●	●			●	
Rubus phoenicolasius	wineberry	●	●	●		●	●		●	
Sorghum halepense	Johnson-grass	●	●	●	●	●			●	
Moderately invasive species										
Acer platanoides	Norway maple	●	●	●	●	●			●	
Agropyron repens	quack grass	●	●	●	●	●			●	
Agrostis tenuis	Rhode Island bent-grass	●	●		●	●			●	
Akebia quinata	five-leaf akebia		●	●	●	●	●		●	
Allium vineale	wild onion	●	●	●	●	●			●	

Key		
M = Mountains	F = Full sun	H = Hydric (wet)
P = Piedmont	P = Partial sun	M = Mesic (moist)
C = Coastal	S = Shade	X = Xeric (dry)

Common name	Scientific name	Region			Light			Moisture		
		M	P	C	F	P	S	H	M	X
Artemisia vulgaris	mugwort	●	●	●	●	●			●	●
Arthraxon hispidus	jointed grass	●	●	●	●	●	●	●	●	
Arundo donax	giant reed		●	●	●	●		●	●	
Berberis thunbergii	Japanese barberry	●	●	●	●	●	●		●	
Cardiospermum halicacabum	balloon vine			●	●				●	
Carduus nutans	musk thistle	●	●	●	●				●	
Cassia obtusifolia	sickle pod		●	●	●	●			●	●
Centaurea jacea	brown knapweed	●	●		●	●			●	●
Cirsium vulgare	bull-thistle	●	●	●	●				●	
Convolvulus arvensis	field-bindweed	●	●	●	●	●			●	
Dipsacus laciniatus	cut-leaf teasel	●			●				●	
Dipsacus sylvestris	common teasel	●	●	●	●			●	●	
Egeria densa	Brazilian water-weed	●	●	●	●	●		●		
Euonymus fortunei	wintercreeper			●		●	●	●	●	
Festuca elatior (*F. pratensis*)	tall fescue	●	●	●	●	●			●	
Foeniculum vulgare	fennel		●	●	●			●	●	●
Glechoma hederacea	gill-over-the-ground	●	●	●		●	●		●	
Hedera helix	English ivy		●	●	●	●	●		●	
Holcus lanatus	velvet-grass	●	●	●	●	●		●	●	
Humulus japonicus	Japanese hops	●	●	●	●	●	●	●	●	
Ipomoea hederacea	ivy-leaved morning-glory	●	●	●	●	●		●	●	
Ipomoea purpurea	common morning-glory	●	●	●	●				●	
Iris pseudacorus	yellow flag	●	●	●	●	●		●		
Lespedeza bicolor	shrubby bushclover	●	●	●	●	●			●	
Ligustrum obtusifolium	blunt-leaved privet		●	●			●		●	
Lonicera maackii	Amur honeysuckle	●	●			●			●	
Lonicera tatarica	Tartarian honeysuckle	●	●		●	●			●	
Lysimachia nummularia	moneywort	●	●	●	●	●	●	●	●	
Melia azedarach	China-berry		●	●	●	●			●	
Phleum pratense	Timothy	●	●	●	●	●			●	
Phyllostachys aurea	golden bamboo		●	●	●	●			●	
Poa compressa	Canada bluegrass	●	●	●	●	●	●		●	●
Poa trivialis	rough bluegrass	●	●	●	●	●	●	●	●	
Polygonum cespitosum	bristled knotweed	●	●	●	●	●	●	●	●	
Populus alba	white poplar	●	●	●	●	●			●	
Raphanus raphanistrum	jointed charlock	●	●	●	●				●	
Rumex acetosella	red sorrel	●	●	●	●	●			●	
Rumex crispus	curled dock	●	●		●				●	●
Setaria faberi	giant foxtail		●	●	●	●			●	
Spiraea japonica	Japanese spiraea	●	●			●	●	●	●	
Stellaria media	common chickweed	●	●	●	●	●	●		●	

Key		
M = Mountains	F = Full sun	H = Hydric (wet)
P = Piedmont	P = Partial sun	M = Mesic (moist)
C = Coastal	S = Shade	X = Xeric (dry)

Common name	Scientific name	Region			Light			Moisture		
		M	P	C	F	P	S	H	M	X
Veronica hederifolia	ivy-leaved speedwell	●	●	●	●	●	●		●	
Wisteria sinensis	Chinese wisteria		●	●		●	●		●	
Xanthium strumarium	common cocklebur	●	●	●	●	●			●	●
Occasionally invasive species										
Agrostis gigantea	redtop	●	●	●	●	●			●	
Ajuga reptans	bugleweed	●	●	●	●	●			●	●
Albizia julibrissin	mimosa	●	●	●	●	●			●	
Arrhenatherum elatius	oatgrass	●	●	●	●	●			●	
Commelina communis	common dayflower	●	●	●	●	●			●	
Conium maculatum	poison hemlock	●	●	●	●	●			●	
Coronilla varia	crown-vetch	●	●	●	●				●	●
Dactylis glomerata	orchard grass	●	●	●	●	●			●	
Elaeagnus angustifolia	Russian olive	●	●	●	●	●			●	
Elaeagnus pungens	thorny elaeagnus		●	●		●			●	
Eragrostis curvula	weeping lovegrass	●	●	●	●				●	●
Euphorbia esula	leafy spurge	●	●			●	●		●	
Ipomoea coccinea	red morning-glory	●	●	●	●				●	
Lapsana communis	nipplewort	●			●	●			●	
Lonicera fragrantissima	sweet breath of spring		●		●	●			●	
Lonicera x bella	Bell's honeysuckle	●	●	●	●	●			●	
Lotus corniculatus	birdsfoot trefoil	●	●	●	●	●			●	●
Miscanthus sinensis	silver grass	●	●	●	●	●			●	
Morus alba	white mulberry	●	●	●	●	●			●	
Pastinaca sativa	wild parsnip	●	●	●	●	●			●	
Perilla frutescens	beefsteak plant	●	●	●		●	●		●	
Pinus thunbergii	black pine			●	●	●			●	
Quercus acutissima	sawtooth oak	●			●				●	
Trapa natans	water chestnut			●	●			●	●	
Ulmus pumila	Siberian elm		●		●	●			●	
Viburnum dilatatum	linden viburnum		●		●	●			●	
Vinca minor & V. major	periwinkle	●	●	●	●	●	●		●	
Wisteria floribunda	Japanese wisteria			●		●	●		●	

Appendix I

Virginia Endangered Species Act

Code of Virginia
Article 6.
Endangered Species.

§ 29.1-563. Definitions. – For the purposes of this article:
"*Endangered species*" means any species which is in danger of extinction throughout all or a significant portion of its range;
"*Fish or wildlife*" means any member of the animal kingdom, vertebrate or invertebrate, except for the class Insecta, and includes any part, products, egg, or the dead body or parts thereof;
"*Person*" means any individual, firm, corporation, association or partnership;
"*Threatened species*" means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. (1972, c. 329, § 29-231; 1977, c. 377; 1987, c. 488; 1990, c. 369.)

§ 29.1-564. Taking, transportation, sale, etc., of endangered species prohibited. – The taking, transportation, processing, sale, or offer for sale within the Commonwealth of any fish or wildlife appearing on any list of threatened or endangered species published by the United States Secretary of the Interior pursuant to the provisions of the federal Endangered Species Act of 1973 (P.L. 93-205), or any modifications or amendments thereto, is prohibited except as provided in § 29.1-568. (1972, c. 329, § 29-232; 1977, c. 377; 1987, c. 488.)

§ 29.1-566. Regulations. – The Board is authorized to adopt the federal list, as well as modifications and amendments thereto by regulations; to declare by regulation, after consideration of recommendations from the Director of the Department of Conservation and Recreation and from other reliable data sources, that species not appearing on the federal lists are endangered or threatened species in Virginia; and to prohibit by regulation the taking, transportation, processing, sale, or offer for sale within the Commonwealth of any threatened or endangered species of fish or wildlife. (1972, c. 329, §§ 29-233, 29-234; 1977, c. 377; 1987, c. 488; 1989, c. 553.)

§ 29.1-567. Penalties; authority of game wardens and police officers; disposition of property seized. –
A. Any person who violates the provisions of § 29.1-564 or § 29.1-566, or any regulations issued pursuant to these sections, or whoever violates any regulation or permit issued under § 29.1-568 shall be guilty of a Class 1 misdemeanor; however, the sale, offering for sale, purchasing or offering to purchase within the Commonwealth of any fish or wildlife appearing on a list of threatened or endangered species as prohibited by § 29.1-564 shall be punishable as provided in § 29.1-553.
B. Any judicial officer or other officer authorized to issue criminal warrants shall have authority to issue a warrant for the search and seizure of any goods, business records, merchandise or fish or wildlife taken, employed or used in connection with a violation of any provision of this article. All such search warrants shall be issued and executed pursuant to Chapter 5 (§ 19.2-52 et seq.) of Title 19.2.
C. Goods, merchandise, fish or wildlife or records seized under the provisions of subsection B of this section shall be held by an officer or agent of the Department at the direction of the judge or court pending disposition of court proceedings, and thereafter be forfeited to the Commonwealth for destruction or disposition as the Director may deem appropriate. However, prior to forfeiture, the Director may direct the transfer of fish or wildlife so

seized to a qualified zoological, educational, or scientific institution for safekeeping, with costs assessable to the defendant. The Board is authorized to issue regulations to implement this section. (1972, c. 329, § 29-235; 1987, c. 488; 1990, c. 123; 1994, c. 848.)

§ 29.1-568. When Board may permit taking, etc., of endangered species. – The Board may permit the taking, exportation, transportation or possession of any fish or wildlife which is listed by the provisions of this article, for zoological, educational, or scientific purposes and for propagation of such fish or wildlife in captivity for preservation purposes. (1972, c. 329, § 29-236; 1987, c. 488.)

§ 29.1-569. Keeping of reptiles generally; penalty. – It shall be unlawful for the owner or keeper of any exotic reptile or type of reptile not native to the Commonwealth of Virginia, including but not limited to the American alligator, to keep the reptile in any manner that will permit its escape or to knowingly permit the reptile to run at large. Any violation of this section shall constitute a Class 2 misdemeanor. (1980, c. 202, § 29-213.35; 1987, c. 488; 1999, c. 85.)

§ 29.1-570. Cooperation of state agencies. – All departments, commissions, boards, authorities, agencies, offices and institutions within any branch of the state government shall cooperate with the Board in carrying out the purposes of this article. (1978, c. 835, § 29-248; 1987, c. 488.)

Appendix J

Virginia Endangered Plant and Insect Species Act

Code of Virginia
Chapter 39
Endangered Plant and Insect Species Act.

§ 3.1-1020. Short title. – This chapter shall be known and may be cited as the "Endangered Plant and Insect Species Act." (1979, c. 372.)

§ 3.1-1021. Definitions. – As used in this chapter:
"*Board*" means the Board of Agriculture and Consumer Services.
"*Candidate species*" means those species formally recommended by the Director of the Department of Conservation and Recreation or other reliable data sources in writing to and accepted by the Commissioner for presentation to the Board of Agriculture and Consumer Services for listing under the Virginia Endangered Plant and Insect Species Act.
"*Commissioner*" means the Commissioner of the Department of Agriculture and Consumer Services or his designee.
"*Department*" means the Department of Agriculture and Consumer Services.
"*Endangered species*" means any species or variety of plant life or insect life determined by the Board to be in danger of extinction throughout all or a significant part of its range other than a species determined by the Commissioner not to be in the best interest of the welfare of man.
"*Insect*" or "*insect life*" means any species of the class Insecta.
"*Person*" means an individual, corporation, partnership, trust, association, or any other private entity, or any officer, agent, department, or instrumentality of the federal government, of any state or political subdivision thereof, or of any foreign government.
"*Plant*" or "*plant life*" means any member of the plant kingdom, including spores, leaves, stems, branches, flowers, seeds, roots, and other parts or products thereof.
"*Proposed species*" means any candidate species authorized by the Board for consideration for listing as endangered or threatened under the Endangered Plant and Insect Species Act.
"*Species*" includes any species or variety of plant life or insects.
"*Take*" means, in reference to plants and insects, to collect, pick, cut, or dig up for the purpose of resale.
"*Threatened species*" means any species determined by the Board to be likely to become an endangered species within the foreseeable future throughout all or a significant portion of its native range. (1979, c. 372; 1985, c. 326; 1989, c. 553; 1990, c. 369.)

§ 3.1-1022. Powers and duties of Commissioner; appointment of State Botanist and assistants; cooperative agreements; programs; permits; funding; when endangered or threatened species may be taken, etc. – For the purpose of effectively administering this chapter, the Commissioner shall have the following powers and duties:
A. It shall be the duty of the Commissioner of Agriculture and Consumer Services to exercise or perform the powers and duties imposed upon him by this chapter.
B. It shall be the duty of the Commissioner to appoint a competent person as State Botanist and such other assistants as he deems necessary, who shall advise and assist the Commissioner in carrying out the provisions of this chapter.

C. In carrying out the program authorized by this chapter the Commissioner may enter into cooperative agreements with federal and state agencies, political subdivisions of the Commonwealth or with private persons or groups for the administration and management of any area or program established under this chapter.
D. The Commissioner may establish programs as are deemed necessary for the management of endangered or threatened species. The Commissioner may issue a permit under certain circumstances for the taking, possessing, buying, selling, transporting, exporting or shipping of any endangered or threatened species which appears on the state list of endangered or threatened species for scientific, biological, or educational purposes or for propagation in order to ensure their survival, provided that such action does not violate federal laws or regulations.
E. The Commissioner may accept funds for a special account or other gifts or grants from any source for use in the furtherance of this chapter. Funds collected for services on articles determined by the Commissioner to be beyond the scope of this chapter shall revert to the fund from which expended.
F. The Commissioner may enter into reciprocal agreements with responsible officers of other states under which any part of this chapter would benefit.
G. Upon good cause shown and where necessary to alleviate damage to property, the impact on progressive development, or protect human health, endangered or threatened species on the state list may be removed, taken, or destroyed but only in accordance with a permit issued by the Commissioner provided that such action does not violate federal laws or regulations. (1979, c. 372; 1985, c. 326.)

§ 3.1-1023. Prohibitions on taking, possession, etc., of endangered or threatened species. – It shall be unlawful for any person to dig, take, cut, process, or otherwise collect, remove, transport, possess, sell, offer for sale, or give away any species native to or occurring in the wild in Virginia that are listed in this chapter or rules and regulations promulgated pursuant thereto as threatened or endangered, other than from such person's own land, except in accordance with this chapter or the rules and regulations adopted pursuant to this chapter by the Board. (1979, c. 372.)

§ 3.1-1024. Power of Commissioner to regulate sale and movement of endangered and threatened species. – A. The Commissioner or his assistants are hereby authorized to stop sale, to seize or return to point of origin at the owner's expense, any endangered or threatened species, or part thereof possessed, transported or moved within this Commonwealth or brought into this Commonwealth from any place outside thereof if such is found by him or his duly authorized agents to be in violation of this chapter or the rules and regulations promulgated pursuant thereto. Products or species seized may be disposed of at the discretion of the Commissioner.
B. The Commissioner may demand of any person possessing endangered species or parts thereof to present such species or parts thereof for inspection and to give full information as to its origin and destination.
C. In those situations in which permission to enter is denied by the owner or occupant, the Commissioner is hereby authorized to seek an administrative inspection warrant signed by any judge of any circuit court whose territorial jurisdiction encompasses the property to be inspected, authorizing the Commissioner or his designated representative to make inspections or develop other biological data for the proper management of any endangered or threatened species. The issuance of an administrative inspection warrant pursuant hereto shall conform, insofar as is practicable, to the requirements and guidelines set forth in Chapter 24 (§ 19.2-393 et seq.) of Title 19.2 relating to the issuance of inspection warrants in connection with the manufacturing or emitting of a toxic substance. (1979, c. 372.)

§ 3.1-1025. Powers and duties of Board; listing of rare species; further powers of Commissioner. – A. The Board may prescribe and adopt regulations including, but not limited to, the listing of endangered or threatened species, their taking, quotas, seasons, buying, selling, possessing, monitoring of movement, investigating, protecting, or any other need in furtherance of the purposes of this chapter.

B. The Commissioner may permit the taking of a threatened species when the Board has determined that its abundance in the Commonwealth justifies a controlled harvest which is not in violation of federal laws or regulations. The Commissioner shall take the necessary action to conserve, protect, restore, or propagate endangered and threatened species.
C. The Board may adopt regulations to permit and control the commercial harvest of certain threatened species that would prevent that species from becoming endangered or extinct.
D. The Commissioner may conduct investigations of species of plants and insects, in order to develop information relating to the population, distribution, habitat needs, limiting factors, and other biological and ecological data in order to determine management measures necessary to assure their continued ability to sustain themselves successfully. As a result of this investigation and recommendations received regarding candidate species from the Director of the Department of Conservation and Recreation and from other reliable data, the Board shall approve proposed species to be added to or deleted from the list of endangered species or the list of threatened species, or to be transferred from one list to the other. (1979, c. 372; 1985, c. 326; 1989, c. 553; 1990, c. 369.)

§ 3.1-1026. License required to buy threatened species; records of purchases. – A. It shall be unlawful for any person to buy any threatened species or part thereof, which is listed in this chapter or rules and regulations promulgated pursuant thereto, without first obtaining a license to do so from the Commissioner. Provided, however, that the provisions of this section shall not apply to the purchase or sale of real property upon which such threatened species or part thereof may be located. Application forms shall be provided by the Commissioner and shall be completed and returned with a fee of ten dollars made payable to the Treasurer of Virginia. Licenses shall expire on December 31 annually and there shall be no abatement in the annual fee. Licenses may be revoked at any time by the Commissioner for good cause.
B. The buyer of any threatened species or part thereof shall maintain and keep records of all purchases for the preceding twelve months on forms prescribed by the Commissioner. Records shall be sent or otherwise provided to the Commissioner within thirty days following the expiration of the license. Records shall be made available to the Commissioner or his assistants during normal business hours for examination or information. (1979, c. 372.)

§ 3.1-1027. Wild ginseng declared threatened plant species; license; harvesting season. – The indigenous plant, *Panax quinquefolius* L., of the Araliaceae family, commonly referred to as ginseng, is hereby declared a threatened plant species when it occurs in the wild. All persons buying wild ginseng or otherwise accepting this plant or part thereof for resale shall be licensed to do so and shall acquire wild ginseng or parts thereof in accordance with this chapter and the rules and regulations established by the authority of this chapter. The wild ginseng harvest season shall be August 15 to December 31 annually. If any person takes wild ginseng, other than from his own land, on any other date it shall be deemed a violation of this chapter. (1979, c. 372; 1983, c. 121.)

§ 3.1-1027.1. Export certificate required for export of ginseng; exception; records. – All persons who have ginseng either wild or artificially propagated in any quantity and who wish to export any amount out of the Commonwealth shall obtain an export certificate from the Department of Agriculture and Consumer Services. The provisions of this paragraph shall not apply to persons exporting ginseng for personal or individual use in quantities not exceeding eight ounces in any calendar year. To obtain an export certificate, an individual shall keep accurate records of the year of harvest and the county of origin of the ginseng. In the case of dealers, a person shall keep accurate records of purchases, quantity purchased, whether the ginseng was wild or cultivated, county of origin, and the name of the seller. Such records shall be presented to the Commissioner or his assistants for inspection. (1983, c. 121.)

§ 3.1-1028. Virginia birch declared endangered species. – Virginia birch or round-leaf birch, *Betula uber* of the Betulaceae family, is hereby declared an

endangered species as defined herein and is subject to this chapter in order to preserve those specimens known to occur in this Commonwealth. (1979, c. 372.)

§ 3.1-1029. Enforcement of chapter; summons. – Any game warden or law-enforcement officer as defined in § 9.1-101, excluding certain Alcoholic Beverage Control Board members, may enforce this chapter and the regulations promulgated under this chapter as well as those who are so designated by the Commissioner. Those designated by the Commissioner are hereby authorized to issue a summons to any violator of the provisions of this chapter to appear at a time and place to be specified in such summons. (1979, c. 372.)

§ 3.1-1030. Penalty. – Any person who violates any provision of this chapter or the rules and regulations promulgated thereto shall be guilty of a Class 1 misdemeanor. (1979, c. 372; 1985, c. 326.)

Appendix K

Scorecard For Candidate Natural Area Preserves

The Natural Heritage Program staff consider a wide range of criteria when evaluating properties for inclusion in the Natural Area Preserve System. This scorecard was devised as a means to compare sites to ensure the best possible allocation of resources when acquiring new preserves.

Criterion	Score	Notes
1) B-rank: What is the Natural Heritage Biodiversity Rank of the site? Assign value below based on the site's B-rank. Maximum score: 15. B1=15 B4=1 B2=10 B5=0 B3=5		
2) No. & Quality of EOs: How many element occurrences are known for the site and what is the quality of those occurrences? Assign the value below for each occurrence based on it's EO-rank. Sum these values. Maximum score: 15 A-rank=4 C-rank=1 AB-rank=3 CD-rank=0.5 B-rank=2 D-rank=0 BC-rank=1.5 E-rank=1		
3) Community Representation: To what extent does the site support exemplary natural communities that are not well protected in Virginia? Maximum score: 10. • Supports communities not found on other protected lands = 10 • Supports communities found on limited number (1–10) of protected lands = 5 • Supports communities well represented (10+) on other protected lands = 0		
4) Rare Species Representation: To what extent does the site support rare species that are not well protected in Virginia? Maximum score: 5. • Supports rare species not found on other protected lands = 5 • Supports rare species found on limited number (1-10) of protected lands = 3 • Supports rare species well represented (10+) on other protected lands = 0		
5) Size & Natural Condition: Are the size and natural condition of the site adequate to protect and allow for management of conservation targets? Maximum score: 5 • Size and condition are adequate to fully protect & manage targets = 5 • Size and condition are uncertain to provide for full protection and management of conservation targets = 3 • Size and condition are unlikely to allow full protection & management of the conservation targets = 0		
6) Proximity: Is the site/tract adjacent to or in close physical or functional proximity (e.g. upstream or upslope) to other protected managed areas and would it expand the protection of natural heritage resources? Maximum score: 5 • Close proximity and supports NHRs = 5 • Close proximity, important buffer, but no NHRs = 3 • No physical or functional proximity to existing natural area = 0		

Criterion	Score	Notes
7) Previous land-use: Are natural heritage resources threatened by the effects of previous land-uses? If so, will it take a significant effort to abate these threats through restoration efforts? Maximum score: 5 • No threat = 5 • Low threat = 4 • Medium threat = 2 • High threat = 0		
8) Fire management: Is fire management needed and feasible? If so, what are the complexity levels of safety, smoke, and escape potential involved? Maximum score: 5 • No fire management needed = 5 • Fire management is needed, low complexity = 4 • Fire management is needed, moderate complexity = 3 • Fire management is needed, high complexity = 2 • Fire management is needed but not feasible, complexity too high = 0		
9) Invasive Species: What is the level of invasive species management needed and how soon can a maintenance level of control be attained? Maximum score: 5 • Invasive species pose no threat to NHRs = 5 • Minor invasive problems; can control in 1-3 years = 4 • Significant invasive problems; can control in 3-6 years = 2 • Major invasive problems; probably cannot be controlled at a reasonable cost = 0		
10) Restoration Potential: Is there potential for restoring degraded or lost communities or natural values? Maximum score: 5 • Site is in excellent condition; no restoration needed = 5 • Site has high potential for habitat restoration = 4 • Site has moderate potential for habitat restoration = 2 • No potential for restoration = 0		
11) Access restrictions: Are there access restrictions to the site that will impair ability to properly manage the property? Maximum score: 5 • No apparent access restrictions = 5 • Some access restrictions = 3 • Major access restrictions = 0		
12) Applicant Qualifications: Does the applicant have the capability to manage and protect the site? Maximum score: 10 • Applicant has proven experience with natural community/rare species management = 10 • Applicant has land management experience = 5 • Applicant has no proven land management experience = 0		
13) Contingencies: Will the acquisition of the property or easement be contingent upon special arrangements such as farming, grazing, housing, hunting, or timber rights? Maximum score: 5 • No = 5 • Yes, but short-term or not likely to significantly interfere with management of the site = 3 • Yes, contingencies are long-term and may significantly interfere with management of the site = 0		
14) In-holdings: Does the property have private in-holdings? Maximum score: 5 • No = 5 • Yes but not likely to significantly interfere with management of the site = 3 • Yes and likely to significantly interfere with management of the site = 0		
TOTAL SCORE		

Other Considerations For Land Protection Projects

Primary considerations: These questions must be asked and must receive a yes answer before proceeding with a land protection project.

- **availability of property:** Is the landowner willing to sell or donate the property or easement?
- **availability of funds:** Does DCR have the funds available to acquire the property or easement?

Secondary considerations: These questions should be asked before proceeding with a land protection project but a negative answer does not necessarily stop a project. Positive responses may have significant influence over the decision to proceed.

- **vulnerability of site:** Is the property likely to become unavailable or significantly degraded if not protected within the next five years?
- **vulnerability of natural heritage resources:** Are the Natural Heritage Resources on the site likely to be lost from Virginia or significantly degraded if not protected within the next five years?
- **completeness of project:** Will this project result in the total protection of a conservation site?
- **geographic representation:** Will this project help DCR have better geographic coverage by establishing a preserve in a locality, watershed, PDC or state senatorial district, which currently is under-represented?
- **other conservation objectives:** Will this project help DCR meet other important conservation objectives such as wetland restoration, Chesapeake Bay watershed protection, ecoregional planning targets or endangered species recovery goals?
- **other values:** Will this project result in other tangible public benefits such as providing significant outdoor recreational opportunities?
- **cost vs. benefit:** Are the costs worth the conservation benefits? Would there be greater benefits if the funds were expended on another project?
- **outside funding sources:** Are there other funding sources to help cover the costs of the project? For every dollar DCR invests, what will be the value of the return when these other sources are considered? (Include donated properties and easements.)

Appendix L

Land Trusts that Operate in Virginia

An increasing number of land trusts are being established in Virginia each year. This list is provided by the Virginia Department of Conservation and Recreation's Office of Land Conservation, which serves as a clearinghouse for information on land protection options in Virginia. For additional information and the most up-to-date list of Virginia land trusts visit the website:

www.dcr.state.va.us/olc/

Accokeek Foundation
3400 Bryan Point Rd
Accokeek, MD 20607-9676
Phone: (301) 283-2113
Fax: (301) 283-2049
Area of Operation: Maryland, Virginia, West Virginia, and the District of Columbia
Email: accofound@accokeek.org
www.accokeek.org

Appalachian Trail Conference
P.O. Box 807
Harpers Ferry, WV 25425-0807
Phone: (304) 535-6331
Fax: (304) 535-2667
Area of Operation: The Appalachian Mountains/Trail
Email: atc-varo@appalachiantrail.org
www.appalachiantrail.org

Association for the Preservation of Virginia Antiquities
204 W. Franklin St.
Richmond, VA 23220
Phone: (804) 648-1899
Area of Operation: Eastern Shore to mountains of Blackburg
Email: clong@apva.org
www.apva.org/apva/index.html

Blue Ridge Foothills Conservancy
HC 6 Box 215
Madison, VA 22719-9711
Phone: (540) 923-9980
Fax: (540)-923-4841
Area of Operation: Madison and Green Counties
Email: blueridgeconserve@nexet.net
www.blueridgeconserve.com

Burwell-van Lennep Foundation
P.O. Box 245
Millwood, VA 22646-0245
Phone: (540) 837-1353
Fax: (540) 837-1352
Area of Operation: Clarke County
Email: cburl@shentel.net

Cedar Creek Battlefield Foundation
P.O. Box 229
Middletown, VA 22645
Phone: (540) 869-2064 Toll-free: (888) 628-1864
Fax: (540) 869-1438
Area of Operation: Cedar Creek Battlefield, Middletown, Va.
Email: cedarcrk@visuallink.com
www.cedarcreekbattlefield.org

Central Virginia Battlefields Trust
64 Brittany Lane
Stafford, VA 22554-7687
Phone: (703) 395-4236
Area of Operation: Fredericksburg and Spotsylvania Counties
Email: webmaster@cvbt.org
www.cvbt.org

Chesapeake Bay Foundation
1108 East Main St, Suite 1600
Richmond, VA 23219
Phone: (804) 780-1392
Area of Operation: Chesapeake Bay watershed
Email: jlerch@cbf.org
www.cbf.org

Civil War Preservation Trust
1331 H St NW Ste 1000
Washington, DC 20005-4745
Phone: (202) 367-1861
Fax: (202) 367-1865
Area of Operation: Civil War battlefields
Email: civilwartrust@civilwar.org
www.civilwar.org

500-Year Forest Foundation
1133 Old Abert Road
Lynchburg, VA 24503-6455
Phone: (804) 384-2324
Fax: (804) 384-3268
Area of Operation: Virginia
Email: info@500yearforest.org
www.500yearforest.org

Friends of Chesterfield's Riverfront
P.O. Box 2158
Chesterfield, VA 23832
(804) 796-6091
Fax (804) 796-6092
Area of Operation: James and Appomattox Riverfronts in Chesterfield County
Email riverfronts@earthlink.net
www.co.chesterfield.va.us / riverfront /

Friends of Dragon Run
P.O. Box 882
Gloucester, VA 23061-0882
Phone: (804) 694-5415
Fax:
Area of Operation: Dragon Run watershed: King and Queen, Gloucester, Middlesex, and Essex Counties
Email: katgreg03@rivnet.net
www.dragonrun.org

Hampton Land Conservancy
4896 Burnham Rd.
Richmond, VA 23234
Phone: (804) 275-6476
Fax: (804) 275-6476 (call prior to Faxing)
Area of Operation: Hampton and adjoining localities
Email: tmatteson1@mindspring.com

Historic Green Springs
P.O. Box 1685
Louisa, VA 23093-1685
Phone: (540) 967-1099
Fax: (540) 967-1308
Area of Operation: Green Springs Historic District, Louisa County

Historic Polegreen Church Foundation
P.O. Box 2111
Mechanicsville, VA 23116
Area of Operation: Richmond battlefield area

James River Association
P.O. Box 909
Mechanicsville, VA 23111
Phone: (804) 730-2898
Fax: (804) 730-2898
Area of Operation: James River watershed
Email: pjackson@jamesriverassociation.org
www.jamesriverassociation.org

Jamestown Compact Land Trust
P.O. Box 2272
Middleburg, VA 20118-2272
Phone: (540) 687-3654
Fax: (540) 687-6632
Area of Operation: Mosby Heritage Area - Loudon and Fauquier Counties
Email: tdodson@jamestowncompact.org
www.jamestowncompact.org

Kernstown Battlefield Association
P.O. Box 1327
Winchester, VA
Area of Operation: Kernstown Battlefield, Winchester and Frederick, Va.
Email: kba@kernstownbattle.org
www.kernstownbattle.org

Land Trust of Virginia
P.O. Box 14
Middleburg, VA 20118
Phone: (540) 687-8441
Fax: (540) 687-4619
Area of Operation: Loudon, Clarke and Madison Counties
Email: bruce@presidential.com
www.landtrustva.org

Mathews County Land Conservancy
P.O. Box 306
Mathews, VA 23109-0306
Phone: (804) 725-9685
Fax: (804) 725-1225
Area of Operation: Mathews County
Email: lcsmclc@ccsinc.com

McLean Land Conservancy
P.O. Box 224
McLean, VA 22101
(703) 241-1095
Fax 703/241-1560
Area of Operation: McLean area, including McLean, Great Falls, and parts of Falls Church
email awhyte@bellatlantic.net

Middle Peninsula Land Trust
P.O. Box 585
Mathews, VA 23109-0585
Phone: (804) 725-4622
Fax: (804) 725-4622
Area of Operation: Essex, Gloucester, King and Queen, King William, Mathews and Middlesex counties
Email: layer@inna.net

National Committee for the New River
4 N. Jefferson Ave.
P.O. Box 1480
West Jefferson, NC 28694
Phone: (336) 246-4871
Fax: (336) 246-6433
Area of Operation: New River watershed
Email: ncnr@fastransit.net
www.ncnr.org

National Forestry Land Trust
374 Maple Avenue
Vienna, VA 22180-4718
Phone: (703) 255-2700
Fax: (703) 281-9200
Area of Operation:
Email: argow@nwoa.net
www.nationalforestry.net

National Trust for Historic Preservation
1785 Massachusetts Ave, NW
Washington, DC 20036
Phone: (202) 588-6000
www.nationaltrust.org

New River Land Trust
P.O. Box 11057
Blacksburg, VA 24062-1057
Phone: (540) 951-1704
Fax: (540) 951-0223
Area of Operation: New River Watershed
Email: betho@i-plus.net

Northern Virginia Conservation Trust
4022 Hummer Road
Annandale, VA 22003-2403
Phone: (703) 354-5093
Fax: (703)-354-5169
Area of Operation: Northern Virginia
Email: pgilbert@nvct.org
www.nvct.org

Piedmont Environmental Council
P.O. Box 460
Warrenton, VA 20188-0460
Phone: (540) 347-2334
Fax: (540) 347-9003
Area of Operation: Albemarle, Clarke, Culpeper, Fauquier, Greene, Loudoun, Madison, Orange, and Rappahannock Counties
Email: pec@pecva.org
www.pecva.org

Potomac Appalachian Trail Club
118 Park St SE
Vienna, VA 22180-4608
Phone: (703) 242-0693
Fax: (703) 242-0968
Area of Operation: Virginia, Maryland, West Virginia, Pennsylvania, and Washington, DC
Email: info@patc.net
www.patc.net

Potomac Conservancy
1730 N Lynn St Ste 403
Arlington, VA 22209-2004
Phone: (703) 276-2777
Fax: (703) 276-1098
Area of Operation: Potomac watershed
Email: webmaster@potomac.org
www.potomac.org

Preservation Alliance of Virginia
108 E. Grace St., Suite 1
Richmond, VA 23219
Phone: (804) 421-9800
Fax: (804) 421-9810
Area of Operation: Virginia
Email: pav@vapreservation.org
www.vapreservation.org

Rivanna Conservation Society
P.O. Box 141
Palmyra, VA 22963-0141
Phone: (434) 589-7576
Area of Operation:
Email: rcs@avenue.org
avenue.org/rcs

Rockbridge Area Conservation Council
P.O. Box 564
Lexington, VA 24450
Phone: (540) 463-2330
Area of Operation: Rockbridge County and immediate surrounding area
Email: RACC@rockbridge.net
http://organizations.rockbridge.net/racc/

Scenic Virginia
P.O. Box 17606
Richmond, VA 23226
Phone: (804) 282-5522
Fax: (804) 282-5506
Area of Operation: Virginia
Email: email@scenicva.org
www.scenicva.org

Shenandoah Valley Battlefields Foundation
P.O. Box 897
New Market, VA 22844
Phone: (540) 740-4545
Fax (540) 740-4509
Area of Operation: Shenandoah Valley
Email: jhutch@shentel.net
www.shenandoahatwar.org

The Nature Conservancy of Virginia
490 Westfield Rd
Charlottesville, VA 22901-1633
Phone: (804) 295-6106
Fax: (804) 979-0370
Area of Operation: Virginia
Email: dwhite@tnc.org
www.nature.org/virginia

Trevilian Station Battlefield Foundation
P.O. Box 124
Trevilians, VA 23170
(804) 589-8989,(540) 832-2862
Area of Operation: Trevilian Station Battlefield
www.trevilianbattlefield.org

Valley Conservation Council
P.O. Box 2335
Staunton, VA 24402-2335
Phone: (540) 886-3541
Fax: (540) 886-1380
Area of Operation: Shenandoah Valley - eleven counties
Email: vcc@cfw.com
www.valleyconservation.org

Virginia Outdoors Foundation
302 Royal Lane
Blacksburg, VA 24060
Phone: (540) 951-2822
Fax: (540) 951-2695
Area of Operation: Virginia
Email: tvance@virginiaoutdoorsfoundation.org
www.virginiaoutdoorsfoundation.org

Waterford Foundation
P.O. Box 142
Waterford, VA 20197-0142
Phone: (540) 882-3018
Fax: (540) 882-3921
Area of Operation: Waterford National Historic Landmark District, Coctania River, and northern Loudoun County
Email: info@waterfordva.org
www.waterfordva.org

Western Virginia Land Trust
722 First Street, Suite L
Roanoke, VA 24016-4120
Phone: (540) 985-0000
Fax: (540) 985-0000
Area of Operation: Western Virginia
Email: info@westernvirginialandtrust.org
www.westernvirginialandtrust.org

Williamsburg Land Conservancy
5000 New Point Road, Suite 1202
Williamsburg, VA 23188-9411
Phone: (757) 565-0343
Fax: (757) 565-0049
Area of Operation: The Historic Triangle - Williamsburg, Yorktown, Jamestown
Email: carenschu@widowmaker.com
www.williamsburglandconservancy.org