A NATURAL HERITAGE INVENTORY OF THE ROCK OUTCROPS OF SHENANDOAH NATIONAL PARK

FINAL REPORT

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**This report is dedicated to Charles E. (Mo) Stevens,
whose field work provided the foundation of our knowledge of rare
plants and natural communities in Shenandoah National Park.**

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KEY PROJECT DATA

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ABSTRACT

Rock exposures comprise approximately two percent of Shenandoah National Park's (SHEN) more than 78,400 ha (196,000 ac)(Young, 2006). Many of the largest of these outcrops have always been popular visitor destinations due to the dramatic scenery and vistas they afford, and some areas have received heavier impacts in recent years due to the increased popularity of rock climbing.

SHEN's rock outcrops support numerous rare plants and animals and significant natural communities. This project entailed a comprehensive inventory of these natural heritage resources at 50 sites where conflicts between resource preservation and visitor use are most likely to occur. In this report, the natural heritage resources found during a two-year field inventory (2005-2006) conducted by the Virginia Department of Conservation and Recreation's Division of Natural Heritage (DCR-DNH) are described. Specific threats to the resources are identified, and management recommendations are made.

Project ecologists identified 54 significant occurrences of 11 community types at 44 sites, including 26 occurrences that were previously undocumented. Also included were five occurrences of a community type previously unknown from the SHEN and seven occurrences of two nonvascular boulderfield communities that were defined on the basis of data collected during the project. Nine of the 11 targeted natural community types are globally rare and two are entirely endemic to the park. Indirect gradient analysis using non-metric multidimensional scaling (NMDS) ordination indicates that geologic substrate, soil chemistry, elevation, and slope position are the most important environmental factors influencing the composition and distribution of vegetation on SHEN rock outcrops.

Project botanists located 76 rare plant populations at the 50 sites, comprising 21 species. Nine of the populations were previously unknown. No rare plant species previously unknown to occur in the park were found. Project zoologists identified 9 populations of five rare invertebrate animals and one population of a rare bat, all of which were new to SHEN.

Collaborative efforts between National Park Service and DCR-DNH biologists to collect lichens resulted in identifications by specialists of six taxa potentially new to science, seven species apparently new to Virginia, 38 species new to SHEN, and a number of geographically disjunct taxa. DCR-DNH identified six lichen taxa for inclusion on the state rare lichen list.

The project stewardship biologist visited 45 of the 50 sites and developed a threat assessment of the study sites based on apparent human impacts and threat level of invasive plants. DCR-DNH botanists performed this task at the other five sites. Human impacts and invasive plants were identified as the primary threats to the natural heritage resources of SHEN's rock outcrops prior to the study. Thirty-one study sites were found to have at least some human impact as a threat to outcrop resources. Trampling by visitors is the foremost human impact. Trampling is associated with all other visitor uses at SHEN rock outcrops: hiking, camping, rock climbing. Frequent visitation to outcrops results in loss of vegetation, lichen cover, and soils. Sites with high levels of visitation exhibit a high proportion of bare rock. Remote sites or sites with no formal access have well-developed soils and plant and/or lichen communities on their outcrops. Invasive plants are another major threat to outcrop resources. Twenty study sites were found to have invasive plants as a threat to outcrop resources. To summarize the human impact and invasive plant threats, a threat assessment rank was assigned to each site. The threat assessment rank will assist park staff in prioritizing management actions. Management recommendations for each site were developed to address the specific threats identified by all DCR-DNH project researchers.

This project is part of a larger National Park Service project to manage SHEN outcrop resources and their human impacts. Other components of this larger project include the development of a classification of the

geologic composition and condition of the outcrops sites and surveys to determine the type and extent of recreational activities at outcrop sites. All of these component projects will provide input to SHEN personnel in developing a Rock Outcrop Management Plan (ROMP) for the park.

EXECUTIVE SUMMARY

This report documents the results of fieldwork conducted in 2005 and 2006 to survey 50 rock outcrop study sites in Shenandoah National Park (SHEN) for rare plants and animals and significant natural communities. The study sites and the natural heritage resources found at each site are described in detail. Threats to these natural heritage resources are evaluated and management recommendations to protect the resources are provided. This work was conducted by biologists from the Virginia Department of Conservation and Recreation, Division of Natural Heritage.

SHEN has one species, the Shenandoah salamander (*Plethododon shenandoah*), listed as endangered under the federal Endangered Species Act of 1973, as amended (Act), and by the Commonwealth of Virginia. The Shenandoah salamander is endemic to SHEN, and five sites are known. The Peregrine Falcon (*Falco peregrinus*), is listed as threatened by the Commonwealth of Virginia. Three sites are known for the Peregrine Falcon. All of these sites were known prior to this study; no new occurrences of federal or state listed species were found in 2005 or 2006.

Over the course of the project, ecologists visited 54 significant occurrences of 11 community types at 44 sites, including 26 occurrences that were previously undocumented. Also included were five occurrences of a community type previously unknown from SHEN, and seven occurrences of two nonvascular boulderfield communities that were defined on the basis of data collected during the project. Nine of the 11 targeted natural community types are globally rare and two are entirely endemic to the park. Indirect gradient analysis using non-metric multidimensional scaling (NMDS) ordination indicates that geologic substrate, soil chemistry, elevation, and slope position are the most important environmental factors influencing the composition and distribution of vegetation on SHEN rock outcrops.

Project botanists located 76 rare plant populations at the 50 sites, comprising 21 species. Nine of the populations were previously unknown. No rare plant species previously unknown to occur in the park were found. Project zoologists identified 9 populations of five rare invertebrate animals and one population of a rare bat, all of which were new to SHEN.

Collaborative efforts between National Park Service and DCR-DNH biologists to collect lichens resulted in identifications by specialists of six taxa potentially new to science, seven species apparently new to Virginia, 38 species new to SHEN, and a number of geographically disjunct taxa.

Thirty-one study sites were found to have at least some human impact as a threat to outcrop resources. Trampling by visitors is the foremost human impact. Twenty study sites were found to have invasive plants as a threat to outcrop resources. To summarize the human impact and invasive plant threats, a threat assessment rank was assigned to each site. The threat assessment rank will assist park staff in prioritizing management actions. Management recommendations for each site were developed to address the specific threats identified by all DCR-DNH project researchers.

The following management recommendations are made:

- Close or partially close access to some outcrops (15 sites).
- Close social trails (12 sites).
- Prohibit rock climbing (2 sites).

- Prohibit camping (8 sites).
- Re-route official SHEN trails (7 sites).
- Manage or monitor invasive plants and annually monitor post-treatment effects of these actions (18 sites).
- Consider allowing prescribed wildfire (8 sites).
- Implement an education program and install signs to inform visitors of the need for natural resource protection (20 sites).
- Monitor the status of rare plants or natural communities (32 sites).
- Schedule periodic surveys to assess invasive plants where they are present but do not currently require management (3 sites).
- Monitor visitor use (7 sites).
- Install a permanent station for rock climbing (1 site).
- Refine trail and viewshed maintenance practices to consider the presence of rare plants and natural communities (3 sites).
- Remove brush piles from the vicinity of the outcrops (1 site).
- Close or restrict use of overlook along horse trail (1 site).
- No management required (3 sites).

ACKNOWLEDGMENTS

This project was made possible through funding provided by the National Park Service (NPS), U.S. Department of the Interior.

Wendy Cass, Shenandoah National Park (SHEN) Botanist, and Steven H. Bair, SNP Backcountry and Wilderness Branch Chief, administered this project for NPS. Assistance with fieldwork was provided by Wendy B. Cass, Nicholas A. Fisichelli, Rachel E. Medley, Joanna M. Reuter, and Melissa Rudacille. Their help is greatly appreciated.

Many of the staff of the Virginia Department of Conservation and Recreation, Division of Natural Heritage (DCR-DNH), participated in the inventory or assisted in the completion of this report. Staff who, in addition to the authors, conducted fieldwork for this project are Zoologist Steven M. Roble, Natural Area Zoologist Christopher S. Hobson, Botanist John F. Townsend, and Zoology Laboratory Assistants Maureen Dougherty, Arthur Evans, and Ryan D. Knisley. Laboratory Assistant Arthur Evans sorted and identified the majority of the invertebrate specimens. Dr. Oliver Flint of the U.S. National Museum graciously identified collected Trichoptera specimens. John F. Townsend reviewed portions of a draft copy of this report. J. Christopher Ludwig handled the overall administration of the project, and Patricia A. Jarrell managed financial affairs. Support in the area of data processing was provided by Cathy L. Milholen, Megan Molique, Red Thompson, and Megan Rollins. Faye B. McKinney made our work easier by handling the multitude of logistical and administrative tasks involved.

SIGNIFICANT FINDINGS

- Ecologists documented 54 significant occurrences of 11 natural community types at 44 sites.

- All but two of the 54 significant occurrences are of globally rare (G1- or G2-ranked) communities, and 26 of the occurrences were previously undocumented. One of the 11 community types was not previously known from the Shenandoah National Park (SHEN).

- Classification work for this project resulted in modifications to two community types in the National Vegetation Classification, and the circumscription of two new Nonvascular Vegetation (lichen) communities.

- The High-Elevation Greenstone Barren and Central Appalachian Mafic Boulderfield communities are endemic to SHEN. The park also harbors six of the eleven known occurrences of the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community.

- Botanists located 76 rare plant populations, comprising 21 species, at 31 sites. In addition, 42 populations of uncommon (watchlist) plants were located, comprising 12 species. One of these uncommon species, northern prickley-ash (*Zanthoxylum americanum*), is new to the park.

- Nine of the 53 populations were previously unknown. These are bristly sarsaparilla (*Aralia hispida*) at Marys Rock, Pinnacles, and Brown Mountain; purple clematis (*Clematis occidentalis* var. *occidentalis*) at Crescent Rock South; hazel dodder (*Cuscuta coryli*) at Bettys Rock; Appalachian fir-clubmoss (*Huperzia appalachiana*) at Little Stony Man; marsh muhly (*Muhlenbergia glomerata*) at Franklin Cliffs North; red raspberry (*Rubus idaeus* ssp. *strigosus*) at Bettys Rock; and three-toothed cinquefoil (*Sibbaldiopsis tridentata*) at Blackrock Central District.

- Six rare plant populations known prior to this study were searched for but could not be relocated: hazel dodder (*Cuscuta coryli*) at Dickey Ridge, Gooney Manor Overlook, Little Devils Stairs, and Halfmile Cliff and Rand's goldenrod (*Solidago randii*) at Pass Mountain and Marys Rock.

- Colonies of Appalachian fir-clubmoss *(Huperzia appalachiana*) at several sites could not be relocated, had declined in population size from earlier reports, and/or appeared sickly. In some cases, declines may be due to a change in microhabitat resulting from the die-off of eastern hemlock (*Tsuga canadensis*). Trampling, wildfire, global warming, and acid deposition may also be contributing factors.

- Lichen collection at four sites representative of several characteristic outcrop and boulderfield habitats resulted in the identification by specialists of approximately 90 taxa, including six taxa potentially new to science, seven species apparently new to Virginia, 38 species new to SHEN, and a number of geographically disjunct taxa. The Department of Conservation and Recreation's Division of Natural Heritage identified six lichen taxa for inclusion on the state rare lichen list.

- Five species of rare invertebrate animals previously unknown to occur in SHEN were collected: a noctuid moth (*Hadena ectypa*) collected at Gooney Manor, a currant spanworm moth (*Itame ribearia*) collected at Crescent Rock Overlook, South Marshall Cliff, and Blackrock Central

District, Herodias underwing moth (*Catocala herodia gehardi*) collected at Blackrock South District, and a philopotamid caddisfly (*Wormalia thyria*) collected at Dickey Hill.

- One rare mammal previously unknown from SHEN was observed. This is the eastern small-footed myotis (*Myotis leibii*), seen at Nakedtop on 30 August 2006.

- 32 uncommon (watchlist) animals were collected or observed. One of these is the smooth green snake (*Liochlorophis vernalis*); the others are invertebrates.

- 31 study sites were found to have at least some human impact as a threat to outcrop resources. Trampling by visitors is the foremost human impact.

- 20 study sites were found to have invasive plants as a threat to outcrop resources. Thirteen invasive species were identified as requiring management.

MANAGEMENT RECOMMENDATIONS

Thirty-one study sites were found to have at least some human impact as a threat to outcrop resources. Trampling by visitors is the foremost human impact. Twenty study sites were found to have invasive plants as a threat to outcrop resources. To summarize the human impact and invasive plant threats, a threat assessment rank was assigned to each site. The threat assessment rank will assist Park staff in prioritizing management actions. Management recommendations for each site were developed to address the specific threats identified by all DCR-DNH project researchers. In addition, further zoology inventory is recommended for three species.

The following management recommendations are made:

- Close or partially close access to some outcrops (15 sites): Marys Rock, Little Stony Man, Stony Man, Old Rag Summit East, Old Rag Summit West, Crescent Rock Overlook, Hawksbill Summit, Franklin Cliffs Overlook, Blackrock Central District, Bearfence Mountain, Hightop, Loft Mountain, Blackrock South District.

- Close social trails (12 sites): Gooney Manor Overlook, North Marshall Summit, Overall Run Falls, Pass Mountain, Marys Rock, Little Stony Man, Crescent Rock South, Hawksbill Summit, Old Rag Summit West, Franklin Cliffs Overlook, Hightop.

- Prohibit rock climbing (2 sites): North Marshall Summit, Hawksbill North Slope Outcrops.

- Prohibit camping (8 sites): North Marshall Summit, Overall Run Falls, Pass Mountain, Marys Rock, Old Rag Summit East, Old Rag Summit West, Old Rag Southside, Hawksbill North Slope Outcrops.

- Re-route official SHEN trails (7 sites): South Marshall Cliffs, Pass Mountain, Little Stony Man, White Oak Canyon, Bettys Rock, Bearfence Mountain, Loft Mountain.

- Manage or monitor invasive plants and annually monitor post-treatment effects of these actions (18 sites): Dickey Ridge, Big Devils Stairs, Overall Run Falls, Little Stony Man, Stony Man, White Oak Canyon, Bettys Rock, Crescent Rock Overlook, Crescent Rock South, Hawksbill North Slope Outcrops, Hawksbill Summit, Franklin Cliffs North, Franklin Cliffs Overlook, Rose River Cliffs, Bearfence Mountain, Field Hollow Cliff, Hightop, Goat Ridge.

- Allow wildfire (prescribed wildfire) (9 sites): Marys Rock, Pinnacles, Old Rag Summit East, Old Rag Summit West, Rocky Mountain, Brown Mountain, CalvaryRocks-Chimney Rock, Trayfoot Saddle Boulderfields East, Trayfoot Saddle Boulderfield West.

- Implement an education program and install signs to inform visitors of the need for natural resource protection (20 sites): Gooney Manor Overlook, North Marshall Summit, South Marshall Cliffs, Overall Run Falls, Marys Rock, Little Stony Man, Stony Man, Millers Head, Old Rag Summit East, Old Rag Summit West, Bettys Rock, Crescent Rock Overlook, Hawksbill Summit, Franklin Cliffs Overlook, Franklin Cliffs South, Blackrock Central District, Bearfence Mountain, Hightop, Loft Mountain, Blackrock South District.

- Monitor the status of rare plants or natural communities (32 sites): Gooney Manor Overlook, Little Devils Stairs, Hogback Mountain Spur, Overall Run Falls, Pass Mountain, North Marshall Summit,

South Marshall Cliffs, Pass Mountain, Marys Rock, Pinnacles, Little Stony Man, Stony Man, Old Rag Summit East, Old Rag Summit West, Old Rag Southside, White Oak Canyon, Bettys Rock, Crescent Rock Overlook, Hawksbill North Slope Outcrops, Hawksbill Summit, Franklin Cliffs North, Franklin Cliffs Overlook, Rose River Cliffs, Blackrock Central District, Bearfence Mountain, Field Hollow Cliff, Dean Mountain Ridge, Hightop, Rocky Mountain, Brown Mountain, Loft Mountain, CalvaryRocks-Chimney Rock, Sawlog Ridge.

- Schedule periodic surveys to assess invasive plants where they are present but do not currently require management (3 sites): Dickey Hill, Browntown Valley Overlook, Dean Mountain Ridge.

- Monitor visitor use (4 sites): Little Stony Man, Crescent Rock South, Franklin Cliffs North, Loft Mountain.

- Install a permanent rappelling station (1 site): Little Stony Man.

- Refine trail and viewshed maintenance practices to avoid impact on rare plants and natural communities (3 sites): Gooney Manor Overlook, Hawksbill North Slope Talus, Franklin Cliffs Overlook.

- Remove brush piles from the vicinity of the outcrops (1 site): Gooney Manor Overlook.

- Close or restrict use of overlook along horse trail (1 site): Stony Man.

- To address the unknown status of the Shenandoah salamander (*Plethodon shenandoah*), target an inventory effort to precisely determine its status in the park. Following that inventory, assess the potential for moving trails that occur within known Shenandoah salamander occurrences.

- Conduct further inventory of Winter Wren (*Troglodytes troglodytes*) to determine its status in the park.

- Conduct further inventory for small-footed myotis (*Myotis leibii*).

INTRODUCTION

INTRODUCTION TO THE INVENTORY PURPOSE AND PROCEDURES

In April 2005, the National Park Service (NPS) contracted the Virginia Department of Conservation and Recreation's Division of Natural Heritage (DCR-DNH) to conduct a biological inventory of approximately 50 rock outcrop study sites within Shenandoah National Park (SHEN). Specifically, the agreement required DCR-DNH to:

A. Assemble relevant biological information on SHEN rock outcrop sites from literature, museum specimens, DCR-DNH and NPS databases to develop a comprehensive understanding of the outcrop communities of SHEN, and prepare target lists of known and potentially significant biological resources within and adjacent to the outcrops.
B. Work with biologists from the U.S. Geological Survey (USGS) and NPS to determine the location of approximately 50 cliff and rock outcrop study sites within SHEN where plant, animal, and natural community inventory and natural community classification will be completed.
C. Inventory each designated study site to determine the presence of rare animals and plants. Collect data on these natural heritage resources, including GPS location, population size and area, reproductive and phenological status, viability, habitat, and apparent immediate and long-term threats.
D. Conduct an ecological inventory of each study site to determine the U.S. National Vegetation Classification (USNVC) association, and, when necessary, collect plot data using the relevé method. Combine community classification plot data with existing NPS vegetation mapping plot data to build on the park-wide vegetation classification and map.
E. Conduct a stewardship inventory of each study site to determine impacts to the natural heritage resources by various threats, including overuse by park visitors and invasive species.
F. Complete standard DCR-DNH field forms to document all natural heritage resources found, entering the data into the DCR-DNH Biotics data system.
G. Collect, identify, and label one specimen of each rare and uncommon (watchlist) plant encountered during the field inventory. Identify, prepare, and label a maximum of two specimens of each vertebrate animal and a maximum of six specimens of each invertebrate animal collected during the inventory. Collect at least 400 invertebrate taxa.
H. Enter label data for plant and animal specimens delivered to SHEN into a database composed of fields exported from NPSpecies and the NPS Automated National Cataloging System (ANCS) databases.
I. Serve as a consultant for the development by NPS of a Rock Outcrop Management Plan (ROMP) and associated Climbing Management Plan. Participate in planning efforts and review draft products.

DCR-DNH is the state agency responsible by statutory authority under the Virginia Natural Area Preserves Act (§10.1-209 through 217, *Code of Virginia*) for inventory, database maintenance, protection, and management of Virginia's natural heritage resources. Such resources are defined as the habitats of rare, threatened, or endangered plant and animal species, rare or state significant communities, and other natural features. The Division's work represents the first comprehensive attempt to identify the Commonwealth's most significant natural areas through ongoing scientific biological survey. Data gathered during this statewide survey are assembled and managed using an advanced database management system, Biotics 4, in which information on ecosystems and species, their biology, habitats, locations, conservation status, and management needs is continually updated and refined. The Division is part of an international network of biological inventories known as natural heritage programs or conservation data centers, operating in all 50 U.S. states, Canada, Latin America, and the Caribbean. This network of natural heritage programs uses standardized inventory methodologies and the Biotics data

management system, a geographical information systems-based software tool developed and maintained by NatureServe for managing biodiversity information.

SHEN is situated in the mountains of northern Virginia within the Blue Ridge physiographic province. Its length is 112.0 km (70.0 mi) from Front Royal at the northeastern terminus to Rockfish Gap at the southeastern end (Gathright, 1976). Its maximum width is only 21.4 km (13.4 mi). Skyline Drive traverses the length of the park along the crest of the Blue Ridge for 168.6 km (105.4 mi).

Rock exposures comprise approximately two percent of the park's more than 79,900 ha (197,438 ac). They range in size from a few square meters to 2.4 ha (6.0 ac; Young, 2006). Inclinations range from moderately steep to sheer cliffs. Exposures may be nearly flush with the surrounding topography or rise up dramatically. They may be isolated or part of an extensive outcrop complex. Small outcrops are generally well shaded by the surrounding forest canopy, while large outcrops are open to full solar irradiation. Outcrops are found throughout the parks elevation range of below 305 m (1,000 ft) to 1, 234 m (4,050 ft) at the Hawksbill summit. Fifty-eight percent of mapped outcrops occur on siliciclastic rock types, 23 percent on Catoctin Formation greenstone, and 18 percent on granitic types of rock (Young, 2006).

Prior to this project, DCR-DNH conducted natural heritage inventories of many of the larger and more accessible of SHEN's rock outcrops. Most of this work was done as part of an inventory of Virginia's mid-Atlantic region national parks in the early 1990s (Ludwig et al., 1993) or during data collection for the SHEN vegetation mapping project (Young et al., 2006). During these surveys, 22 rare plant species, five rare animal species, and nine significant natural community types were located on SHEN rock outcrops. These include *Plethodon shenandoah* (Shenandoah salamander), which is endemic to the park and listed as endangered under the federal Endangered Species Act of 1973, as amended (the Act), and *Falco peregrinus* (peregrine falcon), which is listed as threatened under the Act. Also included are seven globally-rare ecological communities: High-Elevation Greenstone Barren (G1; endemic to SHEN), High-Elevation Outcrop Barren (Black Chokeberry Igneous/Metamorphic Type; G1), Central Appalachian Mafic Barren (Ninebark/Pennsylvania Sedge Type; G2), Central Appalachian Circumneutral Barren (G2), Central Appalachian Basic Woodland (G2), Central Appalachian High-Elevation Boulderfield Forest (G2), and High-Elevation Heath Barren (G2). Because SHEN contains the highest peaks in northern Virginia, many of the park's rare rock outcrop plants are disjunct from further north or reach the southern end of their distribution in the park. Northern plant species for which the only known Virginia locations are on SHEN outcrops include *Arctostaphylos uva-ursi* (bearberry), *Conioselinum chinense* (hemlock parsley), *Juncus trifidus* (highland rush), and *Trisetum spicatum* (narrow false oats).

Rock outcrops are popular destinations for SHEN visitors. Scenic overlooks along Skyline Drive are often located immediately above outcrops, where breaks in the forest canopy provide spectacular views to the valleys below. The Appalachian Trail and other SHEN trails often run along the tops of cliffs, providing hikers with dramatic vistas. Rock climbing has become an increasingly popular activity in recent years, and informal camping sites are sometimes located in proximity to rock outcrops. Many of the largest and most significant outcrops are located short distances from Skyline Drive, which provides ready access to those areas via both designated and unplanned trails. Visitation within a rare plant community located on one of the park's most accessible peaks averaged 980 people per week during the summer and fall of 2002 (Hilke, 2002). Prior to 2005, however, little visitor use data was available for many of SHEN's most popular hiking and rock climbing destinations, including Old Rag Mountain (Cass and Bair, 2004).

The vegetation communities unique to rock outcrops are fragile and highly susceptible to visitor impacts. Rock outcrop plants grow on ledges and in crevices where thin organic mats and rock fragments

substitute for true soil development. Their exposed habitats subject them to desiccation from wind and high levels of solar irradiation. In addition, the habitats are regularly buffeted by low winter temperatures, high winds, and ice storms. Steep inclinations and the absence of soil inhibit substrate water retention during periods of drought. As a result of these harsh environmental factors, rock outcrop plants and lichens grow slowly.

Trampling by hikers and rock climbers adds additional stresses to rock outcrop plant communities. Individual plants are crushed underfoot. Poorly developed outcrop soils are compacted, or they may be blown or washed away once vegetation is removed. The seed of non-native plant species may be inadvertently brought in to outcrop areas by hikers on their boots, where it may thrive in areas disturbed by human impacts. Once damaged or destroyed, the recovery of rock outcrop communities, if possible at all, may take generations.

The purpose of this project is to develop a comprehensive picture of the natural heritage resources of the park's rock outcrops and their apparent threats. Management recommendations have been developed to address those threats. The 50 selected sites were chosen because they represent most of the outcrops likely to support rare plants, rare animals, and significant natural communities, and all of the outcrops that currently have significant direct impacts from human visitation.

This project is part of a larger NPS project to manage SHEN outcrop resources and their human impacts. Other components of this larger project include the development of a classification of the geologic composition and condition of the 50 sites (Butler, 2006) and surveys to determine the type and extent of recreational activities at outcrop sites (Lawson et al., 2006). All of these component projects will provide input to SHEN personnel in developing a Rock Outcrop Management Plan (ROMP) for the park (Cass and Bair, 2004).

SHEN's mission goals require that "the integrity of this portion of the Blue Ridge/Central Appalachian biome is protected, maintained, and restored as appropriate," and that "recreation and re-creation opportunities are provided consistent with the purposes and significance of the Park" (Shenandoah National Park, 2003). Clearly, recreational opportunities are to be made available to the extent that this can be done while preserving the park's natural resources. The ROMP will guide NPS efforts to preserve those natural resources that occur on outcrops, direct visitor use to minimize impacts, and restore damaged outcrop areas (Cass and Bair, 2004).

EXPLANATION OF THE NATURAL HERITAGE RANKING SYSTEM

Each of the significant natural features (species, community type, etc.) monitored by DCR-DNH is considered an element of natural diversity, or simply an **element**. Each element is assigned a rank that indicates its relative rarity on a five-point scale (1 = extremely rare; 5 = abundant). The primary criterion for ranking plant and animal elements is the number of occurrences, i.e., the number of known distinct localities or populations. Also of great importance is the number of individuals at each locality or, for highly mobile organisms, the total number of individuals. Other considerations include the condition of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of occurrences, so that ranks essentially are an index of known biological rarity. These ranks are assigned both in terms of the element's rarity within Virginia (its state or S-rank) and the element's rarity over its entire range (its global or G-rank). Subspecies and varieties are assigned a taxonomic (T-) rank in addition to their G-rank. Taken together, these ranks give an instant picture of an element's rarity. For example, a designated rank of G5S1 indicates an element which is abundant and secure range-wide, but extremely rare in Virginia. Ranks for community types are provisional, or in many cases lacking, due to ongoing efforts by the natural heritage network to classify community taxa. Rarity ranks used by DCR-DNH are not legal designations, and they are continuously updated to reflect new information.

The primary ranking factors used in assessing the appropriate conservation status rank for a community element are: 1) the total number of occurrences and (2) the total area (acreage) of the element. Secondary factors such as the level of threats to the occurrences and the viability of existing occurrences also affect the rank. Additional factors that have been used to arrive at an assessment of a community's rangewide (global) rank include the geographic range over which the type occurs, the long-term decline of the type across the range, the degree of site specificity exhibited by the type, and the rarity across the range based on state ranks assigned by state Natural Heritage Programs. Current global ranks for community types are provided in the U.S. National Vegetation Classification (USNVC; Grossman et al., 1998; NatureServe, 2006a; NatureServe, 2006b), and are constantly reviewed and updated through ongoing collaborative efforts by ecologists throughout the NatureServe / Natural Heritage Network.

Global Ranks

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. This system was developed by The Nature Conservancy and is widely used by other agencies and organizations as the best available scientific and objective assessment of a taxon's rarity and level of threat to its existence. The ranks are assigned after considering a suite of factors, including number of occurrences, number of individuals, and severity of threats. These ranks should not be interpreted as legal designations. The global ranks are defined as follows:

G1 = **Critically Imperiled** - At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2 = **Imperiled** - At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3 = **Vulnerable** - At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

G4 = **Apparently Secure** - Uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 = **Secure** – Common, widespread and abundant.

GH = **Possibly Extinct** (Species)- Missing; known from only historical occurrences but still some hope of rediscovery. **= Presumed Eliminated** (Historic, ecological communities) - Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American Chestnut Forest.

GX = **Presumed Extinct** (species) - Not located despite intensive searches and virtually no likelihood of

rediscovery. **=Eliminated** (ecological communities) - Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

G#G# = Range Rank—A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community.

GU = **Unrankable** - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express minor uncertainty, or a range rank (e.g., G2G3) is used to delineate the range of uncertainty.

G_? = **Inexact Numeric Rank** - Denotes inexact numeric rank (e.g., G3?).

G_Q = **Questionable taxonomy** - Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower conservation priority (e.g., G3Q).

G_T_ = **Infraspecific Taxa** - Signifies the rank of a subspecies or variety. For example, the rank G5T1 would be assigned to a very rare and localized variety of an otherwise widespread and common taxon.

GNR = **Unranked** – Global rank not yet assessed.

GNA = **Not applicable** – A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

State Ranks

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 species which is endemic to Virginia will have the same global and state ranks, a species which may be 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. DCR-DNH maintains lists of rare and watchlist plant and animal taxa (Townsend, 2006; Roble, 2006). Plant and animal taxa designated as rare in Virginia include those having a state rank of S1, S1S2, S2, S2S3, or SH. Plant taxa placed on the watchlist include those taxa with uncommon status, including those ranked S3 and S?. (A separate review list contains plant taxa of uncertain status, including those taxa ranked SU, SNR, SNA, and SE?.) Animal taxa designated as watchlist taxa include those with ranks of S3, S3?, S3S4, and SU. State ranks are defined as follows:

S1 = **Critically Imperiled.** For plants and animals: at very high risk of extirpation from the state due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors. For communities: generally with 5 or fewer occurrences state-wide, and/or covering < 50 ha (124 ac) in aggregate; or covering a larger area but highly threatened with destruction or modification.

S2 = **Imperiled.** For plants and animals: at high risk of extirpation from the state due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors. For communities: generally with 6 to 20 occurrences state-wide, and /or covering < 250 ha (618 ac) in aggregate; or covering a larger area but threatened with destruction or modification.

S3 = **Vulnerable.** For plants and animals: at moderate risk of extirpation from the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. For communities: generally with 21 to 100 occurrences, or a larger number subject to higher levels of threat; may be relatively frequent in specific localities or habitats.

S4 = **Apparently Secure**. For plants and animals: uncommon but not rare; some cause for long-term concern due to declines or other factors. For communities: common, at least in certain regions of the state, and apparently secure.

S5 = **Secure.** For plants, animals, and communities: common, widespread and abundant.

SH = **Possibly Extirpated**(Historical)—Species or community occurred historically in the nation or state, and there is some possibility that it may be rediscovered.

SX = **Presumed Extirpated** -Species or community is believed to be extirpated from the nation or state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered

SU = **Unrankable** - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

S# S# =Range Rank —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community.

S_? = **Inexact Numeric Rank** - Denotes inexact numeric rank (e.g., S3?).

SNR = **Unranked** – State conservation status not yet assessed.

SNA = **Not Applicable** - A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

S_B = Breeding status of an animal (primarily used for birds) in Virginia; these species typically inhabit Virginia only during the breeding season.

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

The spot on the landscape that supports a natural heritage resource is an **element occurrence**. DCR-DNH has mapped almost 10,000 element occurrences in Virginia. Information on the location and quality of these element occurrences is computerized within the Division's Biotics system, and additional information is recorded on maps and in manual files.

In addition to ranking each element's rarity, each element occurrence is ranked to differentiate large, outstanding occurrences from small, vulnerable ones. In this way, protection efforts can be aimed not only at the rarest elements, but at the best examples of each. Species occurrences are ranked in terms of quality (size, vigor, etc.) of the population; the condition (pristine to disturbed) of the habitat; the viability of the population; and the defensibility (ease or difficulty of protecting) of the occurrence. Natural community occurrences are ranked using three criteria: 1) condition, 2) size, and 3) landscape context (*i.e.*, the degree to which the occurrence is embedded or connected to a natural, functioning landscape). The three criteria are weighted somewhat differently depending on whether the community in question is typically a matrix, large-patch, or small-patch type.

These **element occurrence ranks** range from A (excellent) to D (poor). Sometimes these ranks are combined to indicate intermediate or somewhat unclear status, e.g. AB or CD, etc. In a few cases, especially those involving cryptic animal elements, field data may not be sufficient to reliably rank an occurrence. In such cases a rank of E (extant) may be given. Element occurrence ranks reflect the current condition of the species' population or community. A poorly-ranked element occurrence can, with time, become highly-ranked as a result of successful management or restoration.

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

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

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

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

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

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

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

The U.S. Fish and Wildlife Service (USFWS) is responsible for the listing of endangered and threatened species under the Endangered Species Act of 1973, as amended. Federally listed species (including subspecific taxa) are afforded a degree of legal protection under the Act, and, therefore, sites supporting these species need to be identified. USFWS also maintains a review listing of potential candidate endangered and threatened taxa. Table 1 illustrates the various status categories used by USFWS and followed in this report. The status category of candidate species is based largely on the Service's current knowledge about the biological vulnerability and threats to a species.

Table 1. U.S. Fish and Wildlife Service species status codes, with abbreviated definitions.

LE Listed endangered
LT Listed threatened
PE Proposed to be listed as endangered
PT Proposed to be listed as threatened
S Synonyms
C Candidate (formerly C1-Candidate category 1)
E(S/A) - treat as endangered because of similarity of appearance
T(S/A) - treat as threatened because of similarity of appearance
SOC - Species of Concern species that merit special concern (**not a regulatory category**)

In Virginia, two acts have authorized the creation of official state endangered and threatened species lists. The Virginia Endangered Species Act (§29.1-563 through 570, *Code of Virginia*), administered by the Virginia Department of Game and Inland Fisheries (DGIF), authorizes listing of fish and wildlife species, not including insects. The Virginia Endangered Plant and Insect Species Act (§3.1-1020 through 1030, *Code of Virginia*), administered by the Virginia Department of Agriculture and Consumer Services (VDACS), allows for listing of plant and insect species. In general, these acts prohibit or regulate taking, possessing, buying, selling, transporting, exporting, or shipping of any endangered or threatened species appearing on the official lists. Table 2 lists the categories for state legal status. DGIF has also created an informal category of Special Concern (SC) for animals that merit special attention. This is a non-regulatory category that affords no legal protection.

Table 2. State legal status.

LE - Listed Endangered
PE - Proposed Endangered
SC - Special Concern - animals that merit special concern according to VDGIF (not a regulatory category)
LT - Listed Threatened
PT - Proposed Threatened
C - Candidate for listing as threatened or endangered

METHODS

OVERVIEW OF NATURAL HERITAGE METHODOLOGY

Staff of the Virginia Department of Conservation and Recreation's Division of Natural Heritage (DCR-DNH) approach natural heritage inventories in a systematic and prioritized manner. Like other DCR-DNH inventories, this survey of the rock outcrops of SHEN was conducted through the five basic stages listed below. Although a natural areas inventory can logically be broken into these steps, in actuality the work proceeds in multiple directions simultaneously and is often iterative.

1) Review of aerial photographs. Aerial photographs of the survey areas were reviewed in detail to identify landscape features that might support rare species and significant natural communities. To aid in their interpretation, the photographs were compared with topographic and geologic maps.

2) Gathering existing information. Museum collections were visited by DCR-DNH staff, and specimen label information was recorded for rare species. The Biotics 4 database was accessed, and the known distribution of natural heritage resources in the area examined. Published and unpublished information on the survey areas was collected and reviewed. Local naturalists, geologists, and college faculty were consulted for additional information. Target lists of potential natural heritage resources were developed to help focus the inventory effort.

3) Planning for field survey. Based on preceding efforts, field plans were developed to maximize the productivity of the limited field time. Among the factors considered were the best time(s) of year to visit each site to ensure the visibility of rare species, which staff scientist(s) should be involved, and how much time should be budgeted for completing the survey.

4) Field survey. During this stage, detailed information was collected on the rare species and exemplary natural communities present within the study area. Portions of a site not visited on foot were evaluated on the basis of aerial photographs and other information. The area of land needed to protect the special biological features was determined. Threats and past or present disturbances were evaluated. Element occurrence data was transcribed onto DCR-DNH maps and entered into Biotics 4. Throughout this stage of concentrated field inventory, continual communication between DCR-DNH project team members (botanists, zoologists, ecologists, and stewardship biologists) was emphasized to ensure that significant site landscape features were visited by appropriate specialists and that data was coordinated. Flexibility was built into the process so that priorities could be adjusted when unexpected elements were encountered.

5) Compilation of results and preparation of final report. As fieldwork was completed, DCR-DNH biologists reviewed the information gathered and ranked sites according to their ecological significance. Maps were drawn showing element occurrence locations and conservation planning boundaries. Site reports were written to include site and element occurrence descriptions, threat assessments, and management recommendations. These were combined with an introduction, a description of project methods, summary of findings, conclusion, and other required information in preparing the final report.

This inventory differed from most other DCR-DNH natural heritage inventories in several important ways. First of all, site selection was based on rock outcrop mapping performed by the US Geological Survey expressly for the ROMP. This effort involved the interpretation of existing aerial and satellite imagery augmented by a GIS analysis of slope conditions using a digital elevation model. Second, a stewardship biologist (Kevin Heffernan) visited each of the sites to help project botanists, zoologists, and ecologists assess threats and develop management recommendations. Finally, funding levels for this project were sufficient to conduct very intensive surveys of the site areas. Each site was visited at least once by a botanist, two zoologists, one to three ecologists, and a stewardship ecologist.

The methodologies employed in site selection for this project and by the major disciplines in carrying out the inventory are summarized in the sections that follow.

SITE SELECTION

Three criteria were used to develop a master list from which 50 study sites were selected. First, sites were selected that had 1) known occurrences of natural heritage resources, and 2) urgent management issues. Previous natural heritage inventories in SHEN provided a detailed knowledge base for identifying these sites. Second, using aerial digital imagery a search was conducted to identify new sites not previously inventoried by DCR-DNH. Using GIS methods, a USGS researcher generated a map of potential sites that was compared to a map of known sites. From the new sites identified by this method, several reconnaissance field trips were made, and those sites that showed potential for natural heritage resource occurrences were added to the master list. Third, an effort was made to include sites that represented all the major lithographic groups found in the park: Catoctin Formation metabasalt, Old Rag granite, Chilhowee Group silicilastic rocks, charnockite, layered pyroxene granulite, and the Swift Run Formation.

Figures 1-3 show the locations of the 50 selected sites.

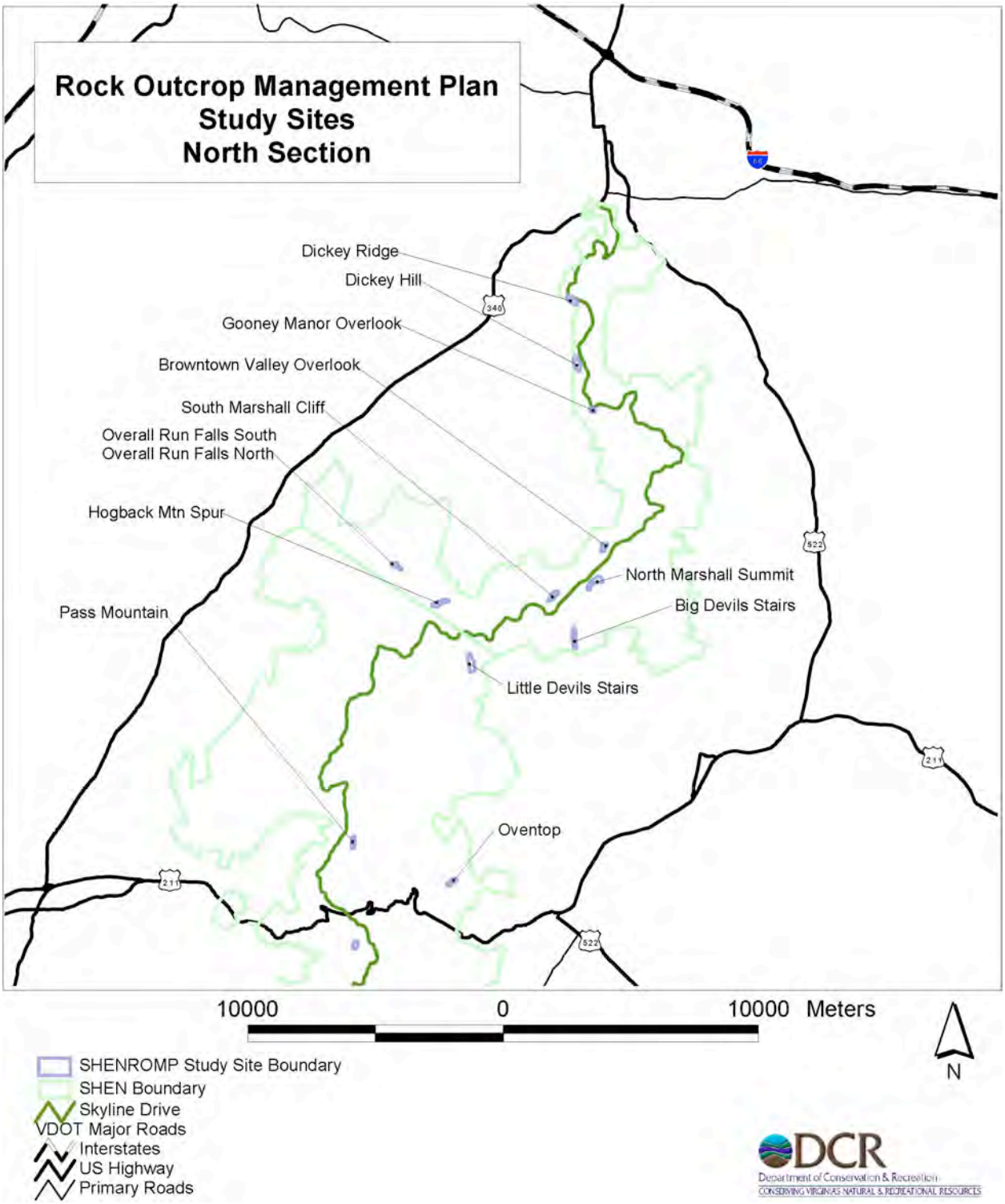


Fig. 1. Rock Outcrop Management Plan Study Sites: North District.

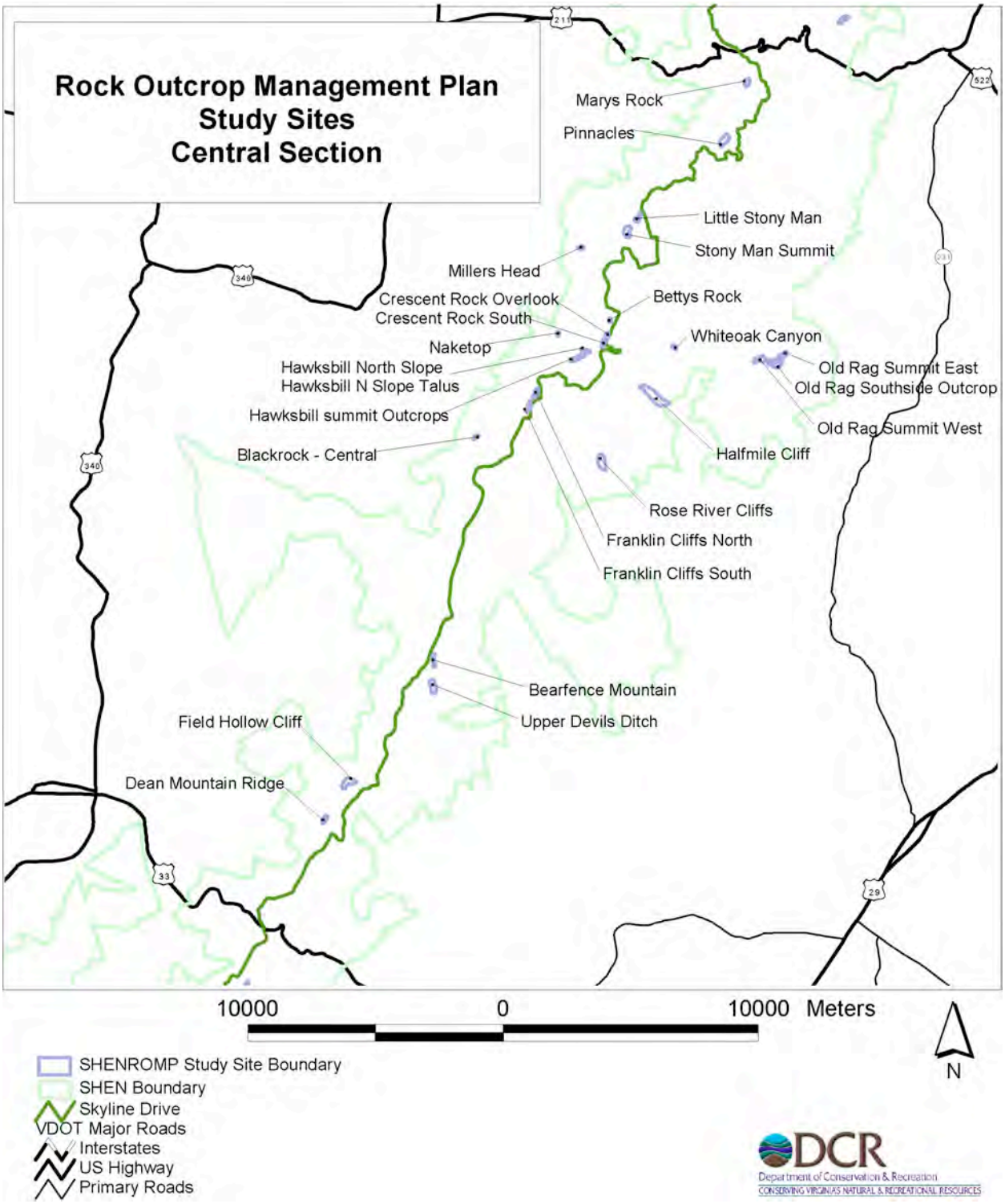


Fig. 2. Rock Outcrop Management Plan Study Sites: Central District.

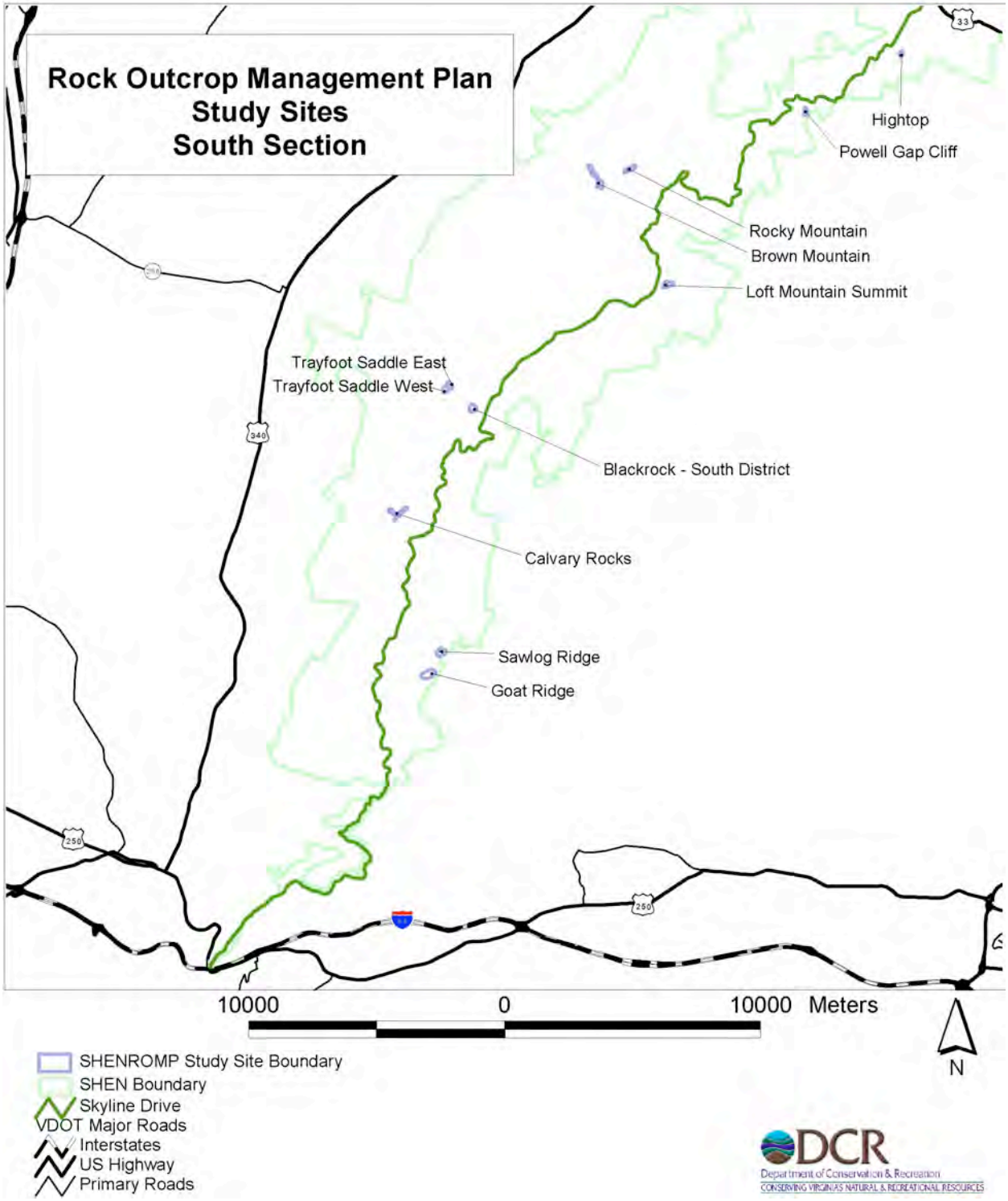


Fig. 3. Rock Outcrop Management Plan Study Sites: South District.

NATURAL COMMUNITY INVENTORY AND DATA ANALYSIS

For the purposes of this study, significant natural community occurrences include all occurrences of globally rare (G1, G2, and G3) types, and high-quality (A or B-ranked) occurrences of more common (G4 and G5) communities. Prior to starting the fieldwork for this project, the results of previous ecological inventories, vegetation classification, and vegetation mapping in SHEN (Ludwig et al., 1993; DCR-DNH unpublished data; Young et al., 2006) were reviewed along with natural community element occurrence data in Biotics 4. Natural community elements in these projects, as well as the current one, follow the standard of the U.S. National Vegetation Classification (USNVC; Grossman et al., 1998; NatureServe, 2006a; NatureServe, 2006b) at the association level. Communities identified by these studies as occurring on rock outcrops in SHEN were identified as the major targets for inventory during the ROMP project (Table 3). Additionally, existing data on the geological and topographic characteristics of the selected inventory sites, as well as leaf-off aerial photographs, were assembled and reviewed.

Among the targeted communities, special emphasis was placed on inventory and evaluation of two extremely rare (G1) types:

- *Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides – Saxifraga michauxii* Herbaceous Vegetation (High-Elevation Greenstone Barren), which is endemic to Shenandoah National Park. At the outset of the project, this community was known from less than 30 discrete outcrops which together form five complexes or occurrences (Franklin Cliffs, Hawksbill, Crescent Rocks, Stony Man Mountain, Mount Marshall). The total coverage of all known occurrences is probably less than 4.0 ha (10.0 ac). The long-term viability of this vegetation type depends entirely on future events in the park.

- *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland **(**High-Elevation Outcrop Barren [Black Chokeberry Igneous / Metamorphic Type]). At the outset of the project, this type was known from eight widely scattered patches on the Virginia Blue Ridge, in aggregate covering less than 3.0 ha (7.5 ac). This type is considered to be potentially under-inventoried.

Fieldwork was conducted in September and early October of 2005, and from June through September of 2006. DCR-DNH Staff Ecologist Gary P. Fleming was responsible for leadership of the ecological fieldwork, with assistance from Field Ecologist Kristin Taverna and Staff Ecologist Karen D. Patterson. ROMP geologist Eric M. Butler and NPS Biologists Wendy Cass and Nicholas A. Fisichelli assisted with some of the work.

Vegetation at selected sites was assessed during field visits and plot data were collected from 26 stands representing newly documented occurrences or vegetation whose classification could not be readily assessed in the field. Detailed, geo-referenced data were recorded on the habitat conditions and floristic composition of each significant community occurrence. Moreover, at each site, general information on site characteristics (geology, topographic position, slope, aspect, elevation) and disturbance was recorded, along with observation data on the forest communities adjoining the rock outcrops within the boundaries of the site. A Garmin GPSMAP 76s global position system (GPS) was used to collect location data at each observation point. For most significant community occurrences, multiple waypoints were recorded at strategic locations. These points were subsequently downloaded to a geographic information system (GIS) using ArcView software (Environmental Systems Research Institute, Inc., 2002) and used in conjunction with aerial photography to map the occurrences.

Table 3. Known ecological communities of rock outcrops in SHEN targeted at the outset of the project.

Scientific Name	**Common Name**	**Global Rank/ State Rank**	**Known ROMP sites**
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation	High-Elevation Greenstone Barren	G1/S1	Little Stony Man Stony Man Summit Bettys Rock Crescent Rock South Hawksbill North Slope Outcrops Hawksbill Summit Franklin Cliffs North Franklin Cliffs South
Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica Shrubland	High-Elevation Outcrop Barren (Black Chokeberry Igneous / Metamorphic Type)	G1/S1	South Marshall Cliff Pass Mountain Hightop
Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia) Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2/S2	Little Devils Stairs Overall Run Falls South Millers Head
Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa Wooded Herbaceous Vegetation	Central Appalachian Circumneutral Barren	G2/S2	Dickey Ridge Gooney Manor Overlook Halfmile Cliff Goat Ridge
Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia Woodland	Central Appalachian Basic Woodland	G2/S2	Dickey Ridge Big Devils Stairs Little Devils Stairs Sawlog Ridge
Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum Forest	Central Appalachian High-Elevation Boulderfield Forest	G2/S2	North Marshall Summit Pinnacles Little Stony Man Stony Man Summit Hawksbill North Slope Talus
Kalmia latifolia - Vaccinium pallidum Shrubland	Central Appalachian Heath Barren	G2/SNR	Millers Head Old Rag Summit West Rocky Mountain
Betula lenta - Quercus prinus / Parthenocissus quinquefolia Woodland	Sweet Birch - Chestnut Oak Talus Woodland	G3G4/S3S4	Blackrock South District Trayfoot Saddle Boulderfields West Calvary Rocks-Chimney Rock
(unclassified)	Lichen / Bryophyte Boulderfield	GNR/SNR	Blackrock South District Trayfoot Saddle Boulderfields East Trayfoot Saddle Boulderfields West

Plot Data Collection Protocols

Plots were sampled using the relevé method (sensu Peet et al., 1998), following standard procedures employed by DCR-DNH. As a rule, 100 m^2 plots with 10 x 10 m, 8 x 12.5 m, or 5 x 20 m configurations were used to sample shrubland or herbaceous vegetation on rock outcrops. For some stands with more of a woodland physiognomy, 400 m^2 plots were used. Plots were carefully located in homogeneous stands of vegetation. Within each plot, the percent cover of each vascular plant taxon was visually estimated as a vertical projection of above-ground biomass onto the full plot area and assigned to one of nine numerical cover classes (Table 4). In addition to this total cover value, cover was estimated for each species in the following height classes:

- herb layer (includes woody stems < 0.5 m and all herbaceous plants)
- shrub layer, 0.5 to 6 m
- tree layer, 6 to 10 m
- tree layer, 10 to 20 m
- tree layer, 20 to 35 m
- tree layer, > 35 m

The overall cover of mosses, lichens, and liverworts was estimated in each plot, but the individual covers of non-vascular taxa were not estimated. Vascular plants characteristic of the stand, but located outside the plot, were recorded parenthetically if visible from the boundary, and assigned a cover class score of "1." The total vegetative cover in each stratum was also estimated using the same nine-point scale of cover classes.

Table 4. Cover class scores used in field sampling and data analysis.

Cover Class:	Percent Cover Range:	Area of Coverage:	Cover Class Midpoint (%):
(p)	present outside plot	-	0.05
1	< 0.1%	< 20 cm^2	0.05
2	0.1% to 1%	20 cm^2 to 4 m^2	0.55
3	1 to 2%	4 m^2 to 8 m^2	1.50
4	2 to 5%	8 m^2 to 20 m^2	3.50
5	5 to 10%	20 m^2 to 40 m^2	7.50
6	10 to 25%	40 m^2 to 100 m^2	17.50
7	25 to 50%	100 m^2 to 200 m^2	37.50
8	50 to 75%	200 m^2 to 300 m^2	62.50
9	75 to 100%	300 m^2 to 400 m^2	87.50

In addition to recording presence and cover for all species, stand structure was quantified by measuring the size distribution and vertical stratification of woody plants. The diameter at breast height (1.4 m dbh) of each woody stem (trees, shrubs, lianas) ≥ 2.5 cm dbh and < 40 cm dbh was measured by size class. Classes used were 2.5-5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, and 35-40 cm. Stems ≥ 40 cm dbh were measured to the nearest 1 cm (0.4 in). Moreover, the maximum canopy height was measured using a clinometer.

Table 5. Topographic / hydrologic environmental indices recorded at each plot-sampling site.

Topographic position:
- A – plain / level
- B – toe
- C – lower slope
- D – middle slope
- E – upper slope
- F – escarpment / face
- G – ledge / terrace
- H – crest
- I – basin / depression
- J – floodplain
- K – stream bottom

Surface Substrate: % cover
- decaying wood
- bedrock
- boulders (> 60 cm diam.)
- stones (> 25 cm diam.)
- cobbles (8-25 cm rounded)
- channery (8-25 cm flattened)
- gravel
- mineral soil
- organic matter
- water
- other

Measured Slope (degrees)

Slope shape

Vertical
- C – concave
- X – convex
- S – straight

Horizontal
- C – concave
- X – convex
- S – straight

H – hummock and hollow microtopography
I – irregular craggy/bouldery microtopography

Measured Aspect

_____ degrees
F (flat)
V (variable)

Soil Drainage Class:
- A – very poorly drained
- B – poorly drained
- C – somewhat poorly drained
- D – moderately well drained
- E – well drained
- F – rapidly drained

Inundation:
- A - never
- B - infrequently
- C – regularly, for < 6 mos.
- D – regularly, for > 6 mos.
- E – always submerged by shallow water (< 30 cm)
- F – always submerged by deep water (> 30 cm)

Soil Moisture Regime:

A – very xeric (moist for negligible time after precipitation)
B – xeric (moist for brief time)
C – somewhat xeric (moist for short time)
D – submesic (moist for moderately short time)
E – mesic (moist for significant time)
F – subhygric (wet for significant part of growing season; mottles at < 20 cm)
G – hygric (wet for most of growing season; permanent seepage / mottling)
H – subhydric (water table at or near surface for most of the year)
I – hydric (water table at or above surface year round)

Hydrologic Regime:

Terrestrial (*i.e.*, not a wetland)
Non-Tidal
- A – Permanently flooded
- B – Semipermanently flooded
- C – Seasonally flooded
- D – Intermittently flooded

E – Temporarily flooded
- F – Saturated

A standard set of environmental data was measured or estimated at each plot (Table 5). Slope inclination and aspect were measured to the nearest degree from plot center. In plots with variable microtopography, slope was measured at several points and averaged. Elevation was determined to the nearest 10 ft (~ 3 m) using GPS data. The percent cover of different surface substrates was estimated visually, with precision varying such that values sum to 100%. Topographic position, slope shape (both horizontally and vertically), soil drainage class, soil moisture regime, and inundation were assessed using scalar values. Bedrock geology was determined to the greatest precision possible using data collected by the project geologist, while the characteristics of surface rocks present in a plot were recorded in the field.

When possible, soil samples were collected from the top 10 cm (4 in) of mineral soil (below the surficial litter and humus). Samples could not be collected from 11 plots where no mineral soil was present on the outcrops. Depth of surface duff, soil color, and texture were evaluated in the field and recorded on the plot forms. Soil samples were oven-dried, sieved (2mm), and analyzed for pH, phosphorus (P), soluble sulfur (S), exchangeable cations (calcium [Ca], magnesium [Mg], potassium [K], and sodium [Na] in ppm), extractable micronutrients (boron [B], iron [Fe], manganese [Mn], copper [Cu], zinc [Zn], and aluminum [Al], in ppm), total exchange capacity (CEC; m.e.q./100g), total base saturation (%TBS), and percent organic matter (%OM). Chemical and textural analyses were conducted by Brookside Laboratories, Inc., New Knoxville, Ohio. Extractions were carried out using the Mehlich III method (Mehlich, 1984) and percent organic matter was determined by loss on ignition.

Evidence of any past or ongoing vegetation disturbance was recorded at each sampling site.

Standard metadata, or information regarding the implementation of the sampling protocol, was recorded at each plot. These include plot numbers, date(s) of sampling, participants, geopolitical locality (county/city), survey site name, USGS quadrangle, plot size and configuration, photographic documentation, and a written description of the plot location. Plots were assigned unique alphanumeric codes.

Data Analysis

Plot data collected during the field work were combined with existing data from SHEN and other Virginia sites and analyzed using the following methods:

Data Preparation and Transformation: Stem diameter measurements were used to compute density (stems/ha) and basal area (m^2/ha) for all woody plants at each sampling site.

Prior to analysis, most environmental variables were transformed, either to normalize frequency distributions or to assign numeric values to categorical variables. Topographic position, slope shape in vertical and horizontal directions, and soil moisture regime were converted to ordinal variables (Table 6). Aspect was transformed using the cosine method of Beers et al. (1966), using the formula A' = cos (45º - A) + 1, where A' = transformed aspect and A = aspect in degrees. This transformation standardizes aspect to a linear variable from 0 (225º; SW, dry, solar-exposed) to 2 (45º; NE, moist, sheltered), reflecting a purported gradient in topographic moisture and solar exposure. Substrate values were converted to decimals and arcsine transformed to normalize their distributions. Values for all soil variables with non-normal distributions were natural log-transformed to normalize their distributions and make the values more biologically interpretable (Palmer, 1993). A synthetic fertility index was also calculated for each plot using the formula CEC X %TBS / 100.

Table 6. Ordinal variables used in analysis for scalar topographic and soil moisture variables estimated in the field.

Topographic Position	Soil Moisture Regime
I – basin/depression = -1	A – very xeric = 1
A, J, K – plain/level, floodplain, stream bottom = 0	B – xeric = 2
B – toe = 1	C – somewhat xeric = 3
C – lower slope = 2	D – submesic = 4
D, G = middle slope, ledge/terrace = 3	E – mesic = 5
E, F = upper slope, escarpment/face = 4	F – subhygric = 6
H = crest = 5	G – hygric = 7
	H – subhydric = 8
Slope Shape – Vertical and Horizontal	I – hydric = 9
C – concave = -1	
X – convex = +1	
S – straight = 0	

Horizontal and vertical slope shape were also converted to a single ordinal variable (scale = 0 to 10) using a modification of Parker (1982):

VERT. PROFILE	+	HORIZ. PROFILE	=	SLOPE SHAPE SCALAR
concave		concave		10
concave		straight		9
straight		concave		7
straight		straight		5
straight		convex		3
convex		straight		2
convex		convex		0

A synthetic Topographic Relative Moisture Index (TRMI) was calculated for each plot using a procedure modified from Parker (1982). TRMI is a scalar ranging from 0 (lowest moisture potential) to 60 (highest moisture potential) and combining four topographic variables that potentially influence water runoff, evapotranspiration, and soil moisture retention:

- Slope inclination (10-point scale; per Parker [1982])
- Slope shape (10-point scale; as above)
- Aspect (20-point scale) = Beers-transformed aspect x 10
- Topographic position (20-point scale; per Parker [1982])

Cluster Analysis: Hierarchical, agglomerative cluster analysis, implemented in the software program PC-ORD (version 5.04; McCune and Mefford, 1999), was employed to generate a classification from sampled plots, which were combined in a 91-plot dataset with rock outcrop plots previously sampled in SHEN and elsewhere in Virginia. The Lance-Williams Flexible-Beta linkage method (Lance and Williams, 1966, 1967) was used in conjunction with a relativized Euclidian (Chord) co-efficient of dissimilarity to identify compositionally similar groups. The Lance-Williams method is a generalized sorting strategy, the performance of which varies with user-specified emphasis (beta) on different measures of between-group distance. In general, beta settings ranging from the default –0.25 to –0.5 produce optimal results with vegetation data, performing very similarly to minimum-variance clustering, i.e., Ward's method (Ward, 1963); a beta setting of -0.375 was used for this project. The relativized

Euclidian coefficient, also known as Chord distance, has performed robustly with quantitative vegetation data (Faith et al., 1987; Minchin, 1987). Among available measures of ecological "distance," represented as a mathematical dissimilarity between samples, Chord distance is a balanced measure that places some emphasis on dominant (i.e., high-cover) species while still giving minor (i.e., low-cover) species considerable weight in the analysis.

Compositional Summary Statistics: Compositional statistics were calculated to evaluate the adequacy of groups recognized in cluster analysis and ultimately to assist in naming and describing the community types. Initially, total mean cover and total frequency across all plots were determined for every taxon. Cover class scores were then converted to the midpoints of their respective percent ranges, the midpoints were averaged, and resulting values back-transformed to cover class scores. For each taxon in each group under consideration, the following summary statistics were then calculated:

- **Frequency** – the number of samples in a group in which a species occurs
- **Mean Cover** – back-transformed cover class value corresponding to mean percent cover calculated from midpoint values of cover class ranges.
- **Relative Cover** – the arithmetic difference between mean cover (for a given group of samples) and total mean cover (for the entire data set) (= Mean Cover – Total Mean Cover).
- **Constancy** – the proportion of samples in a group in which a species occurs, expressed as a percentage (= Frequency / Number of samples in group x 100).
- **Fidelity** – the degree to which a species is restricted to a group, expressed as the proportion of total frequency that frequency in a given group constitutes (= Frequency / Total Frequency x 100).
- **Indicator Value** (IV) (= Constancy x Fidelity / 100).
- **Indicator Value Adjusted by Cover, Scaled** (Scaled Adj IV) (= Indicator Value x Mean Cover / 9). By dividing IV by 9, the maximum possible cover value, this statistic synthesizes information about frequency, diagnostic value, and mean abundance.
- **Indicator Value Adjusted by Cover, Unscaled** (Unscaled Adj IV) (= Indicator Value x $2^{\text{relative cover}}$). An alternative, unscaled synthetic measure of adjusted IV, using relative cover as the modifier of IV. Since cover classes form a logarithmic, rather than linear scale of values, Unscaled Adjusted IV is a statistically more legitimate means of incorporating information on cover, and has the advantage of not favoring only dominant species and better identifying species that are considerably more abundant within a given type than in the data set as a whole.

Additionally, the following statistics were generated for each group:

- **Mean Species Richness** – the average number of species present per plot (*S*); only species rooted inside plot boundaries are included in this calculation.
- **Homoteneity** – the mean constancy of the *S* most constant species, expressed as a fraction. This value (sensu Curtis, 1959) can be considered the constancy of the average species in a community type; higher values for homoteneity indicate greater uniformity in species composition among plots. Although homoteneity is not independent of group size, often increasing as the number of group members decreases, it can be used to evaluate whether community types have been defined at an appropriate level.

Environmental Summary Statistics: Mean values for continuous and ordinal environmental variables were calculated for each group to aid in describing the units and identifying the differences between them. These calculations were performed with raw (untransformed) values, which were averaged across all plots representing a given group. Mean aspect was calculated as the average position along an arc defined by the range of aspect values.

Ordination: The ordination method non-metric multidimensional scaling (NMDS; Kruskal, 1964) was used to validate the classification, detect compositional variation and trends that are obscured in cluster analysis, and aid in identifying the environmental gradients along which vegetation classes and community types are distributed. NMDS is a type of indirect gradient analysis that assigns samples to coordinates in ordination space in a way that maximizes, to the extent possible, the rank-order (i.e., non-parametric) correlation between inter-sample distance in ordination space and inter-sample dissimilarity (i.e., ecological distance; Minchin, 1987). NMDS initially assigns spatial coordinates to samples at random; it then calculates stress as the mismatch between the set of ordination distances and the matrix of dissimilarity between plots. Sample points are then moved such that stress is reduced, stress is recalculated, and the process is repeated interactively. Since NMDS does not converge on a single, tractable solution for a given ordination, a sufficient number of iterations are required to reach a point at which decreases of stress are negligible, and several strating configurations are necessary in order to avoid reaching local *minima* of stress. Additionally, the dimensions of an NMDS ordination do not form a decreasing series of variance in composition explained, and actual axis numbers are arbitrary. NMDS will extract as many dimensions as are specified, and an appropriate number of dimensions must be determined *a priori* by examining the rate at which stress declines with an increasing number of dimensions.

NMDS was implemented in PC-ORD (Version 5.04; McCune and Mefford, 1999). The Bray-Curtis co-efficient was used to calculate dissimilarity and VARIMAX rotation was employed to optimize axis placement in all ordination studies for this project. Each ordination was computed using 100 random starting configurations, and configurations with the lowest stress levels were used for interpretation. Two- or three-dimensional ordinations were used to examine compositional variation within the entire dataset and progressively smaller groups of related types. Pearson correlations between environmental variables and sample coordinates on each axis were calculated, and significant correlations were displayed through joint plot overlays on each ordination. Because soil could not be collected from a number of plots used in the analysis, two ordinations were run for each group of plots under consideration: 1) all plots, with only topographic environmental correlates displayed; and 2) plots that had associated soil chemistry data, with all environmental correlates displayed. After examining the results, it was determined that the reduced-set ordinations showed topographic correlates nearly as well as those that used the full sets of plots.

After completing the classification, units were compared to the standard associations in the USNVC and to previous classifications completed using SHEN vegetation data (Young et al., 2006; Fleming and Coulling, 2001). Targeted community occurrences that were not plot sampled were assigned to a USNVC association based on qualitative data collected in the field. Descriptions of proposed new USNVC associations and of existing associations needing revision were sent to NatureServe regional ecologists and ecologists in other Natural Heritage programs for peer review. Once reviews were completed, revisions and editions to the USNVC based on this project were implemented by NatureServe.

BOTANICAL INVENTORY

For purposes of this study, rare plants are defined as the rarest known species in the Commonwealth. They include species with global ranks of G1, G1G2, G2, and G2G3, and state ranks of S1, S1S2, S2, S2S3, SH, and SX. Data on these species are maintained in the Biotics 4 database and summarized annually on a master list of Virginia's rare plants (Townsend, 2006).

To initiate the inventory of rare plants, existing data on element occurrences located within and near SHEN were obtained from the Biotics 4 database and reviewed. Additional information was gathered from botanical literature and from examination of collections at the following institutions: The College of William and Mary, George Mason University, Longwood College, Lynchburg College, National Arboretum, Old Dominion University, University of Richmond, U.S. National Herbarium (Smithsonian Institution), University of North Carolina, Virginia Commonwealth University, and Virginia Polytechnic Institute and State University (VPI&SU).

Based on the preceding review, it was determined that ninety rare plant species are known from SHEN and vicinity. Many of these plants are not associated with rock outcrops, however. In addition, it was determined that 22 rare plant species are known to occur at the ROMP sites.

A list of known and potential rare plants for the ROMP sites was developed to guide the botanical inventory (Table 7). The list began with the known rare plants from the ROMP sites and other rare plants known from SHEN and vicinity that could occur on rock outcrops. To this was added other rock outcrop plants known from the mountains of northern Virginia and a few plants not known from Virginia that occur on rock outcrops in nearby states to the north. Table 7 gives the scientific and common name for each of these species, the global and state ranks, and the optimal months to search for the species based on when the plant is most visible on the landscape (1=January, 12=December). For plants already known to occur at ROMP sites, a list of those sites is also provided for each species.

A list of known and potential watchlist species was also developed (Table 8). This list consists of plants known by DCR-DNH to occur on SHEN rock outcrops (but not necessarily ROMP sites), species known to occur elsewhere in SHEN that could also potentially occur on outcrops, and other species known to occur on outcrops in the mountains of northern Virginia.

Information on the geology and topography of each ROMP site was gathered through examination of aerial photographs, topographic maps, geologic maps, and SHEN literature. In addition, ROMP geologist Eric M. Butler provided a wealth of information (including photographs) of sites he had visited prior to DCR-DNH fieldwork. These sources, along with information in the Biotics 4 database on sites that had been previously visited by DCR-DNH staff, were used to delineate the distribution of potential rare plant habitats, and, thereby, to determine those rare plants that had the greatest potential to occur at each site. A fieldwork plan was developed to ensure that each site was visited at the time when potential rare species were most visible.

Botanists visited 28 of the sites in 2005 between May 18 and September 28. The remaining 22 sites were visited in 2006 between May 10 and October 3. In addition, six sites visited in 2005 were revisited in 2006: Pass Mountain, Marys Rock, Old Rag Summit East, Old Rag Summit West, Crescent Rock South, and Halfmile Cliff.

Field Botanists Allen Belden Jr. and Nancy E. Van Alstine were responsible for a majority of the botanical fieldwork, with important contributions also coming from DCR-DNH Stewardship Biologist

Kevin E. Heffernan, ROMP geologist Eric M. Butler, DCR-DNH Botanist John F. Townsend, and the DCR-DNH ecology staff: Gary P. Fleming, Karen D. Patterson, and Kristin Taverna. Assistance with fieldwork was provided by Wendy B. Cass, Nicholas A. Fisichelli, Rachel E. Medley, Joanna M. Reuter, and Melissa Rudacille.

Table 7. Known and potential rare plants for SHEN rock outcrop study sites.

Scientific Name	**Common Name**	**Global Rank/ State Rank**	**Known from SHEN or Potential. If known, ROMP sites where known.**	**Best Months to Survey**
Abies balsamea	Balsam fir	G5/S1	Stony Man Summit Crescent Rock Overlook Crescent Rock South Hawksbill North Slope Outcrops Hawksbill North Slope Talus Hawksbill Summit	1-12
Anaphalis margaritacea	Pearly everlasting	G5/S1	Potential	8-10
Arabis hirsuta var. *adpressipilis*	Hairy rockcress	G5T4Q/ S1S2	Potential	4-6
Aralia hispida	Bristly sarsaparilla	G5/S2	Old Rag Summit East (historical) Rocky Mountain CalvaryRocks-Chimney Rocks	5-10
Arctostaphylos uva-ursi	Bearberry	G5/S1	Millers Head	1-12
Asplenium bradleyi	Bradley's spleenwort	G4/S2	Rocky Mountain	1-12
Asplenium septentrionale	Forked spleenwort	G4G5	Potential Virginia record	5-10
Betula cordifolia	Mountain paper birch	G5/S2	Trayfoot Saddle Boulderfields E Trayfoot Saddle Boulderfields W	1-12
Carex polymorpha	Variable sedge	G3/S2	Known, but not from ROMP sites	5-6
Carex roanensis	Roan Mountain sedge	G2/S2	Potential	6-7
Cheilanthes eatonii	Chestnut lipfern	G5?/S2	Potential	5-10
Clematis catesbyana	Satin curls	G4G5/S1	Potential	7-10
Clematis occidentalis var. *occidentalis*	Purple clematis	G5T5/S2	Hawksbill Summit	5-7
Conioselinum chinense	Hemlock parsley	G5/S1	Stony Man Summit	6-8
Cornus canadensis	Bunchberry	G5/S1	Known, but not from ROMP sites	5-10
Cornus rugosa	Roundleaf dogwood	G5/S1	Little Devils Stairs Stony Man Summit (historical) Old Rag Summit W (historical) Blackrock Central (historical)	5-10
Cryptogramma stelleri	Fragile rockbrake	G5	Potential Virginia record	5-10

Table 7 continued. Known and potential rare plants for SHEN rock outcrop study sites.

Scientific Name	Common Name	Global Rank/ State Rank	Known from SHEN or Potential. If known, ROMP sites where known.	Best Months to Survey
Cuscuta coryli	Hazel dodder	G5/S2?	Dickey Ridge Gooney Manor Overlook Little Devils Stairs Halfmile Cliff	7-9
Cuscuta rostrata	Beaked dodder	G4/S2	Historical	7-9
Cyperus houghtonii	Houghton's flatsedge	G4?/SH	Little Stony Man (historical)	8-10
Elymus trachycaulus ssp. *trachycaulus*	Slender wheatgrass	G5T5/S2	Known, but not from ROMP sites	8-10
Geranium robertianum	Herb-robert	G5/S2	Known, but not from ROMP sites	6-8
Helianthemum bicknellii	Plains frostweed	G5/S1	Potential	7-9
Helianthemum propinquum	Low frostweed	G4S1	Potential	7-9
Heuchera alba	White alumroot	G2Q/S2?	Potential	5-6
Huperzia appalachiana	Appalachian fir-clubmoss	G4G5/S2	North Marshall Summit Marys Rock Pinnacles Stony Man Summit Old Rag Summit West Crescent Rock South Hawksbill North Slope Outcrops Hawksbill North Slope Talus Hawksbill Summit	1-12
Juncus trifidus	Highland rush	G5/S1	Stony Man Summit	7-9
Juniperus communis var. *depressa*	Ground juniper	G5T5/S1	Potential	1-12
Melica nitens	Three-flowered melic	G5/S1S2	Potential	5-6
Minuartia groenlandica	Mountain sandwort	G5/S1	Old Rag Summit West	5-8
Muhlenbergii glomerata	Marsh muhly	G5/S2	Little Devils Stairs Crescent Rock Overlook	8-9
Oligoneuron rigidum var. *rigidum*	Stiff goldenrod	G5T5/S2	Gooney Manor Overlook	8-10
Onosmodium virginianum	Virginia false-gromwell	G4/S2	Potential	5-8
Paxistima canbyi	Canby's mountain-lover	G2/S2	Overall Run Falls South	1-12
Phagopteris connectilis	Narrow beech fern	G5	Potential Virginia record	5-10
Phlox buckleyi	Sword-leaved phlox	G2/S2	Known, but not from ROMP sites	5-7

Table 7 continued. Known and potential rare plants for SHEN rock outcrop study sites.

Scientific Name	Common Name	Global Rank/ State Rank	Known from SHEN or Potential. If known, ROMP sites where known.	Best Months to Survey
Poa saltuensis	Drooping bluegrass	G5/S2	Potential	5-7
Populus tremuloides	Quaking aspen	G5/S2	Old Rag Summit East Franklin Cliffs Overlook	5-10
Potentilla arguta	Tall cinquefoil	G5S1	Potential	8-10
Pseudognaphalium helleri	Catfoot	G4G5	Potential	8-10
Pycnanthemum torrei	Torrey's mountain mint	G2/S2?	Potential	7-10
Quercus prinoides	Dwarf chinkapin oak	G5/S1	Historical	8-10
Rhodiola rosea	King's crown	G5	Potential Virginia record	6-9
Rubus idaeus ssp. *strigosus*	Red raspberry	G5T5/S2	Little Stony Man Stony Man Summit Crescent Rock Overlook Crescent Rock South Hawksbill North Slope Outcrops Hawksbill North Slope Talus Hawksbill Summit Blackrock Central District	5-10
Scleria verticillata	Whorled nutrush	G5S2	Potential	8-9
Sibbaldiopsis tridentata	Three-toothed cinquefoil	G5/S2	Little Stony Man Stony Man Summit Bettys Rock Crecent Rock Overlook Crescent Rock South Hawksbill North Slope Outcrops Hawksbill Summit	5-10

Table 7 continued. Known and potential rare plants for SHEN rock outcrop study sites.

Scientific Name	Common Name	Global Rank/ State Rank	Known from SHEN or Potential. If known, ROMP sites where known.	Best Months to Survey
Solidago randii	Rand's goldenrod	G5T4/ S2S3	North Marshall Summit South Marshall Cliff Pass Mountain Marys Rock Little Stony Man Stony Man Summit Bettys Rock Crescent Rock Overlook Crescent Rock South Hawksbill North Slope Outcrops Hawksbill North Slope Talus Hawksbill Summit Franklin Cliffs North Franklin Cliffs Overlook Franklin Cliffs South Blackrock Central District Bearfence Mountain Dean Mountain Ridge Hightop Loft Mountain Summit	8-10
Sporobolus compositus var. *compositus*	Longleaf dropseed	G5T5/ S1S2	Potential	8-10
Sporobolus neglectus	Small dropseed	G5S2	Potential	8-10
Symphoricarpos albus var. *albus*	Snowberry	G5T4/S2	Potential	5-10
Toxicodendron rydbergii	Western poison ivy	G5S1	Known, but not from ROMP sites	7-9
Trichophorum caespitosum	Tufted leafless-bulrush	G5	Potential Virginia record	6-9
Trichostema setaceum	Narrow-leaved blue-curls	G5/S2	Potential	8-9
Trisetum spicatum	Narrow false oats	G5/S1	Hawksbill North Slope Outcrops	7-9
Vaccinium myrtilloides	Velvetleaf blueberry	G5/S1S2	Stony Man Summit	5-10
Vicia americana ssp. *americana*	American purple vetch	G5T5/ S1S2	Potential	5-6

Table 8. Potential watchlist plants for SHEN rock outcrop study sites.

Scientific Name	Common Name	Global Rank/State Rank	Known SHEN Species	Known SHEN Outcrop Species
Aconitum reclinatum	White monkshood	G3G4/S3	■	■
Adlumia fungosa	Climbing fumitory	G4/S3	■	
Allium allegheniense	Allegheny onion	G3?/SU		
Amelanchier sanguinea var. *sanguinea*	Roundleaf serviceberry	G5T5/S3	■	■
Blephilia hirsuta	Hairy woodmint	G4?/S3		
Carex bushii	Bush's sedge	G4/S3		
Carex careyana	Carey's sedge	G4G5/S3		
Carex conjuncta	Soft fox sedge	G4G5/S3		
Carex gravida var. lunelliana	Heavy sedge	G5T3T5Q/SNA		
Carex pedunculata	Longstalk sedge	G5/S3		
Chenopodium simplex	Giant-seeded goosefoot	G5/S3	■	
Corrallorrhiza wisteriana	Spring coralroot	G5/S3	■	
Crataegus pruinosa	A hawthorn	G5/S3		
Cyperus refractus	Reflexed flatsedge	G5/S3		
Galium boreale	Northern bedstraw	G5S3	■	
Gymnocarpium appalachianum	Appalachian oak fern	G3/S3	■	■
Helianthus hirsutus	Stiff-hair sunflower	G5/S3		
Hexalectris spicata	Cersted coralroot	G5/S3		
Hydrastis canadensis	Golden-seal	G4/S3		
Juglans cinerea	Butternut	G3G4/S3?	■	■
Liatris turgida	Robust blazing-star	G3/S3	■	■
Lilium philadelphicum var. *philadelphicum*	Wood lily	G5T4T5/S3		
Linum sulcatum var. *sulcatum*	Grooved yellow flax	G5T5/S3	■	■
Lithospermum latifolium	American gromwell	G5/S3		
Lonicera canadensis	American fly-honeysuckle	G5/S3	■	■
Lycopodium annotinum	Stiff clubmoss	G5/S3?	■	
Lycopodium hickeyi	Hickey's clubmoss	G5/S3?		
Lygodium palmatum	Climbing fern	G4/S3		
Montotropsis odorata	Sweet pinesap	G3/S3	■	
Packera paupercula	Balsam ragwort	G5/S3?	■	
Pellaea glabella ssp. *glabella*	Smooth cliff-brake	G5T5/S3		
Polygonum cilinode	Fringed black bindweed	G5/S3	■	■
Prunus alleghaniensis var. *alleghaniensis*	Allegheny plum	G4T4/S3		
Rhamnus lanceolata ssp. *lanceolata*	Lance-leaved buckthorn	G5T4T5/S3		
Sanicula trifoliata	Large-fruited sanicle	G4/S3	■	
Solidago hispida var. *hispida*	Hairy goldenrod	G5T5/S3	■	■
Taenidia montana	Mountain pimpernel	G3/S3	■	■
Taxus canadensis	American yew	G5/S3	■	■
Zigadensis elegans ssp. *glaucus*	White camas	G4T4T5/S3	■	

During the botanical investigation, field data were recorded during each site survey and were coordinated with data collected from the same site by ecologists and zoologists. These data included the site location, directions, and a site description, as well as comments on land use, potential hazards, exotic flora and fauna, and off-site considerations. When rare plant occurrences were located, additional data were recorded, including the date(s) when the species was found, population boundaries and concentrations within those boundaries, approximate number of individuals, reproductive and phenological status, and species viability. Habitat factors such as moisture, light, and associated species, as well as any apparent immediate or long-term threats to the rare species populations were also noted.

A Garmin GPSMAP 76 global position system (GPS) was used to collect location data for each rare species. For rare plants with small population areas (less than 10x10 meters) a single point was collected. For larger occurrences, several points were taken at strategic points along the boundary of the occurrence. These points were subsequently connected in a geographical information system (GIS) using ArcView software (Environmental Systems Research Institute, Inc., 2002) to create a polygon representing the population area.

One specimen of each rare and watchlist plant encountered was collected and pressed to the extent that this could be done without the possibility of damaging the health and viability of any SHEN rare plant population. In addition, other species not currently represented in the SHEN herbarium were collected as time permitted. A Garmin GPSMAP 76 GPS was used to collect location data for each specimen. In addition, a form developed by SHEN Data Manager Alan Williams was completed for each location, recording information on habitat, location, and associated species. All specimens will be labeled and delivered for deposition in the SHEN herbarium.

LICHEN INVENTORY

Because lichens are abundant inhabitants of rock surfaces and relatively little is known about their ecology and distribution, SHEN botanists, DCR-DNH ecologists and botanists, and several volunteers collaborated on an effort to document lichens thoroughly at several ROMP sites. Collections were made at four sites that are characteristic of specific geologic and topographic habitats:

1. Blackrock South District – a large, exposed to thinly wooded, mid-elevation quartzite boulderfield.

2. Crescent Rock South – exposed, high-elevation metabasalt (greenstone) cliffs and outcrops.

3. Hawksbill North Slope Talus -- a large, exposed to thinly wooded, high-elevation metabasalt boulderfield.

4. Old Rag Summit West – exposed, high-elevation granitic outcrops.

A few additional specimens were collected at the North Marshall Summit. Three hundred thirty-three (333) lichen specimens and rock fragments containing lichens (mostly multiple species) were collected from these sites. These were labeled, photographed, sent to specialists for identification, and ultimately archived in a permanent collection at SHEN, with some duplicates at DCR-DNH. The majority of specimens were identified by Richard Harris of the New York Botanical Garden. Smaller groups were identified by Don Flenniken of Wooster, Ohio and James Lawry of George Mason University.

During field surveys of all ROMP sites, DCR-DNH ecologists and botanists, often with the assistance of SHEN botany technician Nicholas Fisichelli, recorded the most characteristic lichen species occurring on outcrops and boulderfields, particularly those supporting significant natural community occurrences and rare plant species. Because the identification of lichens is difficult, these field identifications were primarily of the more common and conspicuous foliose and fruticose lichens and a few readily identifiable crustose species.

ZOOLOGICAL INVENTORY

For purposes of this study, rare animals are defined as the rarest known species in Virginia. They include species with global ranks of G1, G2, and G3, and state ranks of S1, S2, S2S3, SH, SX, and SU. Data on these species are maintained in the Biotics 4 database and summarized regularly on a master list of Virginia's rare animals (Roble, 2003).

To initiate inventory of rare animals in the SHEN study area, existing data on element occurrences within and in the vicinity of the delineated survey areas were obtained from Biotics 4 and reviewed. Data in Biotics 4 are partly based on information gathered from zoological literature and partly from examination of selected collections at the following institutions: U.S. Museum of Natural History, the Carnegie Museum, Lord Fairfax Community College, Eastern Mennonite College, Old Dominion University, Virginia Polytechnic Institute and State University, Virginia Commonwealth University, and the Virginia Museum of Natural History.

Based on the above review, it was determined that there were 12 rare animal species known from SHEN. Of these, five had been previously located at ROMP sites (Table 9).

Fieldwork began in June 2005 and continued through September 2006. Field Zoologist Anne Chazal was responsible for a majority of the zoological fieldwork, with contributions also coming from DCR-DNH Staff Zoologist Steven Roble, Natural Area Preserve Zoologist Chris Hobson, and zoology interns Ryan Knisley, Angela Hutto, Maureen Dougherty, and Arthur Evans. Arthur Evans and Maureen Dougherty provided assistance with laboratory work. Irvine Wilson and Mark Bradford also assisted with field work. Mark Bradford also provided great help with the Access database, which was originally created by Alan Williams of NPS-SHEN. Approximately 102 person days were spent on zoology fieldwork with all 50 ROMP sites visited.

Fieldwork for this project focused on invertebrate collection. Various inventory and sampling methods were employed during the SHEN inventory. These included the following methods:

Aural and Visual observation – Birds were identified primarily by voice, and by site when able. Additionally, other vertebrates were identified either by direct observation or by sign, such as scat or tracks.

Hand capture - Reptiles and amphibians, as well as some invertebrates, were captured by hand by overturning various cover objects including logs, bark, rocks, and other debris. Seepage habitat was also surveyed by hand for rare crustaceans.

Leaf litter samples – Small, hand-collected samples of leaf litter were examined for invertebrates.

Sweep nets - Invertebrates were sampled by sweeping vegetation such as grasses and forbs and beating the foliage of trees and shrubs.

UV-light traps - Nocturnal invertebrates were captured using standard bucket traps equipped with a blacklight (= ultraviolet) powered by a 12-volt gel-cell battery. 'No pest strips' were used as a killing agent. Traps were run overnight in a variety of habitats.

All 50 sites had hand and sweepnet samples taken. Forty-three sites had samples successfully collected by UV-light traps; six of these sites had multiple UV-trap samples collected. In addition, observed (or heard) fauna lists were maintained at each site.

No vertebrates were collected. All invertebrate specimens collected during the study have been preserved using standard methods (Martin, 1977). Many voucher specimens were identified to species and others to genus or family. Some taxa were identified only to class or order as time constraints precluded us from further identification. Over 700 insect species have been identified. The majority of the material has been returned to SHEN, along with an Access database cataloging all captures. Some select specimens will remain at DCR-DNH on loan from SHEN.

Table 9. Rare, threatened, and endangered animals known from SHEN and from rock outcrop study sites.

Scientific Name	Common Name	NatureServe Rank (Global/ State)	Legal Status (Federal/ State)	ROMP Sites Where Known
Plethodon shenandoah	Shenandoah salamander	G1/S1	LE/ LE	Pinnacles Hawksbill North Slope Talus Little Stony Man Stony Man Summit Miller's Head
Pituophis melanoleucus	Pine snake	G4/S1S3	-/-	
Dendroica fusca	Blackburnian Warbler	G5/S2B	-/-	
Falco peregrinus	Peregrine Falcon	G4/S1B,S2N	-/LT	Stony Man Summit Old Rag Summit East Old Rag Summit West Old Rag Southside Hawksbill Summit
Sitta canadensis	Red-breasted Nuthatch	G5/S1B,S4N	-/SC	
Troglodytes troglodytes	Winter Wren	G5/S2B,S4N	- / SC	Hawksbill Summit Hightop Mountain
Glyphyalinia virginica	Depressed glyph	G3/S2S3	-/-	
Kleptochthonius polychaeus	Shenandoah pseudoscorpion	G1G3/S1S3	-/-	Stony Man Summit
Pallifera varia	Variable mantleslug	G3G4/S2?	-/-	
Striatura exigua	Ribbed striate	G5/S2	-/-	
Semionellus placidus	A millipede	G3/S2	-/-	Hawksbill Summit Little Stony Man
Sphaeroderus schaumii	Shaum's ground beetle	G4/S2	-/-	Crescent Rock Overlook Crescent Rock South Hawksbill North Slope Talus
Lanthus parvulus	Northern pygmy clubtail	G4/S2	-/-	

Two listed animals are known to occur within SHEN ROMP sites. *Falco peregrinus* (Peregrine Falcon) is listed as threatened by the Commonwealth of Virginia and *Plethodon shenandoah* (Shenandoah salamander) is listed as endangered at both federal and state levels. Neither of these species was targeted for surveys under this project. SHEN currently has an intensive and ongoing program to reintroduce Peregrine Falcons to the park and to monitor the status of populations on an annual basis (Gubler, R., pers. comm. 2007). Shenandoah salamander locations in the park have been mapped in the past (Pague 1994, USFWS 1994, Saunders 2005). This species is found in talus habitats which are difficult and time-

consuming to survey. To determine the current population boundaries for this species within ROMP sites would require resources beyond the scope of this project.

Historically in Virginia, Peregrine Falcons nested in the mountains, with 24 historical aeries documented in the Appalachians primarily on open rock faces and ledges (Center for Conservation Biology (CCB), 2007). Peregrine Falcon populations across the eastern United States, including the Appalachian region of Virginia, began to decline during the 1940's with the widespread use of organochlorine pesticides (e.g., DDT). The use of these pesticides continued into the 1970s. The compounds were responsible for direct adult mortality and reproductive failure (i.e., egg shell thinning, egg breakage, and hatching failure) in Peregrines. By the 1960s, no breeding Peregrine Falcons occurred in the eastern U.S. (Hickey, 1969).

With the restriction of pesticide use beginning in the 1970's and development of programs to reintroduce the peregrine in the east, Peregrine Falcon populations have made a slow and steady comeback. In Virginia, the primary success has been in coastal areas, where bridge crossings and man-made structures built for Peregrine nesting are the preferred nesting locations. The mountain locations have not recovered as well, with fewer than 21 nesting pairs over 12 years through the entire Southern/Central Appalachian region (CCB, 2007). To augment numbers, the Foster Falcon Program began in 2000 for the purpose of transplanting at-risk young peregrines from coastal areas to Shenandoah National Park. Between 2000 and 2006, 51 of 55 young have been successfully fledged from SHEN, and in 2007, a pair of Peregrines returned to nest at Stony Man for a third consecutive year.

Hawksbill and Stony Man ROMP sites in SHEN are the areas with current Peregrine Falcon management plans. SHEN has active programs in place to monitor the population, implement management and protection, and engage in reintroduction/hacking efforts. These important efforts should be continued and augmented if necessary. If Peregrines are found at other outcrop sites, SHEN should work with the proper authorities (CCB, Virginia Department of Game and Inland Fisheries, and USFWS) to develop additional site specific management plans.

The Shenandoah salamander is listed as endangered at both the federal and state levels. It is endemic to SHEN where it is found only at Millers Head, Pinnacles, Hawksbill Mountain, and Stony Man Mountain. Thus, SHEN plays a vital role in the conservation of the species and its habitat. The Shenandoah salamander's limited range, restricted habitats, and apparent threats (i.e., changes in microhabitats due to forest alteration from insects or disease, changes in soil organisms consumed by the salamander due to increased acidity of the soils, and human threats from hiking, camping etc.) resulted in its listing as endangered at the federal level in 1989. In 1994, a recovery plan for the species was written by the USFWS in conjunction with SHEN (USFWS, 1994).

The Shenandoah salamander utilizes moist microhabitats in talus slopes where it is able to out-compete the closely related red-backed salamander (*Plethodon cinereus*). In more optimal habitats, the red-backed salamander out-competes the Shenandoah salamander and may prevent it from expanding its range (Jaeger, 1971). It is known to occur within or very close to five ROMP sites: Pinnacles, Hawksbill North Slope Talus, Little Stony Man, Stony Man Summit, and Millers Head.

There is still a significant lack of basic biological information about this species. Some work has been done on genetic and competition biology, but life history information and updated survey information are lacking and need to be compiled for adequate management to occur. Some survey efforts are being conducted in 2007 (J. Atkinson, pers. comm.), and more are needed. As the areas of occurrence are more clearly delineated, management considerations should consider the potential adverse impacts of trampling and soil alteration brought about by visitor use. In addition, regular monitoring surveys should be conducted both to assess population viability and document changes in the species' distribution,

especially in areas where it meets *Plethodon cinereus*.

STEWARDSHIP METHODS

A stewardship biologist visited 28 sites in 2005 and 17 sites in 2006, for a total of 45 of the 50 study sites. The five sites not visited were: Rocky Mount, Nakedtop, Hogback Mountain Spur, Little Devils Stairs, and Blackrock South District. From reports of other DCR-DNH researchers, these sites were already known to have infrequent visitor use and no invasive plant impacts. Qualitative ranking systems were devised to summarize observations of human impacts and invasive plant impacts at each site. These ranks are combined to give a threat assessment rank for each site.

Human Impact Rank

A qualitative assessment was made for each site based on observations made during site visits. Observations made by other researchers were also incorporated.

None	0	No discernable impact. Fairly continuous cover of vegetation or lichens on level areas of outcrop.
Low	1	Some light trampling; some loss of lichen or mosses; mostly confined to trail.
Medium	2	Moderate trampling; loss of herbs, soils; confined to trail-outcrop interface.
High	3	Heavy trampling; loss of grasses; trampled area largely denuded except perhaps in crevices; impact throughout outcrop area or important component of outcrop (e.g. the one large flat open area of an outcrop complex).

Invasive Plant Rank

A qualitative assessment was made for each site based on observations site visits. Observations made by other researchers were also incorporated. The invasiveness of a given non-native species also factored into the ranking. For example, presence of a highly invasive species, such as *Centaurea biebersteinii*, would increase the threat and, therefore, the invasive plant rank for the site.

None	0	No non-native plants present in outcrop community.
Low	1	Non-native species may be present, but not a threat.
Medium	2	Non-native species competing with native species, but not abundant.
High	3	Non-native species competing with native species and abundant.

Threat Assessment Rank

The sum of the Human Impact Rank and the Invasive Plant Rank yields the Threat Assessment Rank. On this scale of 0 to 6, the larger the number, the greater the threat to natural heritage resources at the site. Individual site Threat Assessment Ranks are given in each site report. The Threat Assessment was used in combination with Conservation Site Biodiversity Ranks (B Rank) to prioritize the sites for management action. See the Threat Assessment table in the Results section of this report (Table 19).

RESULTS

SUMMARY OF FINDINGS

Ecology

Fifty-four significant occurrences of 11 distinct natural community types were located at 44 sites (Table 10). Nine of the 11 targeted natural community types are globally rare (G1 and G2-ranked) and all but two of the 54 occurrences are of globally rare (G1 and G2-ranked) types. Two community types (the High-Elevation Greenstone Barren and Central Appalachian Mafic Boulderfield) are entirely endemic to SHEN. Twenty-six (26) of the 54 occurrences were previously undocumented, including five occurrences of a community type (Central Appalachian Xeric Chestnut Oak-Virginia Pine Woodland) previously unknown from the Park and seven occurrences of two nonvascular boulderfield communities that were newly defined on the basis of data collected during the project. Four new occurrences of the two specially targeted G1 community types were documented during the project: three new occurrences of the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) and one new occurrence of the High-Elevation Greenstone Barren.

The community classification is based primarily on analysis of the 91-plot dataset assembled for the project and builds on the broad classification and map of SHEN vegetation recently completed by Young *et al.* (2006). Cluster analysis and compositional summary statistics defined seven community types in the park (Table 11, Fig. 1). Two additional community types (the Central Appalachian High-Elevation Boulderfield Forest and the Sweet Birch - Chestnut Oak Talus Woodland) were not included in the analysis since no new plot data were collected; stands of these were assigned to type in the field, or based on earlier analysis conducted during the vegetation mapping project. Two nonvascular, lichen-dominated communities were defined using extensive data from collections made at representative sites and identified by specialists. For the most part, classification results for this project were consistent with earlier classifications by Young *et al.* (2006) and Fleming and Coulling (2001). Additional plot data collected for the ROMP inventory made the classification, description, and statistical summaries of most outcrop community types more robust but did not result in changes of name or circumscription. However, significant revisions to two community types (Central Appalachian Xeric Chestnut Oak-Virginia Pine Woodland and Central Appalachian Heath Barren) did result from this work.

The Central Appalachian Xeric Chestnut Oak-Virginia Pine Woodland was previously a poorly documented type mostly represented by plots from sedimentary rocks of the Ridge and Valley province. This community had not been previously documented from SHEN, but was found at five sites during this project. Two of the stands had been visited in the past, but were misinterpreted as belonging to different community types. The recent data from SHEN and other sites in Virginia and Maryland (*e.g.*, at Catoctin Mountain Park) made it clear that the type occurs on a variety of sedimentary, metamorphic, and igneous outcrops. Additionally, the new plot data from SHEN and several National Capital Region national parks resulted in revisions to the floristic circumscription of the type.

The Central Appalachian Heath Barren was revised to merge two formerly separate but similar shrublands, one occurring on high-elevation granitic and quartzite summits in western Virginia, the other on high-elevation quartzite and sandstone summits (*e.g.*, Dolly Sods, Spruce Knob) in West Virginia. Since this shrubland is quite similar in some respects to the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type), the relationship between the two was closely evaluated. Various analyses confirmed, however, that these types are distinct floristically and environmentally, and should not be merged.

Table 10. Significant natural communities located at SHEN rock outcrop study sites. The USNVC global element code (CEGL00) is listed after the name.

Scientific Name	**Common Name**	**Global Rank/ State Rank**	**ROMP Sites Where Found** (Sites in **bold** are new locations for the type.)
Fraxinus americana - Carya glabra / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683)	Central Appalachian Basic Woodland	G2 / S2	Dickey Ridge Big Devils Stairs **Little Devils Stairs** **Oventop** **Whiteoak Canyon** Halfmile Cliff **Rose River Cliffs** Sawlog Ridge Goat Ridge
Kalmia latifolia - Gaylussacia baccata - Vaccinium (*angustifolium, pallidum*) - *Menziesia pilosa* Shrubland (CEGL003939)	Central Appalachian Heath Barren	G2 / S1	**Marys Rock** **Pinnacles,** Old Rag Summit West
Lasallia (*papulosa*, *pensylvanica*) - *Dimelaena oreina* - (*Melanelia culbersonii*) Nonvascular Vegetation (CEGL004142)	Central Appalachian Acidic Boulderfield	G4? / S4?	Blackrock South District Trayfoot Saddle Boulderfields East Trayfoot Saddle Boulderfields West
Lasallia papulosa - Stereocaulon glaucescens - Chrysothryx chlorina Nonvascular Vegetation (CEGL004143)	Central Appalachian Mafic Boulderfield	G2? / S2?	**North Marshall Summit** **Little Devils Stairs** **Stony Man Summit** **Hawksbill North Slope Talus** **Franklin Cliffs Overlook**
Juniperus virginiana - Fraxinus americana / *Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation (CEGL006037)	Central Appalachian Circumneutral Barren	G2 / S2	Dickey Ridge **Dickey Hill** Gooney Manor Overlook Halfmile Cliff **Rose River Cliffs**
Betula lenta - Quercus prinus / *Parthenocissus quinquefolia* Woodland (CEGL006565)	Sweet Birch - Chestnut Oak Talus Woodland	G3G4 / S3S4	Blackrock South District, **Trayfoot Saddle Boulderfields East** Trayfoot Saddle Boulderfields West
Betula alleghaniensis / Sorbus americana - Acer spicatum / *Polypodium appalachianum* Forest (CEGL008504)	Central Appalachian High-Elevation Boulderfield Forest	G2 / S2	North Marshall Summit **South Marshall Cliff** Pinnacles Little Stony Man Stony Man Summit Hawksbill North Slope Talus Hawksbill Summit Blackrock Central District
Photinia melanocarpa - Gaylussacia baccata / *Carex pensylvanica* Shrubland (CEGL008508)	High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type)	G1 / S1	South Marshall Cliff Pass Mountain **Blackrock Central District** **Bearfence Mountain** Hightop **Loft Mountain**
Fraxinus americana / *Physocarpus opulifolius* / *Carex pensylvanica - Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation (CEGL008529)	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2 / S2	**Browntown Valley Overlook** Overall Run Falls South Little Devils Stairs Millers Head **Old Rag Summit East** **Nakedtop** **Field Hollow Cliff**

Table 10 continued. Significant natural communities located at SHEN Park rock study sites.

Scientific Name	**Common Name**	**Global Rank/ State Rank**	**ROMP Sites Where Found** (Sites in **bold** are new locations for the type.)
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation (CEGL008536)	High Elevation Greenstone Barren	G1 / S1	**North Marshall Summit** Little Stony Man Stony Man Summit Bettys Rock **Crescent Rock Overlook** Crescent Rock South Hawksbill North Slope Outcrops **Hawksbill North Slope Talus,** Hawksbill Summit Franklin Cliffs North **Franklin Cliffs Overlook** Franklin Cliffs South
Quercus prinus - Pinus virginiana - (*Pinus pungens*) / *Schizachyrium scoparium - Dichanthelium depauperatum* Woodland (CEGL008540)	Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland	G2? / S2	**Hogback Mountain Spur** **Overall Run Falls North,** **Millers Head** **Old Rag Southside** **Whiteoak Canyon**

HIGH-ELEVATION OUTCROP BARRENS

Plate 1. High-Elevation Greenstone Barren (CEGL008536) on Hawksbill Mountain.

Plate 2. High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type (CEGL008508) on the summit of Loft Mountain.

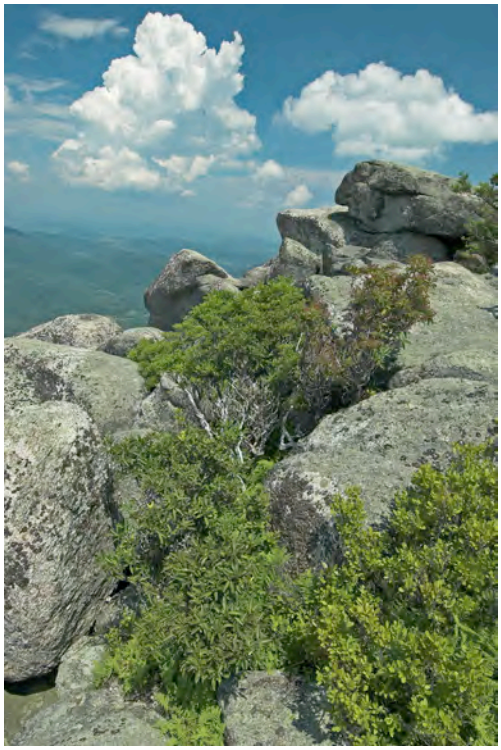


Plate 3. Central Appalachian Heath Barren (CEGL003939) on the west summit of Old Rag.

LOW-ELEVATION OUTCROP BARRENS

Plate 4. Central Appalachian Circumneutral Barren (CEGL006037) at Dickey Ridge.

Plate 5. Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type) (CEGL008529) at Little Devils Stairs.

OUTCROP WOODLANDS

Plate 6. Central Appalachian Basic Woodland (CEGL003683) at Goat Ridge.

Plate 7. Central Appalachian Xeric Chestnut Oak – Virginia Pine Woodland (CEGL008540) on the lower outcrop at Millers Head.

BOULDERFIELD WOODLANDS

Plate 8. Central Appalachian High-Elevation Boulderfield Forest (CEGL008504) at Blackrock, Central District.

Plate 9. Sweet Birch – Chestnut Oak Talus Woodland (CEGL006565) at Blackrock, South District.

NON-VASCULAR (LICHEN AND BRYOPHYTE-DOMINATED) BOULDERFIELDS

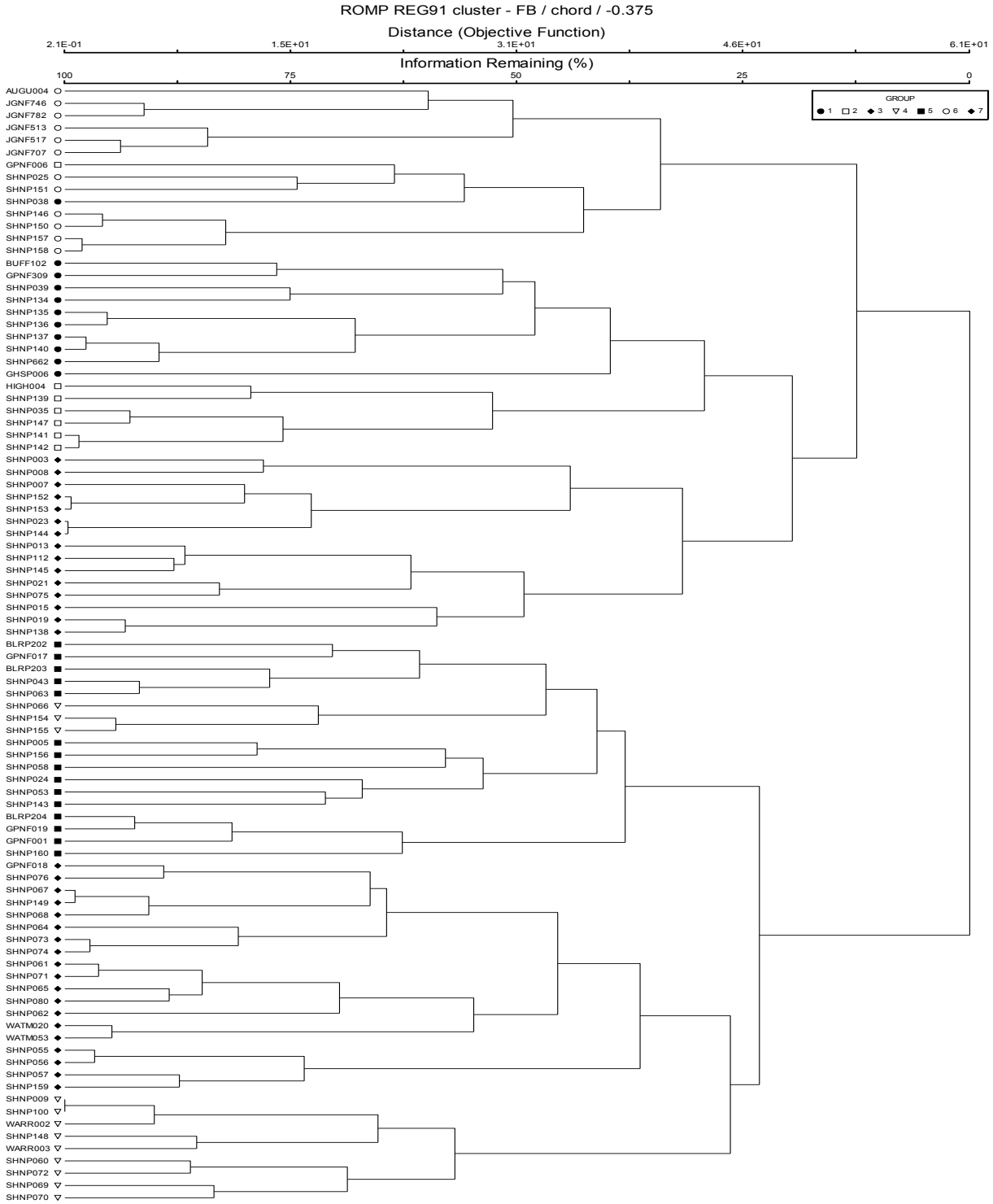
Plate 10. Central Appalachian Acidic Boulderfield (CEGL004142) at Blackrock, South District.

Plate 11. Central Appalachian Mafic Boulderfield (CEGL004143) on the Hawksbill North Slope.

Table 11. Classified community types of SHEN rock outcrop study sites, listed by the global element code (CEGL00) and name in the U.S. National Vegetation Classification (USNVC). The total number of plots analyzed and the number of plots from SHEN is listed for each type. No new data were collected for CEGL004142, CEGL004143, CEGL006565, and CEGL08504.

USNVC CEGL00	Community type (USNVC name)	Common Name	Conservation Ranks	No. plots in dataset	No. SHEN plots
3683	*Fraxinus americana* - *Carya glabra* / *Muhlenbergia sobolifera* - *Helianthus divaricatus* - *Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2 / S2	19	16
3939	*Kalmia latifolia* - *Gaylussacia baccata* - *Vaccinium* (*angustifolium*, *pallidum*) - *Menziesia pilosa* Shrubland	Central Appalachian Heath Barren	G2 / S1	7	5
4142	*Lasallia* (*papulosa*, *pensylvanica*) - *Dimelaena oreina* - (*Melanelia culbersonii*) Nonvascular Vegetation	Central Appalachian Acidic Boulderfield	G4? / S4?	-	-
4143	*Lasallia papulosa* - *Stereocaulon glaucescens* - *Chrysothryx chlorina* Nonvascular Vegetation	Central Appalachian Mafic Boulderfield	G2? / S2?	-	-
6037	*Juniperus virginiana* - *Fraxinus americana* / *Carex pensylvanica* - *Cheilanthes lanosa* Wooded Herbaceous Vegetation	Central Appalachian Circumneutral Barren	G2 / S2	12	10
6565	*Betula lenta* - *Quercus prinus* / *Parthenocissus quinquefolia* Woodland	Sweet Birch - Chestnut Oak Talus Woodland	G3G4 / S3S4	-	-
8504	*Betula alleghaniensis* / *Sorbus americana* - *Acer spicatum* / *Polypodium appalachianum* Forest	Central Appalachian High-Elevation Boulderfield Forest	G2 / S2	-	-
8508	*Photinia melanocarpa* - *Gaylussacia baccata* / *Carex pensylvanica* Shrubland	High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type)	G1 / S1	11	8
8529	*Fraxinus americana* / *Physocarpus opulifolius* / *Carex pensylvanica* - *Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2 / S2	15	9
8536	*Diervilla lonicera* - *Solidago randii* - *Deschampsia flexuosa* - *Hylotelephium telephioides* - *Saxifraga michauxii* Herbaceous Vegetation	High-Elevation Greenstone Barren	G1 / S1	15	15
8540	*Quercus prinus* - *Pinus virginiana* - (*Pinus pungens*) / *Schizachyrium scoparium* - *Dichanthelium depauperatum* Woodland	Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland	G2? / S2	12	6

Fig. 4. Dendrogram showing the results of cluster analysis of 91 plots of rock outcrop vegetation from SHEN and elsewhere in the region. Plots forming groups defined as community types are coded with the same symbols. Note that four plots were reassigned from their original groups in cluster analysis to different groups after conducting statistical and ordination studies.



Relationship of Vegetation Types to Environmental Gradients

The preponderance of globally rare, environmentally restricted vegetation types that are associated with exposed outcrops and talus at SHEN reflects a rare confluence of geologic, climatic, and floristic influences. In the Central Appalachians, the presence of granitic and metabasaltic rocks is limited to the Northern Blue Ridge. Lands above 900 m (3000 ft) underlain by these formations are even more limited to portions of SHEN and a few other areas. For some outcrop and boulderfield communities, the combination of igneous or metamorphic bedrock and cold microclimates at high elevations provides the requisite habitat conditions. For others, xeric conditions and edaphic influences by base-rich metabasalt or pyroxene-bearing granitic rocks are the driving environmental factors. The general environmental characteristics of each SHEN outcrop community are provided in Tables 12 and 13.

The disposition of vegetation types in the various ordination diagrams (Figs. 2-6) generally corresponds well with clusters identified by the Lance-Williams Flexible-Beta method. The four major vegetation groups (Fig. 2) separate along both a soil fertility gradient and multiple topographic gradients. The soil fertility gradient is indicated by high levels of Mg, Ca, Mn, and other cations associated with the Low-Elevation Barrens and Central Appalachian Basic Woodland groups in the lower left part of the diagram. The Central Appalachian Xeric Chestnut Oak – Virginia Pine (Acidic) Woodland and the High-Elevation Outcrop Barrens lie at the opposite end of this gradient but are separated by topographic gradients. In addition to higher values for elevation, the High-Elevation Outcrop Barrens are strongly correlated with higher topographic positions (TopPos), more northern aspects (Baspect), high soil aluminum, and exposed bedrock. The Central Appalachian Xeric Chestnut Oak – Virginia Pine (Acidic) Woodland is positioned lower on the elevation gradient in association with a strong vector for siliciclastic bedrock, indicative of the four Ridge and Valley plots that occur on quartzite.

Ordination of the five outcrop barrens communities (Fig. 4) confirms a very strong separation along these same soil chemistry and topographic gradients, which are more strongly correlated when the two woodlands are removed. The two woodland communities (Fig. 3) are separated primarily by soil fertility and bedrock geology.

Additional ordinations were run to assist in identifying environmental differences between community types in the High-Elevation Outcrop Barrens and Low-Elevation Outcrop Barrens groups. Preliminary studies indicated that there were few significant differences in soil chemistry between the three High-Elevation Outcrop Barrens communities. Ordination of this group (Fig. 5) does, however, indicate several topographic gradients, including the separation of the Central Appalachian Heath Barren from the other two types by bedrock geology (granitic vs. mafic), and the association of some plots of the High-Elevation Greenstone Barrens with higher values for Beers-transformed aspect (more northerly exposure), TRMI (greater site moisture potential), and steeper slopes. The two Low-Elevation Outcrop Barrens community types (Fig. 6) have a more pronounced separation along both a strong elevation gradient (with the Central Appalachian Mafic Barren occurring at significantly higher elevations) and a strong soil fertility gradient (with the Central Appalachian Circumneutral Barren associated with higher Mg, Ca, total base saturation, etc.). In addition, several weaker topographic gradients are indicated by the ordination, but are not highly correlated with the two major gradients.

These studies and a comparison of the environmental summaries by community type (Table 13) indicate that geologic substrate, soil chemistry, elevation, and slope position are the most important environmental factors influencing the composition and distribution of vegetation on SHEN rock outcrops.

Table 12. Geology and geography of classified community types of SHEN rock outcrop study sites. Geologic substrates in bold are those documented in the park; substrates in parentheses indicate that examples on that substrate are infrequent or rare.

USNVC CEGL00	Common Name	Geologic Substrate	Geographic Distribution
3683	Central Appalachian Basic Woodland (G2/S2)	**metabasalt** (**granitic complex**) (calcareous sandstone)	VA & MD; primarily no. Blue Ridge; scattered in Ridge & Valley and on so. Blue Ridge
3939	Central Appalachian Heath Barren (G2S1)	**granitic complex** quartzite/sandstone	NW Virginia and east-central WVA; Blue Ridge, Ridge & Valley, Allegheny Mountains
4142	Central Appalachian Acidic Boulderfield (G4?/S4?)	**quartzite** (metabasalt)	throughout central Appalachians; PA, MD, VA, WVA
4143	Central Appalachian Mafic Boulderfield (G2?/S2?)	**metabasalt**	northern Blue Ridge of VA; endemic to SHEN
6037	Central Appalachian Circumneutral Barren (G2/S2)	**metabasalt** amphibolite calcareous shale	northern Blue Ridge and Ridge & Valley of MD, VA, WVA
6565	Sweet Birch - Chestnut Oak Talus Woodland (G3G4/S3S4)	**quartzite/sandstone** (**metabasalt**) (**granitic complex**)	throughout central Appalachians; PA, MD, VA, WVA
8504	Central Appalachian High-Elevation Boulderfield Forest (G2/S2)	**metabasalt** **granitic complex** quartzite/sandstone	northern Blue Ridge and Ridge & Valley of NW VA and east-central WVA
8508	High-Elevation Outcrop Barren (Chokeberry Type) (G1/S1)	**metabasalt** (granitic complex) (rhyolite)	northern and southern Blue Ridge of VA
8529	Central Appalachian Mafic Barren (Ninebark Type) (G2/S2)	**metabasalt** **granitic complex**	northern Blue Ridge of VA
8536	High-Elevation Greenstone Barren (G1/S1)	**metabasalt**	northern Blue Ridge of VA; endemic to SHEN
8540	Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland (G2?/S2?)	**metabasalt** **granitic complex** sandstone	northern Blue Ridge and Ridge & Valley of MD, VA, WVA

Table 13. Environmental information summary for nine rock outcrop community types; the two non-vascular bounderfield associations are not included because they were not defined using quantitative data. Mean values for measured and scalar topographic variables and soil variables are provided.

COMMUNITY TYPE (CEGL)	**3683**	**3939**	**6037**	**6565**	**8504**	**8508**	**8529**	**8536**	**8540**
Mean Species Richness	61	16	43	24	17	24	37	27	32
ENVIRON. VARIABLE:									
Elevation (m)	554	1070	524	615	1120	1079	834	1078	585
Elevation (ft)	1776	3431	1681	2017	3673	3461	2675	3466	1877
Topographic Position	middle slope	crest	middle slope	middle slope	upper slope	crest	middle slope	upper slope	middle slope
Slope (degrees)	30	26	27	24	31	18	30	33	21
Slope Shape: Vertical	straight	convex	straight	straight	straight	convex	convex	straight	convex
Slope Shape: Horizontal	straight	convex	straight	concave	straight	convex	convex	straight	convex
Slope Shape Index (0 to 10)	3.2	2.86	3.75	6.08	4	2.09	1.27	3.2	2
Mean Aspect (degrees)	196	275	218	354	351	346	240	328	172
Mean Aspect (direction)	S	W	SW	N	N	N	SW	NW	S
Beer's Aspect (0 to 2)	0.46	1	0.21	1.57	1.49	1.04	0.68	1.16	0.71
TRMI (0 to 60)	18.4	17.4	17.37	33.93	25.79	19.35	17.29	20.54	20.57
SURFACE SUBSTRATE (%):									
Wood	1	0	1	2	2	0	1	0	1
Bedrock	26	68	41	1	0	59	41	49	26
Boulders & Stones	19	7	15	60	78	12	9	13	9
Gravel & Cobbles	1	1	4	3	0	1	2	3	12
Mineral Soil	4	1	3	0	0	6	2	4	6
Litter / Organic Matter	49	23	36	34	20	22	45	31	46
Bryophytes & Lichens	26	44	36	33	55	50	35	49	27
SOIL CHEMISTRY:									
pH	5	4.4	5.3	4.1	n.a.	4.1	4.6	4.1	4.3
Calcium (ppm)	1807	130	2015	346	n.a.	165	1205	379	114
Magnesium (ppm)	381	16	561	56	n.a.	32	186	50	23
Iron (ppm)	165	167	101	233	n.a.	180	174	225	131
Manganese (ppm)	97	2	100	102	n.a.	6	105	55	12
Zinc (ppm)	5.13	1.29	4.5	4.41	n.a.	1.85	5.84	3.89	2.06
Phosphorus (ppm)	33	34	19	39	n.a.	29	47	60	8
Potassium (ppm)	121	28	132	61	n.a.	44	98	64	37
Aluminum (ppm)	959	1798	772	850	n.a.	1642	1257	1594	781
Copper (ppm)	2.47	0.26	5.41	0.61	n.a.	2.07	2.12	3.03	0.74
Boron (ppm)	0.69	0.69	0.68	0.38	n.a.	0.77	0.69	0.66	0.25
Sodium (ppm)	21	18	22	13	n.a.	24	23	21	25
Soluble Sulfur (ppm)	34	77	35	43	n.a.	84	64	72	73
% Organic Matter	16	11	13	13	n.a.	21	25	20	9
Estimate Nitrogen Release (lb/ac)	127	126	126	108	n.a.	127	129	128	116
Cation Exchange Capacity	27.11	18.43	17.37	21.25	n.a.	24.5	28.72	25.36	17.43
Total Base Saturation (%)	46.97	5.02	57.16	9.11	n.a.	5.22	26.03	9.87	8.42
Calcium: Magnesium ratio	5.43	8.47	4	6.33	n.a.	5.04	7.1	7.98	4.74
Fertility Index	12.61	0.93	15.18	2.04	n.a.	1.31	7.92	2.57	1.45

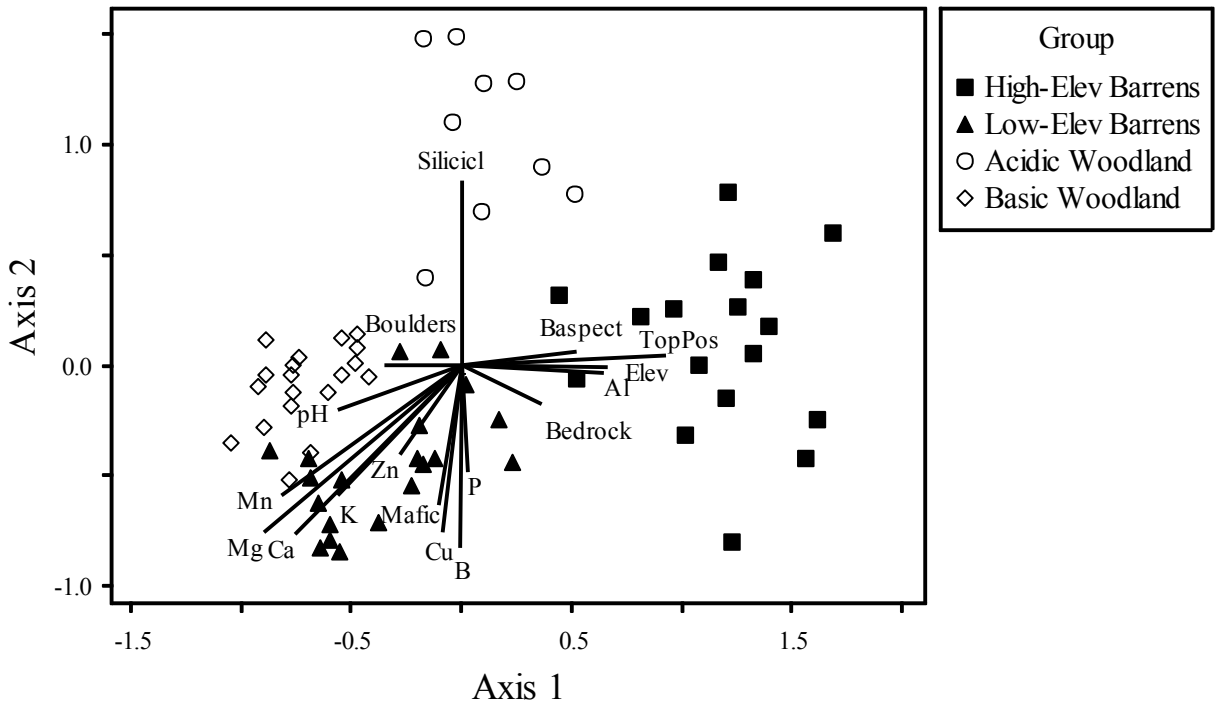


Fig. 5. Scatterplot diagram for two-dimensional NMDS ordination of four major vegetation groups: High-Elevation Outcrop Barrens (CEGL00's 3939, 8508, and 8536), Low-Elevation Outcrop Barrens (CEGL00's 6017 and 8529), Central Appalachian Xeric Chestnut Oak – Virginia Pine (Acidic) Woodland (CEGL008540), and Central Appalachian Basic Woodland (CEGL003683). Overlain vectors show significant correlations between compositional variation and environmental gradients ($p = <0.001$). Baspect = Beers-transformed aspect; northeastern aspects have the highest values, southwestern aspects have the lowest values. Bedrock = exposed bedrock surface cover. Boulders = exposed boulder suface cover. Elev = elevation. Mafic = metabasalt or amphibolite bedrock. Siliciclastic = siliciclastic (quartzite, sandstone) bedrock. TopPos = topographic position; high values indicate higher slope position. See page 19 for full names of soil chemistry variables.

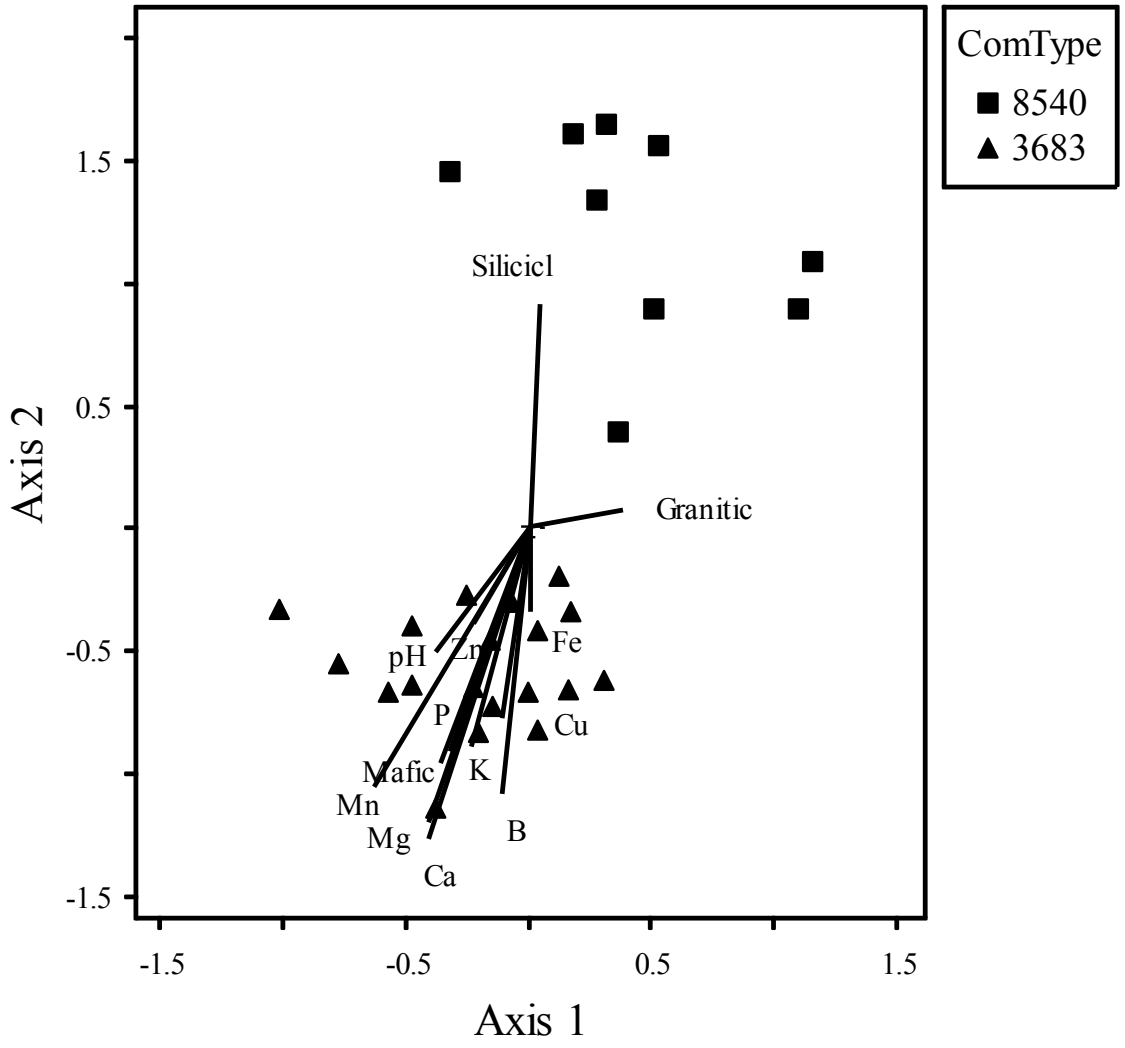


Fig. 6. Scatterplot diagram for two-dimensional NMDS ordination of two woodlands: Central Appalachian Xeric Chestnut Oak – Virginia Pine Woodland (CEGL008540) and Central Appalachian Basic Woodland (CEGL003683). Overlain vectors show significant correlations between compositional variation and environmental gradients ($p = <0.02$). Granitic = granitic bedrock. Mafic = metabasalt or amphibolite bedrock. Siliciclastic = siliciclastic (quartzite, sandstone) bedrock. See page 19 for full names of soil chemistry variables.

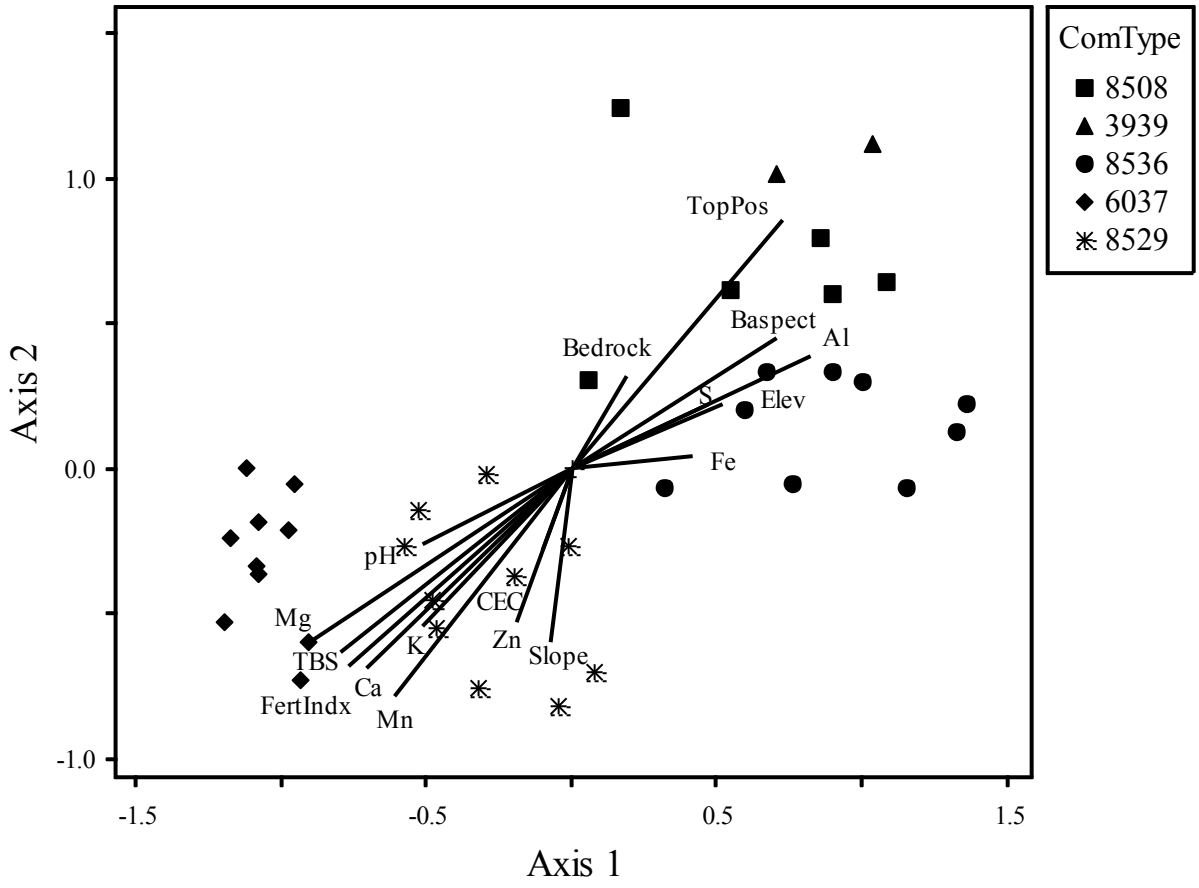


Fig. 7. Scatterplot diagram for two-dimensional NMDS ordination of four outcrop barrens community types: High-Elevation Outcrop Barren (Chokeberry type; CEGL008508), Central Appalachian Heath Barren (CEGL003939), High-Elevation Greenstone Barren (CEGL008536), Central Appalachian Circumneutral Barren (CEGL006037), and Central Appalachian Mafic Barren (Ninebark type; CEGL008529). Overlain vectors show significant correlations between compositional variation and environmental gradients ($p = <0.01$). Baspect = Beers-transformed aspect; northeastern aspects have the highest values, southwestern aspects have the lowest values. Bedrock = exposed bedrock surface cover. Elev = elevation. FertIndx = fertility index (CEC X %TBS / 100). Mafic = metabasalt or amphibolite bedrock. Slope = slope inclination. TopPos = topographic position; high values indicate higher slope position. See page 19 for full names of soil chemistry variables.

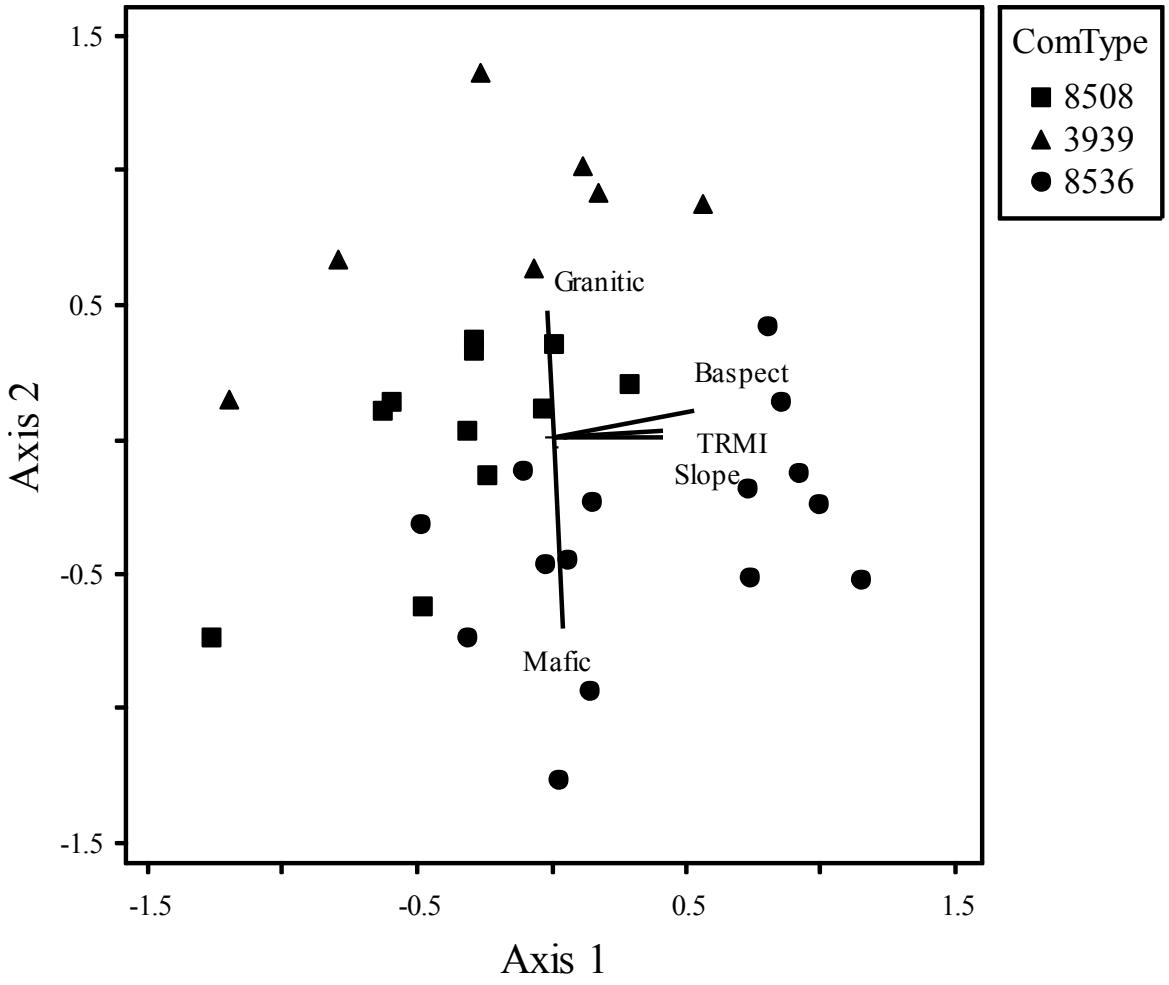


Fig. 8. Scatterplot diagram for three-dimensional NMDS ordination of three high-elevation outcrop barrens, showing the distribution of community types on the first and second axes: High-Elevation Outcrop Barren (Chokeberry type; CEGL008508), Central Appalachian Heath Barren (CEGL003939), and High-Elevation Greenstone Barren (CEGL008536). Overlain vectors show significant correlations between compositional variation and environmental gradients ($p = <0.01$). Baspect = Beers-transformed aspect; northeastern aspects have the highest values, southwestern aspects have the lowest values. Granitic = granitic bedrock. Mafic = metabasalt or amphibolite bedrock. Slope = slope inclination. TRMI = topographic relative moisture index; high values indicate greater site moisture potential. See page 19 for full names of soil chemistry variables.

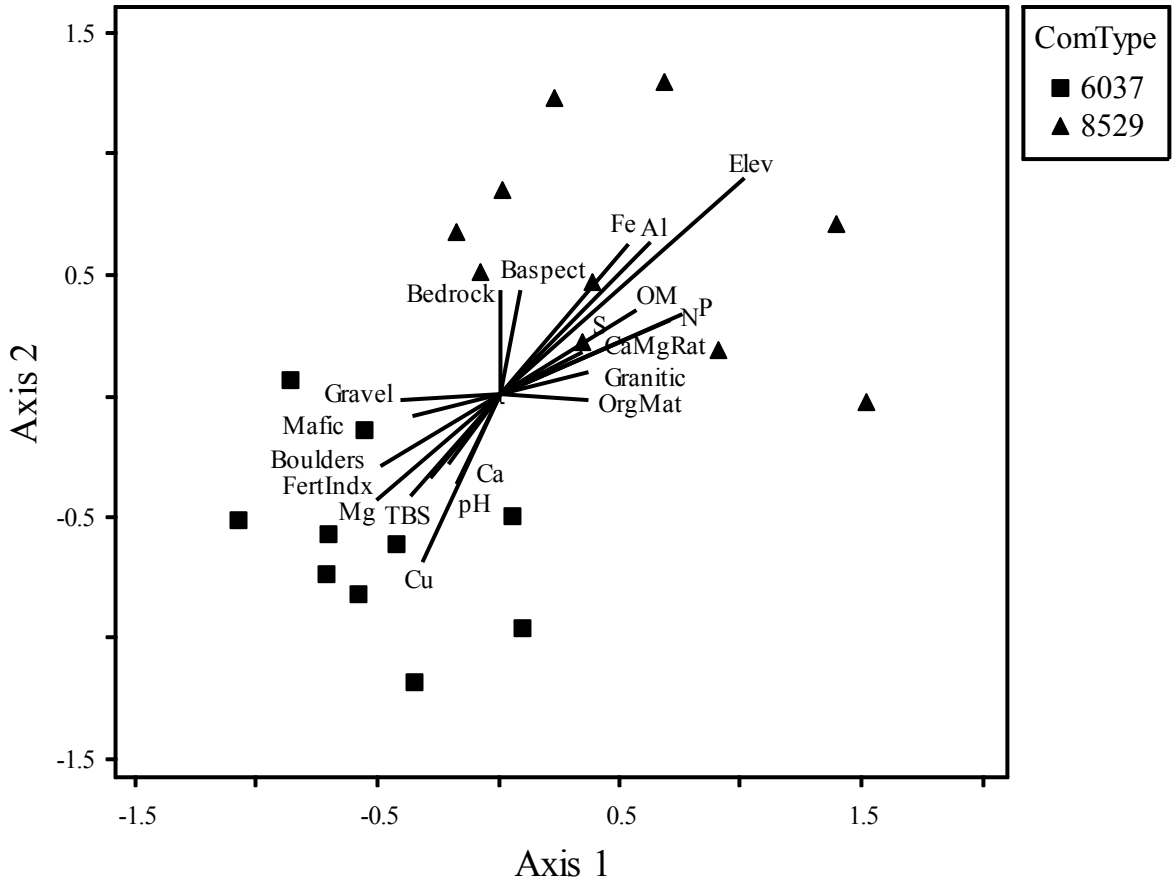


Fig. 9. Scatterplot diagram for two-dimensional NMDS ordination of two low-elevation outcrop barrens community types: Central Appalachian Circumneutral Barren (CEGL006037) and Central Appalachian Mafic Barren (Ninebark type; CEGL008529). Overlain vectors show significant correlations between compositional variation and environmental gradients ($p = <0.05$). Baspect = Beers-transformed aspect; northeastern aspects have the highest values, southwestern aspects have the lowest values. Bedrock = exposed bedrock surface cover. Boulder = exposed boulder suface cover. Elev = elevation. FertIndx = fertility index (CEC X %TBS / 100). Granitic = granitic bedrock. Gravel = exposed gravel surface cover. Mafic = metabasalt or amphibolite bedrock. OrgMat = litter / organic matter surface cover. Slope = slope inclination. TopPos = topographic position; high values indicate higher slope position. See page 19 for full names of soil chemistry variables.

Botany

Botanists located 76 rare plant populations at the 50 sites, comprising 21 species. Nine of the populations were previously unknown. These are *Aralia hispida* (bristly sarsaparilla) at Marys Rock, Pinnacles, and Brown Mountain; *Clematis occidentalis* var. *occidentalis* (purple clematis) at Crescent Rock South; *Cuscuta coryli* at Bettys Rock; *Huperzia appalachiana* (Appalachian fir-clubmoss) at Little Stony Man; *Muhlenbergia glomerata* (marsh muhly) at Franklin Cliffs North; *Rubus idaeus* ssp. *strigosus* (red raspberry) at Bettys Rock; and *Sibbaldiopsis tridentata* at Blackrock Central District. Table 14 lists the rare plant species found and the site(s) at which each species was located. None of the rare species found during this study are new to SHEN, and none are listed as threatened or endangered under either the federal Endangered Species Act of 1973, as amended, or the Virginia Endangered Plant and Insect Act, as amended.

In addition, 42 populations of watchlist species were located, comprising 12 species. One of these species, *Zanthoxylum americanum* (northern prickley-ash), is new to the park. Table 15 lists the watchlist species found and the site(s) at which each species was located.

Six rare plant populations known prior to this study were searched for but could not be relocated. These are *Cuscuta coryli* (hazel dodder) at Dickey Ridge, Gooney Manor Overlook, Little Devils Stairs, and Halfmile Cliff and *Solidago randii* (Rand's goldenrod) at Pass Mountain and Marys Rock. *Cuscuta coryli* is an annual, and populations of this species may appear only in years when conditions are optimal. Therefore, the absence of this species from a known site in any given year is not in itself cause for alarm. It is likely that *Solidago randii* has been extirpated from Marys Rock due to trampling. It is uncertain why *Solidago randii* could not be relocated at Pass Mountain; additional searches for the goldenrod at that site are recommended.

A colony of *Rubus idaeus* ssp. *strigosus* located along the Appalachian Trail within the Crescent Rock South site had previously been mapped as extending north into the Crescent Rock Overlook site. No plants were found within the Crescent Rock Overlook site in 2005, however, and the colony may have previously been mapped incorrectly.

New populations of *Aralia hispida* were found at three sites: Marys Rock, Pinnacles, and Brown Mountain. In addition, a population of *Aralia hispida* was relocated at Old Rag Summit East which had not been documented from that site since it was first discovered there in 1938. Wildfires have recently occurred in all of the areas where bristly sarsaparilla was found during the course of this study, and the rare plant is believed to be unable to compete with other species in the absence of periodic wildfire or a management regime that mimics the effects of wildfire.

Colonies of *Huperzia appalachiana* (Appalachian fir-clubmoss) at several ROMP sites could not be relocated, had declined in population size from earlier reports, and/or appeared sickly. The latter was manifest by the presence of dead, stunted, and/or chlorotic plants. Sites with apparent problems include Pinnacles, Stony Man Summit, Old Rag Summit West, and Hawksbill Summit. In some cases, declines may be due to a change in microhabitat resulting from the die-off of *Tsuga canadensis* (eastern hemlock). Trampling, wildfire, global warming, and acid deposition may also be contributing factors.

Table 14. Rare plants located at SHEN rock outcrop study sites in 2005-6.

Scientific Name	**Common Name**	**Global Rank/ State Rank**	**ROMP Sites Where Found** (Sites in **bold** are new locations for the species.)
Abies balsamea	Balsam fir	G5/S1	Stony Man Summit Crescent Rock Overlook Crescent Rock South Hawksbill North Slope Outcrops Hawksbill North Slope Talus Hawksbill Summit
Aralia hispida	Bristly sarsaparilla	G5/S2	**Marys Rock** **Pinnacles** Old Rag Summit East Rocky Mountain **Brown Mountain** CalvaryRocks-Chimney Rock
Arctostaphylos uva-ursi	Bearberry	G5/S1	Millers Head
Asplenium bradleyi	Bradley's spleenwort	G4/S2	Rocky Mountain
Betula cordifolia	Mountain paper birch	G5/S2	Trayfoot Saddle Boulderfields E Trayfoot Saddle Boulderfields W
Clematis occidentalis var. *occidentalis*	Purple clematis	G5T5/S2	**Crescent Rock South** Hawksbill Summit
Conioselinum chinense	Hemlock parsley	G5/S1	Stony Man Summit
Cornus rugosa	Roundleaf dogwood	G5/S1	Little Devils Stairs
Cuscuta coryli	Hazel dodder	G5/S2?	**Bettys rock**
Huperzia appalachiana	Appalachian fir-clubmoss	G4G5/S2	North Marshall Summit Marys Rock Pinnacles **Little Stony Man** Stony Man Summit Old Rag Summit West Crescent Rock South Hawksbill North Slope Outcrops Hawksbill North Slope Talus Hawksbill Summit
Juncus trifidus	Highland rush	G5/S1	Stony Man Summit
Minuartia groenlandica	Mountain sandwort	G5/S1	Old Rag Summit West
Muhlenbergii glomerata	Marsh muhly	G5/S2	Little Devils Stairs Crescent Rock Overlook **Franklin Cliffs North**
Oligoneuron rigidum var. *rigidum*	Stiff goldenrod	G5T5/S2	Gooney Manor Overlook
Paxistima canbyi	Canby's mountain-lover	G2/S2	Overall Run Falls South
Populus tremuloides	Quaking aspen	G5/S2	Old Rag Summit East Franklin Cliffs Overlook

Table 14 continued. Rare plants located at SHEN rock outcrop study sites in 2005-6.

Scientific Name	**Common Name**	**Global Rank/ State Rank**	**ROMP Sites Where Found** (Sites in **bold** are new locations for the species.)
Rubus idaeus ssp. *strigosus*	Red raspberry	G5T5/S2	Little Stony Man Stony Man Summit **Bettys Rock** Crescent Rock South Hawksbill North Slope Outcrops Hawksbill North Slope Talus Hawksbill Summit Blackrock Central District
Sibbaldiopsis tridentata	Three-toothed cinquefoil	G5/S2	Little Stony Man Stony Man Summit Bettys Rock Crecent Rock Overlook Crescent Rock South Hawksbill North Slope Outcrops Hawksbill Summit **Blackrock Central District**
Solidago randii	Rand's goldenrod	G5T4	North Marshall Summit South Marshall Cliff Little Stony Man Stony Man Summit Bettys Rock Crescent Rock Overlook Crescent Rock South Hawksbill North Slope Outcrops Hawksbill North Slope Talus Hawksbill Summit Franklin Cliffs North Franklin Cliffs Overlook Franklin Cliffs South Blackrock Central District Bearfence Mountain Dean Mountain Ridge Hightop Loft Mountain Summit
Trisetum spicatum	Narrow false oats	G5/S1	Hawksbill North Slope Outcrops
Vaccinium myrtilloides	Velvetleaf blueberry	G5/S1S2	Stony Man Summit

Plate 12. *Abies balsamea* (balsam fir)

Plate 13. *Aralia hispida* (bristly sarsaparilla)

Plate 14. *Betula cordifolia* (mountain paper birch)

Plate 15. *Minuartia groenlandica* (mountain sandwort)

Plate 16. *Muhlenbergia glomerata* (marsh muhly)

Plate 17. *Oligoneuron rigidum* var. *rigidum* (stiff goldenrod)

Plate 18. *Huperzia appalachiana* (Appalachian fir-clubmoss)

Plate 19. *Populus tremuloides* (quaking aspen)

Plate 20. *Trisetum spicatum* (narrow false oats)

Plate 21. *Sibbaldiopsis tridentata* (three-toothed cinquefoil)

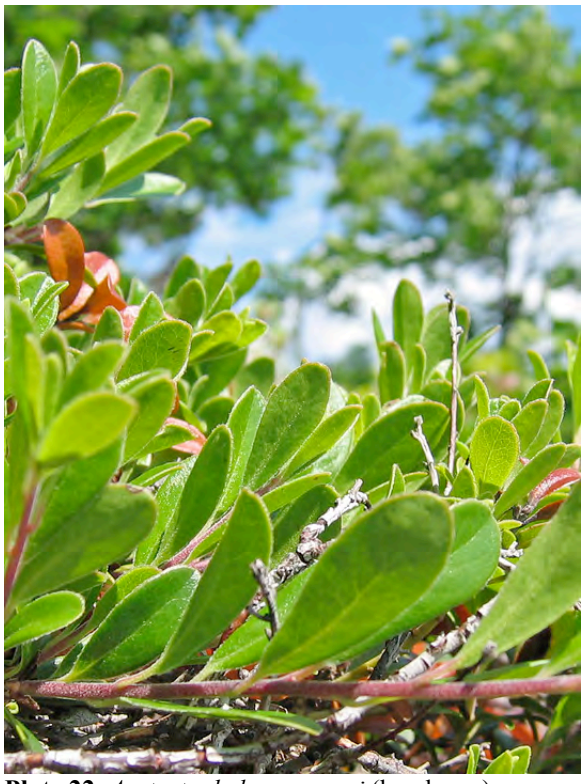


Plate 22. *Arctostaphylos uva-ursi* (bearberry)

Plate 23. *Solidago randii* (Rand's goldenrod)

Table 15. Watchlist plants located at SHEN rock outcrop study sites in 2005-6.

Scientific Name	Common Name	Global Rank/State Rank	ROMP Sites Where Found in 2005
Adlumia fungosa	Climbing fumitory	G4/S3	Browntown Valley Overlook
Amelanchier sanguinea var. *sanguinea*	Roundleaf serviceberry	G5T5/S3	Overall Run Falls South Pass Mountain Little Stony Man Whiteoak Canyon Nakedtop Upper East Slope Franklin Cliffs Overlook Field Hollow Cliff
Crataegus pruinosa	A hawthorn	G5/S3	Dickey Hill Browntown Valley Overlook South Marshall Cliff Millers Head Nakedtop Upper East Slope Franklin Cliffs North Franklin Cliffs Overlook Franklin Cliffs South
Gymnocarpium appalachianum	Appalachian oak fern	G3/S3	Stony Man Summit Hawksbill North Slope Outcrops Hawksbill Summit
Juglans cinerea	Butternut	G3G4/S3?	Little Devils Stairs
Liatris turgida (= *L. helleri*)	Shale-barren blazing-star	G3/S3	Little Stony Man Stony Man Summit Bettys Rock Crescent Rock Overlook Crescent Rock South Franklin Cliffs Overlook Field Hollow Cliff Hightop
Linum sulcatum var. *sulcatum*	Grooved yellow flax	G5T5/S3	Dickey Ridge
Prunus alleghaniensis var. *alleghaniensis*	Alleghany plum	G4T4/S3	Overall Run North Overall Run South
Taenidia montana	Mountain pimpernel	G3/S3	Dickey Ridge Dickey Hill Big Devils Stairs Little Devils Stairs Overall Run North Overall Run South Whiteoak Canyon
Solidago hispida var. *hispida*	Hairy goldenrod	G5T5/S3	Nakedtop Upper East Slope
Taxus canadensis	American yew	G5/S3	Stony Man Summit Crescent Rock South
Zanthoxylum americanum	Northern prickley-ash	G5/S3	Dickey Ridge

A species of *Toxicodendron* (poison ivy) was collected at several ROMP sites in 2005 and 2006 that was initially believed to be *Toxicodendron rydbergii* (western poison ivy), a rare species in Virginia (G5/S1).

Upon further examination of these specimens, it was determined that they were *Toxicodendron radicans* ssp. *negundo* (poison ivy; Thomas F. Wieboldt, Virginia Polytechnic Institute and State University (VPI), pers. comm.; John F. Townsend, Virginia Department of Conservation and Recreation, pers. comm.). Thus, there are only two Virginia records for *Toxicodendron rydbergii*: a specific record for the species along the western edge of a trail 0.1 mi south of the summit of Rocky Mount in Rockingham County (in SHEN but not within a ROMP site) and a vague record for the species in "Page Co.: Luray" (John F. Townsend, pers. comm.; Gillis, 1971; *C.E. Stevens 25471* [VPI]).

A species of *Spiraea* (meadowsweet) from open, rocky, often alpine habitats was described by M.L. Fernald in 1917 as *Spiraea latifolia* (Aiton) Burkhart var. *septentrionalis* Fern. (northern meadowsweet; Fernald, 1917). A specimen collected by J.T. Baldwin on the summit of Hawkbill Mountain on 9 September 1945 and deposited in the Gray Herbarium was determined by Fernald to be this taxa (*J.T. Baldwin 5464*). The taxa was raised to full species status (*Spiraea septentrionalis* (Fern.) A. and D. Löve) in 1994 by J.T Kartesz based on the work of A. and D. Löve (Kartesz, 1994; Löve, 1964) Other authors, including Gleason and Cronquist (1991) and Weakley (2006) do not recognize this taxa as either a variety or full species. These authors include the entity within either *Spiraea latifolia* (Aiton) Burkhart or *Spiraea alba* Du Roi var. *latifolia* (Aiton) Dippel, a species mostly of bogs, seeps, old fields and meadows (Gleason and Cronquist, 1991; Weakley, 2006).

A *Spiraea* that appeared to be a likely candidate for *Spiraea septentrionalis* was found at four ROMP sites:
Pass Mountain, Little Stony Man, Millers Head, and Hawksbill Summit. DCR-DNH Botanist John Townsend collected material from all four of these sites and compared it with material from a known SHEN site for *Spiraea alba* var. *latifolia* at Big Meadows. No morphological differences could be perceived in material from the four rock outcrops sites and the wetland site at Big Meadows. Based on these finding, DCR-DNH has decided at this time not to recognize *Spiraea septentrionalis* as a species confirmed to occur in Virginia.

Liatris turgida Gaiser (shale-barren blazing-star, G3) is a watchlist species known from eight ROMP sites (see Table 15). *Liatris turgida* recently has been combined with *Liatris helleri* T.C. Porter (Heller's blazing-star, G2) by Nesom (2005). *Liatris helleri* sensu stricto is a North Carolina endemic restricted to high-elevation sites in five counties and is also listed as threatened under the federal Endangered Species Act of 1973, as amended (Act). The new, broadened concept of *Liatris helleri*, which includes *Liatris turgida*, is a much more common entity native to Virginia, West Virginia, and North Carolina (Nesom, 2005). If this new concept of *Liatris helleri* becomes generally accepted, the species would appear to be a likely candidate for delisting under the Act.

A specimen was collected of each rare and watchlist plant species encountered except for the following species: *Conioselinum chinense* (hemlock parsley), *Cornus rugosa* (roundleaf dogwood), *Minuartia groenlandica* (mountain sandwort), *Oligoneuron rigidum* var. *rigidum* (stiff goldenrod), and *Vaccinium myrtilloides* (velvetleaf blueberry). Populations of these species were determined to be too small to allow collection without the risk of possible negative impacts. Photographs were taken of these species.

Lichens

Approximately 90 lichen taxa were identified from the 333 specimens collected at five ROMP sites. Although many common and widespread species were documented, the collections included a significant number of uncommon, rare, or otherwise noteworthy species:

- Six potentially undescribed taxa: *Chrysothrix* sp., *Fuscidea* sp., *Lecanora* sp., *Lepraria* sp., *Opegrapha* sp. (possibly *O. gyrocarpa*, which has only recently been recorded from northern North America), unknown yellow crust.

- Seven species evidently not documented before in Virginia: *Arctoparmelia centrifuga*, *Buellia stellulata*, *Cladonia coccifera*, *Microcalicium arenarium*, *Porpidia lowiana*, *Porpidia tuberculosa*, *Stereocaulon glaucescens*. One of these (*Buellia stellulata*) was previously unknown in the eastern United States.

- Thirty-eight species new to Shenandoah National Park's lichen list.

- Twelve species that are significantly disjunct in Virginia from their main geographic range; the majority of these are northern-boreal species: *Arctoparmelia centrifuga*, *Buellia stellulata*, *Cladonia coccifera*, *Melanelia stygia*, *Microcalicium arenarium*, *Parmelia omphalodes*, *Porpidia lowiana*, *Porpidia tuberculosa*, *Punctelia graminicola*, *Rhizocarpon geographicum*, *Stereocaulon glaucescens, Umbilicaria caroliniana.*

In addition, the identification of these collections and other lichen data collected during the project enabled DCR-DNH ecologists to circumscribe two non-vascular, lichen-dominated communities from the park.

DCR-DNH botanists reviewed all available information on the species collected during the project and conservatively identified six species for inclusion on the Virginia rare lichen list (Table 16). A number of other taxa present in the park may merit a ranking of state rare, but information about their ranges and abundance is currently too ambiguous to support a firm rank.

Table 16. Rare lichens at SHEN rock outcrop study sites.

Scientific Name	Global Rank / State Rank	ROMP Sites	Biogeography
Arctoparmelia centrifuga	G3G5 / S1	Blackrock South	arctic-boreal; disjunct in higher Appalachians of VA and WVA
Buellia stellulata	GNR / S1	Blackrock South Hawksbill North Slope Talus	western US
Cladonia coccifera	G5 / S1?	Blackrock South Hawksbill North Slope Talus	arctic-boreal; disjunct in higher Appalachians of VA, NC, GA
Parmelia omphalodes	G2G4 / S2?	Hawksbill North Slope Talus	arctic-boreal; disjunct in higher Appalachians of VA, WVA, NC, TN
Porpidia lowiana	G2G3 / S1	Crescent Rock South Hawksbill North Slope Talus	arctic-boreal; disjunct from northern NY
Porpidia tuberculosa	G2G4 / S1	Crescent Rock South Hawksbill North Slope Talus	arctic-boreal; disjunct in higher Appalachians of VA and NC (Roan Mt)

Zoology

Zoologists located 10 new rare animal populations at the 50 sites, comprising six species (Table 17). All six of these species are new to SHEN; they consist of four moths, one caddisfly, and one bat. None of these species have legal status at either the federal or state level. In addition, 31 watchlist species were identified, comprising 19 species (Table 18).

In addition, two tracked elements previously known from the park were observed, *Falco peregrinus* (Peregrine Falcon, G4S1B/S2N, state threatened), and *Plethodon shenandoah* (Shenandoah Salamander, G1S1, federal and state endangered). *Falco peregrinus* was seen at Crescent Rocks Overlook and *Plethodon shenandoah* was seen at Little Stony Man. These were casual observations and no new data was collected. It should be further noted, that the Peregrine Falcon observation was of an individual flying by, and not indicative of nesting or breeding in the area, and therefore, not noted as an element occurrence. Both of these species are currently monitored by SHEN, and their distributions within the park are well documented.

No populations of the invertebrate animal species previously known from ROMP sites were relocated. These three species are *Kleptochthonius polychaeus* (Shenandoah pseudoscorpion), *Semionellus placidus* (a millipede), and *Sphaeroderus shaumii* (Shaum's ground beetle). *Troglodytes troglodytes* (Winter Wren) was also not found at any ROMP site in 2005 or 2006.

To date, 759 invertebrate taxa have been identified to the species level from vouchers collected in 2005 and 2006. Many more vouchers have been identified to genus or family level. The identified portion of the invertebrate collection is comprised of five classes in the Phylum Arthropoda: Chelicerata, Chilopoda, Diplopoda, Entognatha, and Insecta, two classes of Crustacae, Diplostraca, and Malacostraca, and one class, Gastropoda, in the Phylum Mollusca.

Table 17. Rare animals identified from SHEN rock outcrop study sites.

Class	Family	Scientific Name (Common Name)	Rank (Global/ State)	ROMP Site(s) (Date)
Chiroptera	Vespertilionidae	*Myotis leibii* (Eastern small-footed myotis)	G3/S1	Nakedtop (30Aug2006)
Lepidoptera	Geometridae	*Itame ribearia* (Currant spanworm moth)	G4/S1S3	South Marshall Cliff (27Jul2005) Crescent Rock Overlook (14Jul2005) Blackrock Central District (14Jul2005)
Lepidoptera	Noctuidae	*Catocala herodias gerhardi* (Herodias underwing)	G3T3/ S2S3	Blackrock South District (18Aug2005)
Lepidoptera	Noctuidae	*Hadena ectypa* (A noctuid moth)	G3G4/ S1S3	Gooney Manor Overlook (19Jul2006)
Lepidoptera	Noctuidae	*Properigea costa* (A noctuid moth)	G4/S1S3	Overall Run Falls North (19Sept2006) Whiteoak Canyon (21Jul2006) Halfmile Cliff (21Jul2006)
Trichoptera	Philopotamidae	*Wormaldia thyria* (A philopotamid caddisfly)	G3/S2	Dickey Hill (19Jul2006)

Plate 24. *Myotis leibii* (eastern small-footed myotis) captured at Nakedtop 30 August 2006.

Plate 25. *Plethodon shenandoah* (Shenandoah salamader). Photo © David Liebman

Plate 26. *Falco peregrinus* (Peregrine Falcon)

Plate 27. *Catocala herodias gerhardi* (Herodias underwing)

Plate 28. *Hadena ectypa* (a noctuid moth)

Plate 29. *Itame ribearia* (Currant spanworm moth)

Plate 30. *Properigea costa* (a noctuid moth)

Table 18. Watchlist animals collected from or observed at SHEN rock outcrop study sites.

Class	**Family**	***Scientific Name*** **(Common Name)**	**Rank (Global/ State)**	**ROMP Site(s) (Date)**
Reptilia	Colubridae	*Liochlorophis vernalis* (Smooth green snake)	G5/S3	Rocky Mountain (28Jun2005)
Amphipoda	Crangonyctidae	*Stygobromus spinosus* (Blue Ridge Mountain amphipod)	G3/S3	Field Hollow Cliff (8Jun2005)
Lepidoptera	Geometridae	*Caripeta angustiorata* (Brown pine looper moth)	G?/S1S3	Blackrock South District (30Jun2005)
Lepidoptera	Geometridae	*Cyclophora myrtaria* (A geometrid moth)	G5/S2S4	Franklin Cliffs South (14Sep2005)
Lepidoptera	Geometridae	*Euchlaena marginaria* (A geometrid moth)	G?/S2S4	Calvary Rocks-Chimney Rock (17May2006)
Lepidoptera	Geometridae	*Euchlaena muzaria* (A geometrid moth)	G?/S2S4	Pass Mountain (29Jun2006)
Lepidoptera	Geometridae	*Euchlaena tigrinaria* (Mottled Euchlaena moth)	G/S2S4	Marys Rock (29Jun2006) Pinnacles (29Jun2006) Bettys Rock (29Jun2005)
Lepidoptera	Geometridae	*Eulithis molliculata* (Dimorphic Eulithis moth)	G4/S2S4	Crescent Rock Overlook (14Jul2005) Hawksbill North Slope Talus (8Aug2006)
Lepidoptera	Geometridae	*Heliomata infulata* (Rare spring moth)	G2G4/ S2S4	Calvary Rocks-Chimney Rock (17May2006)
Lepidoptera	Geometridae	*Homochlodes disconventa* (Dark Homochlodes moth)	G?/S2S4	Hawksbill Summit 8Aug2006
Lepidoptera	Geometridae	*Hydriomena bistriolata* (A geometrid moth)	G?/S1S4	Blackrock Central District 7Jun2006
Lepidoptera	Geometridae	*Itame abruptata* (A geometrid moth)	G4/S1S4	Crescent Rock Overlook (14Jul2005)
Lepidoptera	Geometridae	*Itame exauspicata* (A geometrid moth)	GNR/ S1S3	Loft Mountain (30 June 2005)

Table 18 continued. Watchlist animals collected from or observed at SHEN rock outcrop study sites.

Class	**Family**	***Scientific Name*** **(Common Name)**	**Rank (Global/ State)**	**ROMP Site(s) (Date)**
Lepidoptera	Geometridae	*Itame subcessaria* (Barred Itame moth)	G4?/S2S4	North Marshall Summit (27Jul2005) Pass Mountain (29Jun2006) Crescent Rock Overlook (14Jul2005) Blackrock Central District (14Jul2005)
Lepidoptera	Geometridae	*Mesoleuca ruficillata* (White-ribboned carpet)	G4/S2S4	Little Stony Man (3Aug2006) Old Rag Summit East (10Aug2006) Crescent Rock Overlook (14Jul2005)
Lepidoptera	Geometridae	*Metarranthis mestusata* (A geometrid moth)	G?/S2S4	Bettys Rock (7June2006) Crescent Rock Overlook (7June2006) Upper Devils Ditch (9Jun2005) Dean Mountain Ridge (8Jun2005) Loft Mountain Summit (30Jun2005)
Lepidoptera	Geometridae	*Nemoria mimosaria* (An emerald moth)	G3G4/ S2S4	Pinnacles (29Jun2006) Bettys Rock (7Jun2006)
Lepidoptera	Geometridae	*Rheumaptera hastata* (Spear-marked black moth)	G5/S2S3	South Marshall Cliff (27Jul2005) Hawksbill Summit (8Aug2006)

Table 18 continued. Watchlist animals collected from or observed at SHEN rock outcrop study sites.

Class	**Family**	***Scientific Name*** **(Common Name)**	**Rank (Global/ State)**	**ROMP Site(s) (Date)**
Lepidoptera	Geometridae	*Xanthorhoe labradorensis* (Labrador carpet)	G4/S2S4	Bettys Rock (29Jun2005) Blackrock Central District (14Sep2005) Powell Gap Cliff (14Sep2005)
Lepidoptera	Noctuidae	*Apamea lignicolor* (Wood colored Apamea moth)	G5/S2S4	North Marshall Summit (27Jul2005) Hawksbill Summit (8Aug2006) Blackrock Central District (14Sep2005)
Lepidoptera	Noctuidae	*Apamea plutonia* (A noctuid moth)	G4/S2S4	Dean Mountain Ridge (8Jun2005)
Lepidoptera	Noctuidae	*Autographa ampla* (Large looper moth)	G5/S1S3	Bettys Rock (29Jun2005)
Lepidoptera	Noctuidae	*Catocala relicta* (White underwing)	G5/S2S4	Hightop (4Aug2006)
Lepidoptera	Noctuidae	*Catocala serena* (Serene underwing)	G5/S2S4	Hightop (7Jun2006)
Lepidoptera	Noctuidae	*Cucullia florae* (A noctuid moth)	G?/S2S4	North Marshall Summit (27Jul2005)
Lepidoptera	Noctuidae	*Hypena sordidula* (Sordid Hypena moth)	G4/S2S4	Loft Mountain (30Jun2005)
Lepidoptera	Noctuidae	*Leucania commoides* (A noctuid moth)	G?/S1S4	Millers Head (6Jun2006)
Lepidoptera	Noctuidae	*Lithacodia concinnamacula* (Red-spotted Lithacodia moth)	G4/S2S4	Millers Head (6Jun2006) Bettys Rock (7Jun2006) Crescent Rock Overlook (7Jun2006) Blackrock Central District (7Jun2006) Rose River Cliffs (16May2006)

Table 18 continued. Watchlist animals collected from or observed at SHEN rock outcrop study sites.

Class	**Family**	***Scientific Name*** **(Common Name)**	**Rank (Global/ State)**	**ROMP Site(s) (Date)**
Lepidoptera	Noctuidae	*Phlogophora iris* (Olive angle shades)	G?/S2S4	Upper Devils Ditch (9Jun2005) Dean Mountain Ridge (8Jun2005)
Lepidoptera	Sphingidae	*Darapsa versicolor* (Hydrangea sphinx)	G4/S1S3	Crescent Rock Overlook (14Jul2005)
Lepidoptera	Sphingidae	*Sphinx kalmiae* (Laurel sphinx)	G5/S2S4	Hawksbill Summit (8Aug2006) Loft Mountain Summit (30Jun2005)
Orthoptera	Tettigoniidae	*Scudderia septentrionalis* (Northern bush katydid)	G3?/S3	Gooney Manor Overlook (19Jul2006) North Marshall Summit (27Jul2005) Little Stony Man (3Aug2006) Millers Head (3Aug2006) Old Rag Summit West (10Aug2006) Halfmile Cliff (21Jul2006)

Summary of Management Recommendations

The project stewardship biologist developed a threat assessment of all of the study sites based on apparent human impacts and the presence of invasive plants. Human impacts and invasive plants were identified as the primary threats to the natural heritage resources of SHEN's rock outcrops prior to the study. Thirty-one study sites were found to have at least some human impact threatening outcrop resources. Trampling by visitors is the foremost human impact. Trampling is associated with all visitor uses at SHEN rock outcrops: hiking, camping, and rock climbing. Frequent visitation to outcrops results in loss of vegetation, lichen, and soils. Sites with high levels of visitation exhibit a high proportion of bare rock. Remote sites or sites with no formal access have well-developed soils and plant and/or lichen communities on their outcrops.

Twenty study sites were found to have invasive plants as a threat to outcrop resources. Many non-native plants, such as *Microstegium vimineum*, and weedy native plants, such as *Juncus tenuis*, are found along trails to rock outcrops. Their presence is largely due to human disturbances associated with trails. Hikers may disturb soil and may bring in invasive plant seed on their boots and clothing. Trails sometimes create a canopy gap that provides the sunlight that invasive plants often need to become established. Other species of non-native invasive plants are found on the outcrops. The non-native invasive plants *Poa compressa* and *Rhumex acetosella* occur the most frequently on outcrops.

To summarize the human impact and invasive plant threats, a threat assessment rank was calculated for each site. The threat assessment rank is simply the sum of the human impact rank and the invasive plant rank. This composite rank will help park staff to prioritize which sites should receive investment of management resources. Sites are listed by Threat Rank in Table 19. Management recommendations for each site were developed collaboratively by DCR-DNH staff to address specific threats identified during this project. Threats are described in the Threats section of each site report.

Below is a summary of management recommendations made in this report and the sites for which the given action is recommended. Additional details are found in the site reports.

Management Recommendations (sites are listed north to south)**:**

Close or partially close access to some outcrops (15 sites):
Marys Rock, Little Stony Man, Stony Man, Old Rag Summit East, Old Rag Summit West, Crescent Rock Overlook, Hawksbill Summit, Franklin Cliffs Overlook, Blackrock Central District, Bearfence Mountain, Hightop, Loft Mountain, Blackrock South District.

These sites support extremely rare natural communities, and rare plants and animals. Trampling associated with frequent visitation has degraded the habitat for these resources; closing outcrops to visitation will allow their recovery.

Close social trails (12 sites):
Gooney Manor Overlook, North Marshall Summit, Overall Run Falls, Pass Mountain, Marys Rock, Little Stony Man, Crescent Rock South, Hawksbill Summit, Old Rag Summit West, Franklin Cliffs Overlook, Hightop.

Social trails are created by visitors repeatedly leaving official SHEN trails and forging a path to outcrops or other resource. This results in trampled vegetation, soil loss, and a vector for invasive plants. Closing the trails will allow recovery of the resources.

Prohibit rock climbing (2 sites):
North Marshall Summit, Hawksbill North Slope Outcrops.

Trampling from visitation and vegetation removal to enhance the climbing experience have contributed to degradation of the rare natural heritage resources at North Marshall Summit. The pristine condition of the Hawksbill North Slope Outcrops warrants strong protection. Closing these sites to climbing and directing climbers to other climbing sites, such as Little Stony Man or Old Rag Southside Outcrops, will allow recovery at North Marshall and preserve the conditions at Hawksbill.

Prohibit camping (8 sites):
North Marshall Summit, Overall Run Falls, Pass Mountain, Marys Rock, Old Rag Summit East, Old Rag Summit West, Old Rag Southside, Hawksbill North Slope Outcrops.

Camping expands the area of trampling impacts at a site by creating new trails and the campsite area itself. Closing these sites to camping will decrease trampling and allow resources to recover.

Re-route official SHEN trails (7 sites):
South Marshall Cliffs, Pass Mountain, Little Stony Man, White Oak Canyon, Bettys Rock, Bearfence Mountain, Loft Mountain.

The official SHEN trail system at these sites crosses or leads to rare natural heritage resource habitat. Relocating the trails at theses sites will direct visitor traffic to routes with no impact on rare resources and allow recovery at the sites.

Manage or monitor invasive plants and annually monitor post-treatment effects of these actions. (See Table 20 for a list of species requiring management.) (18 sites):
Dickey Ridge, Big Devils Stairs, Overall Run Falls, Little Stony Man, Stony Man, White Oak Canyon, Bettys Rock, Crescent Rock Overlook, Crescent Rock South, Hawksbill North Slope Outcrops, Hawksbill Summit, Franklin Cliffs North, Franklin Cliffs Overlook, Rose River Cliffs, Bearfence Mountain, Field Hollow Cliff, Hightop, Goat Ridge.

Invasive plants compete with native plants for resources in what is already a rare habitat and harsh environment. Controlling the abundance of invasive plants will help maintain rare native plant populations and the integrity of rare natural communities. Pre- and post-treatment monitoring will provide feedback on the effectiveness of control actions.

Allow wildfire to burn (prescribed wildfire) (8 sites):
Marys Rock, Pinnacles, Old Rag Summit East, Rocky Mountain, Brown Mountain, CalvaryRocks-Chimney Rock, Trayfoot Saddle Boulderfields East, Trayfoot Saddle Boulderfield West.

While none of the natural heritage resources of SHEN's outcrops are fire dependent, the dry, acidic forest types (Sweet Birch - Chestnut Oak Talus Woodland, Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland), the Central Appalachian Heath Barren, and the rare plants *Aralia hispida* and *Betula papyrifera* would benefit from fire. These sites should be included in a "prescribed wildfire" management strategy that would allow the sites to burn in the event of unintentional fires occurring in SHEN.

Implement an education program and install signs to inform visitors of the need for natural resource protection (20 sites):
Gooney Manor Overlook, North Marshall Summit, South Marshall Cliffs, Overall Run Falls, Marys Rock, Little Stony Man, Stony Man, Millers Head, Old Rag Summit East, Old Rag Summit West, Bettys

Rock, Crescent Rock Overlook, Hawksbill Summit, Franklin Cliffs Overlook, Franklin Cliffs South, Blackrock Central District, Bearfence Mountain, Hightop, Loft Mountain, Blackrock South District.

A thoughtful education program on SHEN's outcrop resources should be aimed at informing visitor behavior at these sites to reduce trampling on outcrops for the protection of rare plant and animal life.

Monitor the status of rare plants or natural communities (32 sites):
Gooney Manor Overlook, Little Devils Stairs, Hogback Mountain Spur, Overall Run Falls, Pass Mountain, North Marshall Summit, South Marshall Cliffs, Pass Mountain, Marys Rock, Pinnacles, Little Stony Man, Stony Man, Old Rag Summit East, Old Rag Summit West, Old Rag Southside, White Oak Canyon, Bettys Rock, Crescent Rock Overlook, Hawksbill North Slope Outcrops, Hawksbill Summit, Franklin Cliffs North, Franklin Cliffs Overlook, Rose River Cliffs, Blackrock Central District, Bearfence Mountain, Field Hollow Cliff, Dean Mountain Ridge, Hightop, Rocky Mountain, Brown Mountain, Loft Mountain, CalvaryRocks-Chimney Rock, Sawlog Ridge.

Monitoring should be part of any management action taken to provide a record of efforts made and measurement or documentation of the efficacy of those actions. Information from monitoring can then be used to determine the need for further action. Some sites do not require action at this time, but potential threats to the resources at those sites indicate a need to monitor changes that may result in a need for management. Three different monitoring intervals are recommended, depending on site conditions and management efforts: 1) annual monitoring for site receiving active management, 2) a 3-5 year interval for sites having reached management goals or with a moderate threat level, and 3) 5-10 year interval for sites with a low threat level.

Schedule periodic surveys to assess invasive plants where they are present but do not currently require management (3 sites):
Dickey Hill, Browntown Valley Overlook, Dean Mountain Ridge.

Invasive plants are present and a potential threat at these sites, but current abundance levels do not warrant action at this time. Instead, periodic surveys to assess the status of invasives at these sites are recommended.

Monitor visitor use (4 sites):
Little Stony Man, Crescent Rock South, Franklin Cliffs North, Loft Mountain.

Changes in visitor use are a concern at theses sites. Some sites have associated management recommendations, such as relocating a trail or closing access to an outcrop. With no official trail leading to it, Crescent Rock South currently receives very little visitation, but an increase would be a threat to the near pristine condition of the extremely rare High-Elevation Greenstone Barren community, which is endemic to fewer than 30 outcrops covering less than 10 acres, all in a few areas of SHEN.

Install a permanent rappelling station (1 site):
Little Stony Man.

A permanent rappelling station at this popular climbing site will take trampling pressure of other areas of the site. Use of a social trail from the cliff ledge to the base used primarily by climbers is resulting in severe erosion. Representatives of the climbing community agree that a rappelling station would remove the need to use the social trail.

Refine trail and viewshed maintenance practices to avoid impact on rare plants and natural communities (3 sites):
Gooney Manor Overlook, Hawksbill North Slope Talus, Franklin Cliffs Overlook.

Rare plants have been impacted by maintenance activities at these sites. Maintenance crews should be advised of the presence of the plants and refine action accordingly.

Remove cut brush piles from the vicinity of the outcrops (1 site):
Gooney Manor Overlook.

Cut brush from viewshed maintenance has been piled on the site of a rare natural community and near a rare plant population. The piles should be removed from the site.

Close or restrict use of overlook along horse trail (1 site):
Stony Man.

An occurrence of the extremely rare High-Elevation Greenstone Barren community, has been severely degraded at this site. Closing or restricting access to the outcrop overlook will allow recovery of the natural heritage resources.

No management required (3 sties):
Oventop Mountain, Upper Devils Ditch, Powell Gap Cliff.

Table 19. Stewardship threat assessment and site prioritization.

Site ID #	Study Site Name	SHEN Dist.	Biodiversity Rank	Human Impact Rank	Invasive Plants Rank	Threat Rank
C02	Bettys Rock	Central	B1	3	2	5
C10	Crescent Rock Overlook	Central	B1	3	2	5
C63	Overall Run Falls North	North	B2	3	2	5
C67	Bearfence Mountain	Central	B2	3	2	5
C22	Hawksbill Summit	Central	B1	3	1	4
C47	Stony Man Summit	Central	B1	3	1	4
C17	Franklin Cliffs South	Central	B2	3	1	4
C16	Franklin Cliffs Overlook	Central	B2	3	1	4
C28	Little Stony Man	Central	B1	3	0	3
C29	Loft Mountain summit	South	B2	3	0	3
C37	Old Rag Summit East	Central	B2	3	0	3
C62	Old Rag Summit West	Central	B2	3	0	3
C69	White Oak Canyon	Central	B2	2	1	3
C23	Hightop	South	B2	2	1	3
C46	South Marshall cliff	North	B2	2	1	3
C31	Marys Rock	Central	B1	2	0	2
C11	Crescent Rock South	Central	B1	1	1	2
C03	Big Devils Stairs	North	B2	1	1	2
C35	North Marshall summit	North	B2	2	0	2
C40	Pass Mountain	North	B2	2	0	2
C04	Blackrock Central District	Central	B2	2	0	2
C18	Goat Ridge	South	B2	0	2	2
C45	Sawlog Ridge	South	B2	0	2	2
C68	Rose River Cliffs	Central	B2	0	2	2
C19	Gooney Manor Overlook	North	B3	2	0	2
C41	Pinnacles	Central	B1	1	0	1
C60	Hawksbill N slope talus	Central	B1	1	0	1
C15	Franklin Cliffs North	Central	B2	1	0	1
C36	Old Rag South Side	Central	B2	1	0	1
C13	Dickey Hill	North	B2	0	1	1
C14	Dickey Ridge	North	B2	0	1	1
C05	Blackrock South District	South	B3	1	0	1
C38	Oventop	North	B3	0	1	1
C66	Field Hollow Cliff	Central	B3	0	1	1
C08	Calvary Rocks - Chimney Rock	South	B5	1	0	1
C42	Powell Gap cliff	South	B5	1	0	1
C64	Brown Mountain	South	B5	1	0	1
C44	Rocky Mountain	South	B5	1	0	1
C34	Nakedtop Upper East Slope	Central	B1	0	0	0
C21	Hawksbill N slope outcrops	Central	B1	0	0	0
C32	Millers Head	Central	B1	0	0	0
C07	Browntown Valley Overlook	North	B2	0	0	0

Table 19 continued. Stewardship threat assessment and site prioritization.

Site ID #	Study Site Name	SHEN Dist.	Biodiversity Rank	Human Impact Rank	Invasive Plants Rank	Threat Rank
C20	Halfmile Cliff	Central	B2	0	0	0
C24	Hogback Mtn Spur	North	B2	0	0	0
C39	Overall Run Falls South	North	B2	0	0	0
C27	Little Devils Stairs	North	B2	0	0	0
C49	Trayfoot Saddle Boulderfields E	South	B3	0	0	0
C65	Trayfoot Saddle Boulderfields W	South	B3	0	0	0
C12	Dean Mountain Ridge	Central	B5	0	0	0
C50	Upper Devils Ditch	Central	B5	0	0	0

Table 20. Invasive plant species requiring management action.

Species Name	DCR-DNH Invasiveness Rank (DCR 2003)	ROMP Sites
Ailanthus altissima	High	Big Devils Stairs, Overall Run Falls North, Millers Head, Bettys Rock
Alliaria petiolata	High	Dickey Ridge, Field Hollow Cliff
Bromus tectorum	-	Millers Head
Centaurea biebersteinii	High	Bettys Rock, Hawksbill Summit
Commelina communis	Low	Big Devils Stairs, Whiteoak Canyon, Rose River Cliffs
Dactylis glomerata	Low	Millers Head
Digitaria sanguinalis	-	Bearfence Mountain
Microstegium vimineum	High	Dickey Ridge
Poa compressa	Moderate	Stony Man, Crescent Rock Overlook, Crescent Rock South, Hawksbill Summit, Franklin Cliffs Overlook, Field Hollow Cliff, Hightop, Loft Mountain Summit
Poa pratensis	-	Millers Head
Polygonum caespitosum var. *longisetum*	Moderate	Loft Mountain Summit
Rumex acetosella	Moderate	Crescent Rock Overlook, Crescent Rock South, Hawksbill Summit, Franklin Cliffs Overlook, Field Hollow Cliff, Loft Mountain Summit
Symphoricarpus orbiculatus	-	Dickey Ridge, Goat Ridge

INTRODUCTION TO THE SITE REPORTS

A conservation site is a natural area that includes one or more element occurrences and has been assigned a biodiversity rank of at least B5. (Please see the introduction for an explanation of biodiversity ranks.) It is the basic conservation planning land area used by DCR-DNH for the protection and management of natural heritage resources. In addition to containing natural heritage resources, a conservation site includes the adjacent lands determined to be important for the long-term protection of those resources based on available information.

Most DCR-DNH inventory reports are organized by conservation site. The focus of this study, however, is on 50 specific rock outcrop areas and their natural heritage resources, threats, and management concerns. A single conservation site may contain more than one of these rock outcrop sites and may contain many other natural heritage resources not associated with rock outcrops. Conversely, rock outcrops without natural heritage resources will not be contained in a conservation site. Therefore, it was determined that data collected for this report would be more useful to SHEN and NPS personnel if organized by rock outcrop site rather than conservation site.

Each rock outcrop site that supports one or more natural heritage resources is contained within a DCR-DNH conservation site. Boundaries for most of these sites have previously been provided to SHEN in Ludwig et al. (1993). Five new conservation sites were created as a result of fieldwork conducted for this project: Calvary Rocks, Field Hollow Cliff, Hogback Mountain Spur, Oventop, and Rose River Cliffs. In addition, the existing Gooney Run Overlook conservation site boundary was greatly enlarged to encompass the Dickey Hill ROMP site, and the expanded site was renamed Dickey Hill.

The following 50 rock outcrop site reports are presented geographically from north to south. The following standard reporting format is used for each site:

SITE NAME: Rock outcrop site names generally reflect a geographic locality and, in some cases, a prevalent landscape feature. The site name is followed by an alphanumeric site code developed by SHEN personnel.

CONSERVATION SITE: The name of the DCR-DNH conservation site that contains the rock outcrop site is provided. This is followed by the conservation site's biodiversity rank in parentheses. As described previously, these ranks range from B1 (very high significance) to B5 (general biodiversity significance).

THREAT RANK: The Threat Rank (TR) is derived by adding together the site Human Impact Rank (HI) and the Invasive Plant Rank (IP). Threat Ranks range from 0, for no threat, to 6, indicating that both human impacts and invasive plant impacts are high. The Threat Rank is combined with Biodiversity Rank to prioritize sites for management action. For example, four study sites with a Threat Rank of 5 and a Biodiversity Rank of 1 are given the highest priority for action. Sites with a Biodiversity Rank of 3 and Threat Rank of 0 require no management, but may merit periodic surveys for the status of natural heritage resources.

LOCALITY: The county or counties in which the site is located.

QUADRANGLE: The name of the USGS 7.5' quadrangle(s) that includes the site area.

LOCATION: Location of the site within SHEN, using familiar landmarks, is given.

NATURAL HERITAGE RESOURCE SUMMARY TABLE: This field provides a synopsis of the natural heritage resources (rare species and significant communities), together with their status ranks (global, state, USFWS and Virginia legal) and element occurrence ranks.

[Note: The first reference to a vascular plant species in a site report is by scientific name, followed by its common name in parentheses. Subsequent references to the same species are by scientific name only. Lichens and mosses are referred to by scientific name only.**]**

SITE DESCRIPTION: A narrative describing the site's topography and basic geology is presented. Trails and other means of site access are described, and the relative ease of access is evaluated.

NATURAL COMMUNITIES: In this section, an overview of the vegetation of the site is provided, including both the forest communities that form matrices around the outcrops and the specialized communities of the outcrops themselves. Community types are referred to by their National Vegetation Classification common names, as used in Young *et al*. (2006); a few common names have been modified more recently in the USNVC and in these cases, the USNVC name is used. More detailed data on the significant natural communities of each site are presented. Common or conspicuous lichens and mosses at the site are listed.

RARE PLANTS: In this section, data is presented on the rare plants found at the site. Population numbers, coverage, and habitat are indicated for each rare plant found at the site. The apparent health of each plant occurrence is discussed when conditions depart from normal vigor.

RARE LICHENS: In this section, data is presented on rare lichens found at the site. At this time, information about the abundance and coverage of rare lichens within sites is lacking or sketchy, and additional field work is needed. Because lichens were not rigorously inventoried at most sites, this section is included only for the four sites from which extensive collections were identified by specialists.

RARE ANIMALS: In this section, data is provided on the rare animals found at this site in a format similar to that used for rare plants.

THREATS: Threats to the site's natural heritage resources are described. These may include both existing threats and potential threats posed by types of land use activities or other factors that are not currently impacting the site.

MANAGEMENT RECOMMENDATIONS: This field is a summary of the major issues and factors that should be considered in management of the site for its biodiversity and natural heritage resource values. As a rule, generalized recommendations are provided based on potential threats identified during the survey work. The expertise of inventory biologists familiar with each site, as well as input from DCR-DNH stewardship biologists, has been utilized in preparing these recommendations. However, within the context of a relatively short-term (one or two-year) inventory effort on large sites, it may be difficult to identify highly specific management strategies. In many cases, monitoring of element occurrences or site factors is recommended to determine the best long-term management practices. In all cases, if land use changes or specific high-impact actions are proposed within a site's boundary, consultation with DCR-DNH staff is recommended to assess impacts on the natural heritage resources.

ELEMENT LOCATION MAPS: These maps show the exact location of each element occurrence (eo) located during the ROMP project. Maps showing the locations of eos not revisited or relocated during the project are based on a variety of data sources and may show only the general location of the eo. In some

instances where an eo extends outside of ROMP site boundary, all or a portion of the eo area outside the boundary is also shown. These extended boundaries are generally only shown for eo areas that were surveyed in the course of this project.

These location maps are intended to provide resource managers with requisite site-specific information. However, since rare species are often sensitive to disturbance or may be sought out by collectors, we strongly recommend that this information not be shared with the general public or with persons not directly involved in the stewardship of these sites.

NOTE CONCERNING MEASUREMENTS USED IN THE SITE DESCRIPTIONS: The size of sites, various outcrop features, and element occurrences is generally provided in both hectares (ha) and acres (ac). These sizes were calculated in ArcView GIS from polygons digitized over aerial photographs and assisted by field-collected GPS data, and should be considered approximations that likely were subject to errors in precision. In addition, the measurements are uncorrected for distortion that occurs from the vertical projection of planar features onto steep terrain.

DICKEY RIDGE (C14)

CONSERVATION SITE: Dickey Ridge (B2) **THREAT RANK: 1**

LOCALITY: Warren County **QUADRANGLE(S):** Front Royal
Chester Gap

LOCATION: This North District site is located west of Skyline Drive and from 0.63-0.96 km (0.39-0.59 mi) northwest of Dickey Ridge Visitor Center.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Fraxinus americana - Carya glabra / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	B
Juniperus virginiana - Fraxinus americana / *Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation	Central Appalachian Circumneutral Barren	G2	S2	None	None	A
Plants:						
Cuscuta coryli[1]	Hazel dodder	G5	S2?	None	None	D
Animals: None						

[1]This element occurrence (eo) was sought but not relocated for this project. The eo was last seen by DNH in 1996.

SITE DESCRIPTION: This site encompasses a complex of low Catoctin Formation metabasalt outcrops and talus on southwest-facing slopes. The main outcrop is 0.4 ha (1 ac) in size. From its upper end at an elevation of 530 m (1,740 ft), it drops to an elevation of 488 m (1,600 ft). The inclination is mostly about 30 degrees, but a short, nearly vertical cliff runs along the base of the outcrop. The metabasalt forming this outcrop is heavily fractured and weathered, providing excellent habitat for a high diversity of sun-loving herbs. Several other much smaller outcrops area found nearby within the matrix of forested talus.

This site boundary abuts Skyline Drive. However, due to the steepness of the terrain, the fact that the outcrop is not visible from Skyline Drive, and lack of trails, the outcrop receives little or no visitation.

NATURAL COMMUNITIES: The Northern Hardpan Basic Oak-Hickory Forest forms the forest matrix on this slope of Dickey Ridge. This is a globally uncommon (G3) community that is rather rare in SHEN, where it is restricted to the lowest-elevation sites with shallow, droughty soils weathered from metabasalt. In the western portion of the site, this forest cover is abruptly broken by the main outcrop, which supports a 0.4 ha (1 ac) stand of the globally rare Central Appalachian Circumneutral Barren community type. Soil samples collected from this outcrop had extraordinarily high concentrations of calcium and magnesium, which may be a factor influencing the distribution of this community on the Blue Ridge. This association is typically characterized by patchy herbaceous vegetation with scattered, stunted trees and areas of open, lichen-covered bedrock. The occurrence at this site is somewhat unusual

in composition, containing many dense sods of the warm-season grasses *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indian grass), *Bouteloua curtipendula* (side-oats grama), and *Muhlenbergia capillaris* (long-awn hairgrass). Early in the growing season, *Carex pensylvanica* (Pennsylvania sedge) and *Danthonia spicata* (poverty oat-grass) are the most abundant and conspicuous graminoids. Other common or characteristic species of these sods include *Helianthus divaricatus* (woodland sunflower), *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod), *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Pycnanthemum incanum* (hoary mountain-mint), *Symphyotrichum oblongifolium* (= *Aster oblongifolius*, aromatic aster), *Dichanthelium linearifolium* (narrow-leaf panic grass), *Dichanthelium oligosanthes* var. *scribnerianum* (Scribner's panic grass), *Lespedeza virginica* (slender bushclover), *Commelina erecta* var. *erecta* (slender dayflower), and *Linum sulcatum* var. *sulcatum* (grooved yellow flax). Patches of more open rock are exposed throughout, supporting characteristic lithophytes such as *Cheilanthes lanosa* (hairy lipfern), *Polygonum tenue* (slender knotweed), *Allium cernuum* (nodding onion), *Panicum philadelphicum* (Philadelphia panic grass), *Eragrostis capillaris* (tiny lovegrass), *Cyperus lupulinus* ssp. *lupulinus* (a flatsedge), *Sporobolus clandestinus* (rough dropseed), and *Sporobolus vaginiflorus* (sheathed dropseed). Stunted (mostly < 6 m [20 ft] tall), 60 to 130-year-old *Juniperus virginiana* var. *virginiana* (eastern redcedar) and *Fraxinus americana* (white ash), as well as low shrub patches of *Rhus aromatica* var. *aromatica* (fragrant sumac), are scattered over the barren. Quantitative plot data were collected from this occurrence in 1996 (plot SHNP009) and 2000 (plot SHNP100).

A large occurrence (> 1.6 ha [4 ac]) of Central Appalachian Basic Woodland fringes the main barren and extends about 200 m to the southwest in a continuous patch. The moderately to steeply sloping habitat supporting this woodland is extremely rocky with loose boulders and stones, and is broken by several small ledges. The overstory is stunted (mostly < 10 m [33 ft] tall) and semi-closed, becoming more open and scrubby around the larger outcrops. *Fraxinus americana* is the dominant tree, with *Carya glabra* (pignut hickory), *Juniperus virginiana* var. *virginiana*, *Quercus prinus* (chestnut oak), *Celtis occidentalis* (common hackberry), and *Juglans nigra* (black walnut) frequently associated. *Cercis canadensis* var. *canadensis* (eastern redbud), *Viburnum prunifolium* (smooth black haw), and *Rhus aromatica* var. *aromatica* are characteristic shrubs along with *Zanthoxylum americanum* (northern prickly-ash), which dominates in clonal patches over at least one acre. Characteristic herbs throughout include *Elymus hystrix* var. *hystrix*, *Helianthus divaricatus*, *Solidago ulmifolia* var. *ulmifolia*, *Muhlenbergia sobolifera* (cliff muhly), *Dichanthelium boscii* (Bosc's panic grass), *Amphicarpaea bracteata* (hog-peanut), *Anemone virginiana* var. *virginiana* (thimbleweed), *Vicia caroliniana* (Carolina wood vetch), *Polygonatum biflorum* var. *biflorum* (Solomon's-seal), *Scutellaria ovata* ssp. *ovata* (heart-leaved skullcap), *Silene stellata* (starry campion), and *Pycnanthemum incanum*.

RARE PLANTS: A small population of *Cuscuta coryli* (hazel dodder) was found at this site in 1996, but could not be relocated in 2005. A patch of this annual parasitic herb occupying less than 2 m^2 (22 ft^2) was located on July 1, 1996. No signs of flowering were observed on that date.

Three watchlist plants were found at this site. *Linum sulcatum* var. *sulcatum* is frequent on the main outcrop at this site. *Zanthoxylum americanum* is abundant in the dry woodland to the southeast of the main outcrop. *Taenidia montana* (mountain pimpernel) is also found here.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

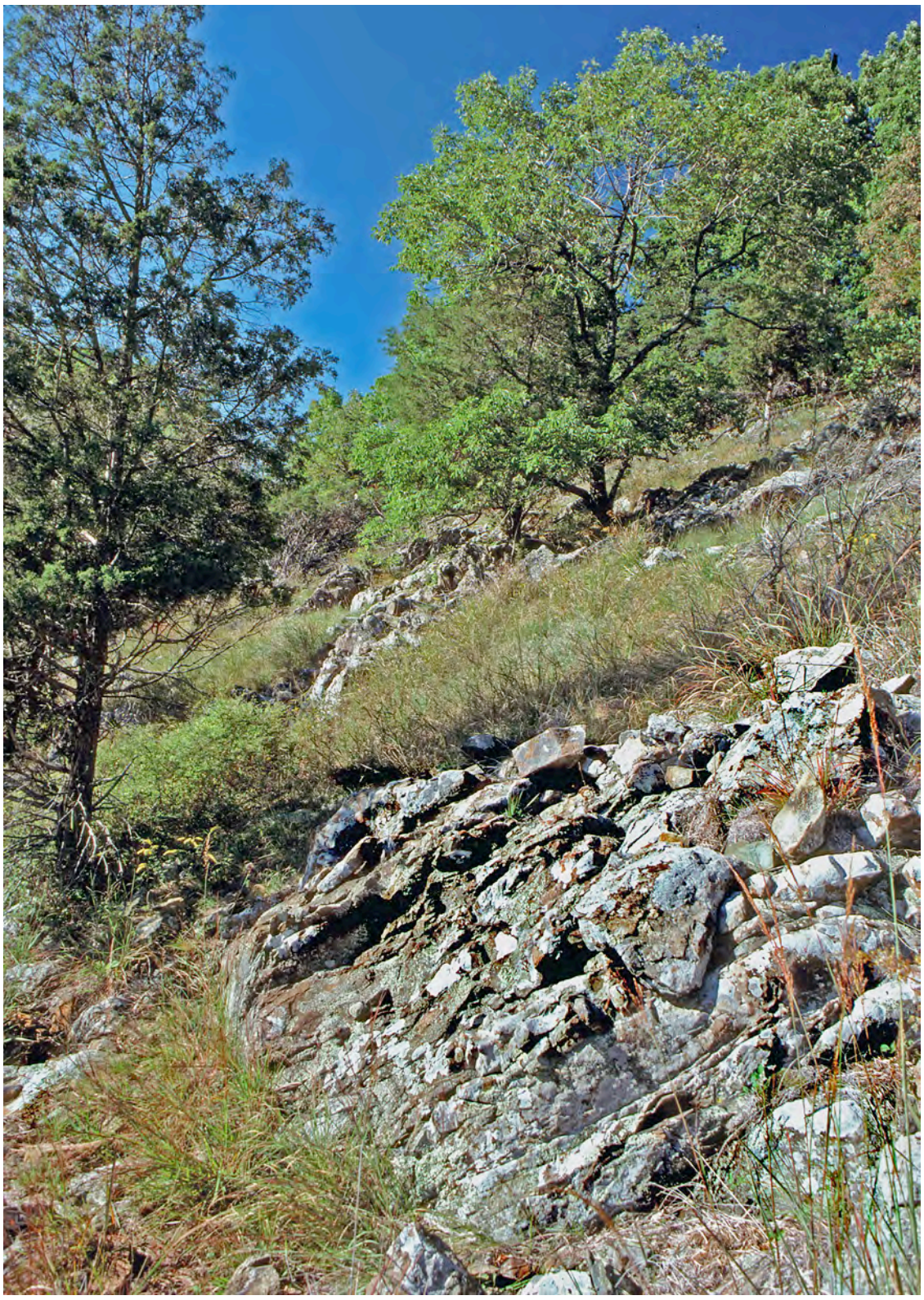


Plate 31. Prairie-like Central Appalachian Circumneutral Barren at Dickey Ridge.

THREATS: The principal problem with the Dickey Ridge site is the increasing abundance of *Microstegium vimineum* (Japanese stiltgrass) on the upper, forested slopes. This species probably first became established on the shoulders and banks along Skyline Drive. In recent years it has marched steadily downslope and small patches are now present in the Central Appalachian Basic Woodland, especially in seasonally moist microhabitats. *Alliaria petiolata* (garlic mustard) is also present, and locally numerous, in the matrix oak-hickory forest and the Basic Woodland. The Central Appalachian Circumneutral Barren is largely unchanged from previous visits in 1996 and 2000, except that patches of the invasive shrub *Symphoricarpos orbiculatus* (coral-berry) have increased greatly in number and size.

Cuscuta coryli is an annual, and populations may appear only in years when conditions are optimal. Therefore, the absence of this species from a known site in any given year is not in itself cause for alarm.

MANAGEMENT RECOMMENDATIONS: The Dickey Ridge site has one of the finest assemblages of low-elevation barrens and woodlands in the park. Although not rich in rare plants, the vegetation and floristics of this area are noteworthy for SHEN and the northern Blue Ridge as a whole. The Central Appalachian Circumneutral Barren, in particular, is a spectacular example of its type, with a composition approaching that of a limestone barren. Plants such as *Bouteloua curtipendula*, *Muhlenbergia capillaris*, *Sporobolus clandestinus*, *Linum sulcatum* var. *sulcatum*, and *Zanthoxylum americanum* are more characteristic of limestone habitats than of metabasalt, and are restricted in the park to the greater Dickey Ridge area and, in most cases, are not found elsewhere on the northern Blue Ridge. The quality of this site's natural communities and their unusual floristics argues for active management to control several rapidly worsening problems with exotic invasive plants.

Manage invasive plants *Symphoricarpus orbiculatus*, *Microstegium vimineum*, and *Alliaria petiolata*. Management of *Symphoricarpus* is the highest priority at this site since it is the only invasive found in the open prairie-like barren. Herbicide is recommended for controlling these species because hand-pulling will create more soil disturbance and is labor-intensive. Growing in dense monotypic patches, *Symphoricarpus* and *Microstegium* can be treated by spray application using a backpack sprayer. *Alliaria* occurs more sparsely and should be treated using sponge- or glove-application methods to minimize non-target impacts that may accompany spray application.

Annually monitor post-treatment effects on the invasive species and natural vegetation. Once sufficient control has been achieved, initiate a 3-5 year monitoring interval to survey the rare plants and natural communities and assess threats from invasive plants.

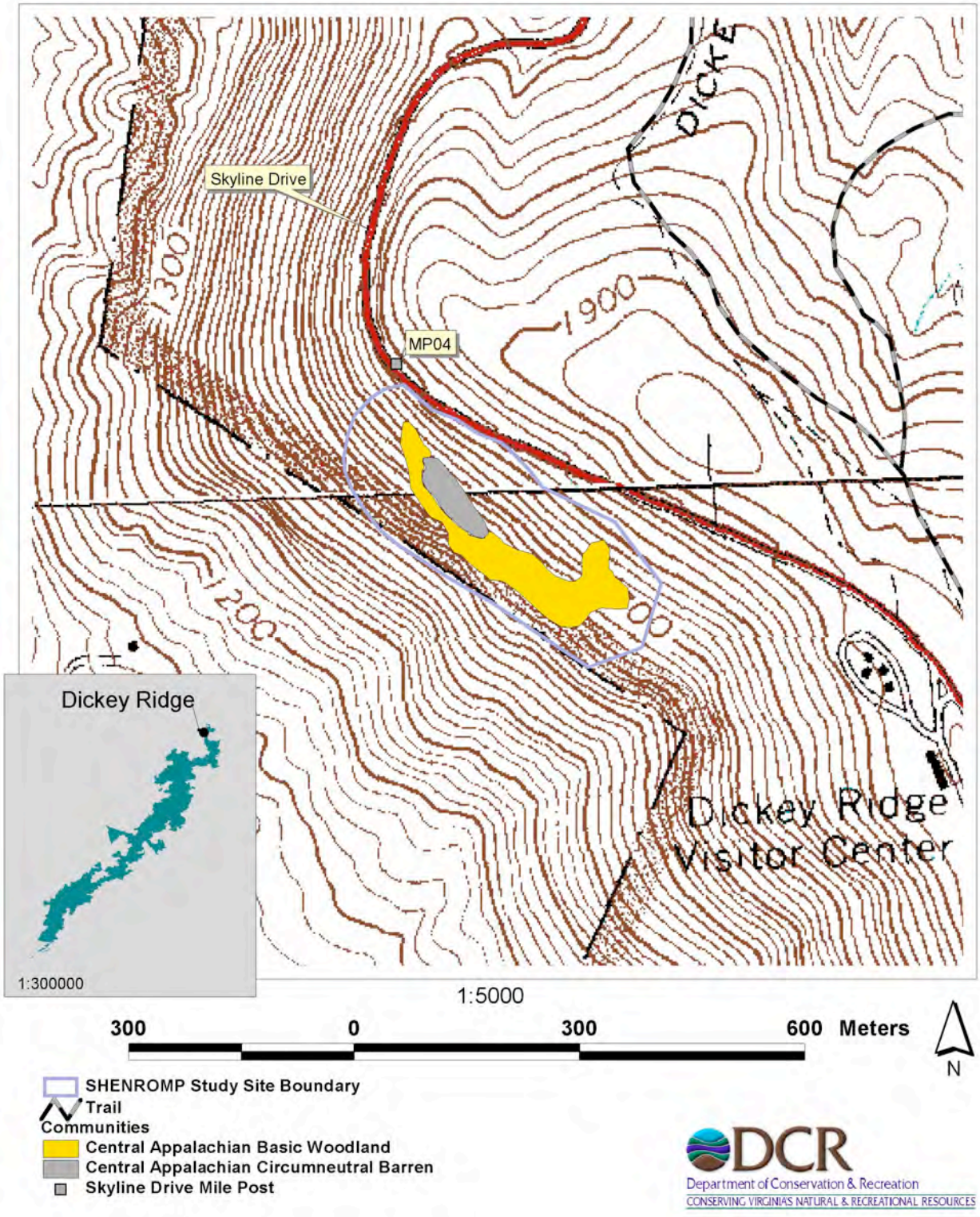


Fig. 10. Location of significant natural communities at Dickey Ridge.

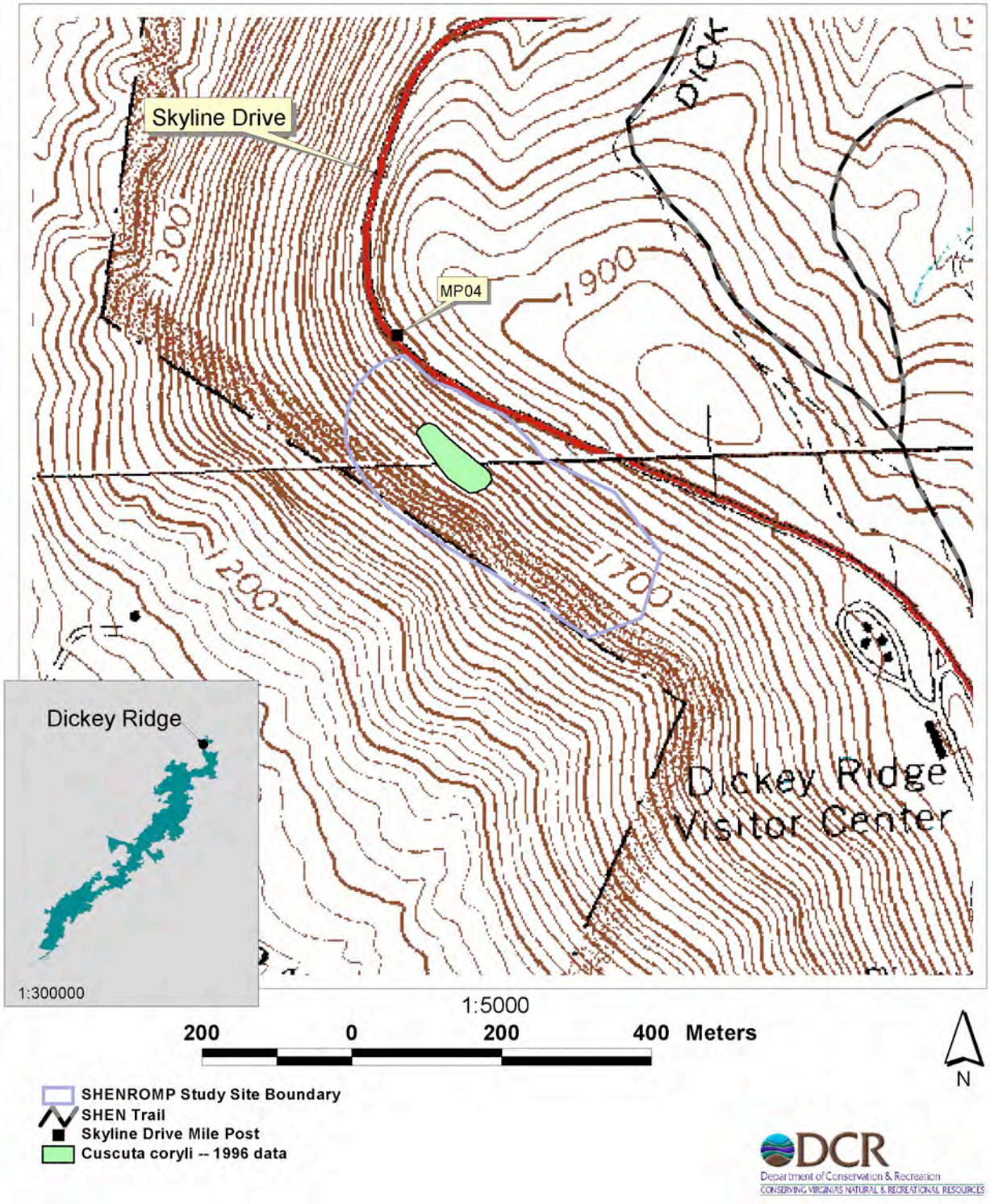


Fig. 11. Location of 1996 occurrence of *Cuscuta coryli* at Dickey Ridge.

DICKEY HILL (C13)

CONSERVATION SITE: Dickey Hill (B2) **THREAT RANK: 1**

LOCALITY: Warren County **QUADRANGLE(S):** Chester Gap

LOCATION: Located in the North District west of Skyline Drive, this site extends from 0.39-0.92 km (0.26-0.58 mi) south of Signal Knob Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Juniperus virginiana - Fraxinus americana* / *Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation	Central Appalachian Circumneutral Barren	G2	S2	None	None	A
Plants: None						
Animals: *Wormaldia thyria*	A philopotamid caddisfly	G3	S2	None	None	E

SITE DESCRIPTION: This site encompasses three areas of open metabasalt exposures at elevations of 500-567 m (1,640-1,860 ft). From north to south, these openings comprise about 0.49 ha (1.21 ac), 0.09 ha (0.23 ac), and 0.66 (1.62 ac), respectively. In addition, a talus field is situated just north of the southernmost opening.

The three exposures face west to southwest and consist mostly of small cliffs interspersed with ledges, creating a stairstep topography. The ledges often hold enough soil to support well developed herb layers and scattered woody plants. The northernmost exposure has a higher cliff at its base which reaches a maximum height of about 10 m (33 ft).

This site receives little of no visitation. Although the site is located a short distance west of Skyline Drive, it is not visible from the road, the topography is very steep, and there are no trails into the area.

NATURAL COMMUNITIES: Except for a small, scrubby boulderfield, the steep, stony slopes surrounding the main outcrops of this site are covered by the Central Appalachian Basic Oak-Hickory Forest (Submontane / Foothills Type). The three areas of exposed cliffs and ledges support a large occurrence of the globally rare Central Appalachian Circumneutral Barren community. Soil samples collected from these outcrops had extraordinarily high concentrations of calcium and magnesium, which may be a factor influencing the distribution of this community on the Blue Ridge. Covering approximately 1.2 ha (3.0 ac) in aggregate, the occurrence varies in composition and character with microhabitat conditions. On the ledgy, sloping, ephemerally wet outcrops and boulder deposits below cliffs, vegetation is very thick under an open canopy of scrubby *Fraxinus americana* (white ash) and *Juglans nigra* (black walnut). Large thickets of *Rhus aromatica* var. *aromatica* (fragrant sumac), *Chionanthus virginicus* (fringetree), *Celtis* spp. (hackberries), and other shrubs are characteristic, along with dense patches of *Elymus hystrix* var. *hystrix* (bottlebrush grass) and ruderal weeds (see Threats

section below). The lichen *Dermatocarpon luridum* is abundant on outcrops that are periodically wet with seepage.

The drier cliffs and ledges support more open, xerophytic vegetation with stunted *Juniperus virginiana* var. *virginiana* (eastern redcedar) prominent. *Fraxinus americana*, *Carya glabra* (pignut hickory), *Ostrya virginiana* (eastern hop-hornbeam) and, more locally, *Pinus virginiana* (Virginia pine) are also characteristic of the scattered tree cover. Patches of *Rhus aromatica* var. *aromatica*, *Rosa carolina* var. *carolina* (pasture rose), and other shrubs are less dense than in the mesophytic variant. In addition, the herb layer generally lacks ruderal species and is dominated by xerophytic graminoids. Unlike the occurrence at Dickey Ridge, the Dickey Hill stand lacks warm-season grasses. *Danthonia spicata* (poverty oat-grass), *Carex pensylvanica* (Pennsylvania sedge), and *Elymus hystrix* var. *hystrix* are the dominant graminoids. Also abundant or characteristic are *Helianthus divaricatus* (woodland sunflower), *Symphyotrichum oblongifolium* (= *Aster oblongifolius*, aromatic aster), *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod), *Pycnanthemum incanum* (hoary mountain-mint), *Allium cernuum* (nodding onion), *Penstemon canescens* (gray beardtongue), *Asclepias verticillata* (whorled milkweed), *Lespedeza virginica* (slender bushclover), *Commelina erecta* var. *erecta* (slender dayflower), *Ambrosia artemisiifolia* (common ragweed), *Antennaria plantaginifolia* (plantain-leaf pussytoes), *Paronychia montana* (mountain nailwort), *Draba ramosissima* (rocktwist), *Acalypha virginica* (Virginia copperleaf), and *Taenidia montana* (mountain pimpernel). *Cheilanthes lanosa* (hairy lipfern), *Isanthus brachiatus* (false pennyroyal), *Heuchera americana* (American alumroot), and *Woodsia obtusa* ssp. *obtusa* (blunt-lobed woodsia) are prominent lithophytes of rock crevices. Diverse lichen cover on exposed rock surfaces includes *Xanthoparmelia conspersa*, *Flavoparmelia baltimorensis*, *Acaraspora fuscata*, *Rhizoplaca subdiscrepens*, *Usnea cf. halei*., *Lasallia papulosa*, *Diploschistes scruposus*, *Lepraria cf. neglecta*, *Cladonia* spp., and many unidentified crusts.

Ring counts and increment cores taken from *Juniperus virginiana* var. *virginiana* at this site indicate that even small trees (< 10 cm DBH) can be 100 years old, and that the largest trees are at least 250 years old. Fires appear to have been a limiting factor in the age of Eastern redcedars on Dickey Ridge (sensu lato) outcrops. Extensive evidence that fires swept upslope on the western flank of Dickey Ridge historically was noted on a visit to several sites in October 2006. At the Dickey Ridge ROMP site, the grassy, prairie-like barren probably had sufficient fuel to carry these fires, killing most trees. As a result, the redcedars at that site are almost all < 100 years old. By contrast, at the Dickey Hill ROMP site and another outcrop several hundred meters to the south, large, old Eastern redcedars appear to have survived these fires because of their location on very rocky, cliff-top or cliff-foot habitats that do not carry fire well.

The xerophytic variant of the Central Appalachian Circumneutral Barren dominates the southernmost outcrop of this site, as well as a large cliff at the south end of the northernmost outcrop. This occurrence also includes a large patch several hundred meters to the south, outside the ROMP site boundary. The very good quality of this occurrence, along with its excellent size and landscape context, combine to justify an overall rank of "A" despite local areas degraded by weeds. Quantitative plot data were collected from this occurrence during the ROMP project (plot SHNP148). The portion located outside the ROMP site boundary was plot-sampled in 1999 (plots SHNP070).

RARE PLANTS: Two watchlist plants were located at this site: *Crataegus pruinosa* (a hawthorn) and *Taenidia montana* (mountain pimpernel).

RARE ANIMALS: One adult specimen of *Wormaldia thyria* (a philopotamid caddisfly) was captured in a UV-trap on 19 July 2006. The population is probably associated with a nearby first-order stream (O. Flint, pers. comm., 2006). It is difficult to determine population status based on a single sighting.

Plate 32. Diverse herbaceous vegetation and gnarled, old *Juniperus virginiana* var. *virginiana* (eastern redcedar) at Dickey Hill.

THREATS: The matrix forest of this site contains a few disturbed areas with abundant *Ailanthus altissima* (tree-of-heaven), *Alliaria petiolata* (garlic mustard), and *Microstegium vimineum* (Japanese stiltgrass). The more mesic outcrop areas have a number of weedy invaders, including *Rosa multiflora* (multiflora rose), *Lonicera japonica* (Japanese honeysuckle), *Alliaria petiolata*, *Commelina communis* (Asiatic dayflower), *Bromus tectorum* (cheat grass), and *Verbascum thapsus* (great mullein), some of which are abundant. Scattered saplings of *Ailanthus altissima* are present even on the drier outcrops but may have limited viability there due to constant drought stress.

Little is known about the life history of *Wormaldia thyria* or potential threats to the species. Threats may include the use of pesticides for gypsy moth or other insect control and activities that decrease the water quality of the stream habitats upon which this species' larvae are dependent.

MANAGEMENT RECOMMENDATIONS:

Conduct surveys on a 3-5 year cycle to assess invasive plants. Currently, the invasive plants at this site are restricted to the matrix forest and do not appear to be directly impacting the outcrop communities; therefore, no invasive plant management is recommended at this time.

No specific management recommendations for *Wormaldia thyria*. Almost nothing is known about the life history of *Wormaldia thyria*, making management recommendations difficult. General conservation

measures to protect large tracks of land may provide indirect positive benefits for this species. It is unlikely to be impacted by management decisions specifically targeting cliffs and rock outcrops; however, caution should be used if gypsy moth or other insect suppression is contemplated in the area as certain pesticides have broad effects on non-targeted invertebrate species. Also, activities that would contribute to the sedimentation of small streams in the area or increase the water temperature of these streams should be avoided.

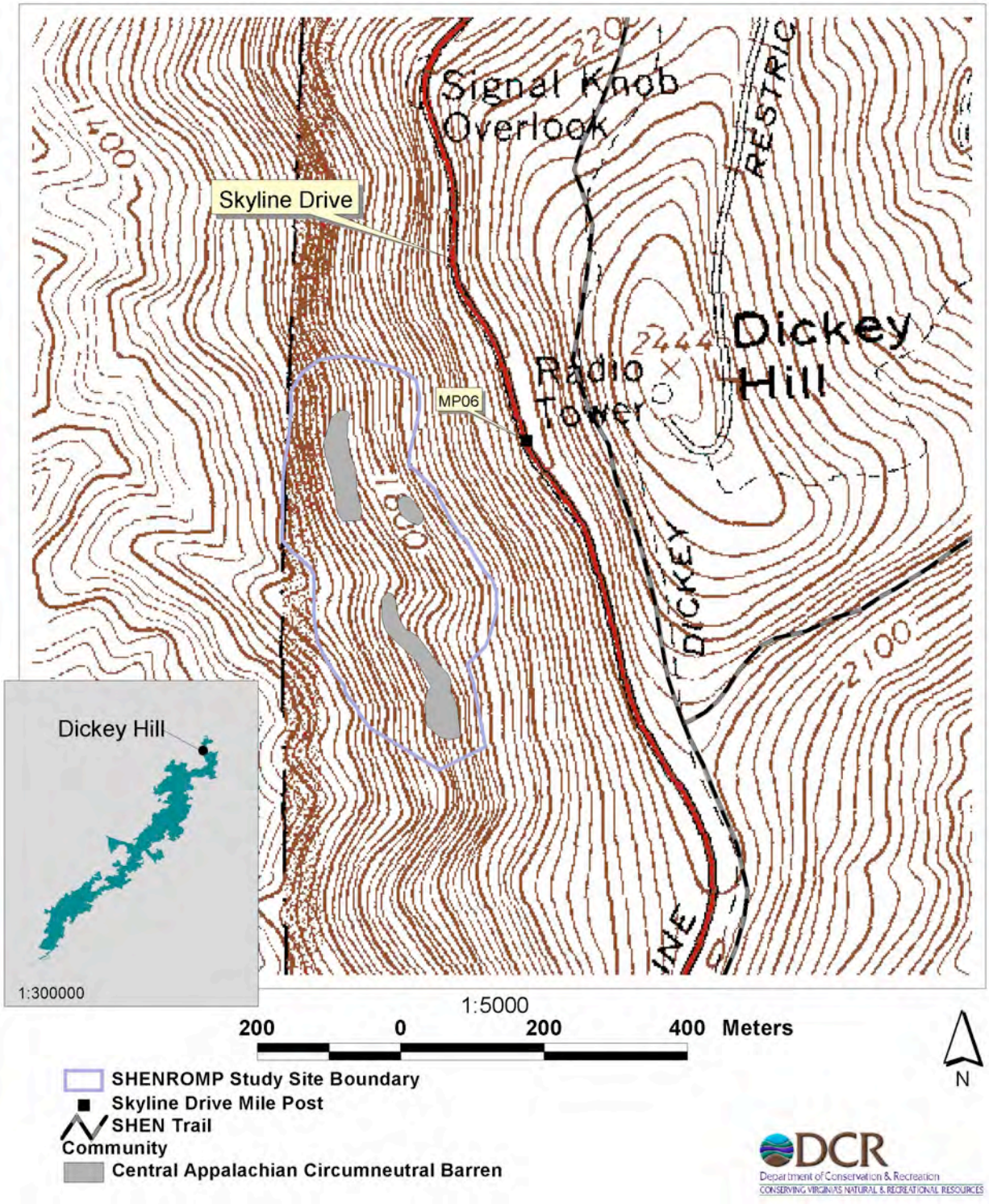


Fig. 12. Location of significant natural community at Dickey Hill.

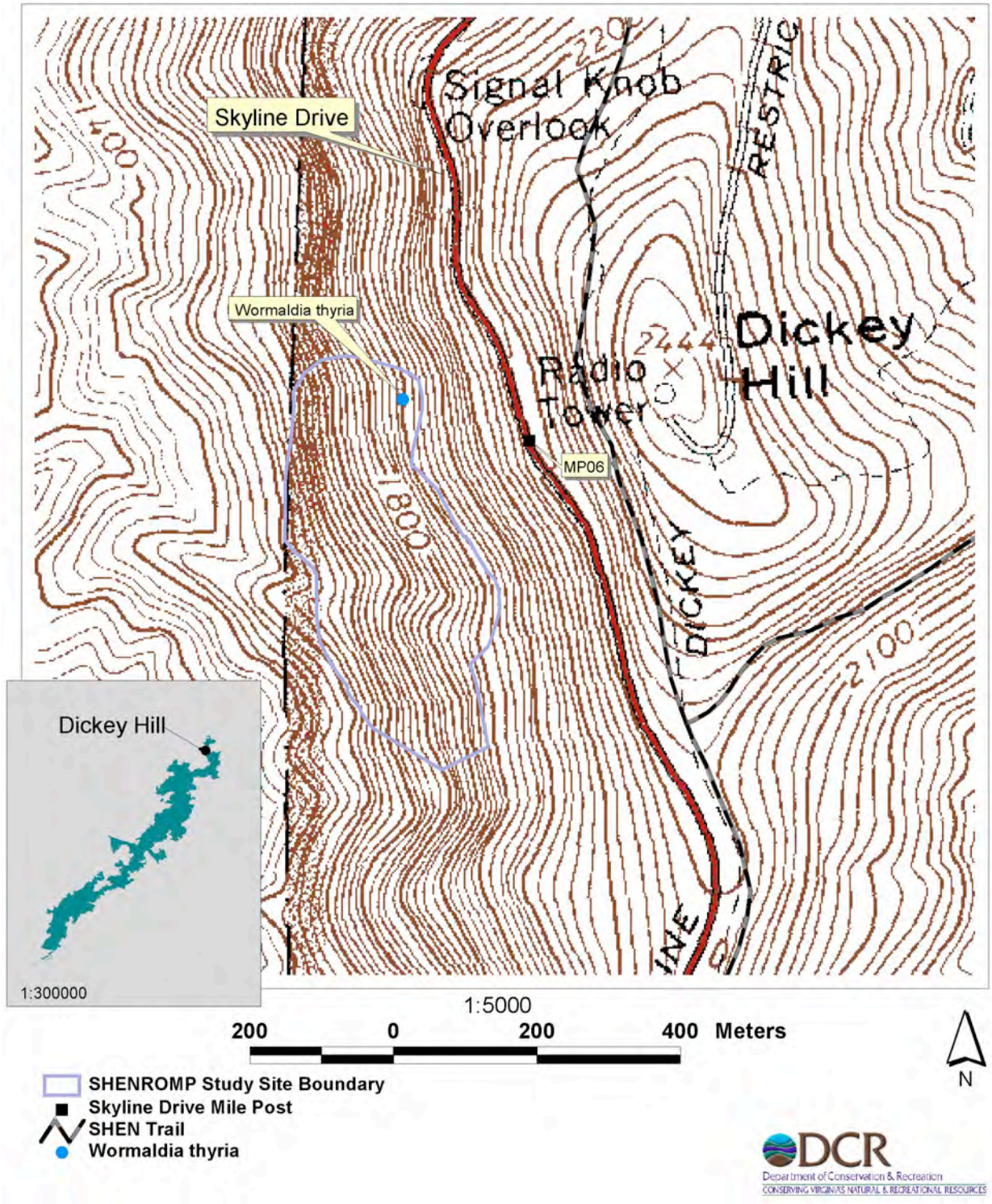


Fig. 13. Location of *Wormaldia thyria* at Dickey Hill.

GOONEY MANOR OVERLOOK (C19)

CONSERVATION SITE: Gooney Manor Overlook (B3) **THREAT RANK: 2**

LOCALITY: Warren County **QUADRANGLE(S):** Chester Gap

LOCATION: This North District site is located on the west side of Skyline Drive. It begins at Gooney Manor Overlook and extends to the south-southwest for 0.14 km (0.09 mi).

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Juniperus virginiana - Fraxinus americana* / *Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation	Central Appalachian Circumneutral Barren	G2	S2	None	None	C
Plants:						
Cuscuta coryli[1]	Hazel dodder	G5	S2?	None	None	BC
Oligoneuron rigidum var. *rigidum*	Southeastern stiff goldenrod	G5T5	S2	None	None	C
Animals:						
Hadena ectypa	A noctuid moth	G3G4	S1S3	None	None	E

[1]This element occurrence (eo) was sought but not relocated for this project. The eo was last seen by DNH in 1991.

SITE DESCRIPTION: This site is dominated by two major exposures of Catoctin Formation metabasalt within an arc of cliffs at elevations of 559-578 m (1840-1900 ft). A trail accessed through a gap in the stone wall at the overlook parking area leads down a steep slope to a point midway along the top of the northwestern exposure, which extends for 80 m (262 ft) from northwest to southeast. To the southeast of this exposure, and separated from it by a vegetated talus slope, is a second exposure, extending southwest to northeast for 60 m (197 ft). The tops of these exposures are ledgy, gentle slopes where open rock is interspersed with scrub and herb-dominated patches. The cliff faces are steep but not sheer, reaching heights of up to 12 m (40 ft). Talus slopes occur below the cliffs and at the eastern and western edges of the site.

NATURAL COMMUNITIES: The matrix vegetation of this site is one of the low-elevation, basic oak-hickory forests. However, this site has been so disturbed by vista clearing and weeds below the overlook that it is now difficult to determine which community type is represented. The two exposed outcrops support a small (0.2 ha [0.5 ac]), disturbed occurrence of the globally rare Central Appalachian Circumneutral Barren community type. Soil samples collected from this outcrop had extraordinarily high concentrations of calcium and magnesium, which may be a factor influencing the distribution of this community on the Blue Ridge. Its vegetation is characterized by scattered scrubby trees and patches of *Rhus aromatica* var. *aromatica* (fragrant sumac) and sparse to locally dense patches of xerophytic herbaceous plants. The most abundant of the latter are *Danthonia spicata* (poverty oat-grass), *Symphyotrichum oblongifolium* (= *Aster oblongifolius*, aromatic aster), *Carex pensylvanica* (Pennsylvania sedge), *Oligoneuron rigidum* var. *rigidum* (southeastern stiff goldenrod), *Helianthus divaricatus* (woodland sunflower), *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod), *Allium cernuum* (nodding onion), *Pycnanthemum incanum* (hoary mountain-mint), *Ambrosia artemisiifolia* (common ragweed),

Polygonum scandens var. *cristatum* (crested false-buckwheat), and *Clitoria mariana* (Maryland butterfly-pea). The lithophytes *Cheilanthes lanosa* (hairy lipfern), *Isanthus brachiatus* (false pennyroyal), *Talinum teretifolium* (roundleaf fameflower), *Polygonum tenue* (slender knotweed), *Eragrostis capillaris* (tiny lovegrass), *Panicum philadelphicum* (Philadelphia panic grass), and *Sporobolus vaginiflorus* (sheathed dropseed) were noted on more exposed rock surfaces. The northwestern outcrop is much more floristically diverse than the southeastern outcrop. Quantitative plot data were collected from this occurrence in 1999 (plot SHNP069).

RARE PLANTS: Two rare plants had previously been found at this site: *Cuscuta coryli* (hazel dodder) and *Oligoneuron rigidum* var. *rigidum*. *Cuscuta coryli* was not relocated at this site in 2005. It was last documented from here in 1991 when numerous stems were seen within a 2 x 3 m (7 x 10 ft) area.

Oligoneuron rigidum var. *rigidum* was observed during the August 2005 visit on the northwestern exposure. Most plants were found in a 7 x 16 m (23 x 52 ft) area, growing in crevices and soil pockets on an open, gentle to moderately sloping, south-facing metabasalt outcrop or under the partial shade of adjacent scrubby trees. Forty-six stems were counted here, including 19 in bud and 27 that appeared to have been clipped by deer. Many sterile clumps were also observed. In addition, a small cluster of sterile plants was seen 15-20 m (49-66 ft) southeast of the main colony along an informal trail which crosses the top of the exposure.

RARE ANIMALS: One specimen of *Hadena ectypa* (a noctuid moth) was collected in a UV trap set from 18-19 July 2006 below the Gooney Manor Overlook. It is difficult to determine the population status of this species based on a single sighting. One watchlist species, *Scudderia septentrionalis* (northern bush katydid, n= 5), was captured in a UV-trap.

Plate 33. Herbaceous barren vegetation on exposed metabasalt outcrop below Gooney Manor Overlook. Rosettes of *Oligoneuron ridigum* var. *rigidum* (stiff goldenrod) are in foreground.

THREATS: Extensive woody vegetation between the overlook and the two outcrops at this site was cut in recent years as part of a vista-clearing program. Brush from this cutting was dumped on and just upslope of both outcrops. The newly open conditions have stimulated vigorous growth of woody coppice, as well as of both native and introduced herbaceous species. Large colonies of some of the barrens species, e.g., *Helianthus divaricatus*, *Allium cernuum*, and *Symphyotrichum oblongifolium*, now extend well upslope of the outcrops proper in this cutover area. However, exotics such as *Centaurea biebersteinii* (spotted knapweed), *Poa compressa* (flat-stemmed bluegrass), *Hypericum perforatum* (common St. John's-wort), and *Verbascum thapsus* (great mullein) have also benefited from the disturbance.

Based on the frequency of browsed stems observed, deer herbivory is a threat to the *Oligoneuron rigidum* var. *rigidum* population; deer droppings were frequent across the site. The cluster of *Oligoneruon rigidum* var. *rigidum* in the trail is threatened by trampling. Several exotic plant species are present near the population: *Centaurea biebersteinii*, *Poa compressa*, and *Verbascum thapsus*. *Centaurea biebersteinii* is mostly associated with the social trail leading down from the overlook. However, these species are largely absent from the outcrops proper, are not acting aggressively, and are most likely symptoms of trampling disturbance.

Cuscuta coryli is an annual, and populations may appear only in years when conditions are optimal. Therefore, the absence of this species from a known site in any given year is not in itself cause for alarm.

Little is known about the life history of *Hadena ectypa* or potential threats to the species. The primary threat may be the use of pesticides for gypsy moth or other insect control.

MANAGEMENT RECOMMENDATIONS: The rarity of the Central Appalachian Circumneutral Barren community and the fact that this is one of only two sites for the rare *Oligoneuron rigidum* var. *rigidum* on the Virginia Blue Ridge make Gooney Manor Overlook a priority for protection. In addition, ease of access from Skyline Drive makes active management feasible.

Do not deposit cut brush on the outcrops. Ensure that future viewshed management at this site does not include dumping brush on the outcrops and associated natural heritage resources.

Close social trail from the overlook to the outcrop. If necessary, use barriers. Post educational signs.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN, how they interact, and why their conservation is important.

Monitor recovery of the rare plants and the health of the significant natural community. Initially, conduct annual surveys to assess effectiveness of revised viewshed maintenance procedures and closing of the social trail. At the same time, conduct a survey and assessment of invasive plants. Thereafter, shift to a 3-5 year monitoring interval.

No specific management recommendations for *Hadena ectypa*. Almost nothing is known about the life history of *Hadena ectypa*, making management recommendations difficult. General conservation measures to protect large tracks of land may provide indirect positive benefits for this species. It is unlikely to be impacted by management decisions specifically targeting cliffs and rock outcrops; however, caution should be used if gypsy moth or other insect suppression is contemplated in the area as certain pesticides have broad effects on non-targeted invertebrate species.

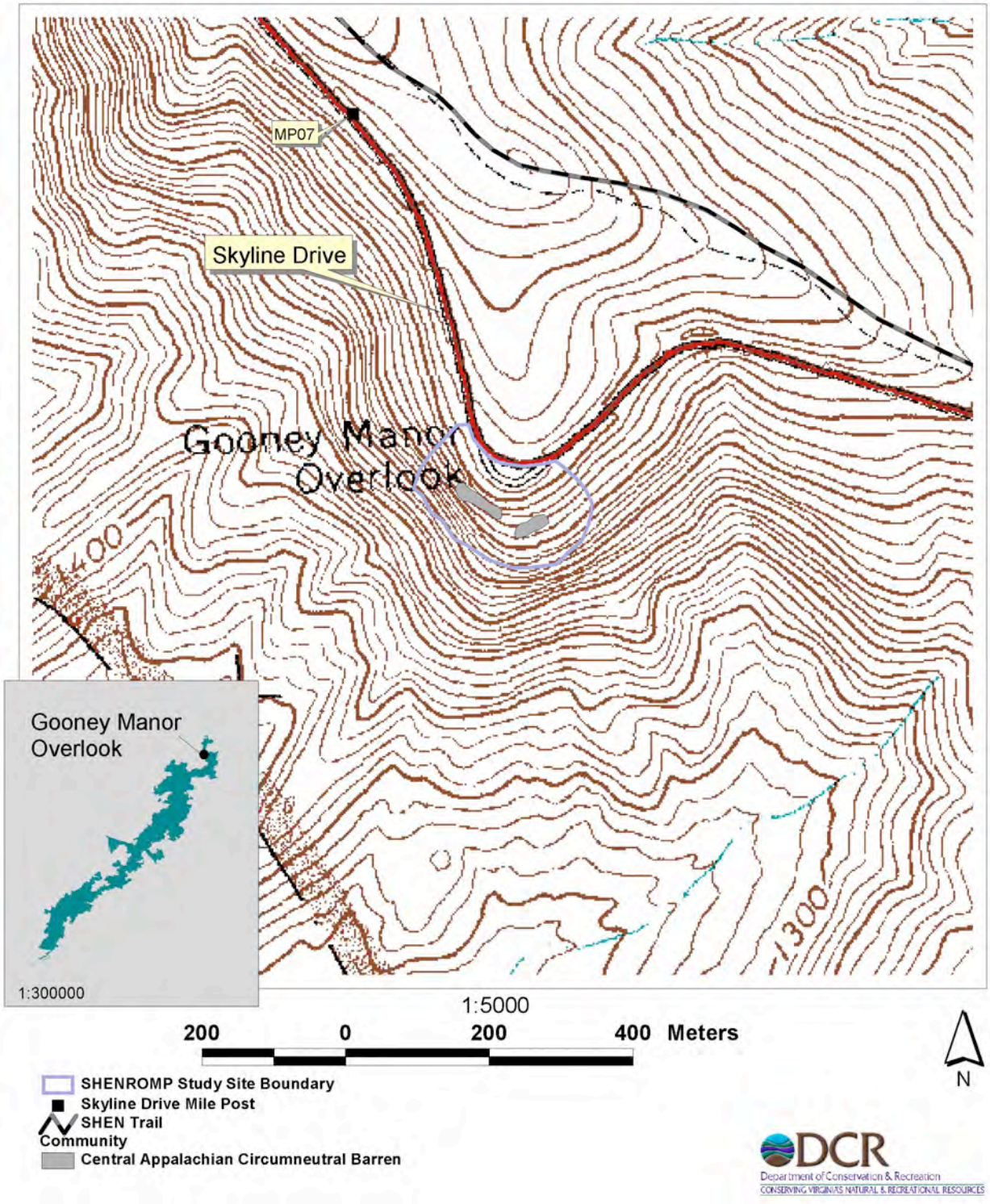


Fig. 14. Location of significant natural community at Gooney Manor Overlook.

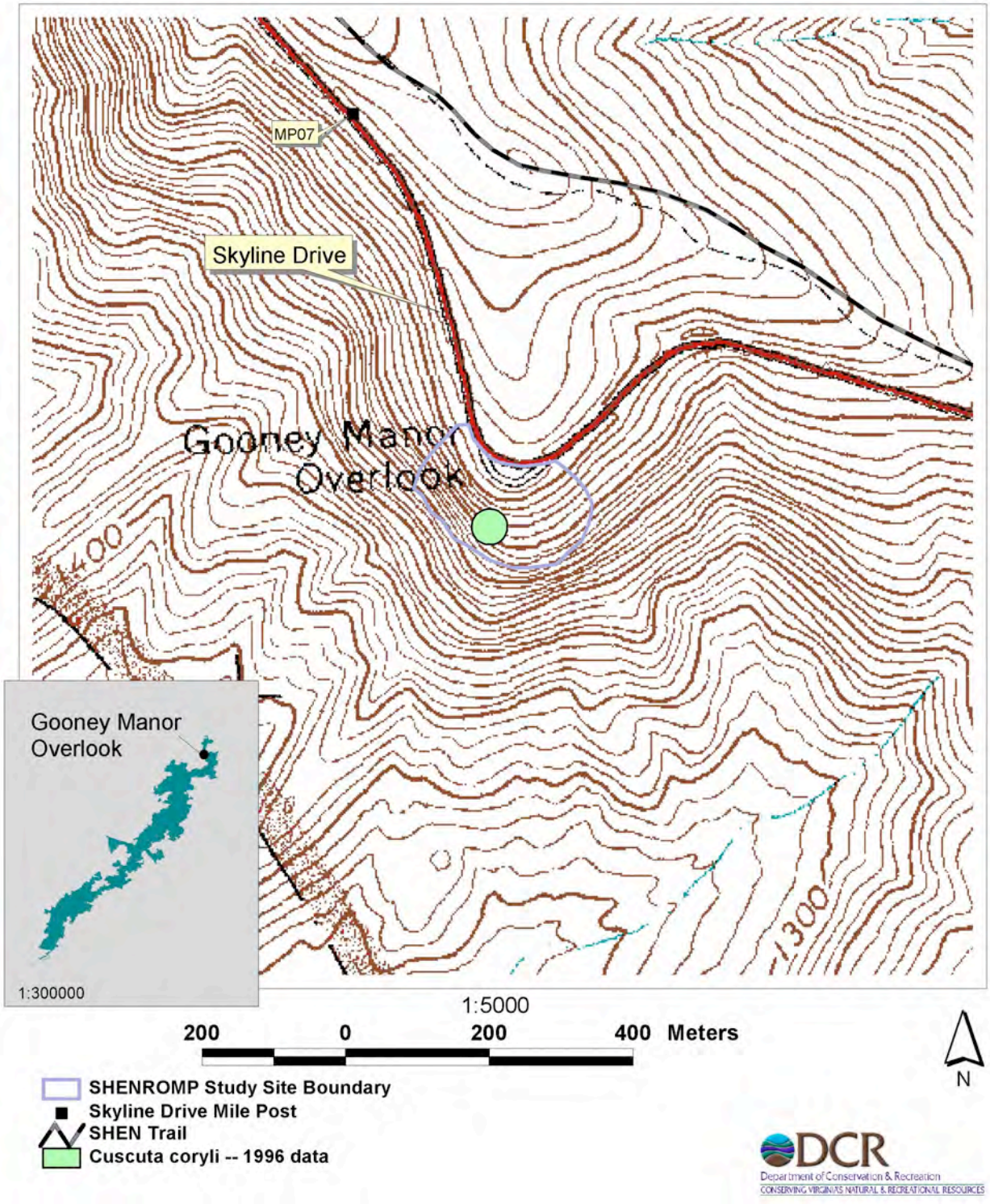


Fig. 15. Location of 1996 occurrence of *Cuscuta coryli* at Gooney Manor Overlook.

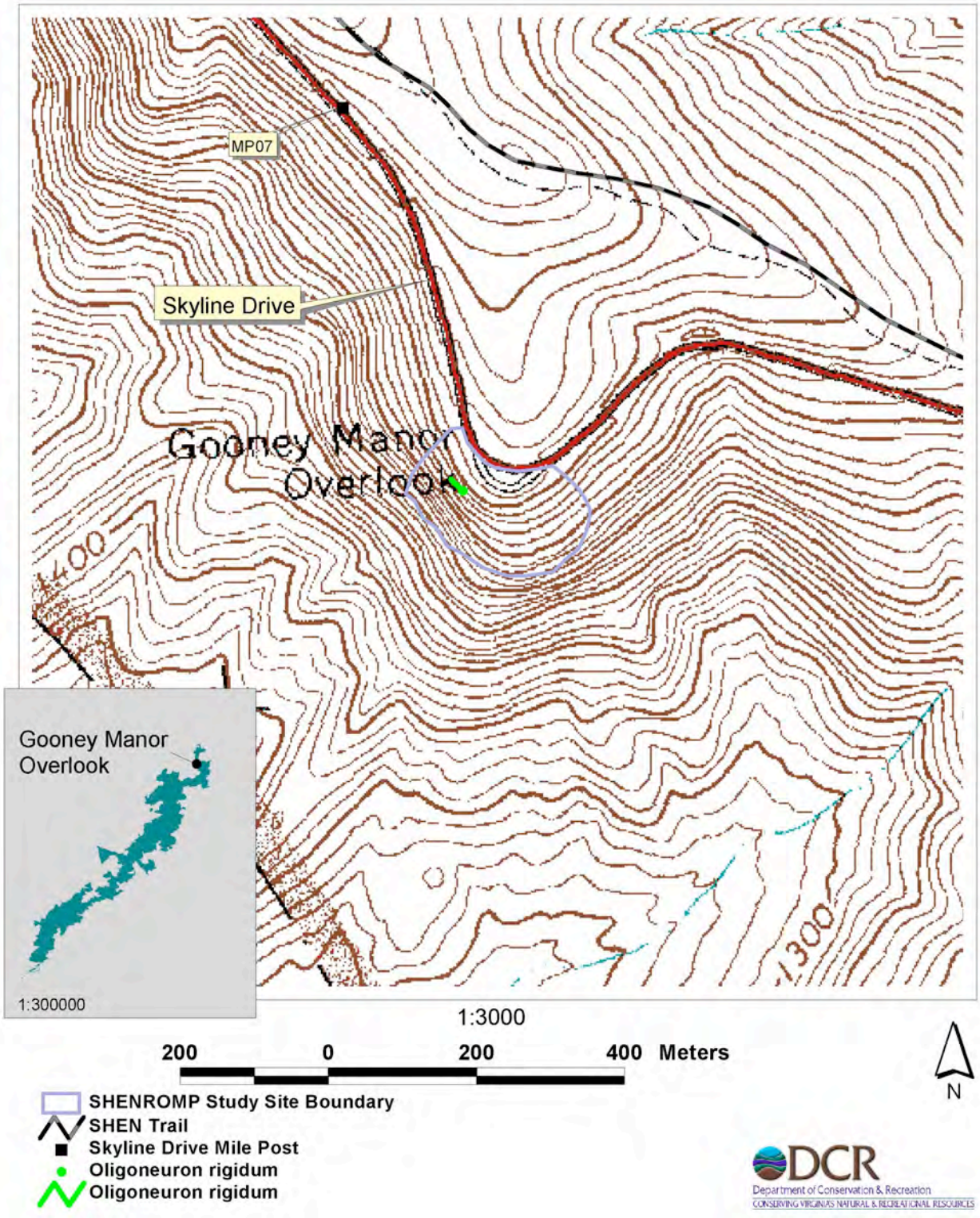


Fig. 16. Location of *Oligoneuron rigidum* var. *rigidum* at Gooney Manor Overlook.

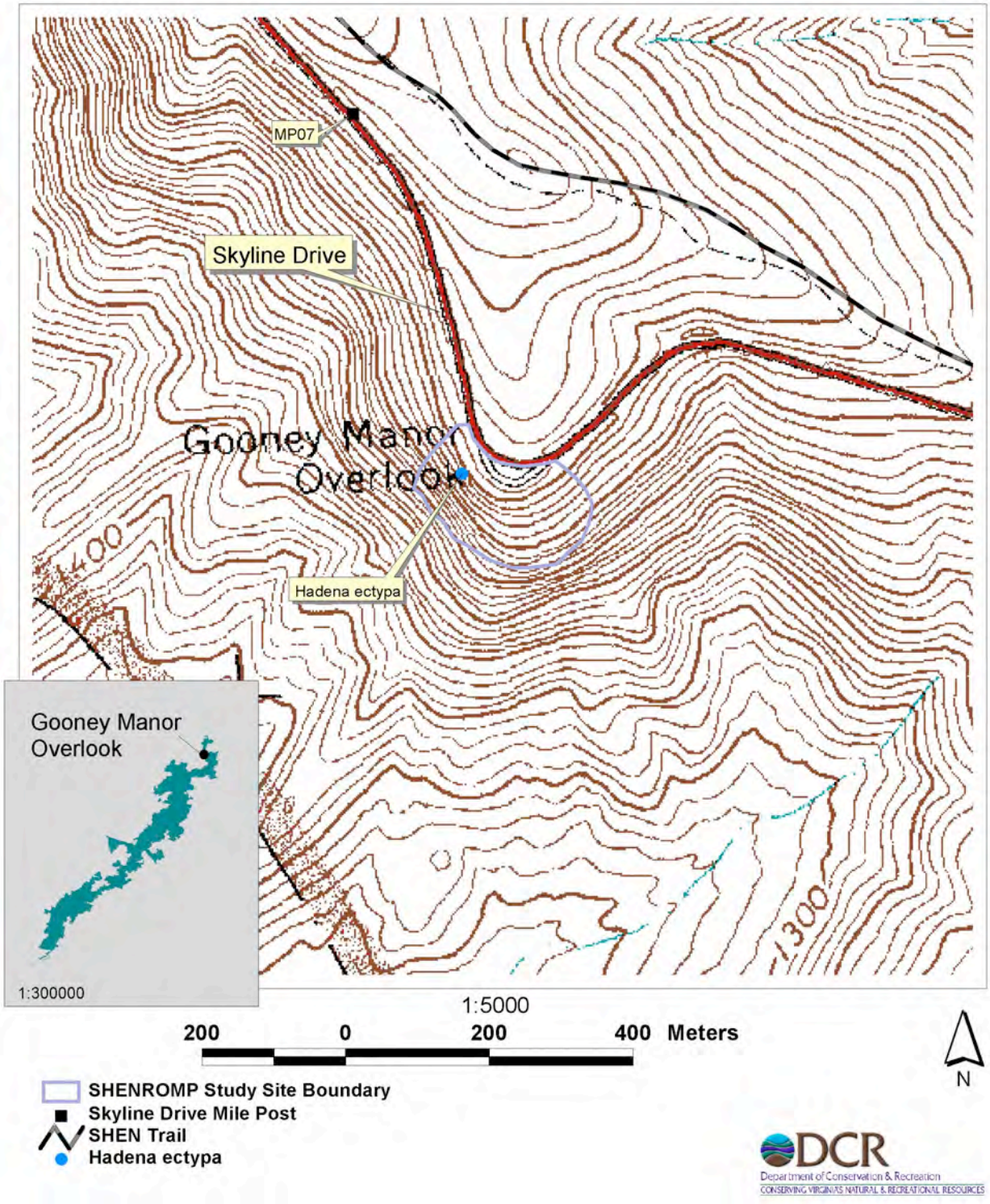


Fig. 17. Location of *Hadena ectypa* at Gooney Manor Overlook.

BROWNTOWN VALLEY OVERLOOK (C07)

CONSERVATION SITE: Mount Marshall (B2) **THREAT RANK: 0**

LOCALITY: Warren County **QUADRANGLE(S):** Chester Gap

LOCATION: This site is located in the North District west of Skyline Drive. It extends from 0.30 km (0.18 mi) northwest to 0.53 km (0.33 mi) north northwest of Browntown Valley Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana* / *Physocarpus opulifolius* / *Carex pensylvanica* - *Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2	S2	None	None	A
Plants: None						
Animals: None						

SITE DESCRIPTION: This site encompasses a forested, west-facing slope broken by two lines of rock exposures, each at a distinct topographic level. The bedrock here is Catoctin Formation metabasalt. The lower set of exposures consists of a series of several open, mostly west- facing cliffs. The largest of these is about 90 m (295 ft) long and 21 m (70 ft) high. These cliffs are located at an elevation band of 756-777 m (2,480-2,550 ft). The upper set of exposures consists of a string of relatively small, forested to open, west to northwest-facing outcrops at elevations between 786 m (2,580 ft) and 798 m (2,620 ft). These outcrops generally have short vertical faces and numerous ledges.

Although this site is located only 0.26 km (0.16 mi) from Skyline Drive, it receives little or no visitation due to its rugged topography and lack of trails.

NATURAL COMMUNITIES: The forests at this site are generally uneven-aged and mature, with some very large trees scattered throughout the area. The gentler upper slopes support lush stands of the Central Appalachian Montane Oak-Hickory Forest (Basic Type), which has a rich herb layer with *Laportea canadensis* (wood nettle), *Asarum canadense* (wild ginger), *Amphicarpaea bracteata* (hog-peanut), *Caulophyllum thalictroides* (blue cohosh), and other nutrient-demanding forbs. At and just below the upper line of outcrops, these nutrient-demanding species drop out, substrates appear to become drier and more oligotrophic, and the forest cover abruptly changes to a mosaic of Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest and Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. At the top of the lower cliffs, stands of the latter with thick *Kalmia latifolia* (mountain-laurel) are prevalent. The forests below the lower line of cliffs were not examined in this study.

It is not clear whether the apparent gradation in soil fertility at this site is related to bedrock chemistry or to shallower soil depth and increased leaching below the upper bedrock exposures. However, a similar pattern was noted in the composition of vegetation on the two lines of outcrops. Three open exposures on the upper line support 0.2 ha (0.5 ac) of vegetation that was assigned by inspection to the globally rare

Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type). This community is typically associated with middle-elevation outcrops of metabasalt and pyroxene-bearing granitic gneisses. At this site, the vegetation is predominantly herbaceous with scattered, stunted trees and shrubs of *Fraxinus americana* (white ash), *Carya glabra* (pignut hickory), *Ostrya virginiana* (eastern hop-hornbeam), *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Crataegus pruinosa* (a hawthorn), *Rosa carolina* var. *carolina* (pasture rose), and *Betula lenta* (sweet birch). Characteristic herbs are *Deschampsis flexuosa* var. *flexuosa* (wavy hairgrass), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oat-grass), *Hylotelephium telephioides* (Allegheny stonecrop), *Helianthus divaricatus* (woodland sunflower), *Solidago erecta* (erect goldenrod), *Corydalis sempervirens* (pink corydalis), *Polypodium appalachianum* (Appalachian rock polypody), *Viola sagittata* (arrow-leaved violet), *Dryopteris marginalis* (marginal wood-fern), and *Polygonatum biflorum* var. *biflorum* (Solomon's-seal). The northwesternmost patch of this vegetation is transitional to a high-elevation barren, with species such as *Diervilla lonicera* (northern bush-honeysuckle) and *Sorbus americana* (American mountain-ash) present in small numbers. The exposed rock surfaces support diverse lichens, including *Lasallia pensylvanica*, *Stereocaulon glaucescens*, *Rhizoplaca subdiscrepens*, *Xanthoparmelia conspersa*, *Xanthoparmelia plittii*, *Acaraspora fuscata*, *Usnea cf. halei*, *Porpidia* sp., and numerous unidentified crusts.

By contrast, the lower, more massive outcrops at this site are sparsely vegetated with a lithophytic variant of the Central Appalachian Pine – Oak / Heath Woodland. *Pinus pungens* (table-mountain pine) and *Quercus prinus* (chestnut oak) are present in crevices and along the back edges of the cliff tops. Scattered patches of *Gaylussacia baccata* (black huckleberry) and *Kalmia latifolia* are present on the ledges. The exposed rocks have a very sparse representation of herbaceous plants, consisting of scattered individuals of *Deschampsia flexuosa* var. *flexuosa*, *Danthonia spicata*, *Campanula divaricata* (southern hairbell), and *Viola sagittata*. Lichen cover is dominated by *Lasallia pensylvanica*, *Lasallia papulosa*, and *Dimelaena oreina*.

RARE PLANTS: No rare plants were found at this site. Small populations of two watchlist species, *Adlumia fungosa* (climbing fumitory) and *Crataegus pruinosa* were found on a small forested outcrop located about 30 m (98 ft) northeast of the site.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

Plate 34. Central Appalachian Mafic Barren at Browntown Valley Overlook

THREATS: Although small in size, the significant community at this site is in pristine condition and free of invasive species. The exotic weeds *Polygonum caespitosum* var. *longisetum* (long-bristled smartweed), *Symphoricarpos orbiculatus* (coral-berry), and *Alliaria petiolata* (garlic mustard) are present in forested parts of the site but at present do not pose significant threats to the rare community.

MANAGEMENT RECOMMENDATIONS:

Conduct surveys on a 5-10 year interval to assess invasive plants. Currently, the invasive plants at this site are restricted to the matrix forest and do not appear to be directly impacting the outcrop communities; therefore, no invasive plant management is recommended at this time.

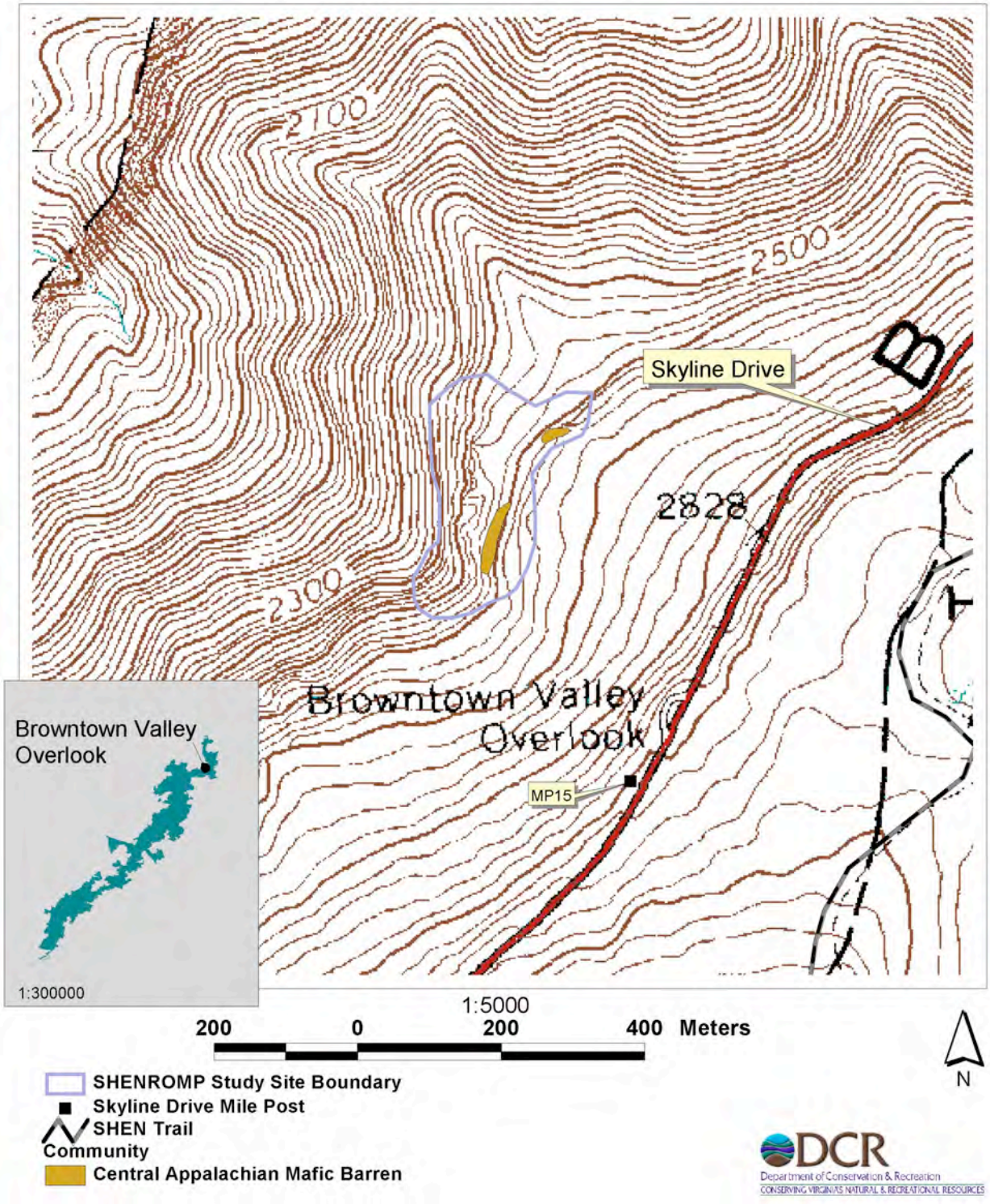


Fig. 18. Location of significant natural community at Browntown Valley Overlook.

NORTH MARSHALL SUMMIT (C35)

CONSERVATION SITE: Mount Marshall (B2) **THREAT RANK: 2**

LOCALITY: Warren and Rappahannock Counties **QUADRANGLE(S):** Chester Gap

LOCATION: Situated east of Skyline Drive, this North District site extends from 0.95-1.60 km (0.59-1.00 mi) southwest of Browntown Valley Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula alleghaniensis / *Sorbus americana* - *Acer spicatum* / *Polypodium appalachianum* Forest	Central Appalachian High-Elevation Boulderfield Forest	G2	S2	None	None	B
Diervilla lonicera - *Solidago randii* - *Deschampsia flexuosa* - *Hylotelephium telephioides* - *Saxifraga michauxii* Herbaceous Vegetation	High-Elevation Greenstone Barren	G1	S1	None	None	C
Lasallia papulosa - *Stereocaulon glaucescens* – *Chrysothryx chlorina* Nonvascular Vegetation	Central Appalachian Mafic Boulderfield	G2?	S2?	None	None	A
Plants:						
Huperzia appalachiana	Appalachian fir-clubmoss	G4G5	S2	None	None	C
Solidago randii	Rand's goldenrod	G5T4	S2S3	None	None	BC
Animals: None						

SITE DESCRIPTION: This site encompasses two main levels of intermittent Catoctin Formation metabasalt cliffs that occur along the northwestern slope of Mount Marshall. Cliff heights in the lower level average 12 m (40 ft), whereas those of the upper level average less than 3 m (10 ft). These cliffs face west to northwest. A broad, gently sloping, forested ridge is located upslope from the upper line of cliffs. The summit of Mount Marshall, an abruptly rising knob, is at the northeastern end of this ridge. Rock exposures on this knob face east and south.

Wooded and open talus slopes are found throughout this site. They are located between the two levels of cliffs, at the base of the lower level of cliffs, between the individual cliffs that comprise each level, and below the summit exposures. Open, unforested talus is generally found only immediately downslope from cliffs.

This area is easily accessed by the Appalachian Trail, which traverses the steep slope that supports the two levels of cliffs, climbs the gentle ridge above these cliffs, and crosses the summit knob. Numerous informal trails lead to overlooks from the Appalachian Trail.

NATURAL COMMUNITIES: The prevailing forest cover of this site is a mosaic of Northern Red Oak Forest (Pennsylvania Sedge – Wavy Hairgass Type) and Central Appalachian Northern Hardwood Forest (Yellow Birch Northern Red Oak Type). It is broken by several areas of metabasalt boulderfields totaling approximately 5.5 ha (13 ac) in aggregate; these are occupied partly by Central Appalachian High-Elevation Boulderfield Forest and partly by the lichen-dominated Central Appalachian Mafic Boulderfield nonvascular community. The boundaries between these communities are not always distinct, with scattered shrubby trees of the forest slowly invading the edges of the open boulderfields. Overall, the boulderfield forest covers a much larger area, with the nonvascular community occupying only the most exposed and resistant areas of talus. At the west end of the site, the tops of two exposed cliffs support a very small (0.09 ha [0.20 ac]) occurrence of the globally rare High-Elevation Greenstone Barren community, which is endemic to SHEN.

The Central Appalachian High-Elevation Boulderfield Forests at this site are dominated by stunted and often wind-pruned *Betula alleghaniensis* (yellow birch), *Sorbus americana* (American mountain-ash), and *Acer spicatum* (mountain maple). Other important woody plants at this site are *Prunus pensylvanica* (pin cherry), *Menziesia pilosa* (minniebush), *Ribes rotundifolia* (Appalachian gooseberry), *Sambucus racemosa* var. *pubens* (red elderberry), *Tilia americana* var. *americana* (American basswood), *Acer pensylvanicum* (striped maple), *Prunus virginiana* (choke cherry), *Rubus alleghaniensis* (Alleghany blackberry), and *Parthenocissus quinquefolia* (Virginia creeper). Scattered colonies and individuals of *Polypodium appalachianum* (Appalachian rock polypody), *Hylotelephium telephioides* (Allegheny stonecrop), *Polygonatum pubescens* (downy Solomon's-seal), *Heuchera pubescens* (marbled alumroot), *Impatiens pallida* (pale jewelweed), *Carex aestivalis* (summer sedge), and *Carex appalachica* (Appalachian sedge) are present, but herbaceous plants are generally very sparse. Much of this occurrence has been severely impacted by wind, ice, and other disturbances, and is extremely scrubby and dense. Quantitative plot data were collected from this occurrence in 1999 (SHNP048).

Prominent lichens of the fully exposed boulderfields and crumbling outcrops include *Stereocaulon glaucescens* (abundant), *Lasallia papulosa*, *Lasallia pensylvanica*, *Umbilicaria muehlenbergii*, *Umbilicaria caroliniana* (one location), *Rhizoplaca subdiscrepens*, *Xanthoparmelia conspersa*, *Aspicilia cinerea*, *Fuscidea recensa*, *Acaraspora fuscata*, *Porpidia* sp., *Cladonia rangiferina*, *Chrysothrix chlorina* (sheltered faces and crevices), *Melanelia stygia*, *Rhizocarpon geographicum*, and numerous other crustose species.

The small High-Elevation Greenstone Barren at this site has been heavily disturbed by hikers and rock climbers but is compositionally representative of the type. Scrubby *Betula alleghaniensis* and *Quercus rubra* (northern red oak) are present, along with scattered specimens of *Diervilla lonicera* (northern bush-honeysuckle), *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Sorbus americana*, *Gaylussacia baccata* (black huckleberry), *Smilax tamnoides* (bristly greenbrier), and *Vaccinium pallidum* (early lowbush blueberry). Herbaceous patches are dominated by *Solidago randii* (Rand's goldenrod) and *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass). *Hylotelephium telephioides* (Allegheny stonecrop), *Dennstaedtia punctilobula* (hay-scented fern), *Carex pensylvanica* (Pennsylvania sedge), and *Lysimachia quadrifolia* (whorled loosestrife) were also noted. Plot data were not collected from this occurrence.

RARE PLANTS: Prior to 2005 two rare plant species were known for the North Marshall Summit area, *Huperzia appalachiana* (Appalachian fir-clubmoss) and *Solidago randii*. The small population of *Huperzia appalachiana* was relocated in 2005 on a cliff top north of the Appalachian Trail. Six mature and 37 juvenile clumps were counted in a 1 x 2 m (3 x 7 ft) area of shaded, mossy upper cliff top and

adjacent crevices. Most mature clumps were present on the cliff top whereas most of the juveniles were found in two vertical rock crevices immediately below. Sporangia and gemmae were present on the mature clumps.

A total of 108 clumps of *Solidago randii* was found in four cliff-top areas on the lower level of cliffs south of the Appalachian Trail. From north to south, the four areas had 6, 30, 36, and 36, clumps, respectively. Plants were mostly healthy, although a few were chlorotic and wilted from heat/drought-stress, and flowering frequency was high. More clumps were found in 2005 than the 30 seen in 1990, but it is not clear if this is a real increase in population or the result of different levels of survey effort or slightly different areas being searched.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2005.

Two male specimens of the watchlist *Scudderia septentrionalis* (northern bush katydid) were collected with a sweepnet along the west facing cliffs of North Marshall Summit. Three watchlist moths were captured in a UV-trap set along the west facing cliffs. These species are: *Apamea lignicolora* (wood colored dagger moth, n = 2), *Cucullia florae* (a noctuid moth, n = 1), and *Itame subcessaria* (a Geometrid moth, n = 1).

Plate 35. Jagged metabasalt cliffs at the west end of the North Marshall summit.

THREATS: The small High-Elevation Greenstone Barren at the southwest end of the site has been severely damaged by park visitors, with large areas now devoid of all vegetation and organic mats. The cliff tops supporting this community are popular viewpoint destinations for hikers and the cliff faces are used by rock climbers. Numerous social trails lead from the Appalachian Trail to the tops of these cliffs and at least one very steep trail leads to the cliff base. During the visit of June 28, 2006, remains of a campfire ring were found on the top of one cliff, and cut saplings, cut shrubs, and climbing gear were found at the base of the other. Trampling of *Solidago randii* on these cliffs was noted by Fleming in 1990, and this threat has worsened considerably over the years. The plants are now relegated to crevices, lower ledges, and back sections of outcrops -- areas inaccessible to trampling by hikers or where less time would be spent standing or walking. Exotic species are sparse here, and mostly confined to trail edges.

MANAGEMENT RECOMMENDATIONS: The North Marshall Summit is a very significant site that harbors three globally rare natural communities, two of them with extremely narrow distributions. The High-Elevation Greenstone Barren is confined to less than 30 discrete outcrops covering less than 4 ha (10 ac), all of it in four high-elevation areas of the park. The Central Appalachian Mafic Boulderfield is confined to less than 20 discrete talus fields covering less than 1.5 ha (4 ac), and is also endemic to the park. As a result, even the smallest occurrences of these types become priorities for conservation and protection.

Prohibit rock climbing and camping at this site. Work with the climbing community to ensure understanding of and cooperation with this closure.

Close social trails to outcrops at south end of site. If necessary, use barriers to deter visitors.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the rare plants and the health of the significant natural communities. Conduct annual surveys to assess effectiveness of management actions, rare plant populations and the health of natural community types. At the same time, conduct a survey and assessment of invasive plants.

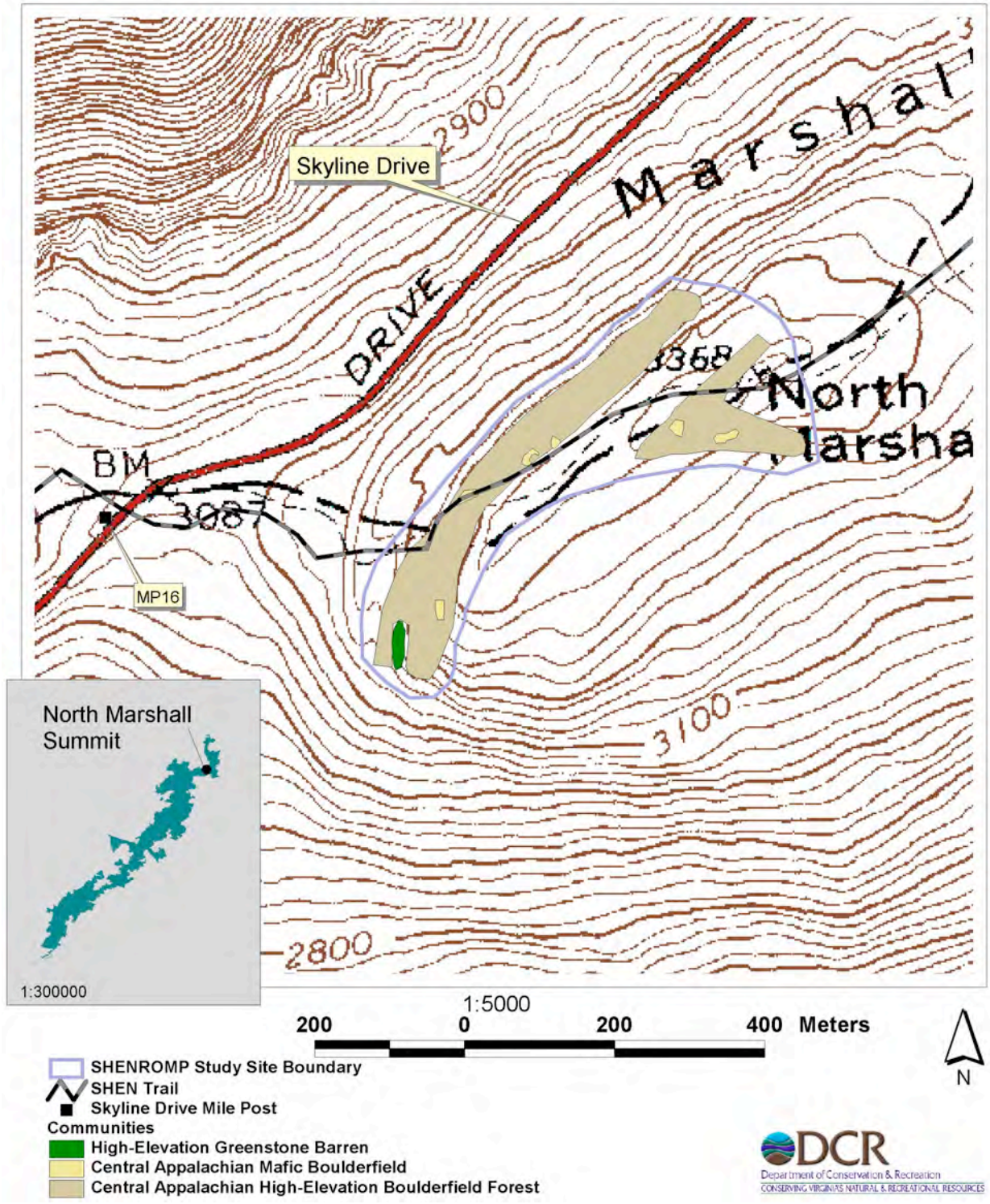


Fig. 19. Location of significant natural communities at North Marshall Summit.

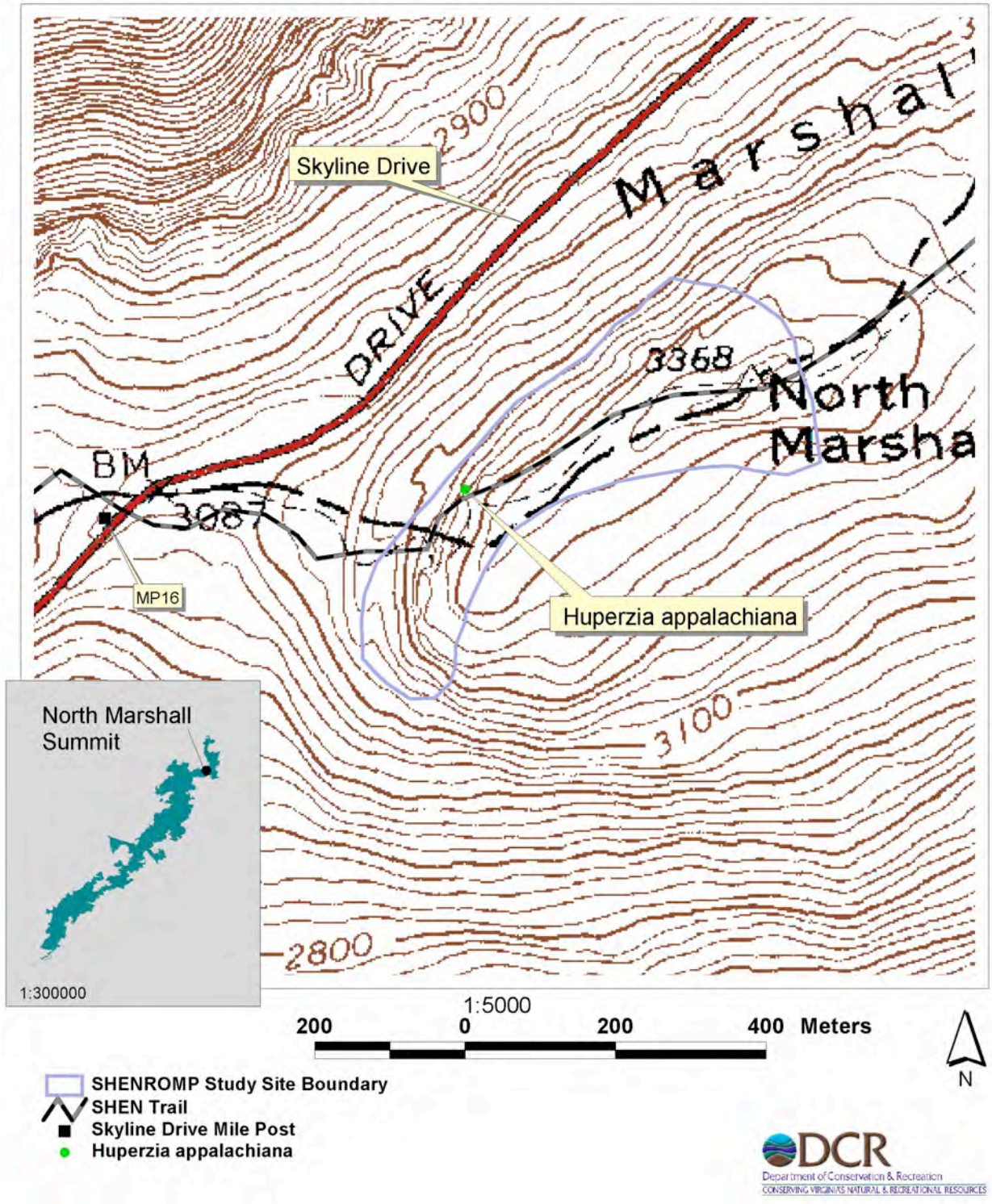


Fig. 20. Location of *Huperzia appalachiana* at North Marshall Summit.

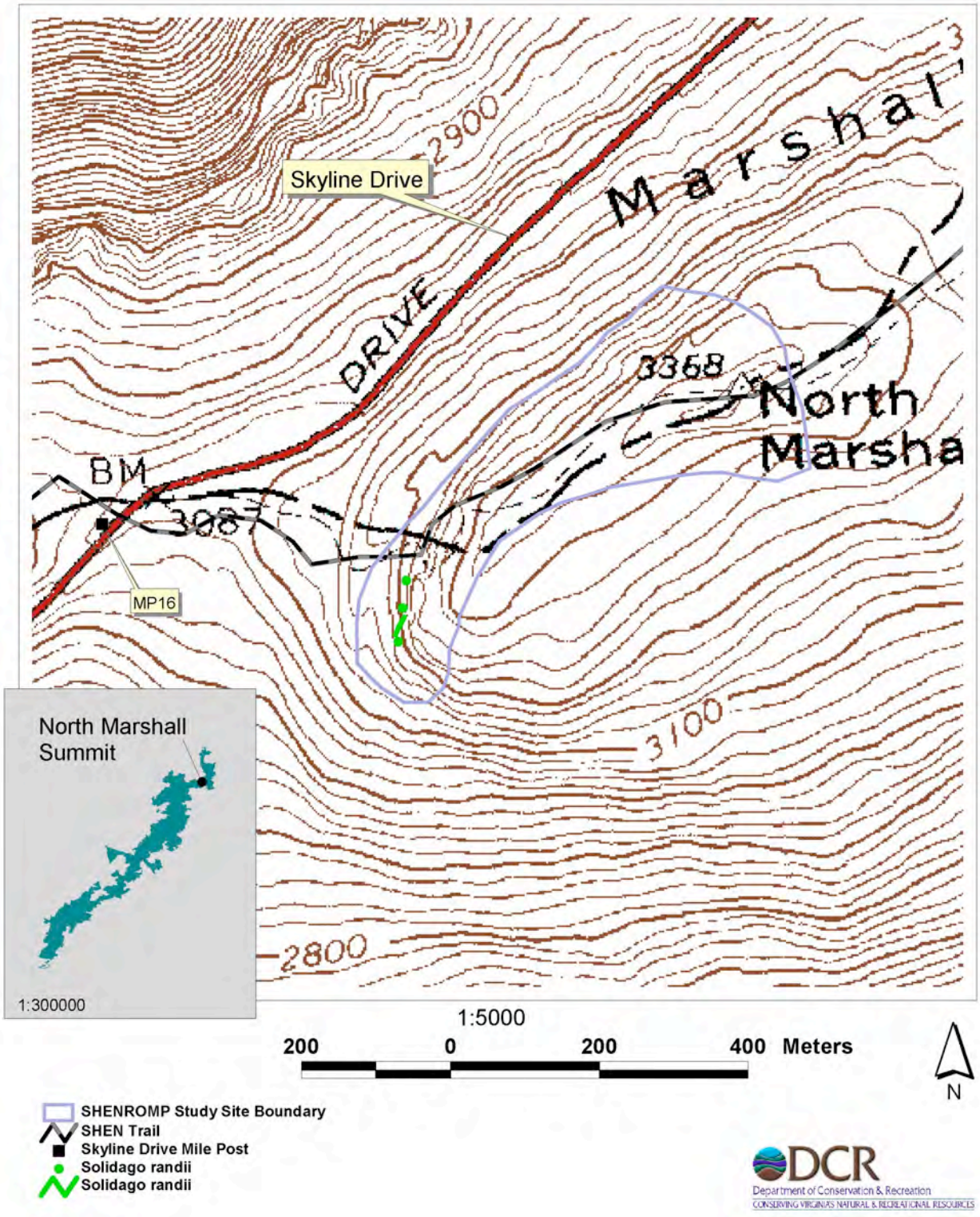


Fig. 21. Location of *Solidago randii* at North Marshall Summit.

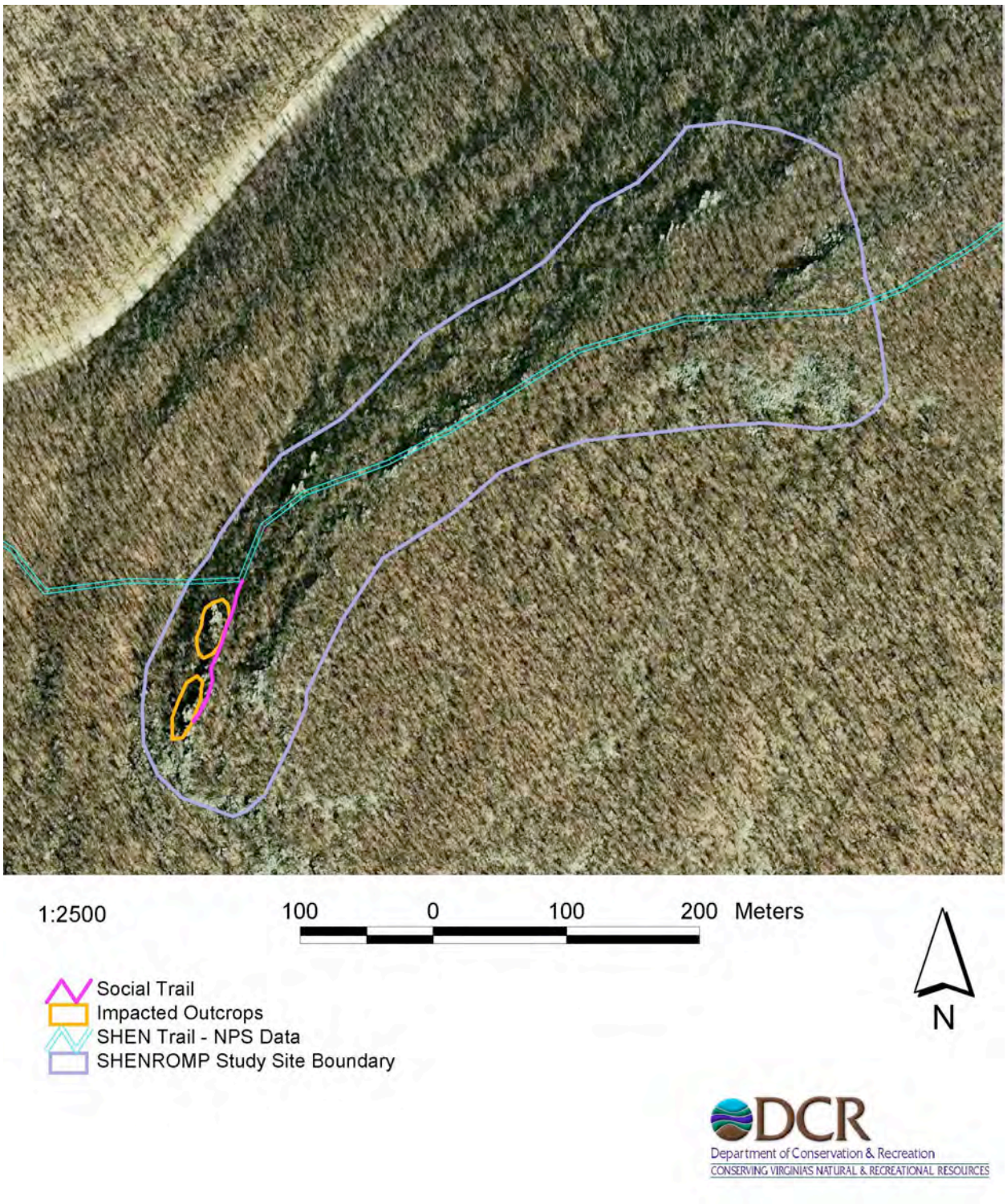


Fig. 22. Site details for North Marshall Summit, including social trails recommended for closure.

SOUTH MARSHALL CLIFF (C46)

CONSERVATION SITE: Mount Marshall (B2) **THREAT RANK: 3**

LOCALITY: Warren County **QUADRANGLE(S):** Chester Gap

LOCATION: This North District site is located west of Skyline Drive. It extends from 0.55 km (0.34 mi) north to 1.02 km (0.63 mi) north northeast of Range View Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula alleghaniensis / *Sorbus americana* - *Acer spicatum* / *Polypodium appalachianum* Forest	Central Appalachian High-Elevation Boulderfield Forest	G2	S2	None	None	A
Photinia melanocarpa - *Gaylussacia baccata* / *Carex pensylvanica* Shrubland	High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type	G1	S1	None	None	B
Plants:						
Solidago randii	Rand's goldenrod	G5T4	S2S3	None	None	C
Animals:						
Itame ribearia	Currant spanworm moth	G4	S1S3	None	None	E

SITE DESCRIPTION: This site contains a series of north-northwest to west-northwest facing cliffs, outcrops, and talus slopes situated to the west and southwest of the South Marshall summit. Rock exposures at this site occur in two levels, representing two separate flows of Catoctin Formation metabasalt. The upper level is located at elevations between about 920 m (3,020 ft) and 951 m (3,120 ft) in the northern portion of the site. This intermittent line of ledgy cliffs peters out to the south. Considerable areas of vegetated talus are found here, extending far outside the site boundary to the north.

The lower level of exposures is found at elevations between about 884 m (2,900 ft) and 927 m (3,040). The site's single most impressive feature is found at this level – a large cliff about 30 m (98 ft) high with an open top of about 25 m (82 ft). This outcrop is located in the center of the site, and smaller outcrops are found at this level to the northeast and southwest. Outcrops here are surrounded by extensive areas of talus.

This site is readily accessed by the Appalachian Trail, which crosses the eastern edge of the site upslope from most of the outcrops. Informal trails lead to the tops of the large cliff in the center of the site, one of the upper level cliffs, and the site's northern end.

NATURAL COMMUNITIES: The gentler upper slopes of this site are covered with Northern Red Oak forest (Pennsylvania Sedge – Wavy Hair Grass Type). Some of this forest is quite open, but portions immediately upslope from rock outcrops represent a variant with a dense understory of *Kalmia latifolia*

(mountain-laurel). The forested slopes below the upper line of exposed rocks were not examined in the field, but represent one of the typical oak-dominated communities of the park.

Three patches of the globally rare High-Elevation Outcrop Barren (Chokeberry Metamorphic / Igneous Type) covering about 0.1 ha (0.25 ac) in aggregate were located on open outcrops, two on the upper line of exposures and one on the large cliff on the lower line. These patches are co-dominated by the shrubs *Photinia melanocarpa* (black chokeberry) and *Gaylussacia baccata* (black huckleberry), with less abundant associates of *Hamamelis virginiana* (witch-hazel), *Sorbus americana* (American mountain-ash), *Kalmia latifolia*, *Vaccinium palldium* (early lowbush blueberry), *Menziesia pilosa* (minniebush), and *Spiraea betulifolia* var. *corymbosa* (dwarf spiraea). Scrubby saplings of *Betula alleghaniensis* (yellow birch) and *Betula lenta* (sweet birch), and scrambling vines of *Smilax tamnoides* (bristly greenbrier), are also present. Crevices and thin organic mats on ledges support *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Polypodium appalachianum* (Appalachian rock polypody), *Hylotelephium telephioides* (Allegheny stonecrop), and a few other herbaceous species. In thicker, more protected organic accumulations under the shrubs, *Maianthemum canadense* (Canada mayflower) and *Carex aestivalis* (summer sedge) may be locally numerous. Quantitative plot data were collected from this occurrence in 2003 (plot SHNP662) and again during the ROMP project (plot SHNP140).

Characteristic lichens on untrampled and protected areas of the outcrops here include *Lasallia papulosa*, *Lasallia pensylvanica*, *Rhizoplaca subdiscrepens*, *Porpidia* spp., *Rhizocarpon cf. reductum*, *Stereocaulon glaucescens*, and *Xanthoparmelia conspersa*.

At the base of the lower cliffs is 0.25 ha (0.6 ac) area of metabasalt talus that supports an open, scrubby occurrence of the Central Appalachian High-Elevation Boulderfield Forest. Several patches of open talus also occur in this area and may deserve separate recognition, but are currently included in the boulderfield forest. This vegetation was not examined closely but appears to be dominated by *Betula alleghaniensis*, *Betula lenta*, *Quercus rubra* (northern red oak), *Sorbus americana*, *Acer spicatum* (mountain maple), and *Kalmia latifolia*. Its composition is somewhat unusual, perhaps because the stand is located at or close to the lower-elevation limit for the community type.

RARE PLANTS: A previously known population of *Solidago randii* (Rand's goldenrod) was found at this site. A total of about 70 clumps were found in three population areas. An outcrop within the upper level of cliffs at the northern end of the site supports 29 clumps in a 4 m^2 (43 ft^2) area. A single additional clump was found on a ledge to the northeast of this area. The large cliff in the center of the site supports 40 clumps within a 4 x 25 m (13 x 82 ft) area. Most plants are found in woodland areas behind (east of) the cliff tops or on cliff-face ledges.

A small colony of the watchlist plant, *Crataegus pruinosa* (a hawthorn), was found in a thicket behind one of the outcrops where *Solidago randii* occurs.

RARE ANIMALS: One specimen of *Itame ribearaia* (currant spanworm moth) was collected in a UV-trap set along the line of cliffs at this site. It is difficult to determine population status for this species based on a single sighting.

In addition, one specimen of the watchlist invertebrate, *Rheumptera hastata* (spear-marked black moth), was captured in the UV-trap.

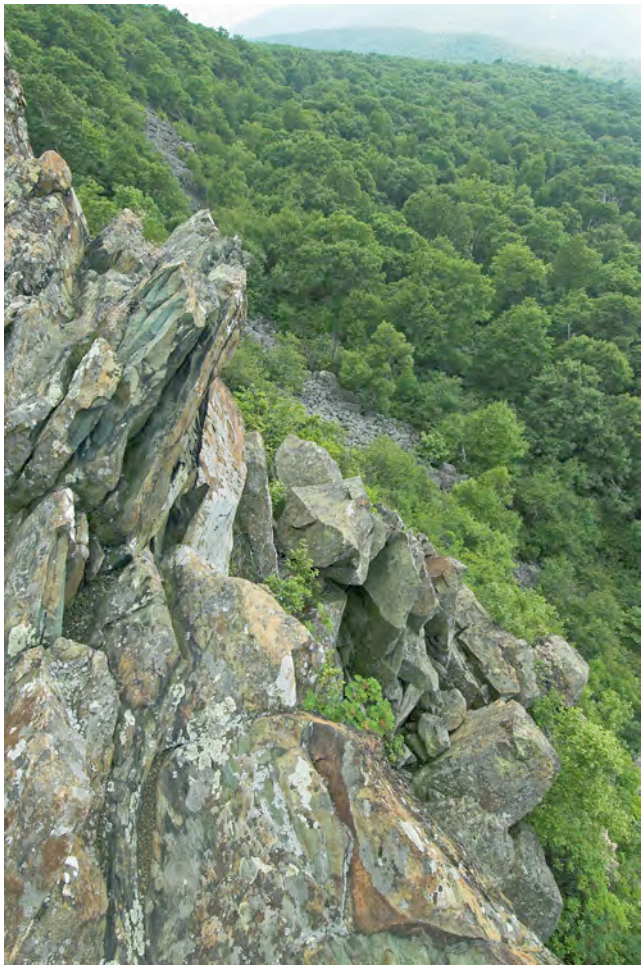


Plate 36. View southwest from the top of the largest open cliff on South Marshall.

THREATS: Trampling is a serious problem at this site. Social trails lead onto several of the outcrops and soil compaction was observed at the back of one outcrop. The patches of High-Elevation Outcrop Barren on the upper line of outcrops are off the beaten track and in pristine condition. However, the patch on the lower cliff has been partly degraded. The fact that *Solidago randi* is found mostly on the back edge of this cliff or on lower ledges indicates trampling has eliminated it from the bulk of the cliff-top habitat and continues to impede its reestablishment more widely over the outcrops.

The exotic *Poa compressa* (flat-stemmed bluegrass) is present in some crevices, and may be a direct competitor for the crevice habitat occupied by *Solidago randii*. This tough-rooted perennial grass often exhibits increases in abundance following trampling disturbances, but may also be present at remote, rarely visited outcrops. Currently it would have to be considered a direct threat to the rehabilitation of cliff-top areas at this site.

There are potential adverse affects to moth populations from certain types of gypsy moth suppression measures.

MANAGEMENT RECOMMENDATIONS: This is one of only 11 known sites in the world for the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community. As such, it

merits strong protection and remedial action to reduce and contain the ongoing destructive impacts by hikers.

Re-route the Appalachian Trail away from the cliff and outcrops. Close the social trails to the outcrops. If necessary, use barriers to deter visitation.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the rare plant and the health of the significant natural communities. Conduct annual surveys to assess the effectiveness of management actions and the health of the *Solidago randii* population and significant natural communities. At the same time, conduct a survey and assessment of invasive plants.

No specific management recommendations for *Itame ribearia*. Little is known about the life history of *Itame ribearia*, making management recommendations difficult. Covell (2005) reports that this species feeds on species of *Ribes* (currants). It is unlikely to be impacted by management decisions specifically targeting cliffs and rock outcrops; however, caution should be used if gypsy moth or other insect suppression is contemplated in the area, as certain pesticides have broad effects on non-targeted invertebrate species.

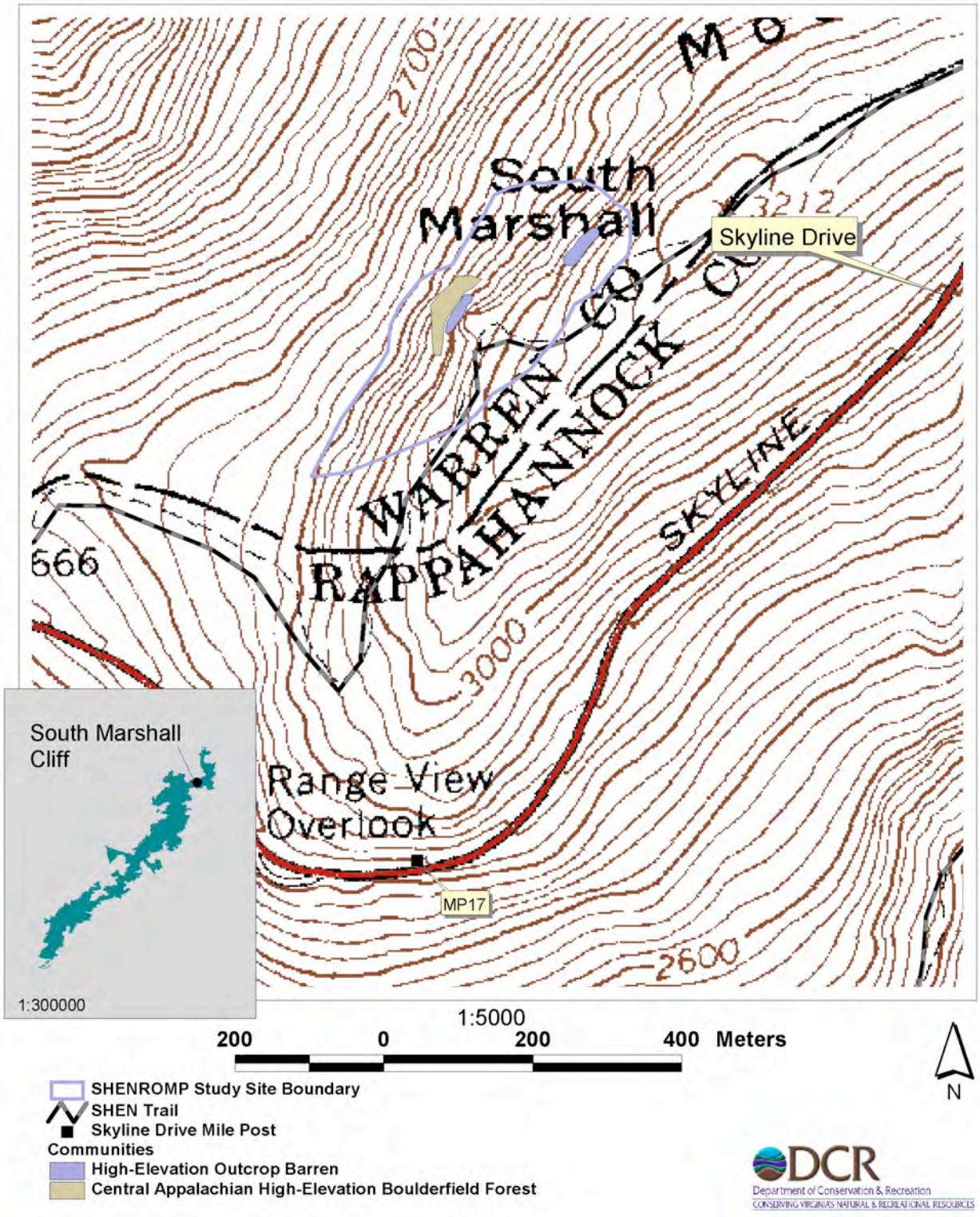


Fig 23. Location of significant natural communities at South Marshall Cliff.

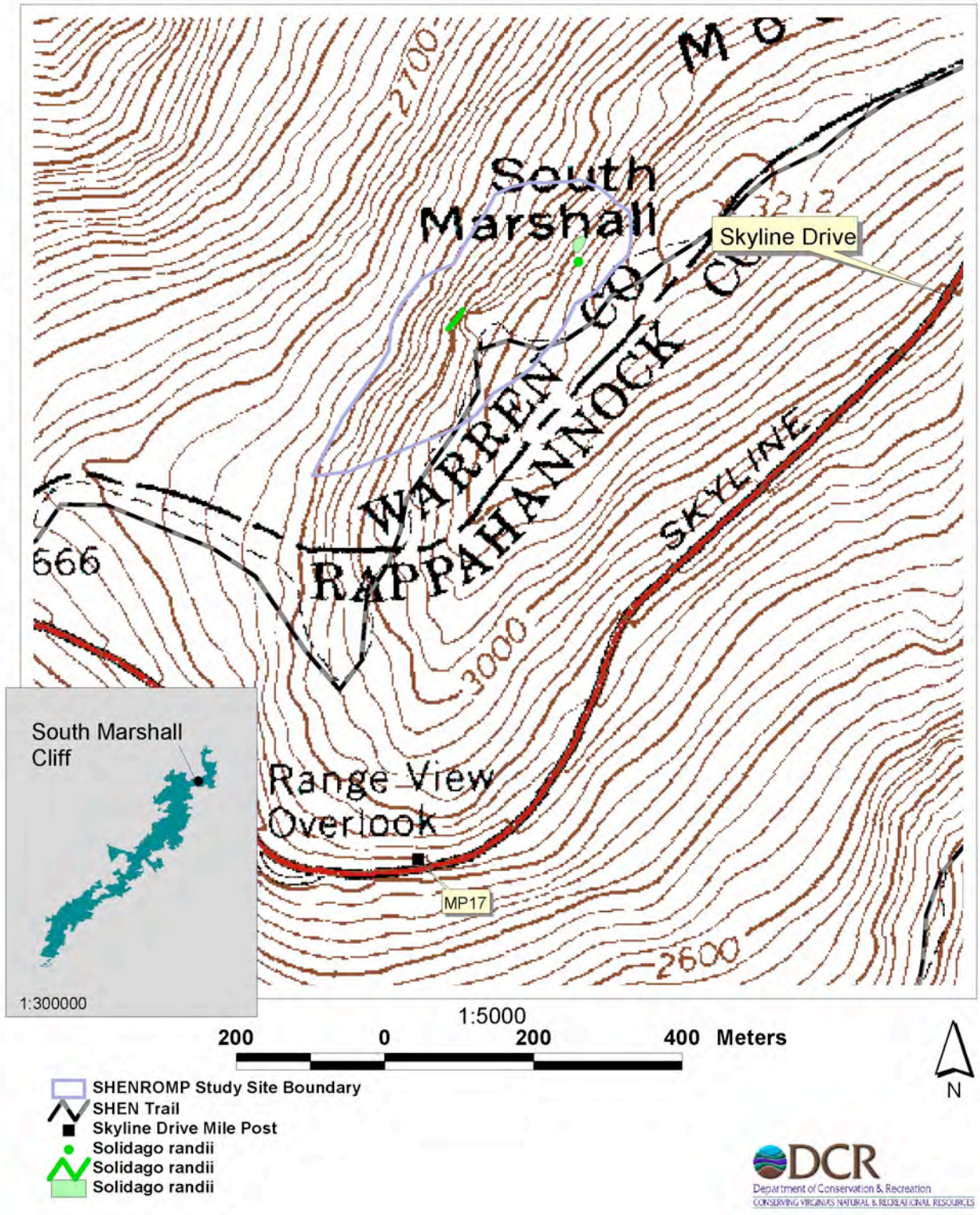


Fig. 24. Location of *Solidago randii* at South Marshall Cliff.

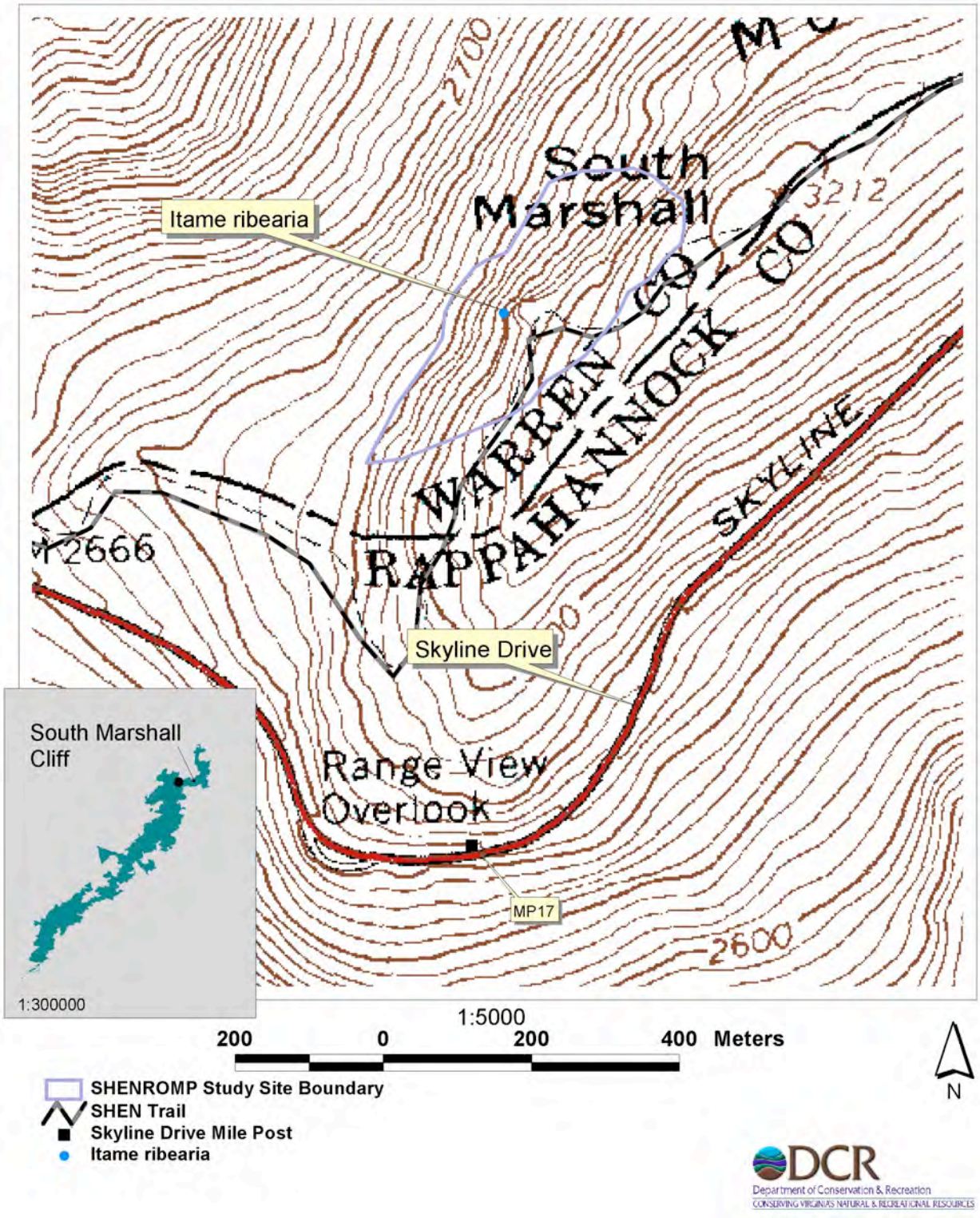


Fig. 25. Location of *Itame riberia* at South Marshall Cliff.

BIG DEVILS STAIRS (C03)

CONSERVATION SITE: Mount Marshall (B2) **THREAT RANK: 3**

LOCALITY: Rappahannock County **QUADRANGLE(S):** Chester Gap

LOCATION: Situated east of Skyline Drive, this North District site extends from 1.18 km (0.74 mi) east southeast to 1.74 km (1.09 mi) southeast of Range View Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana - Carya glabra* / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	A
Plants: None						
Animals: None						

SITE DESCRIPTION: This site encompasses the eastern side of a steep, south-trending slot canyon formed by a headwater tributary of the Rush River. The principal feature here is a line of high, mostly west-facing metabasalt cliffs at elevations between 488-597 m (1,600-1,960 ft). These cliffs rise above the stream along the western edge of the site and are nearly continuous. The cliff tops are open to partially shaded, and a few ledges are present below the tops. The faces are mostly quite sheer, however, and could be safely explored only with binoculars.

Above these cliffs lies a line of lower, more intermittent exposures, but these are mostly well shaded. At the southern end of the site, the principal line of cliffs follows the contour of the slope to face southwest and gradually peters out. Scattered cliffs and ledges are found below, interspersed with areas of sufficient soil development to support woodland vegetation. The slope here is not as steep and could be safely explored.

The Big Devils Stairs Trail traverses this site from north to south and runs along the open top of the cliff for a short distance near the cliff's northern end. At one time, this trail was open to hikers across private lands to the south of the SHEN boundary. The trail is now closed at the SHEN boundary, a short distance to the south of the site. As hikers can no longer use this trail to make a circuit hike, it currently receives only moderate use.

NATURAL COMMUNITIES: The forest cover in the northern and eastern portions of this site is a mosaic of Central Appalachian Basic Oak-Hickory Forest (Submontane / Foothills Type) and Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. The relative distributions of these types probably reflect within-site differences in soil depth, chemistry, and degree of nutrient leaching on different topographic positions. On the very steep eastern face of the canyon, a 4 ha (10 ac) stand of Central Appalachian Basic Woodland dominates the vegetation cover on and between massive metabasalt outcrops. Soil samples collected from this woodland indicate moderate to high levels of calcium and magnesium; however, high iron and aluminum lower pH to the extremely acidic class (mean ~ 4.5). At

the very bottom of the gorge is a narrow stand of rich Southern Appalachian Cove Forest (Typic Montane Type) that has been extensively damaged by repeated flash floods.

The occurrence of Central Appalachian Basic Woodland at this site extends beyond the ROMP site boundary to the opposite side of the gorge. It is a very large (ca. 8 ha [20 ac]), high-quality occurrence that is only somewhat degraded by the local abundance of invasive weeds. Within the ROMP site, this woodland is quite variable depending on soil depth, degree of rock cover, and exposure. *Fraxinus americana* (white ash) is generally the most abundant tree, but *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), *Quercus prinus* (chestnut oak), and *Pinus virginiana* (Virginia pine; mostly on outcrops) are also important. Characteristic small trees and shrubs include *Cercis canadensis* var. *canadensis* (eastern redbud), *Ostrya virginiana* (eastern hop-hornbeam), *Ulmus rubra* (slippery elm), *Rhus aromatica* var. *aromatica* (fragrant sumac), *Rosa carolina* var. *carolina* (pasture rose), *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Rhus typhina* (staghorn sumac), *Chionanthus virginicus* (fringetree), and *Viburnum rafinesquianum* (downy arrow-wood). The herb layer is generally patchy but species-rich, featuring *Symphyotrichum oblongifolium* (= *Aster oblongifolius*, aromatic aster), *Allium cernuum* (nodding onion), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oat-grass), *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Helianthus divaricatus* (woodland sunflower), *Lespedeza intermedia* (wand bushclover), *Muhlenbergia sobolifera* (cliff muhly), *Phacelia dubia* var. *dubia* (Appalachian phacelia), *Sedum glaucophyllum* (cliff stonecrop; on outcrops), *Solidago arguta* (cut-leaved goldenrod), *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod), *Solidago bicolor* (white goldenrod), *Liatris scariosa* (large blazing-star), *Triosteum perfoliatum* (perfoliate tinker's-weed) and many other species. Quantitative plot data were collected from this occurrence in 1999 (plots SHNP073 and SHNP074).

RARE PLANTS: The watchlist herb *Taenidia montana* (mountain pimpernel) was found here.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2005.

Plate 37. West-facing metabasalt ledges and Central Appalachian Basic Woodland on the east flank of Big Devils Stairs.

THREATS: At least in the past, this site was extremely popular with hikers. This site was formerly accessible from the bottom, via a trail through private property. The main trail originally went up the steep bottom of the canyon but had to be re-routed to the top of the cliffs in the 1980's because of repeated damage and downfalls from flash flooding. Access from outside the Park was closed approximately ten years ago, and the site is now less easily reached. During the 1980's and 1990's, very heavy visitation resulted in the development of numerous social trails leading from the main trail to some of the outcrops. Although the damage from these trails persists today, most of the significant woodland community is unaffected. Invasive species, such as *Ailanthus altissima* (tree of heaven) and *Commelina communis* (Asiatic dayflower) are also locally common, even in remote parts of the site, and appear to represent an increasing threat to this vegetation.

MANAGEMENT RECOMMENDATIONS:

Manage invasive plants *Ailanthus altissima* and *Commelina communis*. The use of herbicide is recommended for controlling these species. Hand-pulling *Commelina* will create more soil disturbance and is labor-intensive. Sponge or glove herbicide application methods are recommended to minimize non-target impacts that may accompany spray application. *Ailanthus* is best treated using the hack and squirt method.

Monitor the health of the rare natural community. Following treatment of invasive plants, conduct monitoring to determine the success of the treatments or any need for further action.

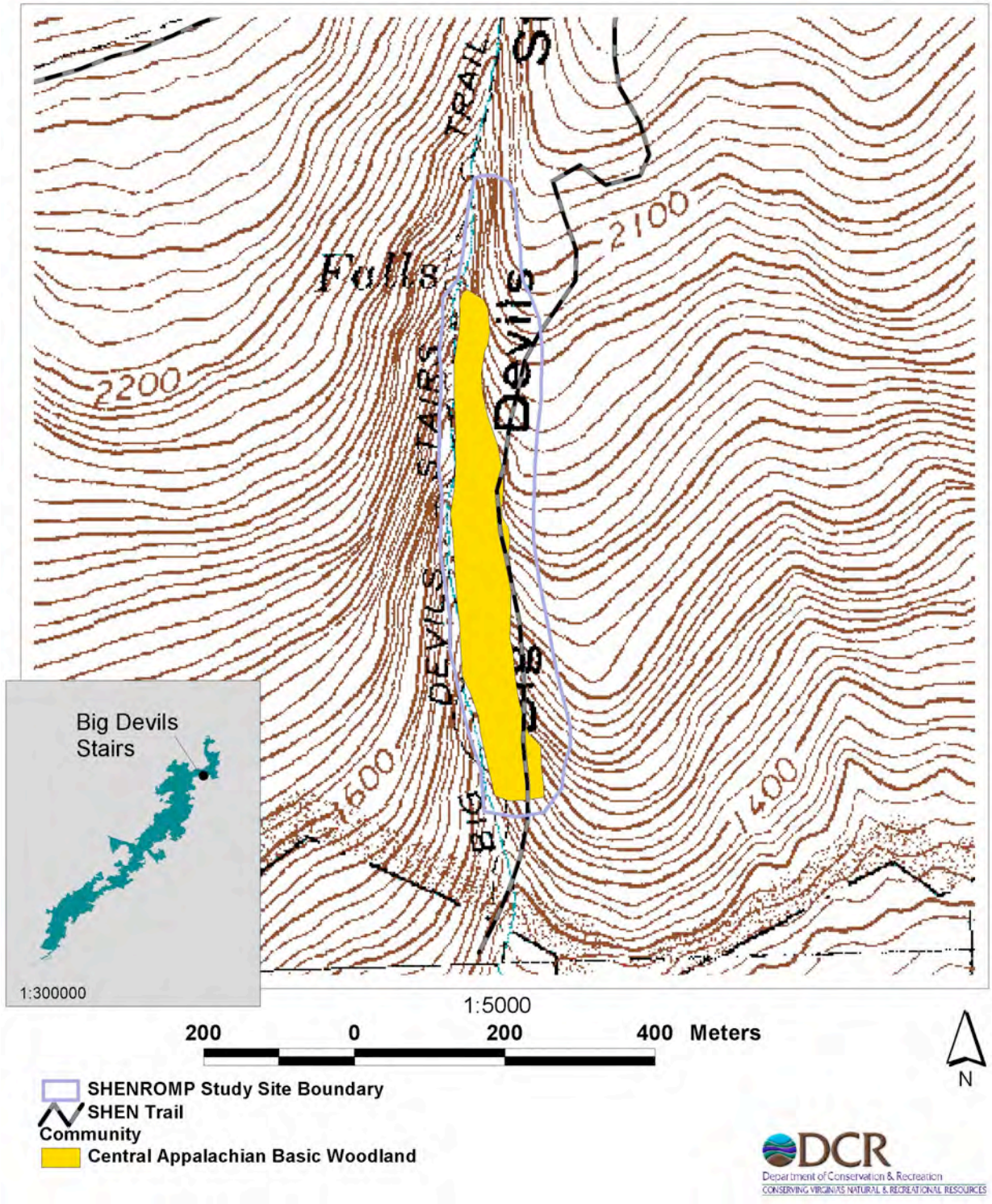


Fig. 26. Location of significant natural community at Big Devils Stairs.

LITTLE DEVILS STAIRS (C27)

CONSERVATION SITE: Hogback Mountain-Little Devils Stairs (B2) **THREAT RANK: 0**

LOCALITY: Rappahanock County **QUADRANGLE(S):** Bentonville
Thornton Gap

LOCATION: This North District site lies on the east side of Skyline Drive. It is situated from 0.92-1.57 km (0.56-0.98 mi) south of Little Hogback Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Fraxinus americana - Carya glabra / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	A
Fraxinus americana / *Physocarpus opulifolius* / *Carex pensylvanica - Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2	S2	None	None	A
Lasallia papulosa - Stereocaulon glaucescens – Chrysothryxchlorina Nonvascular Vegetation	Central Appalachian Mafic Boulderfield	G2?	S2?	None	None	A
Plants:						
Cornus rugosa	Roundleaf dogwood	G5	S1	None	None	D
Cuscuta coryli[1]	Hazel dodder	G5	S2?	None	None	AB
Muhlenbergia glomerata	Marsh muhly	G5	S2	None	None	B
Animals: None						

[1]This element occurrence (eo) was sought but not relocated for this project. The eo was last seen by DNH in 1991.

SITE DESCRIPTION: This site encompasses a complex series of metabasalt cliffs, outcrops, ledges, and boulderfields. These exposures frame the east side of a south-trending canyon formed by Keyser Run, and are located at elevations of 512-792 m (1,680-2,600 ft).

High, west-facing cliffs front Keyser run along much of the western edge of this site, and the slopes above these cliffs are often very steep. These areas could not be safely explored. Higher on the slope, a broad band of exposures faces west at the northern end of the site, but, mostly following the contour of the slope, wraps around to face southwest at the site's southern end. Several cliffs are found in this area capped by open ledges. Near the center, a steep slope with many small outcrops and ledges interfingered

with pockets of thin soil supports an impressive mafic barren community. Several sizable boulderfields are also found at this level. An open metabasalt face is located above all of this near the top of the slope.

The Little Devils Stairs trail follows Keyser Run along the western edge of this site. However, entry into the interior of the site from this trail is difficult due to high cliffs that abut the stream in the area. The easiest access points are at the site's northern end by way of a steep, extensive boulderfied or at the southern end by way of a long, very steep slope. Consequently, this area has few visitors.

NATURAL COMMUNITIES: The Little Devils Stairs ROMP site contains a spectacular assemblage of vegetation associated with low-elevation basic outcrops. Approximately half of the site is occupied by outcrop communities targeted by this project. Forested areas in the northern, eastern, and southwestern portions of the site are represented by the Central Appalachian Boulderfield Forest (Montane Basswood – White Ash Type), Central Appalachian Dry-Mesic Chestnut Oak – Northern Red Oak Forest, and Basic Oak-Hickory Forest (Submontane / Foothills Type), respectively. At the western edge of the site, a narrow band of Central Appalachian Rich Cove Forest occupies the lowest slopes and bottom of the gorge.

The very steep slopes forming the southeast-facing flank of the Little Devils Stairs gorge containing numerous outcrops, including a number of cliffs that cannot be explored safely. Within the more accessible, middle-slope portion of the area, six open, steeply dipping outcrops support outstanding patches of the globally rare Central Appalachian Mafic Barren community type. With an aggregate size of at least 0.6 ha (1.5 ac), this occurrence is large for the type and is pristine except for the presence of a few scattered weeds. Its vegetation is largely herbaceous with stunted trees and shrubs scattered throughout. Characteristic woody species are *Fraxinus americana* (white ash), *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Chionanthus virginicus* (fringetree), *Rosa carolina* var. *carolina* (pasture rose), *Rhus typhina* (staghorn sumac), and *Viburnum rafinesquianum* (downy arrow-wood). The most characteristic herbs are *Schizachyrium scoparium* (little bluestem), *Carex pensylvanica* (Pennsylvania sedge), *Symphyotrichum oblongifolium* (= *Aster oblongifolius*, aromatic aster), *Solidago harrisii* (shale-barren goldenrod), *Symphyotrichum laeve* var. *concinnum* (= *Aster laevis* var. *concinnus*, smooth blue aster), *Danthonia spicata* (poverty oat-grass), *Allium cernuum* (nodding onion), and *Pycnanthemum incanum* (hoary mountain-mint). Other noteworthy herbs occurring here include *Taenidia montana* (mountain pimpernel), *Woodsia ilvensis* (rusty woodsia), *Phlox subulata* (moss phlox), *Thalictrum revolutum* (skunk meadowrue), *Polygonum tenue* (slender knotweed), *Muhlenbergia mexicana* (Mexican muhly), and *Muhlenbergia glomerata* (marsh muhly). Quantitative plot data were collected from this occurrence in 1990 (plot SHNP005) and again during the ROMP project (plot SHNP156).

The barrens occur within a matrix of Central Appalachian Basic Woodland covering approximately 5 ha (12 ac). This large and high-quality occurrence was explored only cursorily but consists of semi-closed to very open woodlands dominated by variable combinations of *Fraxinus americana*, *Carya* spp. (hickories), and *Quercus prinus* (chestnut oak). *Muhlenbergia sobolifera* (cliff muhly), *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod), *Helianthus divaricatus* (woodland sunflower), and numerous other xerophytic herbs are associated. This unit was mapped using aerial photo signatures and probably contains inclusions of other community types.

Several open, lichen-dominated boulderfields, representing the Central Appalachian Mafic Boulderfield community, cover approximately 0.2 ha (0.5 ac) and must be considered very significant resources given the relative rarity of non-forested metabasalt talus. Despite a relatively low elevation (~ 700 to 800 m [2200 to 2500 ft]), composition of these boulderfields appears to be similar to metabasalt boulderfields at much higher elevations on Hawksbill and Stony Man. Some of the most abundant or characteristic lichens of the Little Devils Stairs boulderfields are *Stereocaulon glaucescens*, *Lasallia papulosa*,

Xanthoparmelia conspersa, *Rhizoplaca subdiscrepens*, *Asplicilia cinerea*, and several other unidentified crusts.

RARE PLANTS: Populations of two rare plants were found at this site: *Cornus rugosa* (roundleaf dogwood) and *Muhlenbergia glomerata* (marsh muhly). In addition, a population of *Cuscuta coryli* (hazel dodder) was found at this site in 1991, but could not be relocated in 2006. This annual parasitic herb was found scattered over a 0.04 ha (0.1 ac) area along the top of an open metabasalt cliff on August 12, 1991. Plants were in late flower and early fruit on that date.

Three clumps of *Cornus rugosa* (roundleaf dogwood) were found at this site in two subpopulation areas. The northern station was first found in 1990, and consisted on a single clump with five stems in 2006. About 250 m (820 ft) to the south, two new clumps were found within a 4 x 6 m (13 x 20 ft) area. Each of these clumps has about 10 living and several dead stems. The remains of two inflorescences were observed on one of these two clumps, and one of these inflorescences had immature fruits. All of the plants were found on greenstone talus.

About 75 clumps of *Muhlenbergia glomerata* (marsh muhly) were located over a 0.06 ha (0.14 ac) area within the Central Appalachian Mafic Barren and adjacent Central Appalachian Basic Woodland communities. Most clumps had fertile culms on the September 6, 2006, survey date.

A few individuals of the watchlist tree *Juglans cinerea* (butternut) were found at this site. In addition, the watchlist herb *Taenidia montana* (mountain pimpernel) was found here.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

Plate 38. One of the many massive, west-facing metabasalt exposures on the east flank of Little Devils Stairs.

THREATS: Despite the presence of a popular trail along Keyser Run, there are few threats to this site because of its extremely rugged and remote nature. Although the presence of a fire ring was observed on the uppermost exposure at this site, this appears to be an isolated incidence. In addition, invasive weeds are scarce, and the barrens and boulderfields have not undergone any noticeable changes over a period of fifteen years.

Cornus rugosa is a species that may be in trouble in Virginia. The species is at the southern end of its range in the mountains of the northern part of the state. There are historical records from the 1960s and 1970s for this dogwood at three SHEN sites: Old Rag Summit East, Stony Man Summit, and Blackrock Central District. The plant has been searched for at these sites in recent years without success.

Holes were noted in the leaves of *Cornus rugosa* at this site. This appeared to be a fungal infection, but probably not *Discula destructiva* (dogwood anthracnose).

Several hundred clumps of *Muhlenbergia glomerata* were reported from a 0.10 ha (0.25 ac) area at this site in 1991. It is not known whether or not the much smaller population found here in 2006 represents a cyclical fluctuation in the population or a general decline.

Cuscuta coryli is an annual, and populations may appear only in years when conditions are optimal. Therefore, the absence of this species from a known site in any given year is not in itself cause for alarm.

MANAGEMENT RECOMMENDATIONS:

Monitor the rare plants and the health of the rare natural communities. Conduct surveys on a 5-10 year interval to assess the status of rare plant populations and natural community types at this site and include a survey for invasive plants.

Recommendations for *Cornus rugosa*. The apparent decline of *Cornus rugosa* in the park may be due to disease. It may be worthwhile to investigate the cause of the apparent fungal infection on *Cornus rugosa* plants at this site. Once a pathogen has been identified, control measures should be undertaken if necessary and feasible. More frequent monitoring of this species at the site may be warranted.

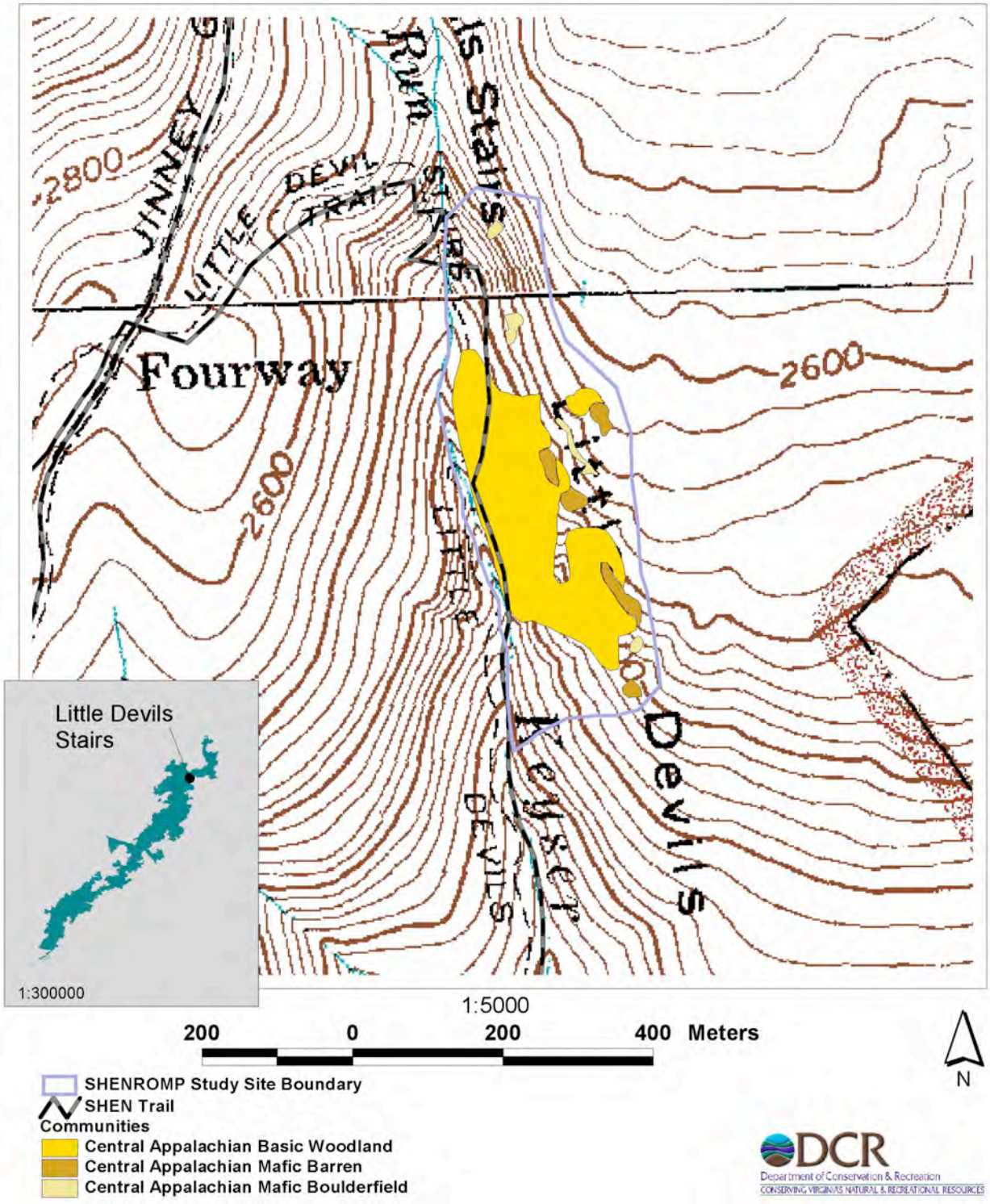


Fig. 27. Location of significant natural communities at Little Devils Stairs.

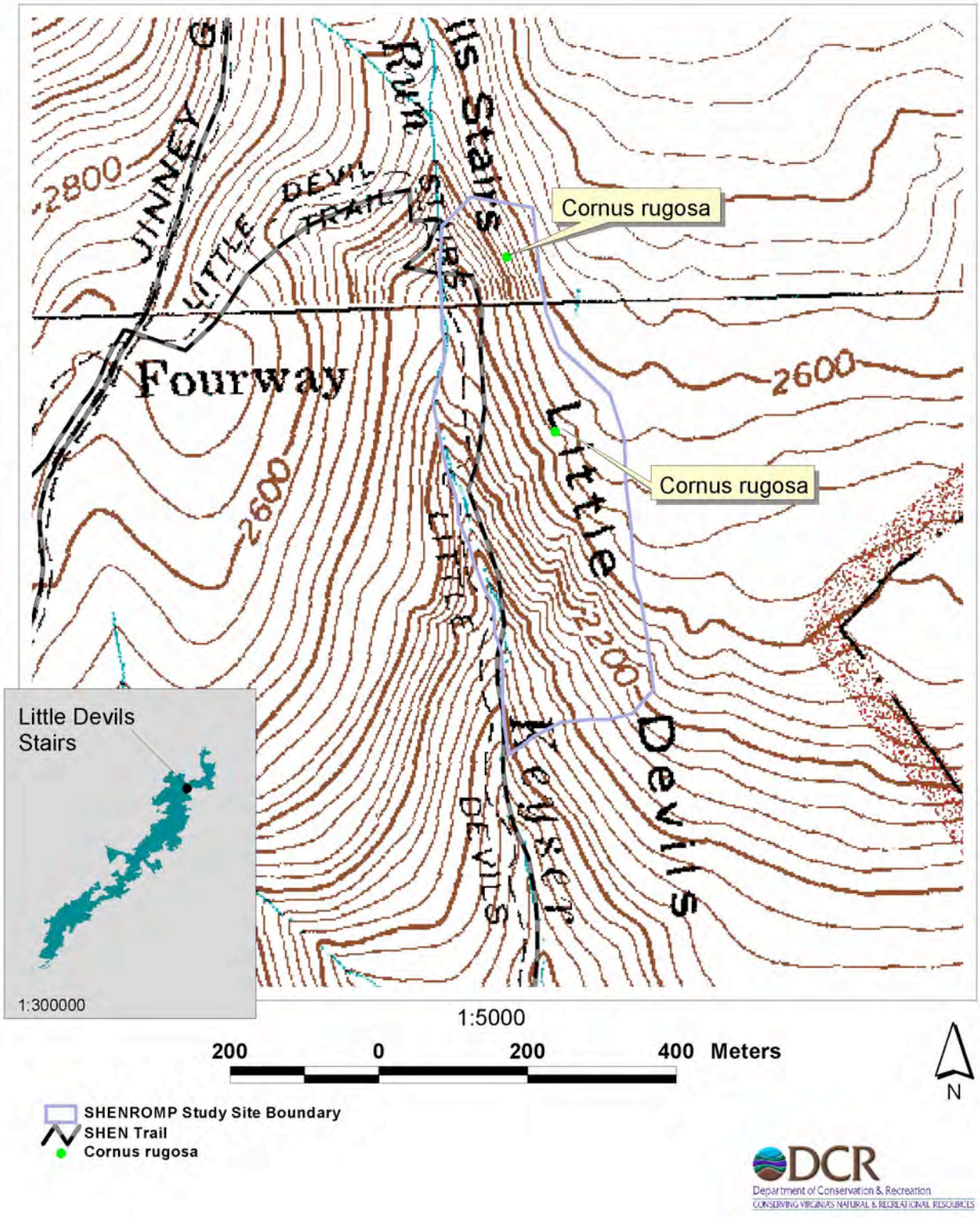


Fig 28. Location of *Cornus rugosa* at Little Devils Stairs.

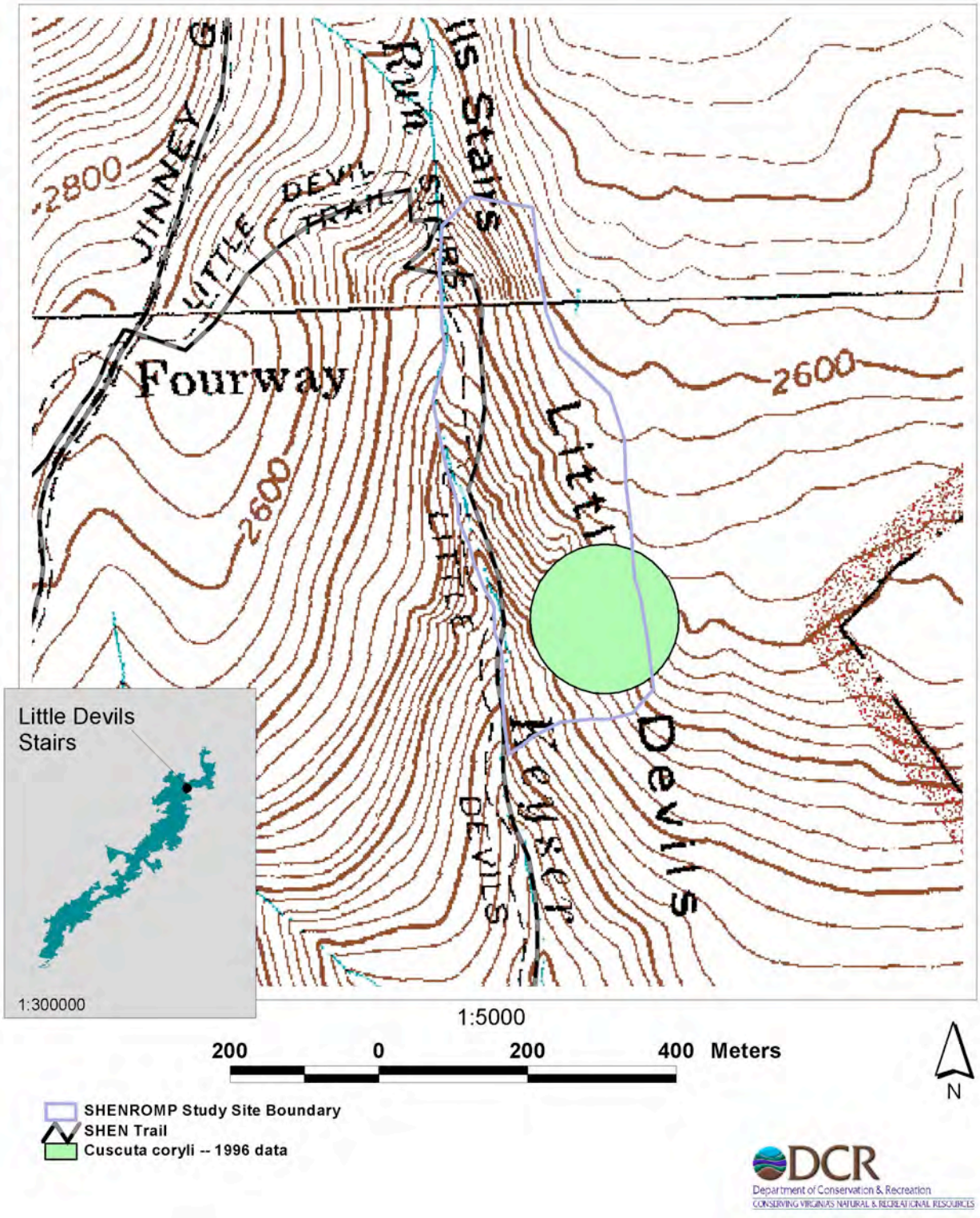


Fig. 29. Location of 1996 occurrence of *Cuscuta coryli* at Little Devils Stairs.

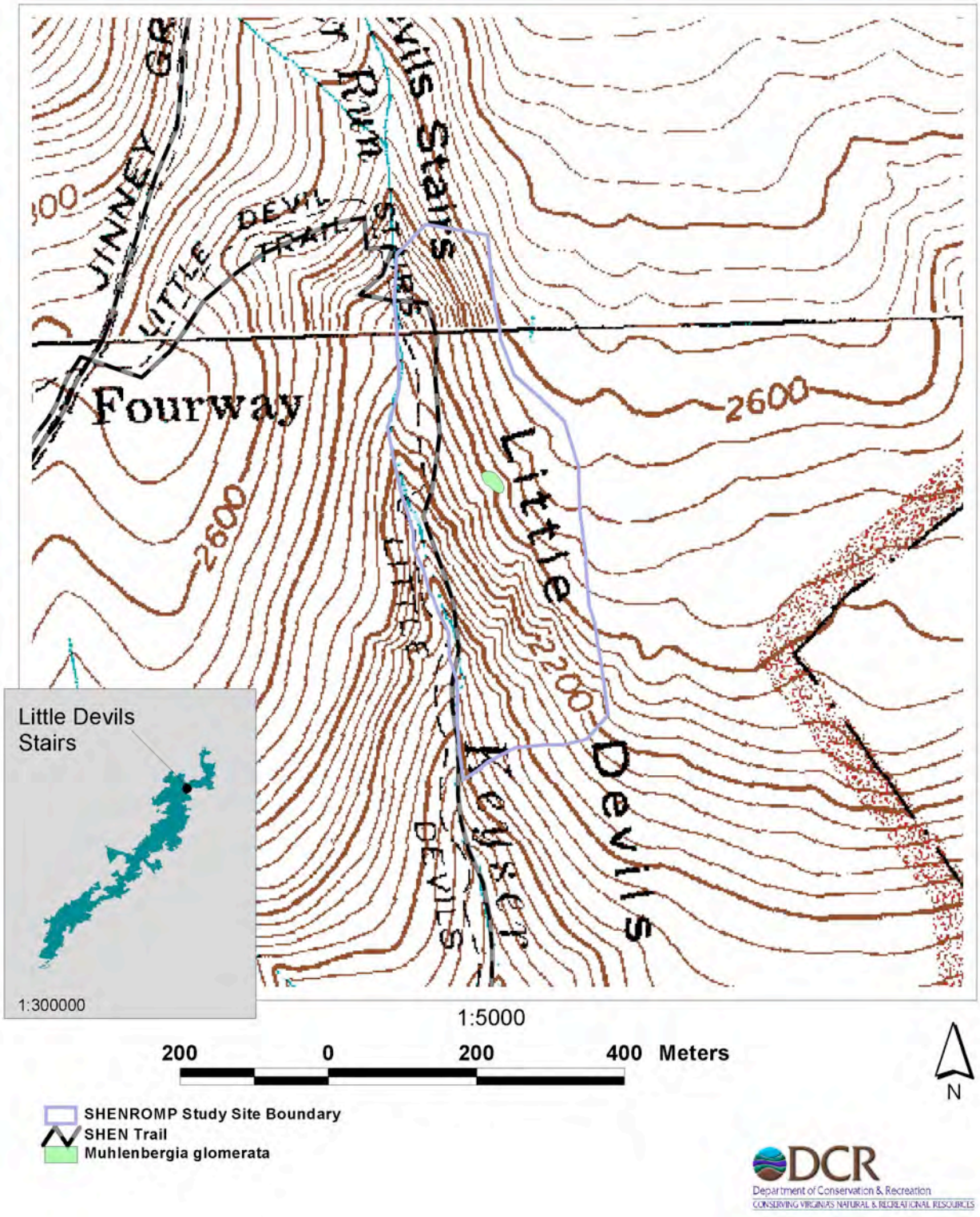


Fig. 30. Location of *Muhlenbergia glomerata* at Little Devils Stairs.

HOGBACK MOUNTAIN SPUR (C24)

CONSERVATION SITE: Hogback Mountain Spur (B2) **THREAT RANK: 0**

LOCALITY: Warren County **QUADRANGLE(S):** Bentonville

LOCATION: Located to the west of Skyline Drive, this North District site extends from 0.65-1.13 km (0.40-0.70 mi) northeast of Hogback Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Quercus prinus* - *Pinus virginiana* - (*Pinus pungens*) / *Schizachyrium scoparium* - *Dichanthelium depauperatum* Woodland	Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland	G2?	S2	None	None	A
Plants: None						
Animals: None						

SITE DESCRIPTION: This site encompasses the southern flank of a narrow north northeast-trending spur ridge located north of the summit of Hogback Mountain. Rock exposures here are highly variable granitic gneisses whose composition changes on a meter scale.

The major area of open rock exposures at this site is located on mostly southeast-facing slopes within the site's eastern half. These exposures are situated at elevations between 671-792 m (2,200-2,600 ft). Other exposures are scattered elsewhere on the flank. In addition, a series of outcrops and small talus deposits runs down the spine of the spur, but these are generally well-shaded.

The gneisses at this site are often heavily fractured into angular blocks. Where steep outcrops occur, some of these blocks have broken away, leaving smooth walls or, in some areas, soil-filled chutes alternating with raised rock ribs. These heavily fractured outcrops are mostly found near the crest of the spur ridge. Lower down on the flank, rock exposures take the form of smooth faces. Some of these faces were too steep to safely explore on foot.

This site is located in a remote area and receives little or no visitation.

NATURAL COMMUNITIES: Forests of the narrow ridge crest and uppermost slopes of this site mostly belong to the Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest community. In slightly more mesic and protected saddles and side slopes, this grades toward the Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest. Much of the very steep, very thick middle and lower slopes of the site were not explored because of dangerous conditions. It is worth noting, however, that outside the site boundary, a very fine example of the Central Appalachian Basic Boulderfield Forest (Montane Basswood – White Ash Type) was seen growing in fine talus on the north-facing upper slope of the ridge. This forest was very rich, with *Tilia americana* var. *americana* (American basswood), *Acer saccharum* var. *saccharum* (sugar maple), *Quercus rubra* (northern red oak), and *Fraxinus americana*

(white ash) forming an open overstory, and nutrient-demanding herbs such as *Impatiens pallida* (pale jewelweed), *Solidago flexicaulis* (broad-leaved goldenrod), *Hylotelephium telephioides* (Allegheny stonecrop), and *Asplenium rhizophyllum* (walking fern) forming the herb layer.

In the eastern half of the site, a 2 ha (5 ac) area of xeric, steeply dipping outcrops on the upper slopes supports an essentially pristine occurrence of Central Appalachian Xeric Chestnut Oak – Virginia Pine Woodland. It is dominated by variable combinations of scrubby *Quercus prinus* (chestnut oak), *Pinus virginiana* (Virginia pine), *Pinus pungens* (table-mountain pine), and *Quercus rubra*. Shrubs are patchy, with the deciduous ericads *Vaccinium pallidum* (early lowbush blueberry), and *Vaccinium stamineum* (deerberry) most abundant. *Kalmia latifolia* (mountain-laurel), *Betula lenta* (sweet birch), *Amelanchier arborea* (downy serviceberry), and *Vitis aestivalis* var. *bicolor* (silverleaf grape) are also present in the shrub layer. Thin pockets of soil and organic matter on ledges support a number of xerophytic herbs, with *Schizachyrium scoparium* (little bluestem), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oat-grass), *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), and *Solidago erecta* (erect goldenrod) locally achieving 1 to 5% cover over a 200 m^2 (2,153 ft^2) area. Other characteristic herbs recorded in two quantitative plot samples (plots SHNP157 and SHNP158) here were *Aureolaria laevigata* (entire-leaved yellow foxglove), *Campanula divaricata* (southern hairbell), *Heuchera americana* (American alumroot), *Houstonia longifolia* (longleaf bluets), *Hylotelephium telephioides* (Allegheny stonecrop), *Polypodium appalachianum* (Appalachian rock polypody), *Symphyotrichum undulatum* (= *Aster undulatus*, wavy-leaved aster), and *Viola sagittata* (arrow-leaved violet).

Lasallia pensylvanica, *Xanthoparmelia plittii*, and *Xanthoparmelia conspersa* are generally the dominant lichens on the open and thinly shaded outcrops at this site. Also present are *Dimelaena oreina*, *Asplicilia cinerea*, *Rhizoplaca subdiscrepens*, *Lasallia papulosa*, *Diploschistes scruposus*, *Physcia subtilis*, *Flavoparmelia baltimorensis*, *Umbilicaria mammulata*, *Acarospora fuscata*, and *Cladonia* spp. In addition, the lichens *Flavoparmelia caperata* and *Punctelia rudecta* abundantly cover the branches of the stunted oaks and pines.

RARE PLANTS: No rare or watchlist plants were found at this site.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

Plate 39. Granitic outcrops and pine-dominated xeric woodland at Hogback Mountain Spur.

THREATS: Because of its remote and extremely rugged character, there are no anthropogenic threats to this site or its significant community. In addition, substrates are extremely drought-prone and

oligotrophic, which tends to preclude invasive weeds. A few small sprouts of *Ailanthus altissima* (tree-of-heaven) were seen in the woodland, but it seems doubtful that this species will become numerous or persistent in such a stressful, xeric environment.

MANAGEMENT RECOMMENDATIONS:

Monitor the health of the significant natural community. Conduct surveys on a 5-10 year interval to assess the status of the significant natural community at this site and include a survey for invasive plants.

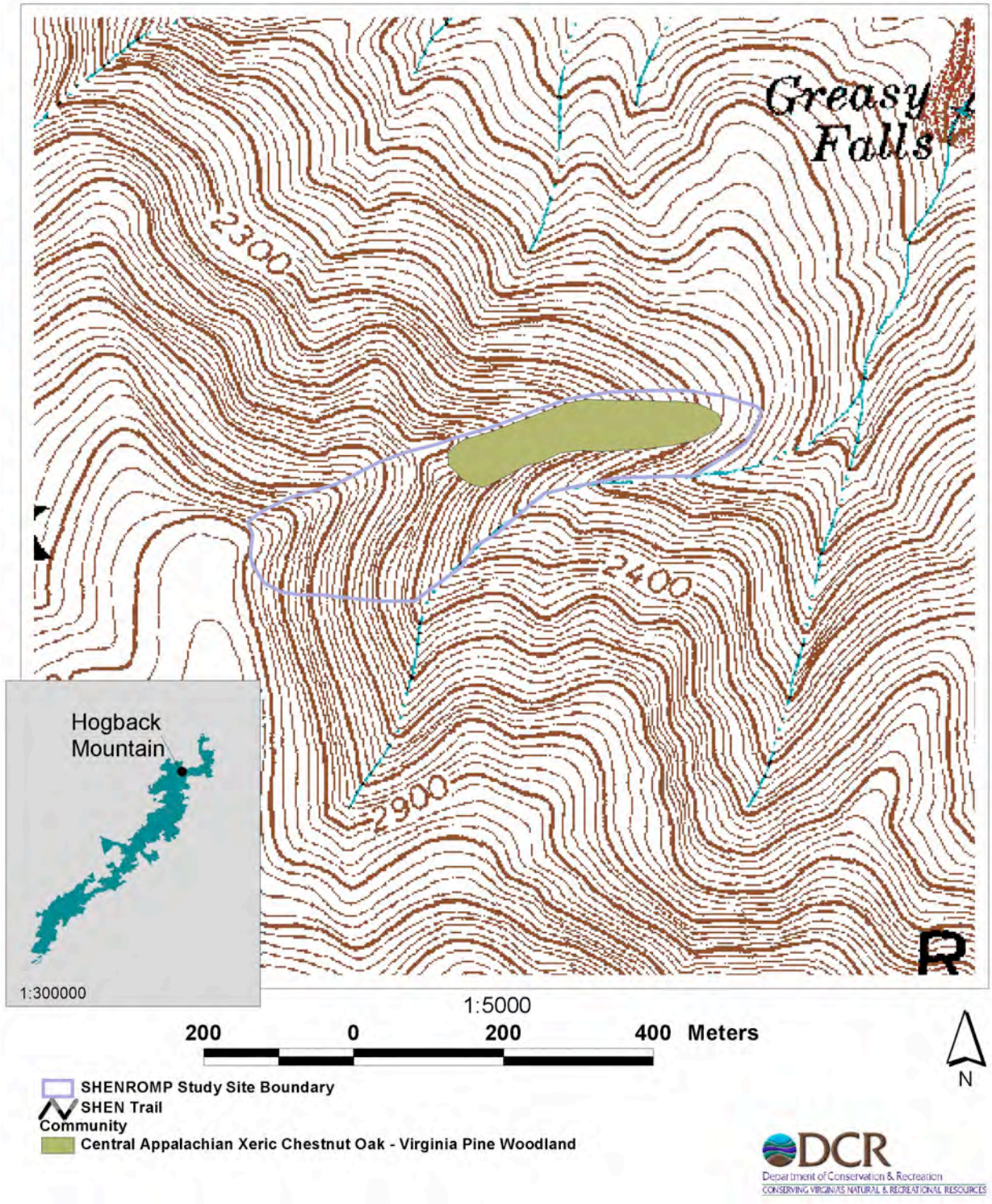


Fig. 31. Location of significant natural community at Hogback Mountain Spur.

OVERALL RUN FALLS NORTH (C63)

CONSERVATION SITE: Overall Run Watershed (B2) **THREAT RANK: 5**

LOCALITY: Warren County **QUADRANGLE(S):** Bentonville

LOCATION: This North District site lies west of Skyline Drive and abuts the Overall Run Falls South site. It extends from 2.46-2.78 km (1.54-1.73 mi) northwest of Hogback Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Quercus prinus* - *Pinus virginiana* - (*Pinus pungens*) / *Schizachyrium scoparium* - *Dichanthelium depauperatum* Woodland	Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland	G2?	S2	None	None	C
Plants: None						
Animals: *Properigea costa*	A noctuid moth	G4	S1S3	None	None	E

SITE DESCRIPTION: This site includes an extensive metabasalt cliff overlooking the steep canyon of Overall Run and several small metabasalt outcrops that face Overall Run further upstream.

The northwestern end of this site is dominated by a west-facing cliff, extending north from Overall Run at the point where the stream plunges into a 28 m (93 ft) waterfall, the highest in the park. This cliff extends north within the site for about 130 m (426 ft) and also extends outside of the site boundary on the southwestern side of the stream. The open top of that portion of the cliff within the site has an elevation of about 597 m (1,960 ft) a short distance north of Overall Run, but drops in a series of stair steps to about 579 m (1,900 ft) at its northern end. Much of the cliff is about 12 m (40 ft) high.

The southeastern portion of this site contains a series of small, southeast-facing outcrops above overall run. Most of these outcrops are moderately steep and ledgy, but the easternmost exposure has cliffy areas. Most of these outcrops are fairly well-shaded.

The Tuscarora-Overall Run Trail runs just above much of the cliff and quite near the other outcrops. From it, numerous social trail lead to cliff top and outcrop overlooks.

NATURAL COMMUNITIES: The matrix forest of this south- to west-facing site is a rather dry and heath-rich variant of the Central Appalachian Dry-Mesic Chestnut Oak - Red Oak Forest. The forest cover is intermittently broken on and near the major outcrops flanking Overall Run. The shallower soils of these outcrop areas support three patches of Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland covering 0.6 ha (1.5 ac) in aggregate. This woodland varies from semi-closed with trees > 10 m (33 ft) tall to very open with trees stunted to shrub (< 6 m [20 ft]) size; the most open patches are on the cliff tops overlooking the falls. The dominant species are *Quercus prinus* (chestnut oak) and *Pinus virginiana* (Virginia pine), with *Quercus rubra* (northern red oak) and *Fraxinus americana* (white ash)

also important in places. Shrubs and small trees include *Ostrya virginiana* (eastern hop-hornbeam), *Prunus alleghaniensis* var. *alleghaniensis* (Alleghany plum), *Carya glabra* (pignut hickory), *Pinus strobus* (eastern white pine), *Vaccinium stamineum* (deerberry), *Vaccinium pallidum* (early lowbush blueberry), *Rosa carolina* var. *carolina* (pasture rose), *Amelanchier arborea* (downy serviceberry), and *Vitis aestivalis* (summer grape). Herbaceous species occupy shallow soil mats and crevices. *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (poverty oat-grass), and *Carex pensylvanica* (Pennsylvania sedge) are locally abundant on shallow soils, while *Helianthus divaricatus* (woodland sunflower) and *Solidago harrisii* (shale-barren goldenrod) are common forbs. Other herbs associated with this community include *Heuchera americana* (American alumroot), *Symphyotrichum undulatum* (wavy-leaved aster), *Taenidia montana* (mountain pimpernel), *Aureolaria laevigata* (entire-leaved yellow foxglove), *Campanula divaricata* (southern hairbell), *Antennaria plantaginifolia* (plantain-leaf pussytoes), *Houstonia longifolia* (longleaf bluets), *Dichanthelium depauperatum* (starved panic grass), *Solidago erecta* (erect goldenrod), *Phlox subulata* (moss phlox), and *Viola sagittata* (arrow-leaved violet). Conspicuous lichens on rock faces in the woodland community include *Lasallia papulosa*, *Flavoparmelia baltimorensis*, *Dimelaena oreina*, *Usnea cf. halei*, *Xanthoparmlia conspersa*, *Rhizoplaca subdiscrepens*, *Cladonia cf. chlorophaea*, and several gray and pink crusts. The bryophyte *Grimmia laevigata* is common on outcrops that receive periodic or ephemeral seepage. Quantitative plot data were collected from this occurrence during the ROMP project (plot SHNP146).

RARE PLANTS: No rare plants were found here, but two watchlist species were encountered. *Taenidia montana* is a common component of the woodland community here. A few individuals of *Prunus alleghaniensis* var. *alleghaniensis* were seen along the top of the cliff.

RARE ANIMALS: One specimen of *Properigea costa* (a noctuid moth) was collected on 19 September 2006 in a UV-trap set on the main cliff. It is difficult to determine population status based on a single sighting.

Plate 40. Central Appalachian Xeric Chestnut Oak – Virginia Pine Woodland at Overall Run Falls North. *Schizachyrium scoparium* (little bluestem) is the dominant grass in the foreground.

THREATS: This is a very popular site for day hikers and campers. The existing Tuscarora-Overall Run Trail provides access to spectacular views of the falls from the top of a massive cliff, as well as to Overall Run upstream of the falls. Numerous social trails lead from the main trail to both the stream and to outcrops overlooking the stream. Some of these trails are significantly eroding as the result of soil exposure on the steep slopes. Impacts from visitor trampling on and around outcrops have locally damaged herbaceous vegetation and lichens in the significant woodland community. In addition, the remains of illegal campfires were found in two locations. These impacts appear to have increased significantly since this area was first surveyed by DCR-DNH in 1990.

Invasive introduced plants are also present. The most serious problem is a colony of large *Ailanthus altissima* (tree-of-heaven) growing in rich soil and talus near the base of the falls. This colony is probably a source of constant seed dispersal in and around the site, and *Ailanthus* seedlings and saplings were found scattered throughout the area.

There are potential adverse affects to moth populations, such as *Properigea costa*, from certain types of gypsy moth or other insect suppression measures.

MANAGEMENT RECOMMENDATIONS:

Prohibit camping at this site.

Close social trails to outcrops. See Figure 34.

Control *Ailanthus altissima* infestation to restore the site and reduce the further spread of *Ailanthus* from this site where it is well-positioned to disperse numerous seeds, particularly downstream. The use of herbicide is recommended for controlling this species. Spray application may be used on this stand of *Ailanthus* since it is not within a rare community type or rare plant population. Conduct annual post-treatment monitoring for several years to assess success of control efforts.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the health of the rare natural communitiy. Following implementation of management actions, conduct annual surveys to assess the health of the significant natural community and include a survey for invasive plants. After management actions have achieved success, use a 3-5 year monitoring interval.

No specific management recommendations for *Proprigea costa*. Little is known about the life history of *Properigea costa*, making management recommendations difficult. It is unlikely to be impacted by management decisions specifically targeting cliffs and rock outcrops; however, caution should be used if gypsy moth or other insect suppression is contemplated in the area, as certain pesticides have broad effects on non-targeted invertebrate species.

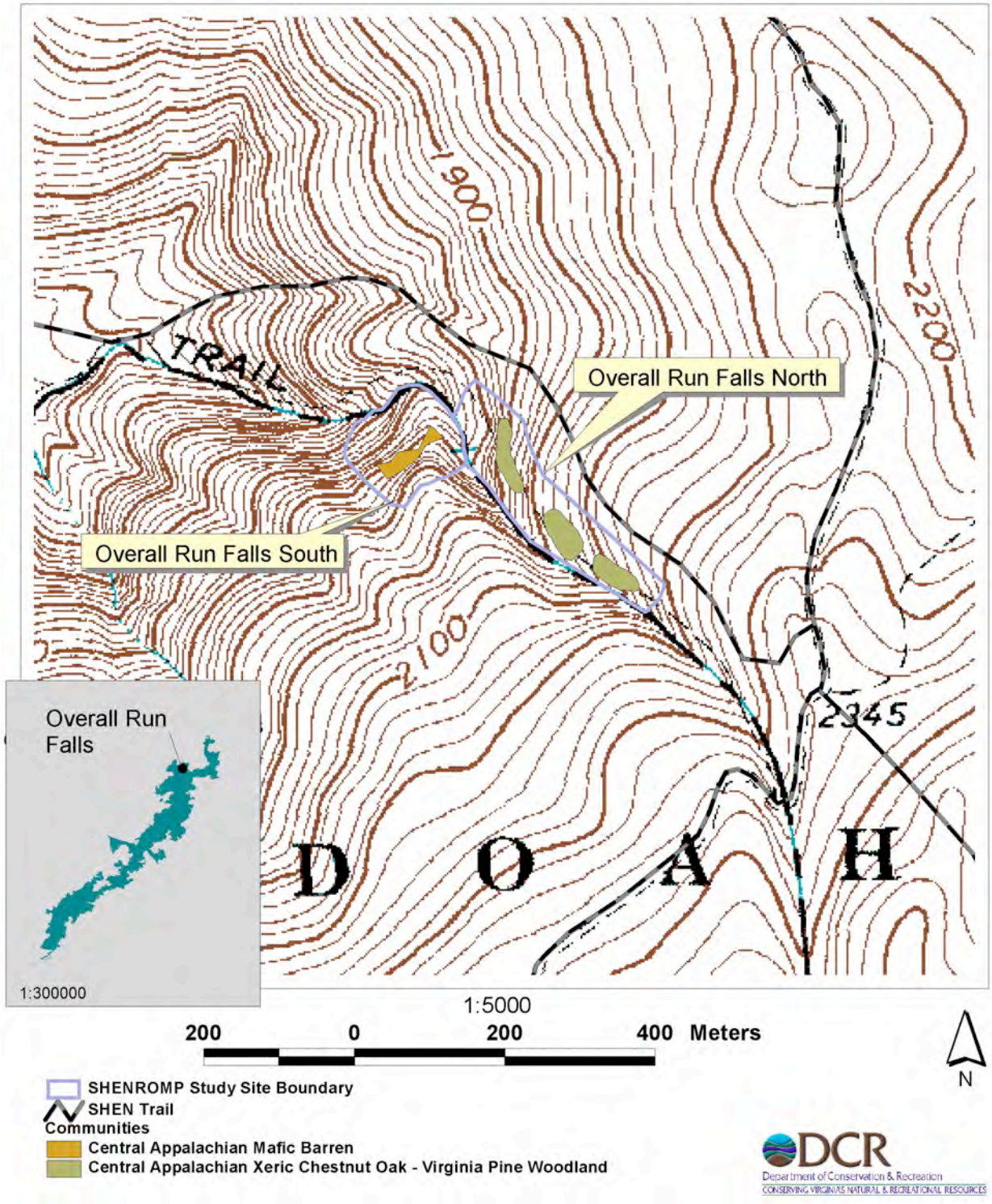


Fig. 32. Location of significant natural community at Overall Run Falls North.

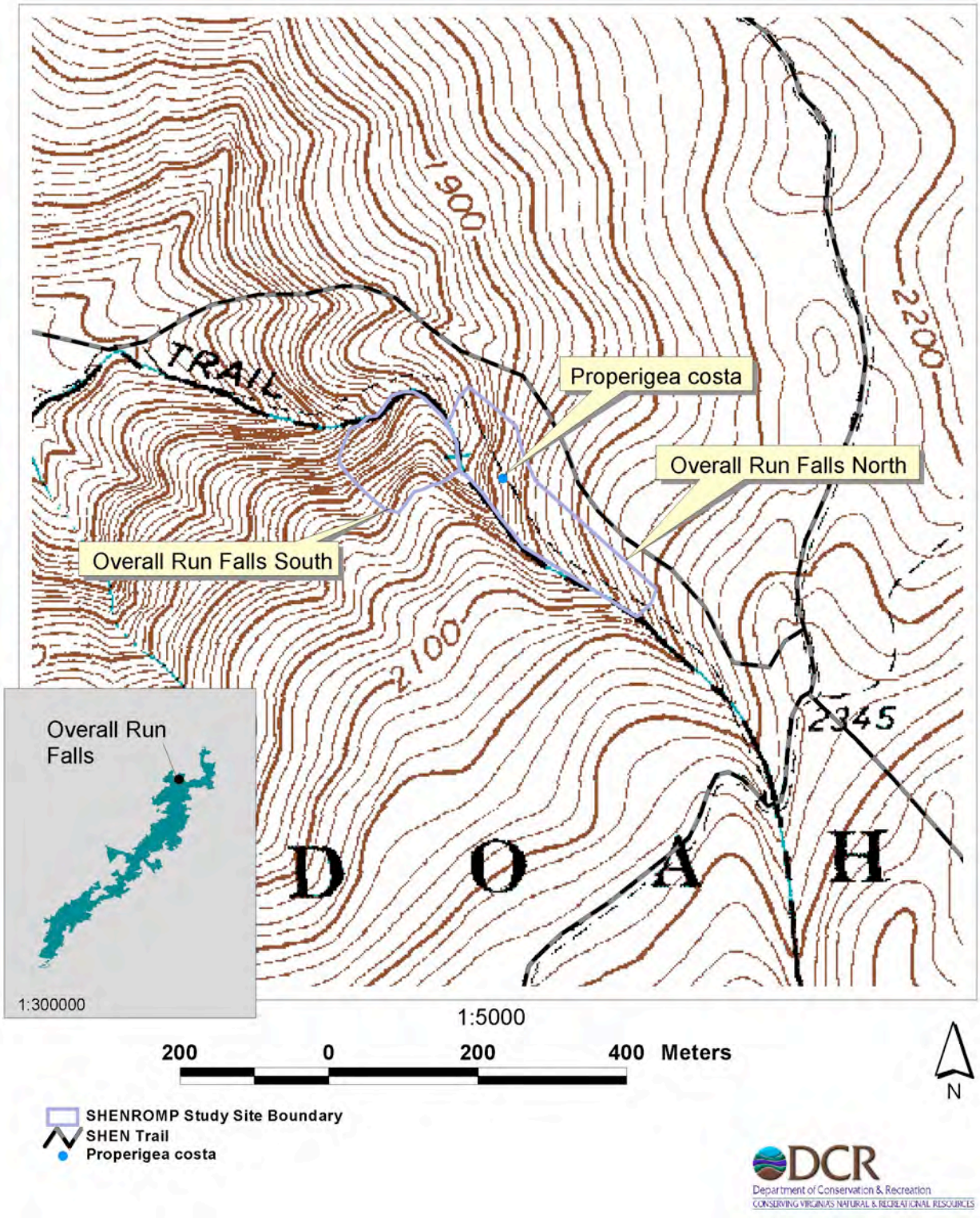


Fig. 33. Location of *Properigea costa* at Overall Run Falls North.

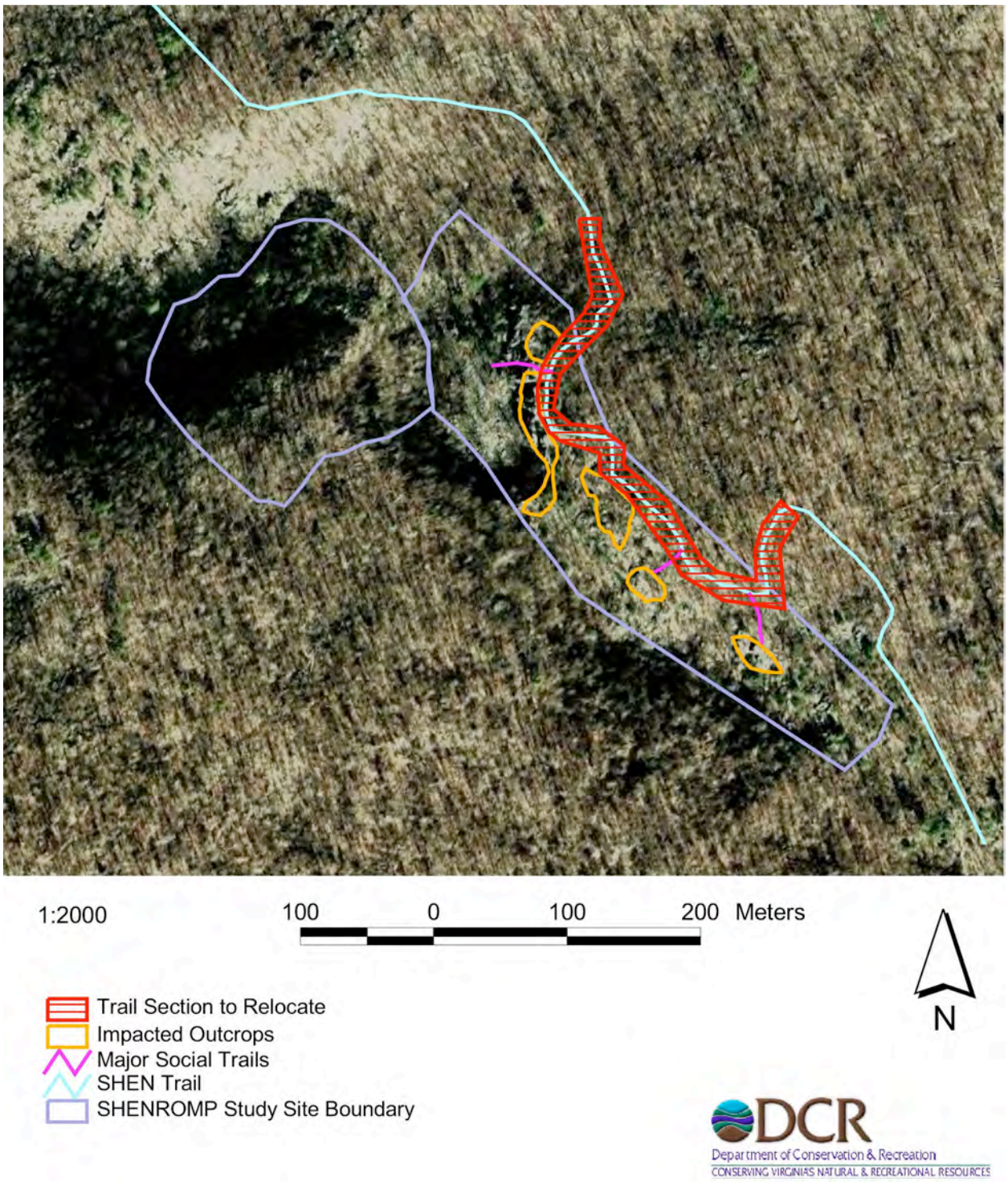


Fig 34. Site details and recommended trail relocation for Overall Run Falls North.

OVERALL RUN FALLS SOUTH (C39)

CONSERVATION SITE: Overall Run Watershed (B2) **THREAT RANK: 0**

LOCALITY: Page County **QUADRANGLE(S):** Bentonville

LOCATION: This North District site lies west of Skyline Drive and abuts the Overall Run Falls North site. It extends from 2.58-2.73 km (1.61-1.69 mi) northwest of Hogback Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana* / *Physocarpus opulifolius* / *Carex pensylvanica* - *Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2	S2	None	None	A
Plants: *Paxistima canbyi*	Canby's mountain-lover	G2	S2	None	None	B
Animals: None						

SITE DESCRIPTION: This site encompasses a steep, north-trending ridge above a bend in Overall Run. The ridge is flanked by two metabasalt cliffs: a northeast-facing cliff above the steep canyon produced by Overall Run Falls and a northwest-facing cliff fronting the stream just beyond where it makes a sharp turn to the southwest. These cliffs are located at elevations between 488 m (1,600 ft) and 549 m (1,800 ft).

Just above the cliffs, and spanning the nose of the ridge from northwest to northeast, is a series of small metabasalt outcrops and ledges. Several small areas of talus are also found in this zone.

This site is located on the opposite side of Overall Run from the trail that leads to the falls, a popular hiking destination. The site is difficult to access from the trail, however, and receives little visitation.

NATURAL COMMUNITIES: The slope above the metabasalt cliff at this site is mostly forested with Central Appalachian Basic Oak - Hickory Forest (Submontane / Foothills Type). An area of talus immediately above the cliff supports a small stand of Central Appalachian Basic Boulderfield Forest (Montane Basswood - White Ash type). Forests at the base of the cliff were not examined.

The open, xeric, sloping cliff top is vegetated with a graminoid-rich variant of the Central Appalachian Mafic Barren community type. Although not large (ca. 0.15 ha [0.37 ac]), this occurrence is in pristine condition. The barren has scattered shrubs and stunted trees of *Fraxinus americana* (white ash), *Carya glabra* (pignut hickory), *Ostrya virginiana* (eastern hop-hornbeam), *Ptelea trifoliata* (hop-tree), *Prunus alleghaniensis* var. *alleghaniensis* (Alleghany plum), *Viburnum rafinesquianum* (downy arrow-wood), *Amelanchier sanguinea* var. *sanguinea* (roundleaf serviceberry), *Amelanchier arborea* (downy serviceberry), *Celtis occidentalis* (common hackberry), *Vaccinium pallidum* (early lowbush blueberry), and *Betula lenta* (sweet birch). *Carex pensylvanica* (Pennsylvania sedge) and *Danthonia spicata* (poverty oat-grass) are the dominant graminoids. Forbs are also well-represented, with *Solidago harrisii* (shale-

barren goldenrod), *Helianthus divaricatus* (woodland sunflower), *Ambrosia artemisiifolia* (common ragweed), *Antennaria plantaginifolia* (plantain-leaf pussytoes), *Symphyotrichum laeve* var. *concinnum* (= *Aster laevis* var. *concinnus*, smooth aster), and *Allium cernuum* (nodding onion) most numerous. A population of the globally rare sub-shrub *Paxistima canbyi* (Canby's mountain-lover) occurs partly within the community boundary. Quantitative plot data were collected from this occurrence in 1999 (plot SHNP058).

RARE PLANTS: A globally-rare plant, *Paxistima canbyi* occurs at this site. The population is located in the woodland community above the metabasalt cliff, where much of the population is growing in small to medium block talus. Ninety-six clumps were counted on May 11, 2006, within a 15 x 20 m (49 x 66 ft) area. Clumps ranged in size from a single sprig to a 50 cm^2 (20 in^2) patch. It was difficult to differentiate individuals of this species as they reproduce vegetatively by rooting stems. Larger plants were in flower on the survey date. *Paxistima canbyi* is the rarest plant found on rock outcrops in SHEN.

Three watchlist plants are also found at this site -- *Taenidia montana* (mountain pimpernel), *Prunus alleghaniensis* var. *alleghaniensis* (Alleghany plum), and *Amelanchier sanguinea* var. *sanguinea*.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

Plate 41. Central Appalachian Mafic Barren on cliff top at

Overall Run Falls South.

THREATS: Despite its proximity to much-visited areas on the north side of Overall Run, this site offers no views of the falls and is rarely visited. Conditions have remained the same since this area was first surveyed by DCR-DNH in 1990, and there are no apparent threats to the significant barren.

MANAGEMENT RECOMMENDATIONS:

Monitor *Paxistima* population on a 3-5 year interval. Include observations of any changes in visitor use patterns and presence of invasive plant species.

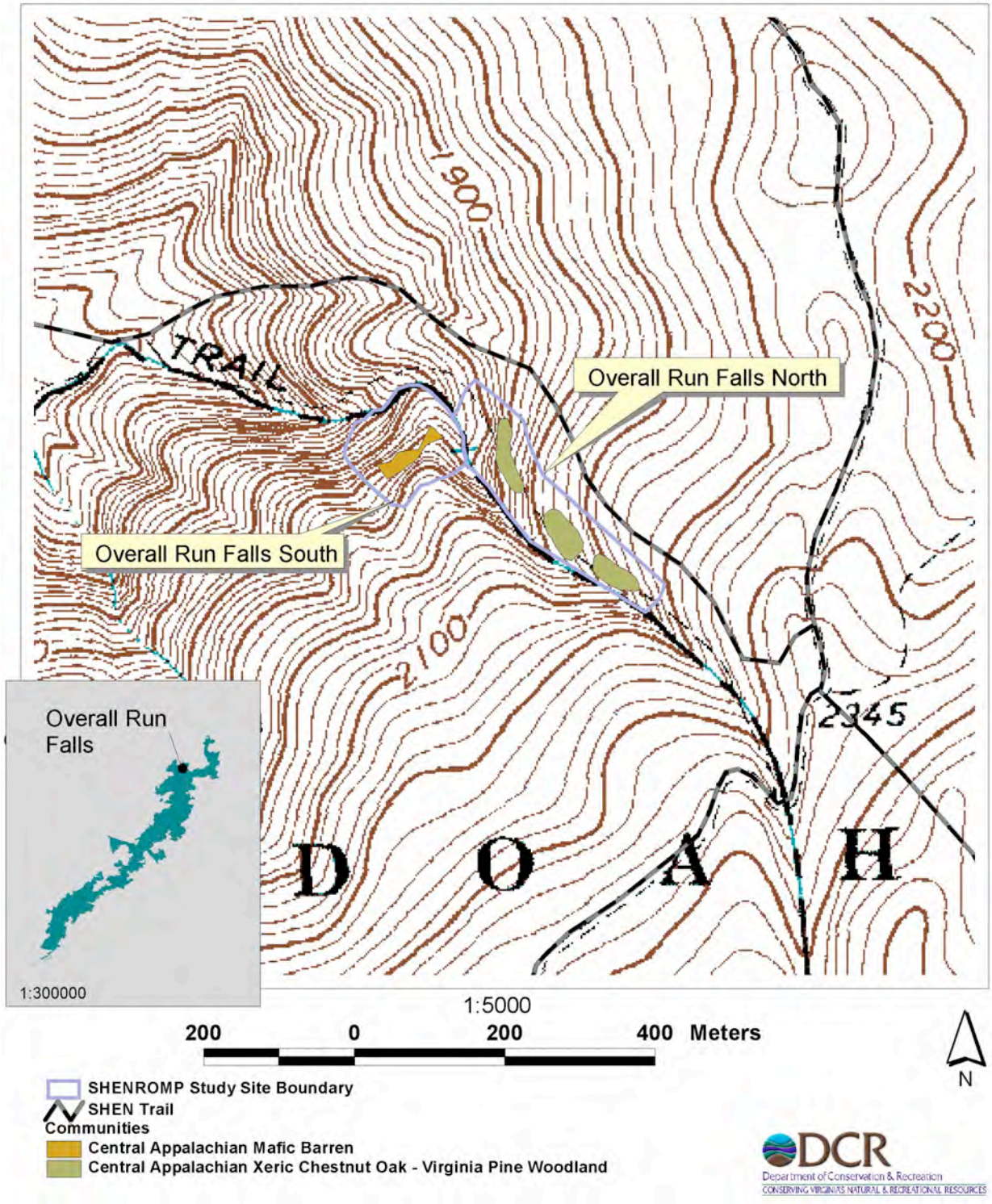


Fig. 35. Location of significant natural community at Overall Run Falls South.

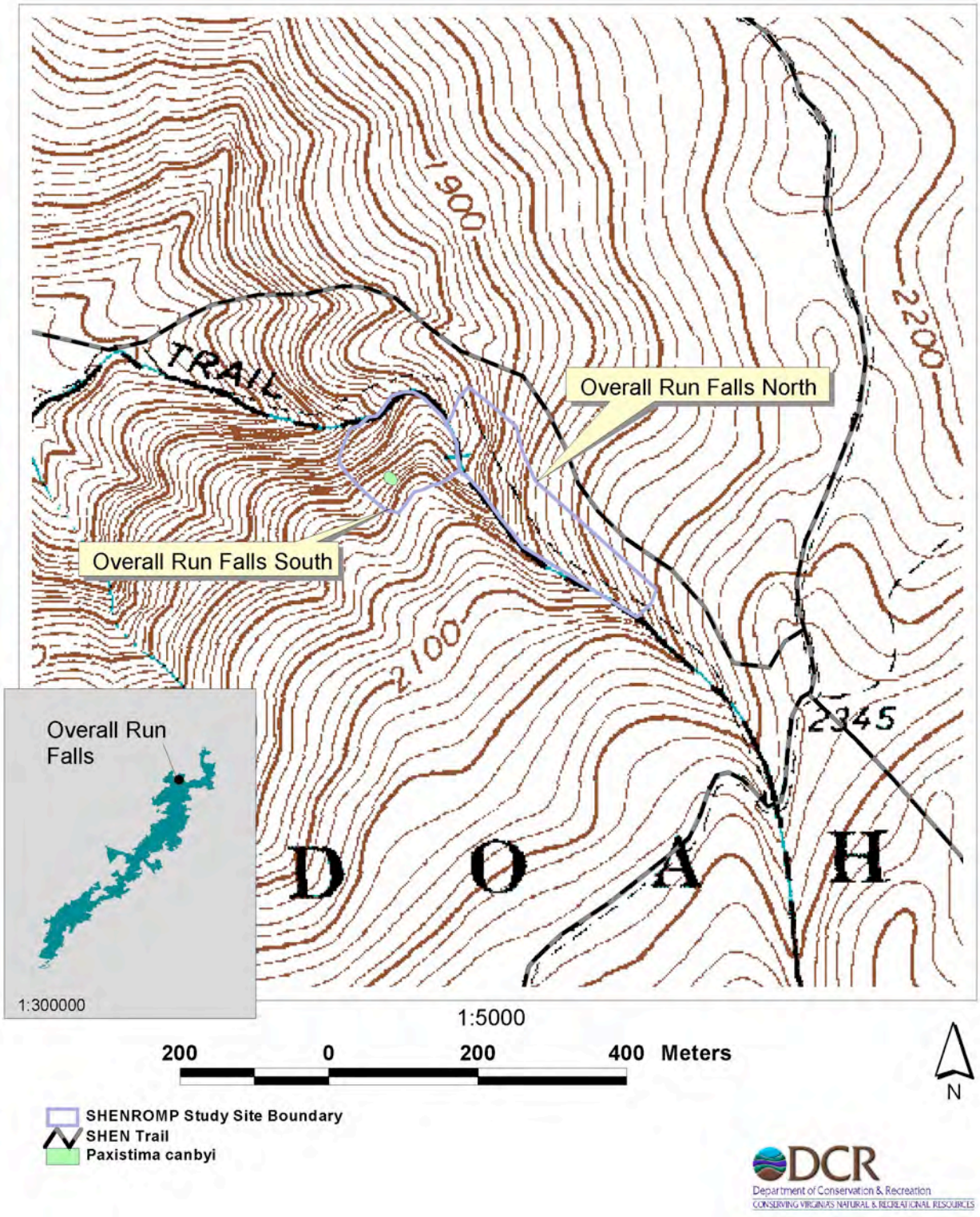


Fig. 36. Location of *Paxistima canbyi* at Overall Run Falls South.

PASS MOUNTAIN (C40)

CONSERVATION SITE: Pass Mountain (B2) **THREAT RANK: 2**

LOCALITY: Page County **QUADRANGLE(S):** Thornton Gap

LOCATION: This North District site is located east of Skyline Drive and about 300 m (984 ft) northwest to 670 meters (2,198 ft) north northwest of the summit of Pass Mountain.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Photinia melanocarpa - Gaylussacia baccata* / *Carex pensylvanica* Shrubland	High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type	G1	S1	None	None	AB
Plants: *Solidago randii*[1]	Rand's goldenrod	G5T4	S2S3	None	None	BC
Animals: None						

[1] This element occurrence was searched for but not found in 2006.

SITE DESCRIPTION: This site contains a west-facing Catoctin Formation metabasalt outcrop. The outcrop extends for about 375 m (1,230 ft) between elevations of 853 m (2,800 ft) and 884 m (2,900 ft). The northern two-thirds of the outcrop differs dramatically from the southern third, and a small gap separates the two areas. The northern portion of the outcrop has a broad, gently sloping top with numerous ledges. Many areas here are open, providing sunny habitat for a wide diversity of shrubs and herbs. This broad top grades gently into steeper topography at mid slope. A short, steep cliff runs along the base of the outcrop. A steep mass of fractured and broken columnar metabasalt crowns the southern portion of the outcrop. Below this is a steeply pitched slope of large block talus.

The Appalachian Trail (AT) is located just east of this site, and a social trail leads from the AT to the top of the outcrop. Most visitation and, hence, trampling appears to be confined to a small area at the end of this trail.

NATURAL COMMUNITIES: Most forests surrounding the open outcrops at this site belong to the Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest community. At the south end of the site is a small area of Black Birch – Chestnut Oak Talus Woodland. Three discrete patches of the globally rare High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) occupy the most open outcrop areas and are separated by small patches of scrubby forest. This barren is a shrubland that varies from patchy to dense, with shrub colonies interspersed with areas of open rock and small herbaceous mats. The occurrence at Pass Mountain has an aggregate size of 0.3 ha (0.75 ac), which is one of the largest stands of this type that has been documented, and is mostly in excellent condition. Variable co-dominants in the shrub complex here are *Photinia melanocarpa* (black chokeberry), *Gaylussacia baccata* (black huckleberry), *Spiraea alba* var. *latifolia* (broad-leaved meadowsweet), *Vaccinium angustifolium* (northern lowbush blueberry), and *Vaccinium pallidum* (early lowbush blueberry). The scattered

herbaceous cover includes *Carex pensylvanica* (Pennsylvania sedge), *Lysimachia quadrifolia* (wholed loosestrife), *Solidago erecta* (erect goldenrod), *Danthonia spicata* (poverty oat-grass), *Schizachyrium scoparium* (little bluestem), *Hypericum gentianoides* (orange-grass), *Corydalis sempervirens* (pink corydalis), *Agrostis perennans* (autumn bentgrass), *Houstonia longifolia* (longleaf bluets), and *Hylotelephium telephioides* (Allegheny stonecrop). Quantitative plot data were collected from this occurrence in 1999 (plot SHNP038).

RARE PLANTS: A previously known population of *Solidago randii* (Rand's goldenrod) could not be relocated at this site in August 2006. A population of about 100 clumps over a 0.4 ha (1.0 ac) area was reported from this site in 1990, growing from crevices in exposed sloping outcrops and ledges. This population was also reported as being present in 1999.

To ensure that the 1990 report for *Solidago randii* at this site was correct, a specimen collected from the population was checked. This specimen was collected on 8 September 1990 by Gary P. Fleming [*5218*] and deposited in the herbarium of The College of William and Mary. The specimen was checked by DCR-DNH botanist John F. Townsend at that herbarium on 14 February 2007 and determined to have been correctly identified as *Solidago randii.*

The watchlist shrub *Amelanchier sanguinea* var. *sanguinea* (roundleaf serviceberry) was found at this site.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

Two watchlist moths were captured in a UV-trap set along the west facing cliffs. These species are: *Euchlaena muzaria* (a geometrid moth, n = 1), and *Itame subcessaria* (a geometrid moth, n = 2).

Plate 42. High-Elevation Outcrop Barren dominated by *Spiraea alba* var. *latifolia* (broad-leaved meadowsweet) and *Photinia melanocarpa* (black chokeberry) at Pass Mountain.

THREATS: The significant community has been slightly degraded by visitor trampling and the subsequent destruction of soil mats and vegetation. This problem is mostly confined to a small area at the north end of the outcrops, where a social trail from the Appalachian Trail leads to an overlook. The exotic weeds *Rumex acetosella* (sheep sorrel) and *Poa compressa* (flat-stemmed bluegrass) are symptomatic of trampling on the outcrops, but are confined to a small area and do not appear to be a serious threat to the significant natural community at present.

MANAGEMENT RECOMMENDATIONS: This is possibly the best of 11 known sites in the world for the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community. As such, it merits strong protection and remedial action to ensure that visitor impacts are reduced and the occurrence remains largely undisturbed.

Re-route the Appalachian Trail away from the outcrops. See Figure 39.

Close the social trail to the impacted outcrop. If necessary, use barriers to deter visitation. See Figure 39.

Prohibit camping on the outcrops.

Additional searches for *Solidago randii* should be made at this site during the plant's late August and September flowering period.

Monitor the health of the rare High-elevation Outcrop Barren. Following re-routing of the trail, conduct annual surveys to assess the effect of this action on visitation to the site. After management actions have achieved success, use a 3-5 year monitoring interval.

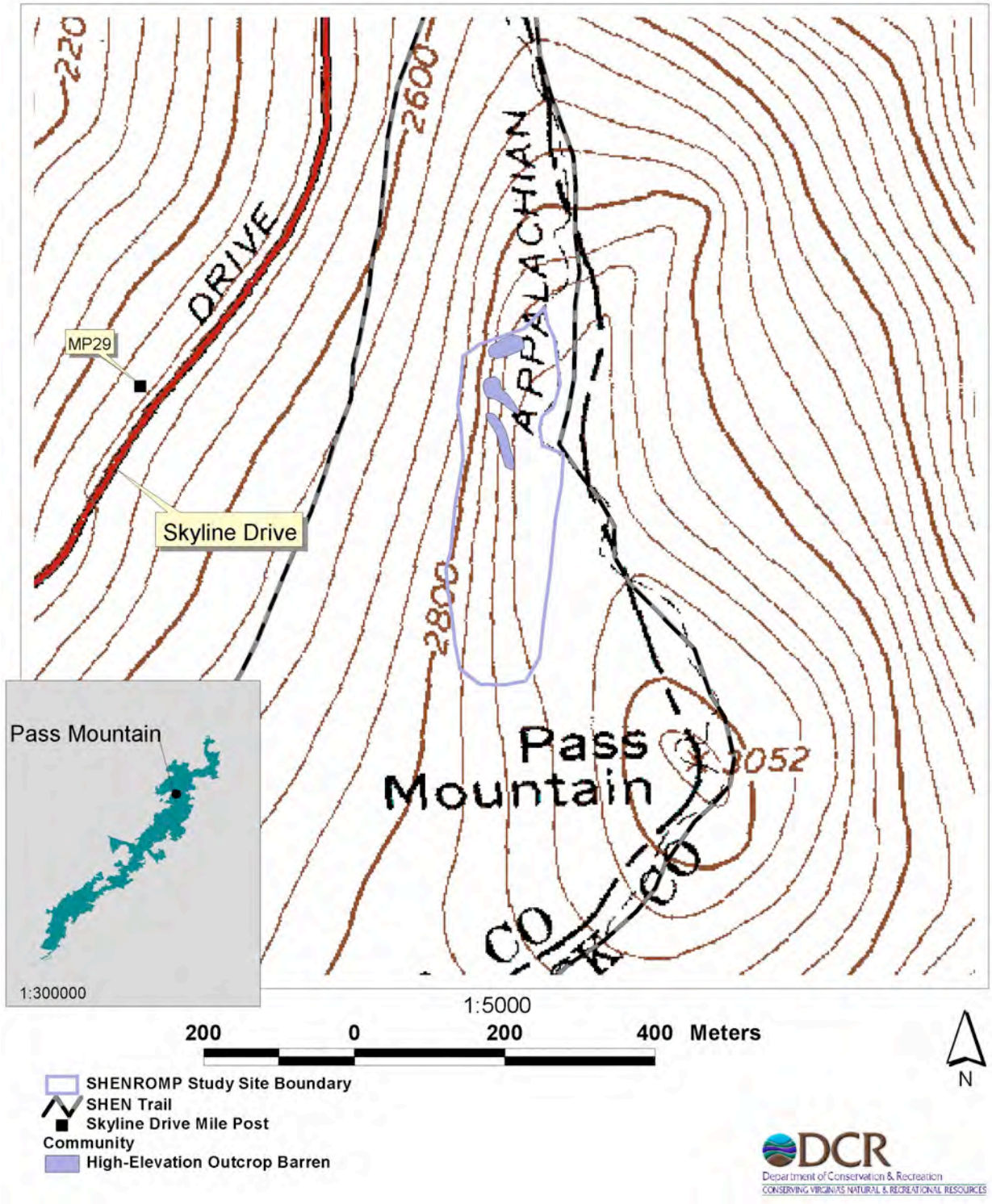


Fig. 37. Location of significant natural community at Pass Mountain.

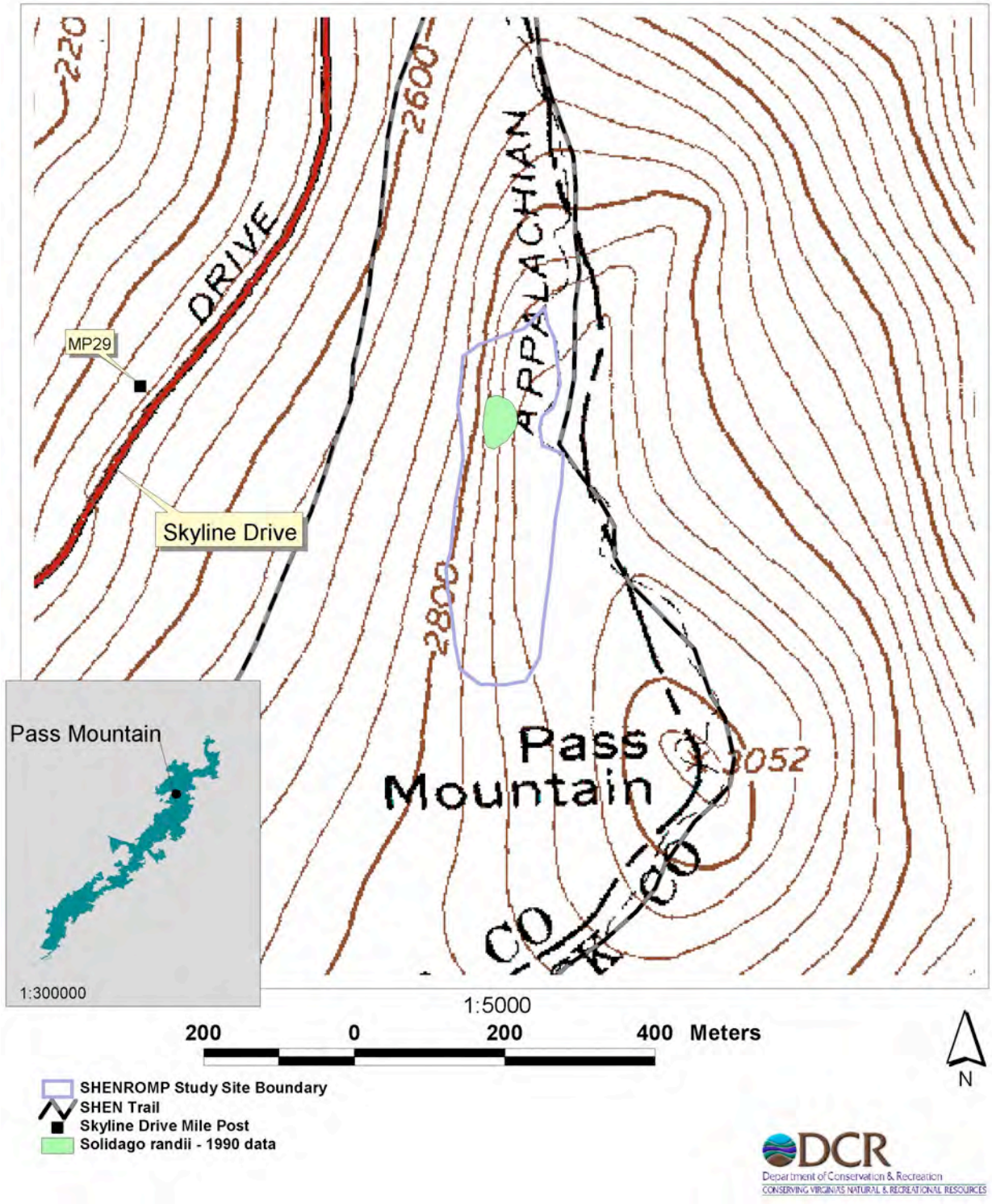


Fig. 38. Location of 1990 occurrence of *Solidago randii* at Pass Mountain.

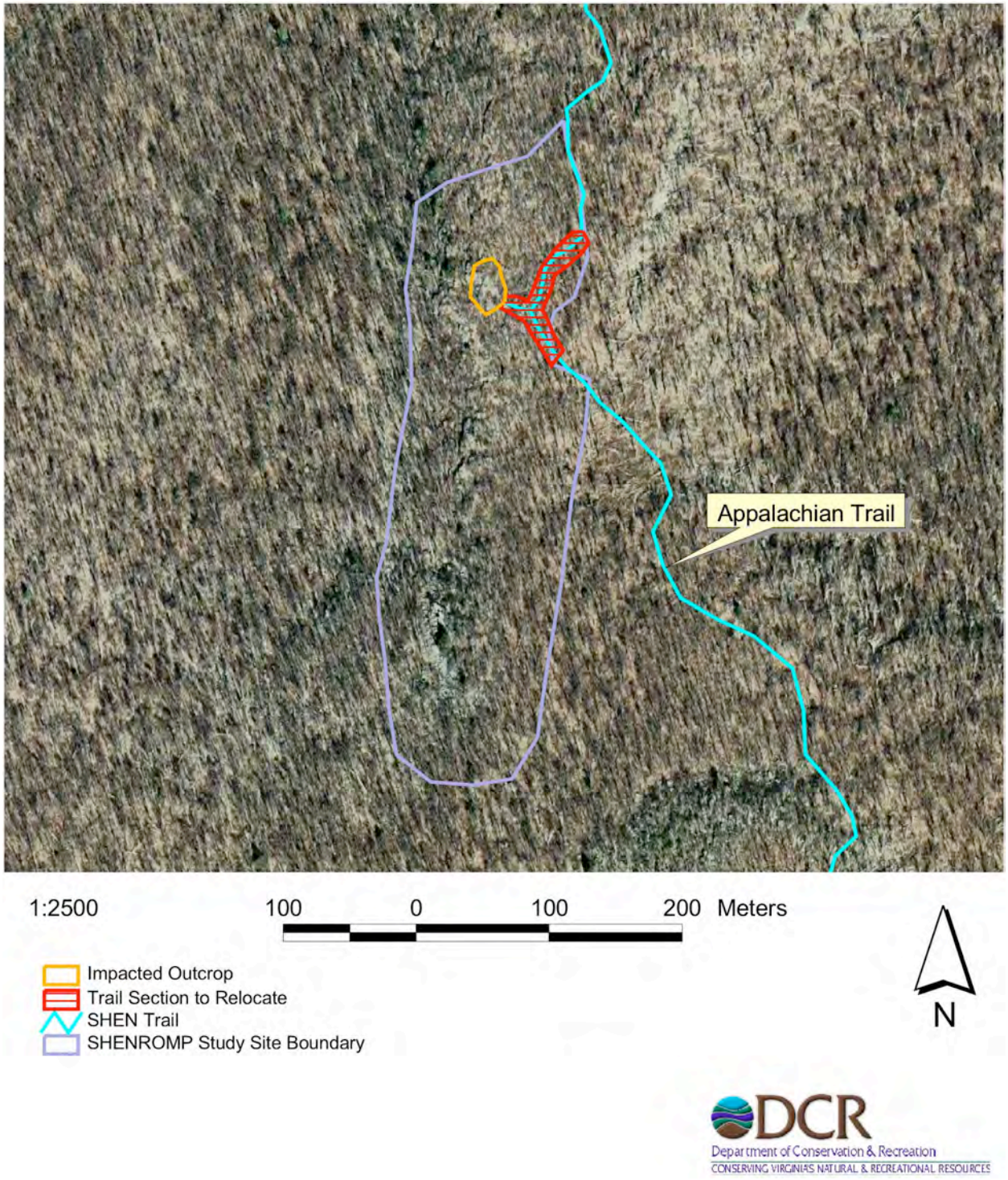


Fig 39. Site details for Pass Mountain, including the location of social trails recommended for closure.

OVENTOP (C38)

CONSERVATION SITE: Oventop (B3) **THREAT RANK: 1**

LOCALITY: Rappahannock County **QUADRANGLE(S):** Thornton Gap

LOCATION: This North District site is located in Thornton Gap north of Route 211. It is situated from 0.81 km (1.32 mi) east to 1.07 km (1.72 mi) east northeast of the parking area along Route 211 at the eastern terminus of the Pass Mountain Trail.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana - Carya glabra* / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	BC
Plants: None						
Animals: None						

SITE DESCRIPTION: This site contains several smooth, often undulating outcrops of Old Rag Granite. The outcrops are located on south-facing slopes at elevations between 616 m (2,020 ft) and 744 m (2,440 ft). There are two large, exposed outcrops within the site boundary. An outcrop at the northeastern end of the site just below the ridgeline covers about 0.33 ha (0.82 ac). Another large outcrop in the center of the site, and about 65 m (200 ft) lower in elevation, has a size of about 0.27 ha (0.69 ac). Several smaller, more or less forested outcrops are scattered through the site area.

These granite faces are generally steeply and convexly pitched, and have weathered by exfoliation. There is usually a fairly flat area at the top capped by large boulders, but the mid section typically has an inclination of 30-40 percent. The lower slope may be steeper still, sometimes approaching vertical. These outcrops are sparsely vegetated. A few shallow depressions and crevices allow a build-up of organic debris sufficient to supports mats of herbs and an occasional woody species. The large outcrops are very open, but small faces receive ample shade from the surrounding canopy.

This site is accessed by an unmaintained and infrequently used trail that connects to the Pass Mountain Trail to the southeast. The trail was at one time an official park trail, and still provides easy access to the top of the northeasternmost outcrop. However, the few visitors who make it to that point are unlikely to venture down the steep slope from there.

NATURAL COMMUNITIES: The principal community type over much of the site is the Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. Sizeable patches of Central Appalachian Pine – Oak / Heath Woodland occur in the northeastern and southwestern portions of the site. The northeastern exposed outcrop supports a sparse, lithophytic variant of this woodland, with small groves of *Pinus pungens* (table-mountain pine), *Pinus virginiana* (Virginia pine), *Pinus strobus* (white pine), *Quercus prinus* (chestnut oak), *Quercus coccinea* (scarlet oak), and *Sassafras albidum* (sassafras) around the peripheries of the outcrop. Patches of *Kalmia latifolia* (mountain-laurel), *Gaylussacia baccata*

(black huckleberry), and *Smilax rotundifolia* (common greenbrier) are also present, but herbaceous plants are extremely sparse. Very small colonies of the lithophytes *Talinum teretifolium* (roundleaf fameflower) and *Hypericum gentianoides* (orange-grass) occur in crevices on the outcrop. Prevalent lichens include *Xanthoparmelia plittii*, *Lasallia pensylvanica*, *Lasallia papulosa*, *Physcia* sp., and *Flavoparmelia baltimorensis*.

The lower exposed outcrop has similar vegetation on its top and western side, but vegetation on the east side of this outcrop is dramatically different. Here, soils appear to be more fertile and a small patch of diverse woodland occupies a linear area of rocky soils adjacent to the outcrop and extending somewhat above it. This woodland was assigned by inspection to the Central Appalachian Basic Woodland community type. It grades into a fine stand of Central Appalachian Basic Oak – Hickory Forest (Submontane / Foothills Type) that extends farther east and downslope of the outcrop. The occurrence of Central Appalachian Basic Woodland here covers less than 0.4 ha (1 ac) but is in excellent condition except for the presence of a few *Ailanthus altissima* (tree of heaven) seedlings. Composition is fairly typical with *Fraxinus americana* (white ash), *Carya glabra* (pignut hickory), *Quercus prinus* (chestnut oak), and *Tilia americana* var. *americana* (American basswood) forming an open, short overstory. The shrub layer is open and contains *Ulmus rubra* (slippery elm), *Cercis canadensis* var. *canadensis* (eastern redbud), *Amelanchier arborea* (downy serviceberry), *Vaccinium stamineum* (deerberry), *Spiraea betulifolia* var. *corymbosa* (dwarf spiraea), *Rosa carolina* var. *carolina* (pasture rose), and *Vitis aestivalis* (summer grape). *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oat-grass), *Helianthus divaricatus* (woodland sunflower), and *Solidago ulmifolia* var. *ulmifolia* (leaf-leaf goldenrod) are the most common herbs. Other noteworthy herbs are *Dichanthelium boscii* (Bosc's panic grass), *Pycnanthemum incanum* (hoary mountain-mint), *Eupatorium sessilifolium* var. *sessilifolium* (upland boneset), *Symphyotrichum cordifolium* (= *Aster cordifolius*, heart-leaved aster), *Symphyotrichum undulatum* (= *Aster undulatus*, wavy-leaved aster), *Heuchera americana* (American alumroot), *Ambrosia artemisiifolia* (common ragweed), *Woodsia obtusa* ssp. *obtusa* (blunt-lobed woodsia), *Antennaria plantaginifolia* (plantain-leaf pussytoes), *Penstemon canescens* (gray beardtongue), *Lespedeza intermedia* (wand bushclover), *Silene stellata* (starry campion), *Solidago arguta* (cut-leaved goldenrod), and *Campanula divaricata* (southern hairbell).

The pronounced differences in vegetation and apparent soil fertility observed at this site may be related to wide, site-level variability in chemical composition of the Blue Ridge granitic complex.

RARE PLANTS: No rare or watchlist plants were found at this site.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

Plate 43. Smooth, steep, exfoliating granite outcrop at Oventop.

THREATS: Low cover of characteristic umbilicate and foliose lichens, as well as the presence of *Digitaria ischaemum* var. *ischaemum* (smooth crabgrass), on the northeasternmost outcrop near the trail may be indicative of heavier past use and trampling. There is no current threat from trampling due to remote location and vegetation being restricted to a few isolated pockets on these outcrops.

The invasive exotic tree *Ailanthus altissima* (tree-of-heaven) is a problem on and around the lower outcrop, and is likely to become more abundant over time. *Commelina communis* (Asiatic dayflower) is also present in the significant woodland and represents a potential threat to the native species of this community. Both species are ranked as invasive by DCR-DNH and are best controlled before their number become too large to feasibly control, but current abundance levels do not warrant management actions.

MANAGEMENT RECOMMENDATIONS:

No management required at this site.

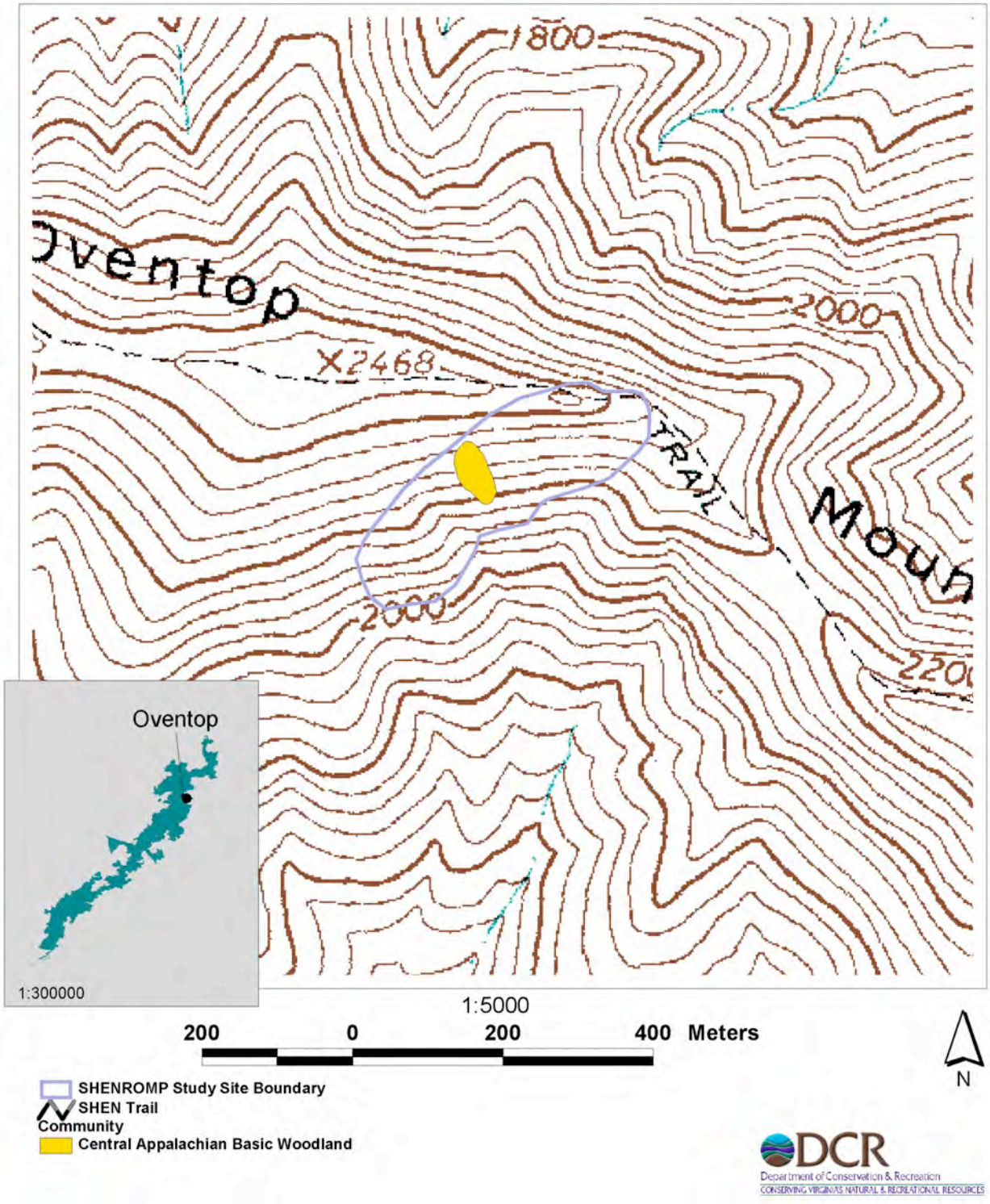


Fig 40. Location of significant natural community at Oventop.

MARYS ROCK (C31)

CONSERVATION SITE: SNP Pinnacles (B1) **THREAT RANK:** 2

LOCALITY: Page and Rappahannock Counties **QUADRANGLE(S):** Thornton Gap

LOCATION: Located west of Skyline Drive, this is the northernmost site in the Central District. It extends from 0.49 km (0.30 mi) west to 0.68 km (0.43 mi) southwest of Tunnel Parking Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Kalmia latifolia - *Gaylussacia baccata* - *Vaccinium* (*angustifolium*, *pallidum*) - *Menziesia pilosa* Shrubland	Central Appalachian Heath Barren	G2	S1	None	None	AB
Plants:						
Aralia hispida	Bristly sarsaparilla	G5	S2	None	None	B
Huperzia appalachiana	Appalachian fir-clubmoss	G4G5	S2	None	None	C
Solidago randii[1]	Rand's goldenrod	G5T4	S2S3	None	None	
Animals: None						

[1] This element occurrence was searched for in both 2005 and 2006 but was not relocated.

SITE DESCRIPTION: The prominent feature of this site is a northwest-facing granitic cliff about 30 m (100 ft) high and 145 m long. A flat area at the northeastern end of the cliff top is easily accessed by the Marys Rock Peak Trail, a short trail connecting to the Appalachian Trail. Most of the remainder of the open cliff top has a jagged, irregular surface, discouraging all but the heartiest visitors from off-trail exploration. However, the slope bordering the outcrop from the east is relatively gentle, and numerous social trails provide access to various points on the outcrop. Large boulder and talus under a forest canopy occupy the steep northwest-facing slope below the northeastern end of the site. Other areas below the cliff top were not explored in 2005.

NATURAL COMMUNITIES: Gypsy moth-damaged Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type) ascends the eastern slope of the site to the base of the outcrops. Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type) occupies bouldery colluvium on the steep western slope below the outcrop. The line of massive exposed rocks supports a more or less continuous patch of Central Appalachian Heath Barren covering approximately 0.18 ha (0.44 ac). This shrubland occupies the rocky summits and extends down the cliff-like western flank of the outcrop on ledges and shelves. The barrens are dominated by stands of *Kalmia latifolia* (mountain-laurel), with variable co-dominance by *Sorbus americana* (American mountain-ash), and *Vaccinium pallidum* (early lowbush blueberry). Additional shrubs occurring in the stand include *Gaylussacia baccata* (black huckleberry), *Photinia melanocarpa* (black chokeberry), *Ilex montana* (mountain holly), *Hamamelis virginiana* (witch-hazel), and *Quercus ilicifolia* (bear oak). Severely stunted specimens of *Betula alleghaniensis* (yellow birch) and *Quercus rubra* (northern red oak) are scattered in the shrublands. Small patches of *Carex pensylvanica* (Pennsylvania sedge), *Dichanthelium acuminatum* (woolly panic grass), *Aralia hispida* (bristly sarsaparilla), *Solidago arguta* var. *arguta* (cut-leaved goldenrod), *Dennstaedtia punctilobula* (hayscented fern), and *Saxifraga michauxii* (Michaux's saxifrage)

contribute to a sparse herbaceous flora. The vegetation is patchy and interspersed with sizeable rock faces unvegetated by vascular plants. Prominent lichens on inaccessible and untrampled faces include *Lasallia papulosa*, *Lasallia pensylvanica*, *Dimelaena oreina*, *Rhizoplaca subdiscrepens*, *Stereocaulon glaucescens*, and several crusts. Quantitative plot data were collected from this stand during the ROMP project (plot SHNP139). Although locally damaged by hiker trampling and social trails, much of the occurrence is located on inaccessible areas of the Marys Rock outcrop.

RARE PLANTS: Two rare plants, *Solidago randii* (Rand's goldenrod) and *Huperzia appalachiana* (Appalachian fir-clubmoss), were previously known from this site. *Solidago randii* could not be relocated at the site in either September 2005 or October 2006. A small population of this species was reported from the top of the granite cliff on 17 September 1990. Only 10-20 clumps were found here within a few square meters. The population at that time was of below average vigor due to habitat degradation and confinement to an area with more than usual competition from other plants. This is the only population of the goldenrod in SHEN known from a granitic substrate and only one of two found on a substrate other than Cactoctin Formation metabasalt.

The previously known population of *Huperzia appalachiana* was relocated at this site on 3 October 2006. About 20 mature clumps and 80 small, young plants were found within a 4 x 7 m (13 x 23 ft) area on shady ledges at the foot of a north northwest-facing cliff. This area is directly below the overlook at the upper terminus at the Marys Rock Peak Trail. Plants here appeared healthy and many mature clumps had both gemmae and sporangia.

On 16 June 2006, a population of *Aralia hispida* was found near the south end of the outcrop. This species was not previously known from this site, and probably appeared after the area burned in the large fire of 2000. The population contained 35 budding and full-grown sterile plants in a 25 m^2 (269 ft^2) area, plus several additional plants in a second area a few meters from the first. The plants occupied soil pockets on a sunny, sloping outcrop around the edge of dense shrub thickets and a social trail.

RARE ANIMALS: No animal element occurrences were found during DCR-DNH surveys in 2006. One watchlist moth, *Euchlaena tigrinaria* (mottled Euchlaena moth) was captured here in a UV-trap on 29 June 2006.

Plate 44. Central Appalachian Heath Barren at the south end of Marys Rock.

THREATS: Severe loss of vegetation, lichen and bryophyte cover, and organic soil mats has occurred due to visitor trampling in the level area at the north end of Marys Rock, at the terminus of the Marys

Rock Peak Trail. In this area, the substrate has been reduced to severely compacted gravel and silt. *Solidago randii* has apparently been extirpated from the site because of this. Trampling has also denuded smaller ledges and crevices leading to the summit outcrop.

No invasive species were seen on the outcrops themselves. *Polygonum caespitosum* var. *longisetum* (long-bristled smartweed) was found along Appalachian Trail within the rock outcrop site, but not within the significant barrens community on the outcrop.

A campfire ring was found on the backside of the summit rocks, and a social trail leads to it from the Appalachian Trail. A network of social trails traverses the east side of the outcrop and provides access to several places on the outcrop, including a level shelf near the south end. These trails have caused soil erosion and damage to vegetation of the significant Central Appalachian Heath Barren community, but such damage is not yet severe.

The Appalachian fir-clubmoss is located in an area that is difficult to access and currently receives no visitation. Bristly sarsaparilla is believed to be a fire dependent species that cannot compete with other species in the absence of periodic wildfire or prescribed burning.

MANAGEMENT RECOMMENDATIONS:

Contain visitation to the north end overlook outcrop. Use signs to inform visitors of the sensitive resources and their conservation value. If necessary, use a barrier to keep visitors from scrambling up the summit outcrop from the overlook. See Figure 45.

Close social trail on the east side of the outcrop leading to the south end. Close the social trail. See Figure 45.

Prohibit camping at this site.

Determine feasibility of allowing prescribed wildfire at this site. The rare plant *Aralia hispida* and the Central Appalachian Heath Barren would benefit from a more frequent fire return interval. The SHEN fire manager should be consulted during the development of the rock outcrop management plan to determine feasibility of allowing wildfire to burn this site.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the rare plants and the health of the rare natural community. Following management actions, conduct annual monitoring to assess rare plant populations and the rare Central Appalachian Heath Barren. Include a survey for invasive plants.

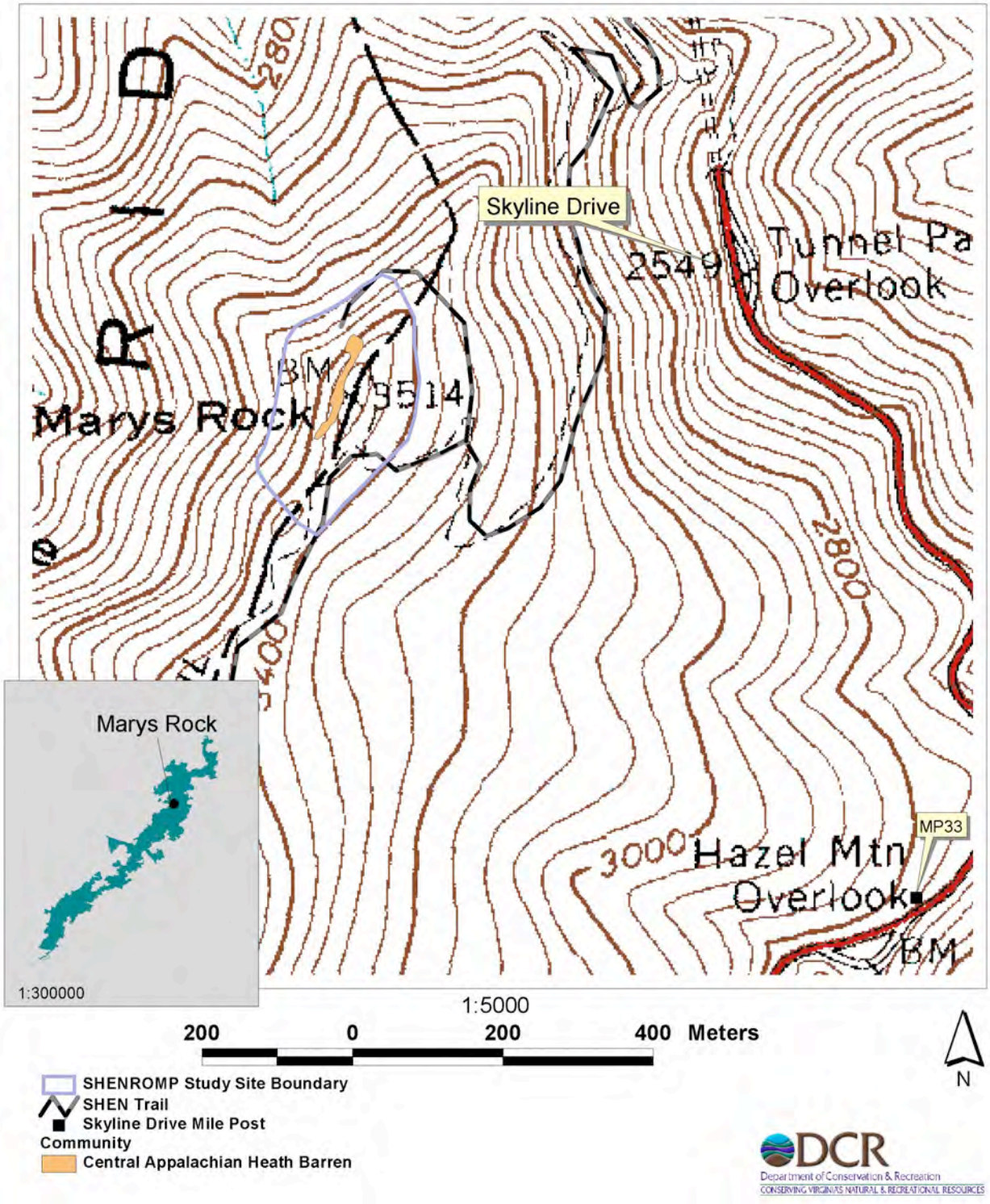


Fig. 41. Location of significant natural community at Marys Rock.

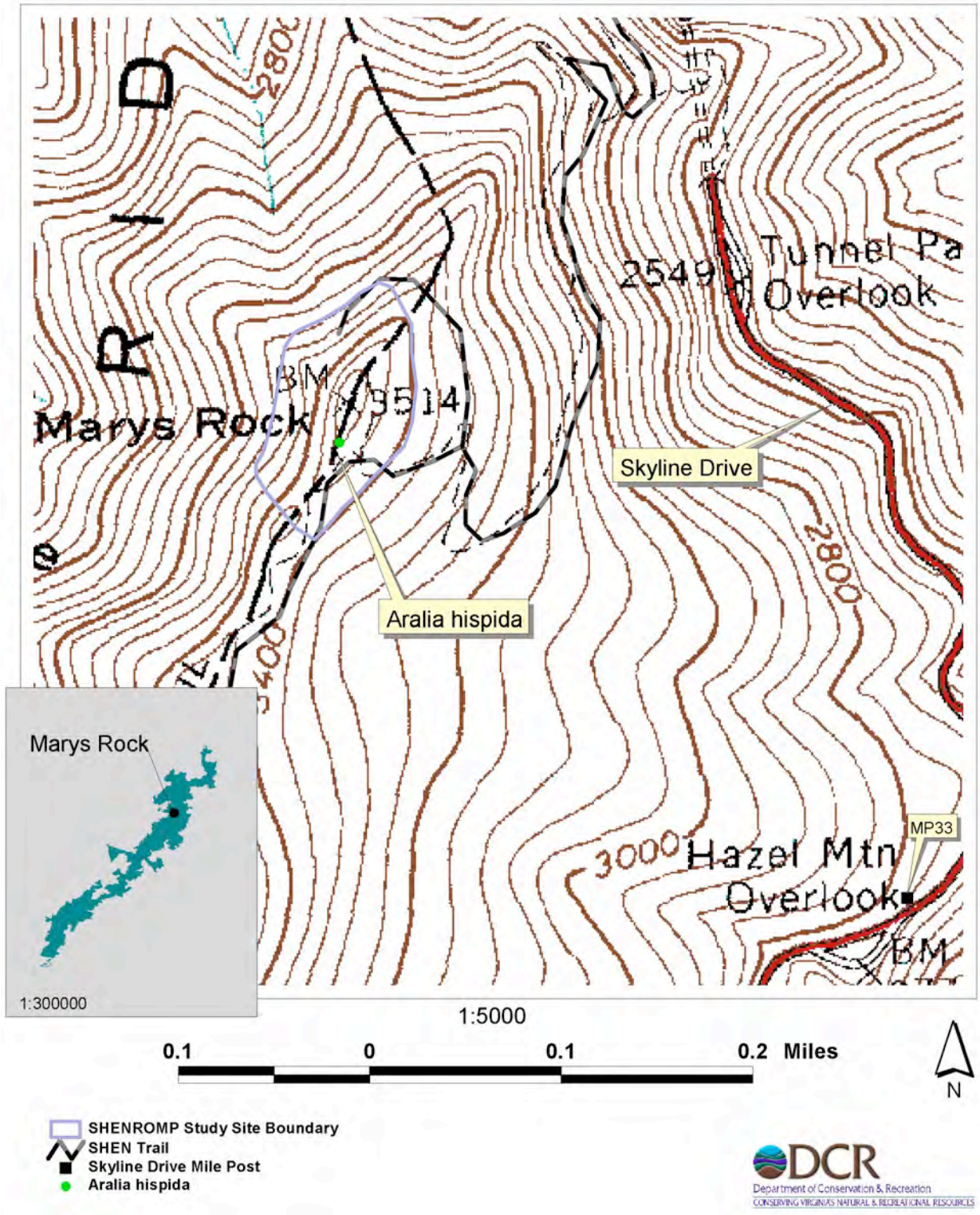


Fig. 42. Location of *Aralia hispida* at Marys Rock.

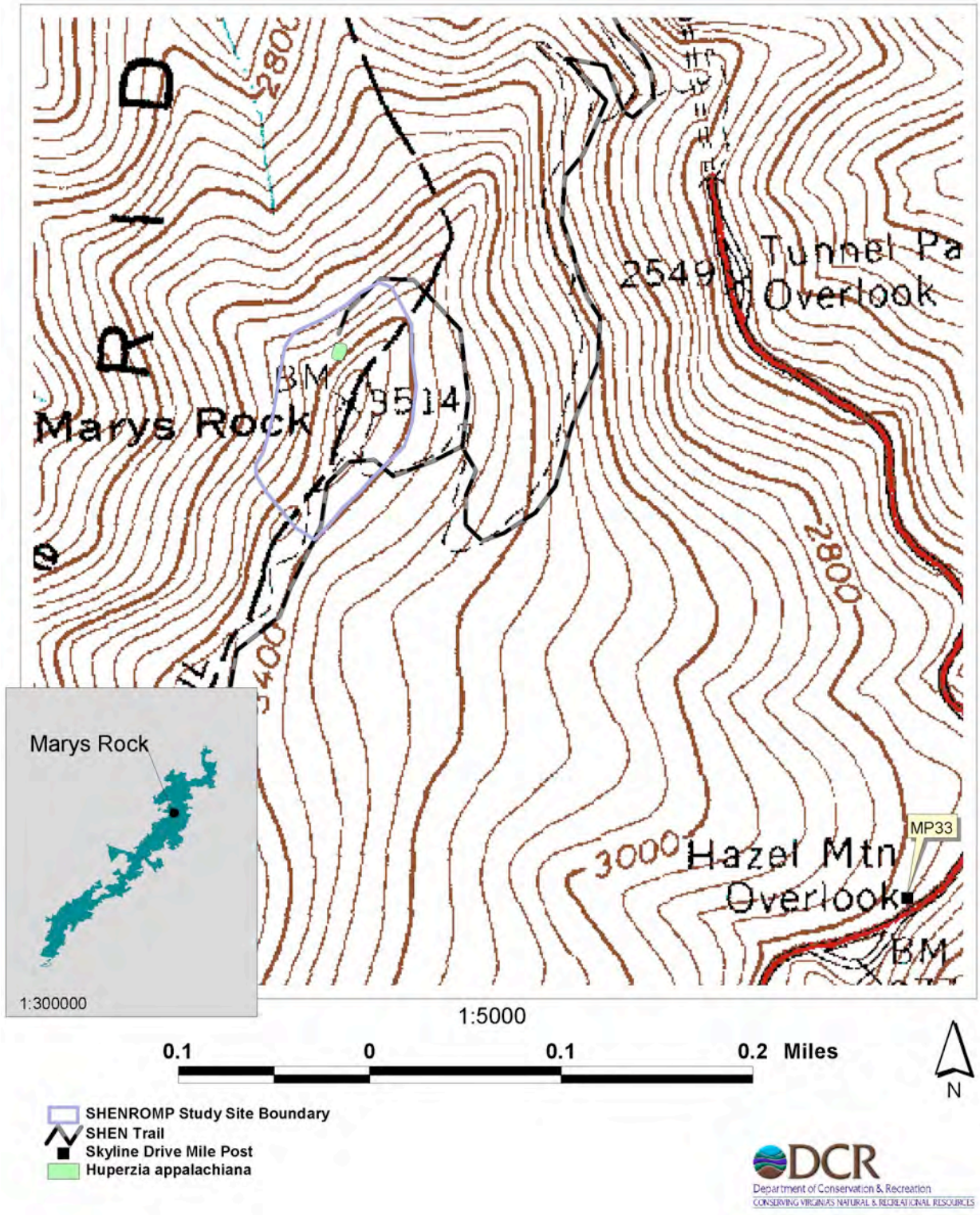


Fig. 43. Location of *Huperzia appalachiana* at Marys Rock.

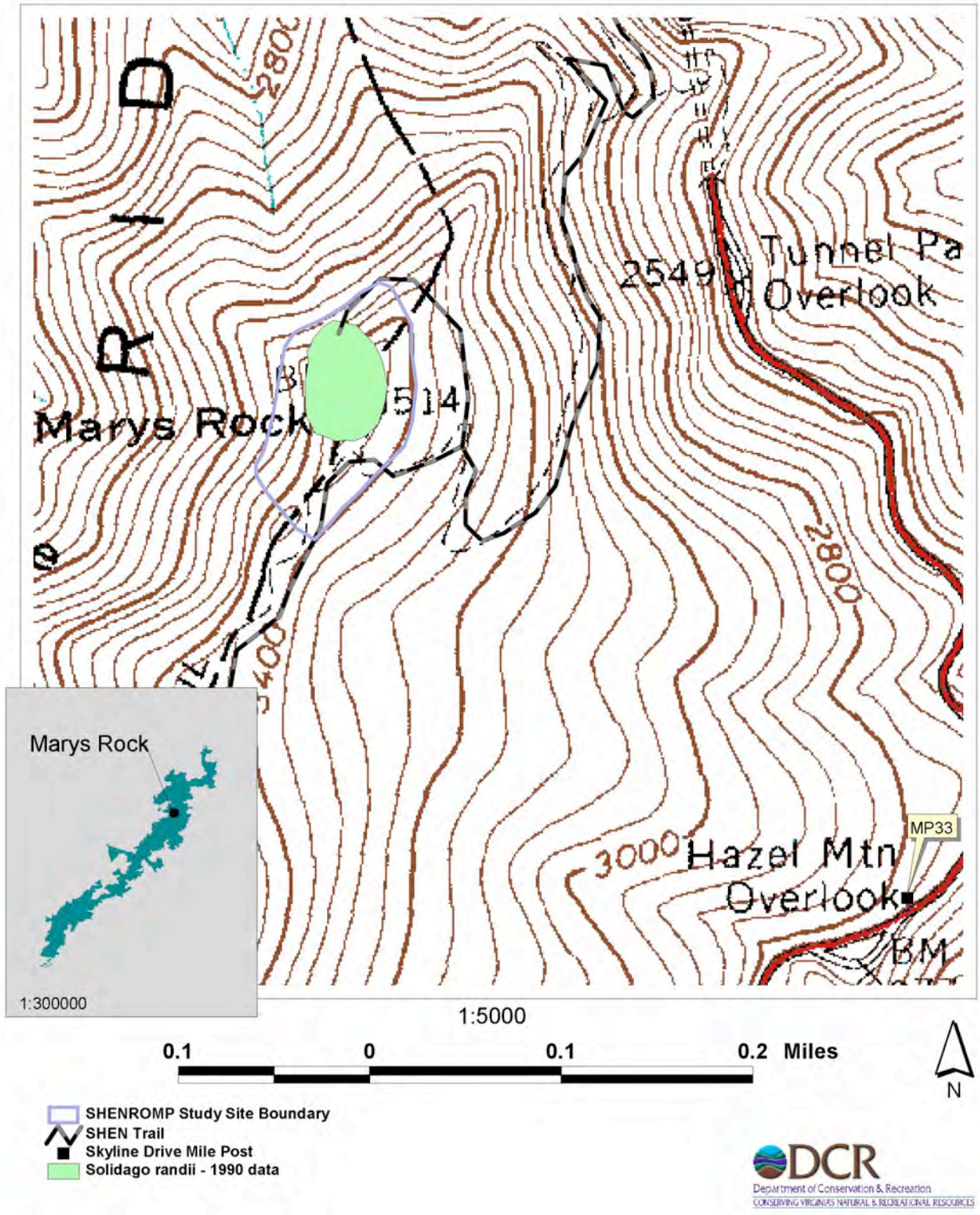


Fig. 44. Location of 1990 occurrence of *Solidago randii* at Marys Rock.

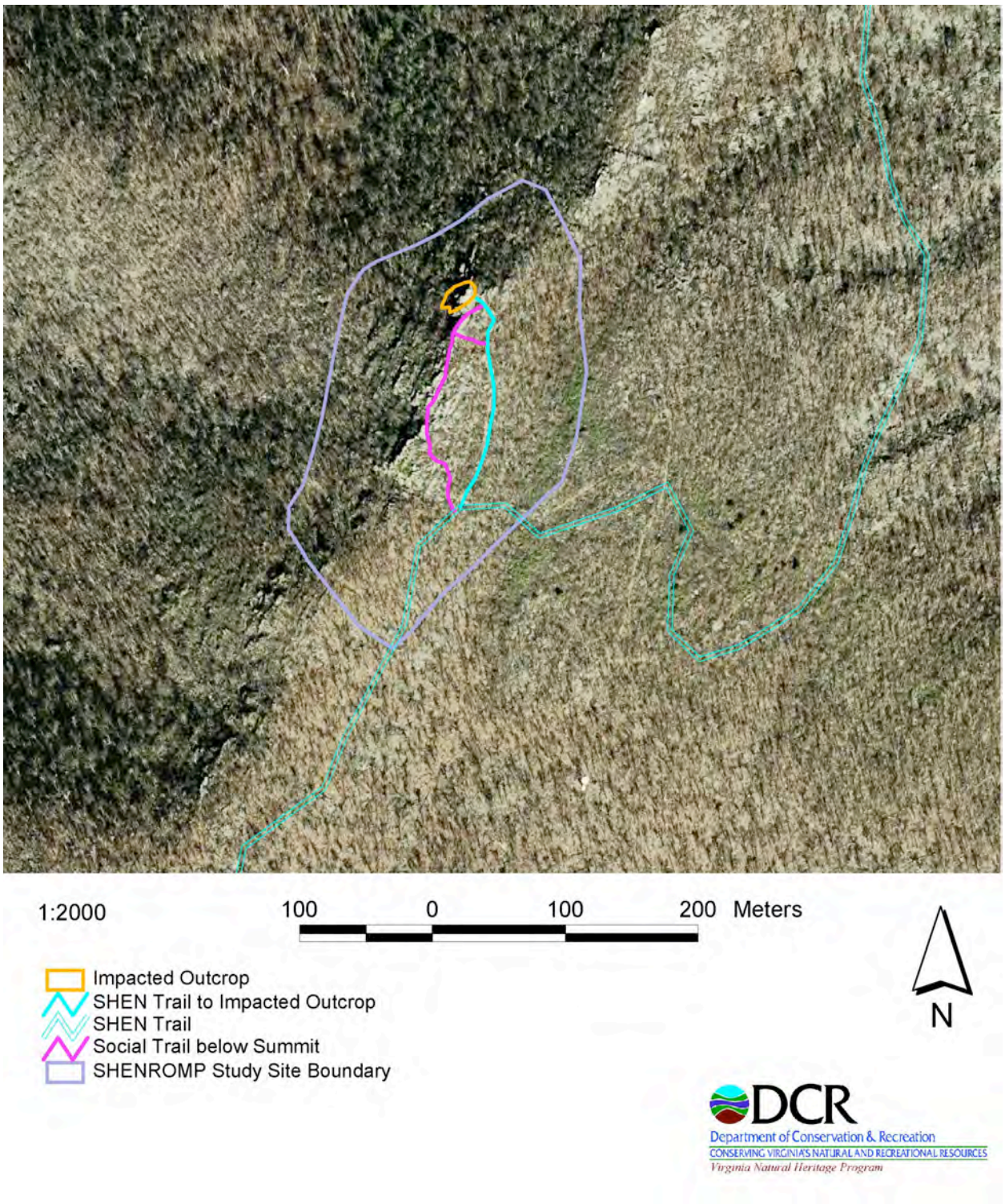


Fig. 45. **S**ite details for Marys Rock, including the location of social trail recommended for closure.

PINNACLES (C41)

CONSERVATION SITE: SNP Pinnacles (B1) **THREAT RANK:** 1

LOCALITY: Page and Rappahannock Counties **QUADRANGLE(S):** Thornton Gap

LOCATION: This site is located in the Central District west of Skyline Drive. It extends from 0.72 km (0.52 mi) east to 1.04 km (0.73 mi) northeast of Jewell Hollow Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula alleghaniensis / *Sorbus americana* - *Acer spicatum* / *Polypodium appalachianum* Forest	Central Appalachian High-Elevation Boulderfield Forest	G2	S2	None	None	A
Kalmia latifolia - *Gaylussacia baccata* - *Vaccinium* (*angustifolium*, *pallidum*) - *Menziesia pilosa* Shrubland	Central Appalachian Heath Barren	G2	S1	None	None	A
Plants:						
Aralia hispida	Bristly sarsaparilla	G5	S2	None	None	C
Huperzia appalachiana	Appalachian fir-clubmoss	G4G5	S2	None	None	AB
Animals:						
Plethodon shenandoah[1]	Shenandoah salamander	G1	S1	LE	LE	A

[1]Based on a previously documented record (DCR-DNH Biotics data). This element occurrence (eo) has not been updated by DCR-DNH for this report. Part of this eo lies outside of any ROMP site.

SITE DESCRIPTION: This site encompasses a series of charnockite exposures along a narrow ridge that reaches an elevation of 1,137 m (3,730 ft). Most of the exposures are near the top of the steep northwest flank of this ridge, which curves slightly to form a shallow bowl. Additional exposures are found at the northeastern end of the site along a ridge oriented perpendicular to the main ridge. This ridge drops steeply to the northwest. Most of the exposures at this site are located at elevations between 1,049 m (3,440 ft) and 1,109 m (3,640 ft). Charnockite is a granitic rock.

Rock outcrops at this site are not large, but they are numerous and diverse. The charnockite bedrock here is characterized by strong jointing, forming large angular blocks. Some of these blocks have weathered in place, while others have broken off to form massive piles of jumbled boulders. In some areas, sheer cliffs up to about 20 m (66 ft) high have formed on the downslope sides of outcrops as massive blocks have broken away. Areas of talus often surround outcrops, particularly in the eastern portion of the site.

The Appalachian Trail runs along the ridge just above the main line of rock exposures, and social trails lead to a few small overlooks. Hikers appear to be discouraged from further off-trail exploration in this area by the steep slopes and loose rock -- a combination which results in a treacherous footing.

NATURAL COMMUNITIES: The ridge crest at the extreme southeastern edge of this site is forested with Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type). On the upper slopes, there are a number of large, angular granitic outcrops with steeply sloping faces and deep crevices supporting shrublands classified as Central Appalachian Heath Barrens. The coarser and drier talus weathered off the upper-slope outcrops supports a large and outstanding occurring of Central Appalachian High-Elevation Boulderfield Forest. On concave slopes where more soil has accumulated among the bouldery colluvium, the woodland transitions into a mature stand of Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type) that extends well outside the ROMP site boundary.

Six more or less discrete patches of Central Appalachian Heath Barrens covering an aggregate area of approximately 0.3 ha (0.75 ac) were documented. These are dominated by patchy stands of *Kalmia latifolia* (mountain-laurel), with lesser numbers of *Sorbus americana* (American mountain-ash), *Menziesia pilosa* (minniebush), *Gaylussacia baccata* (black huckleberry), *Photinia melanocarpa* (black chokeberry), and *Vaccinium angustifolium* (northern lowbush blueberry). Severely stunted specimens of *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak), *Prunus pensylvanica* (pin cherry), and *Tsuga canadensis* (eastern hemlock) are also scattered in the shrublands. Herbaceous plants are uncommon. However, small patches of *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Dennstaedtia punctilobula* (hayscented fern), *Aralia hispida* (bristly sarsaparilla), *Carex pensylvanica* (Pennsylvania sedge), and *Campanula divaricata* (southern hairbell) occupy exposed shelves and crevices on the outcrops. More shaded and protected microhabitats under the shrubs and against rock faces support *Aralia nudicaulis* (wild sarsaparilla), *Maianthemum canadense* (Canada may-flower), and *Huperzia appalachiana* (Appalachian fir-clubmoss). The vegetation is patchy and interspersed with sizeable areas of rock face unvegetated by vascular plants. Excepting one of two small outcrops that serve as viewpoints off the Appalachian Trail, the rocks at this site are densely covered by lichens. Characteristic species include *Lasallia pensylvanica* (abundant), *Lasallia papulosa* (abundant), *Stereocaulon glaucescens*, *Melanelia stygia*, *Porpidia* sp., *Umbilicaria muehlenbergii*, *Acarospora fuscata*, *Rhizocarpon reductum*, *Rhizocarpon geographicum*, *Dimelaena oreina*, *Rhizoplaca subdiscrepens*, *Usnea cf. halei*, *Xanthoparmelia conspersa*, and many gray and dark crusts. Some of the *Kalmia latifolia* branches in the significant shrublands are covered by the arboreal lichen *Pseudevernia consocians*. Quantitative plot data were collected from this occurrence during the ROMP project (plots SHNP141 and SHNP142).

The Central Appalachian High-Elevation Boulderfield Forest at this site is one of the finest occurrences of the type. It is dominated by highly gnarled and stunted (6-10 m [10-33 ft] tall) specimens of *Betula alleghaniensis* and shrub-sized *Sorbus americana*. *Acer spicatum* (mountain-maple), *Menziesia pilosa*, and *Prunus pensylvanica* are also frequent or common in the shrub layer. The few microhabitats on the large-block boulders capable of supporting herbaceous plants tend to support dense colonies of *Polypodium appalachianum* (Appalachian rock polypody). Nevertheless, scattered individuals and patches of *Aralia nudicaulis*, *Oclemena acuminata* (= *Aster acuminatus*, whorled aster), *Carex brunnescens* ssp. *sphaerostachya* (brownish sedge), and *Hylotelephium telephioides* (Allegheny stonecrop) occur. Species-richness is very low (~ 11 taxa per 400 m^2). Plot data were collected from this stand in 1999 (plot SHNP037).

RARE PLANTS: Nine flowering plants and several juveniles of *Aralia hispida* were noted on a 3 m^2 (32 ft^2) area of a sloping granite face on June 30, 2006. These plants were growing in the open and in partial shade of *Kalmia latifolia* and other shrubs. This species was not previously known from this site and may have appeared after the area burned in the large fire of 2000.

About 470 clumps of *Huperzia appalachiana* (Appalachian fir-clubmoss) were counted within six subpopulation areas at this site on May 10, 2006. The approximate number of clumps and size of each area follows here, beginning with the southeasternmost and proceeding to the northeasternmost: 70

clumps within a 2 x 5 m (6 x 15 ft) area, 60 clumps within a 5 x 8 m (15 x 25 ft) area, 50 clumps within a 9 x 15 m (30 x 50 ft) area, 110 clumps within a 3 x 21 m (10 x 69 ft) area, 60 clumps within a 2 x 5 m (5 x 15 ft) area, and 120 clumps within a 5 x 12 m (15 x 40 ft) area. Most clumps were found at the base of cliffs or large outcrops, favoring northern or eastern exposures. A smaller number of plants were found on open talus.

Many dead or chlorotic clumps of *Huperzia appalachiana* were observed here, and population numbers appear to have declined dramatically from an estimated 850 mature clumps reported in 1990. A fire swept through the population area in 2000, which may have resulted in the loss of *Huperzia appalachiana* plants both directly and by creating a drier, more exposed microhabitat due to woody plant mortality. Strong winds and ice storms may also have contributed to the many downed trees observed in the area.

Numerous young plants were also observed, indicating healthy recruitment. Gemmae were present in large quantities on older clumps, and sporangia have been observed on mature plants in this population during the summer and fall months.

RARE ANIMALS: No new animal element occurrences were found during 2006 surveys. *Plethodon shenandoah* (Shenandoah salamander) was previously known from this area. *Plethodon shenandoah*, endemic to SHEN, utilizes forested talus slopes and is known from only five locations. Pague (1991) suggests that the range of *Plethodon shenandoah* at Pinnacles encompasses all but the extreme southwest corner of the ROMP boundary. Maps provided by SHEN, however, indicate that *Plethodon shenandoah* is west and northeast of the ROMP site (Sanders, 2005). The USFWS recovery plan maps suggest that there is suitable habitat within the ROMP site (USFWS, 1994). It should be assumed that it does occur within the site until further surveys can unequivocally determine otherwise.

In addition, two watchlist moth species were captured in a UV-trap on 29 June 2006: *Euchlaena tigrinaria* (mottled Euchlaena moth) and *Nemoria mimosaria* (an emerald moth).

Plate 45. Central Appalachian Heath Barren shrubs growing in crevices of charnockite at Pinnacles.

THREATS: Except in one small overlook area immediately adjacent to the Appalachian Trail, the rare Central Appalachian Heath Barren community is in pristine condition. Considerable trampling has occurred at the overlook by the trail. However, visitors are constrained to a very limited area here, since the rock faces drop off steeply and rapidly.

While the 2000 fire may have had a negative impact on the *Huperzia appalachiana* population, it is believed to have benefited the *Aralia hispida* occurrence. The rare plant populations at this site are located in areas that are difficult to access and, consequently, have not been impacted by hiker trampling.

Until recently, the primary threat to *Plethodon shenandoah* was thought to be inter-specific competition with *Plethodon cinereus* (red-backed salamander). In general terms, in the drier conditions typically found in talus, *Plethodon shenandoah* can compete with *Plethodon cinereus* (Thurow, 1976; Jaeger, 1974); however, it is believed that alterations in climatic conditions may tip the balance to favor *Plethodon cinereus*. In addition, natural succession of the talus, through weathering and soil formation, would also favor *Plethodon cinereus* (Jaeger, 1970). Recent thought is that there are also human-related factors that may adversely impact the rare species. These include acid deposition in the atmosphere and forest defoliation associated with introduced pest species. Further, there may be impacts from activities such as trail building and maintenance and camping that adversely impact *Plethodon shenandoah* either directly or by enabling *Plethodon cinereus* to out compete it (U.S. Fish and Wildlife Service, 1994).

MANAGEMENT RECOMMENDATIONS:

Determine feasibility of allowing prescribed wildfire at this site. The rare plant *Aralia hispida* and the Central Appalachian Heath Barren would benefit from a more frequent fire return interval. The SHEN fire manager should be consulted during the development of the rock outcrop management plan to determine feasibility of allowing wildfire to burn this site.

Monitor the rare plants and the health of the rare natural communities. Conduct a survey on a 3-5 year interval to assess rare plant populations and the health of the two rare natural community types. Include a survey for invasive plants.

Conduct survey to determine if *Plethodon shenandoah* does occur in the study area. If it does, the possible impacts of trampling and trails through talus areas should be assessed. Rock climbing on vertical surface should not impact this species, though caution should be used if any staging areas for climbers are within *Plethodon shenandoah* sites.

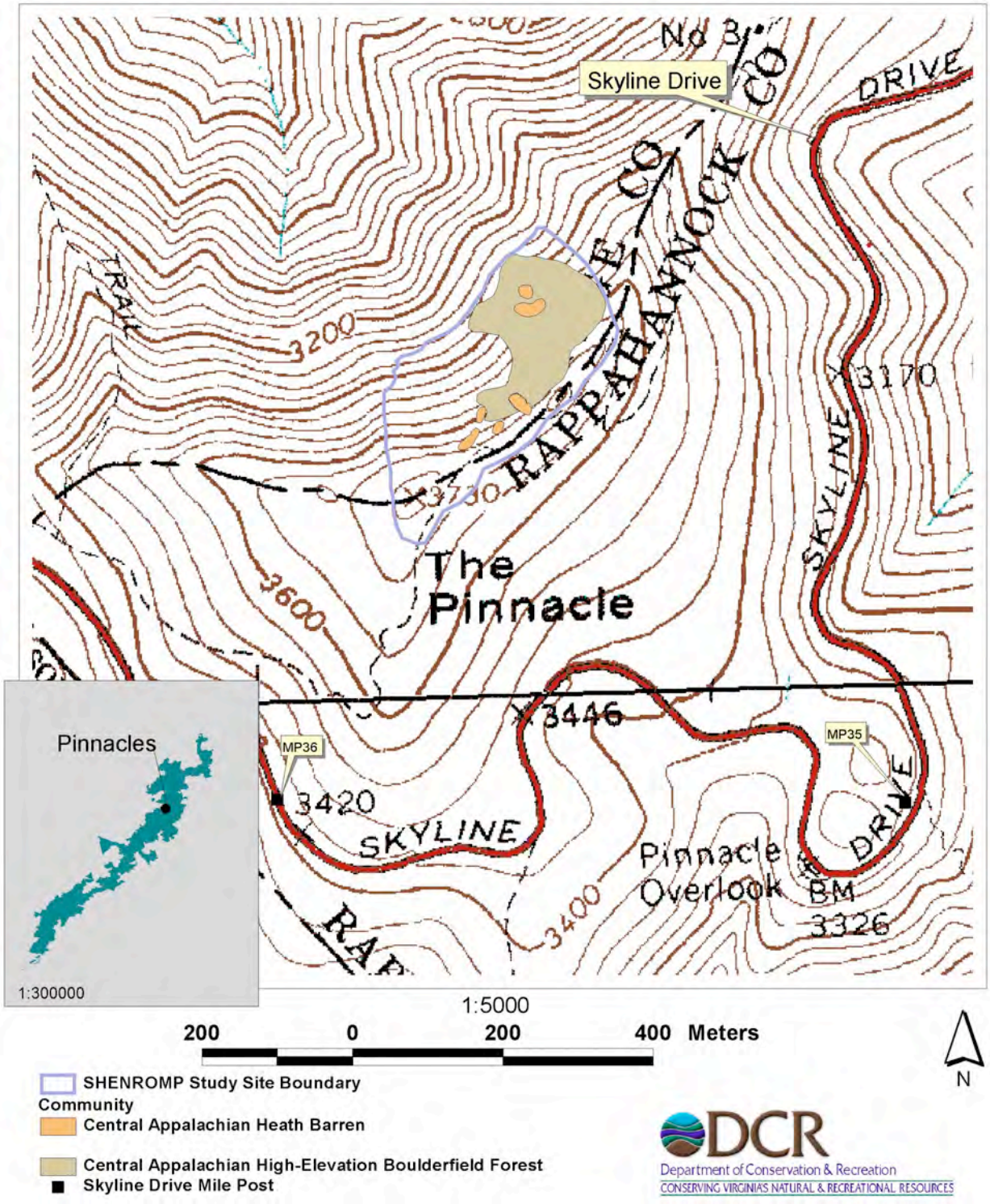


Fig. 46. Location of significant natural communities at Pinnacles.

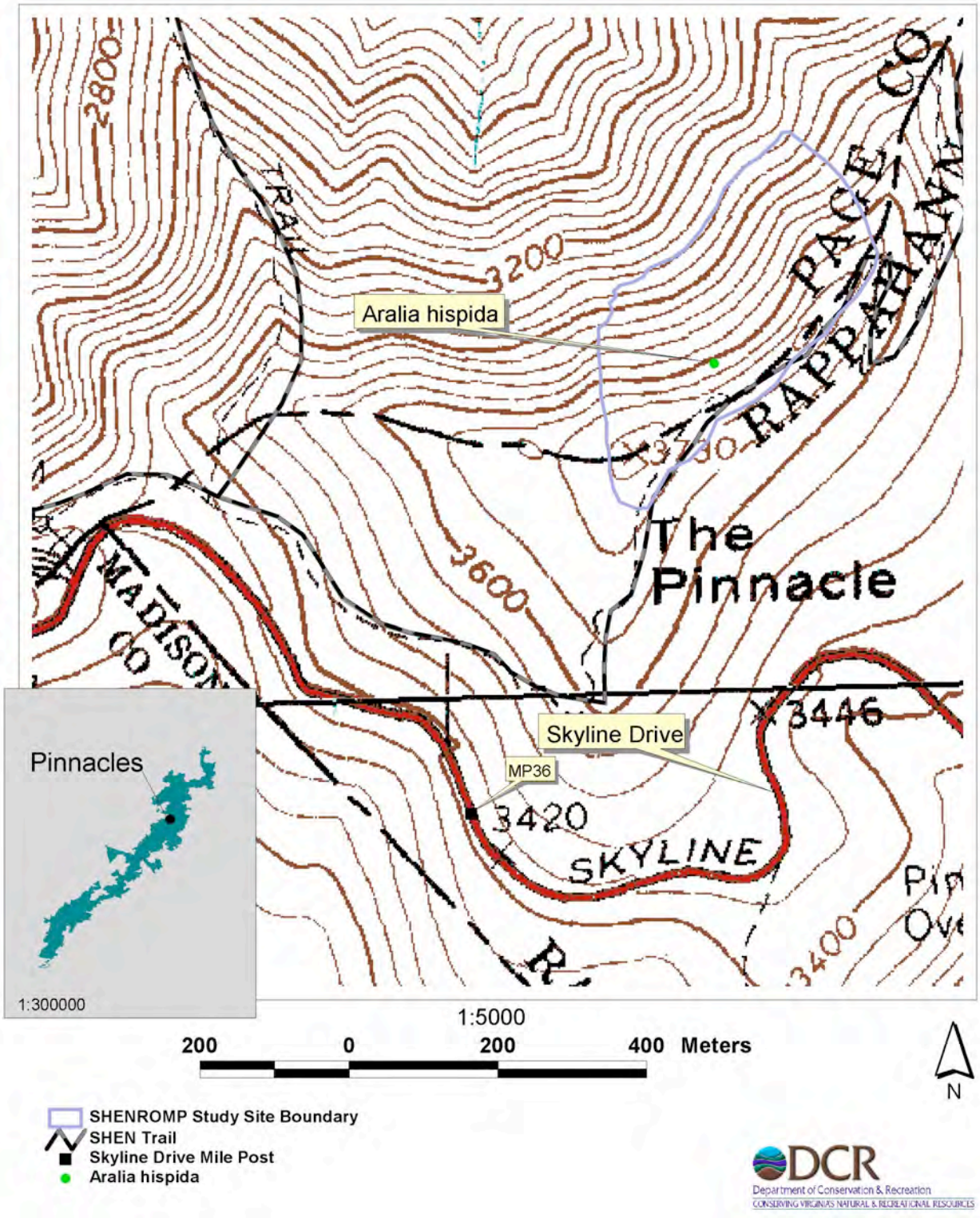


Fig. 47. Location of *Aralia hispida* at Pinnacles.

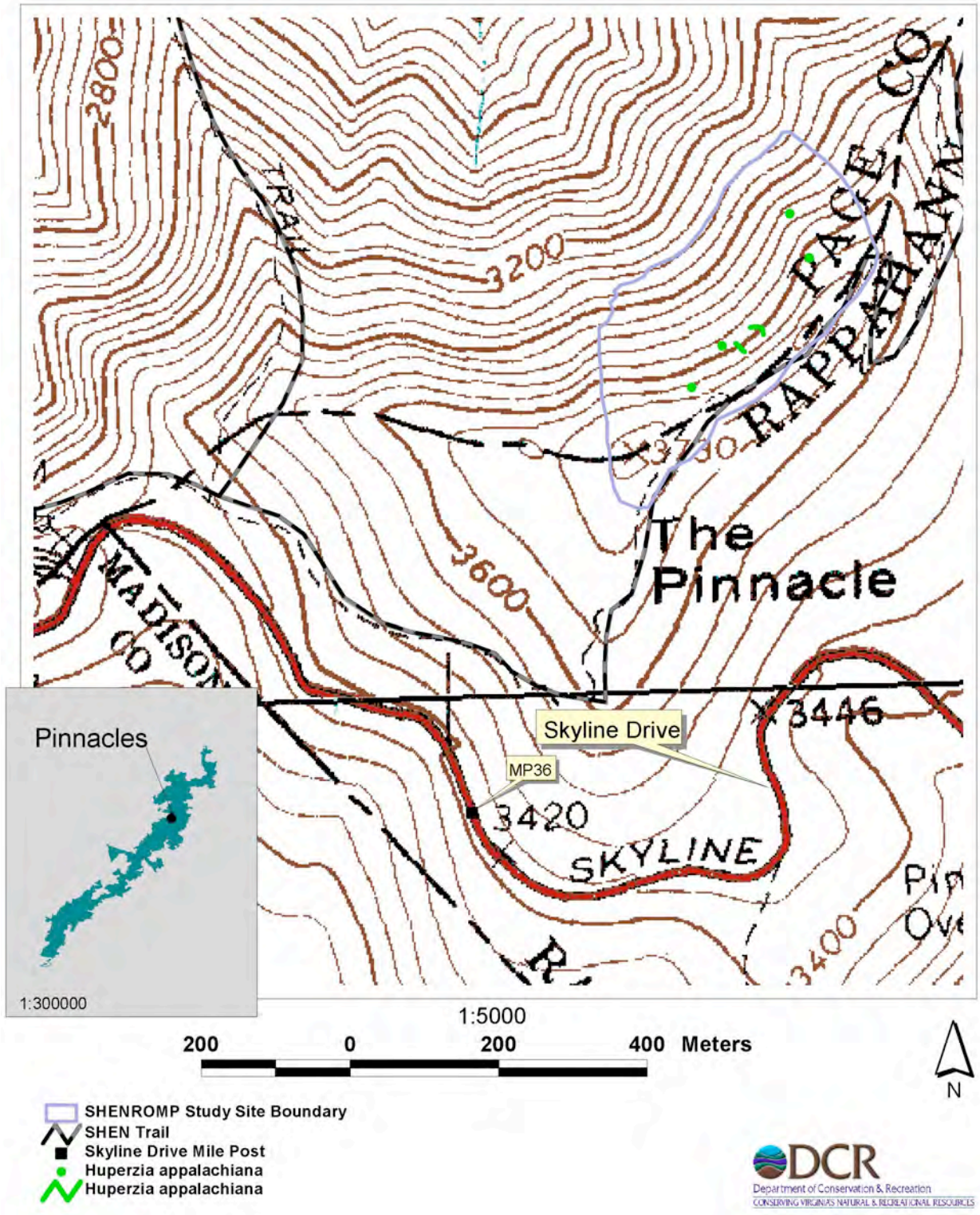


Fig. 48. Location of *Huperzia appalachiana* at Pinnacles.

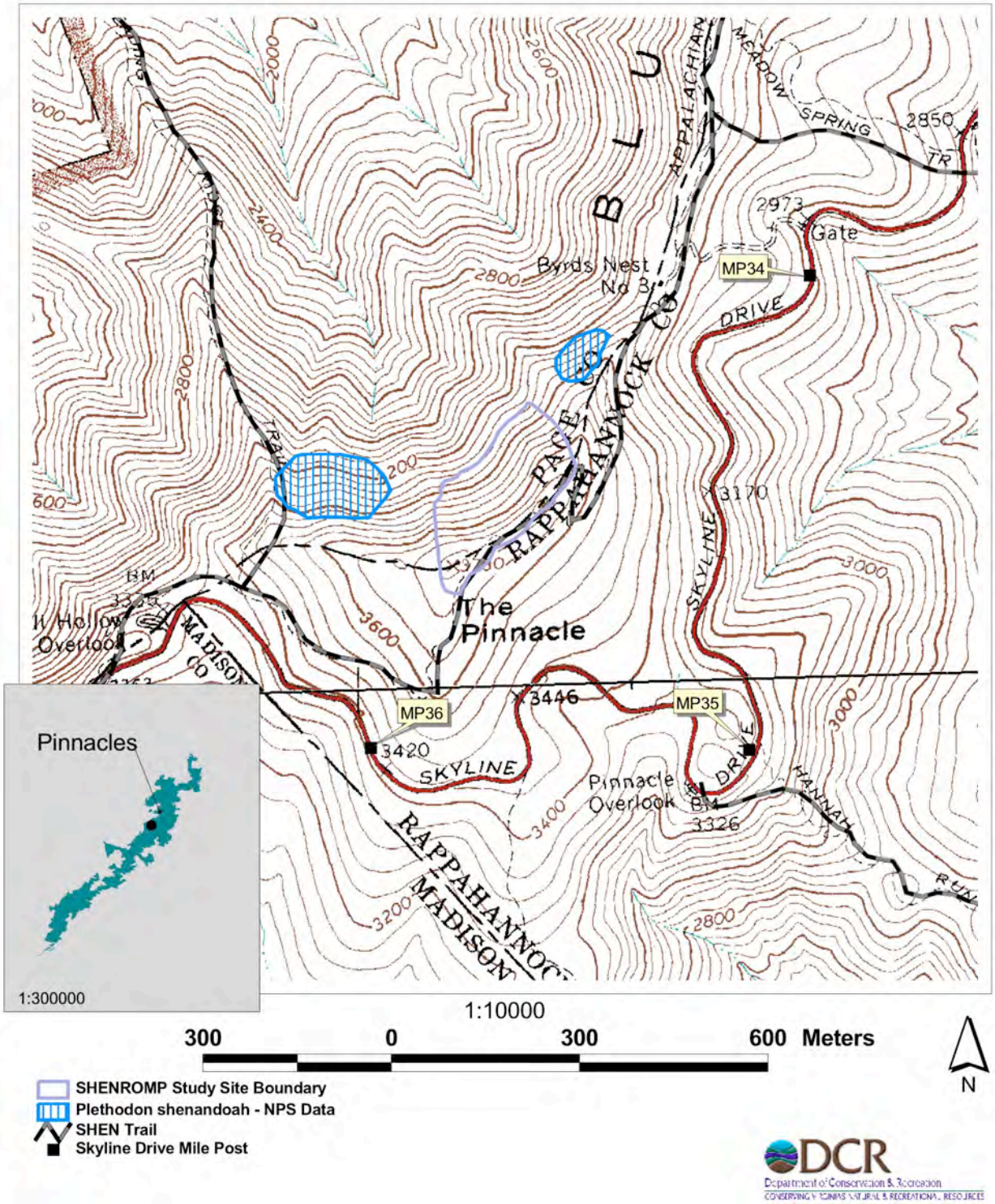


Fig. 49. Location of *Plethodon shenandoah* at Pinnacles.

LITTLE STONY MAN (C28)

CONSERVATION SITE: Stony Man Mountain (B1) **THREAT RANK:** 3

LOCALITY: Page and Madison Counties **QUADRANGLE(S):** Old Rag Mountain

LOCATION: This Central District site is located west of Skyline Drive. It extends from 0.71 km (0.44 mi) to 1.08 km (0.67 mi) south-southwest of Stony Man Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum Forest[1]	Central Appalachian High-Elevation Boulderfield Forest	G2	S2	None	None	A
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation[2]	High-Elevation Greenstone Barren	G1	S1	None	None	B
Plants:						
Huperzia appalachiana[2]	Appalachian fir-clubmoss	G4G5	S2	None	None	B
Rubus idaeus ssp. *strigosus*[1]	Red raspberry	G5T5	S2	None	None	A
Sibbaldiopsis tridentata[2]	Three-toothed cinquefoil	G5	S2	None	None	C
Solidago randii[1]	Rand's goldenrod	G5T4	S2S3	None	None	A
Animals:						
Plethodon shenandoah[1,3]	Shenandoah salamander	G1	S1	LE	LE	A
Semionellus placidus[3]	A millipede	G3	S2	None	None	E

[1] Part of this eo lies within the Stony Man Summit rock outcrop study site and part lies outside of any ROMP site.
[2] Part of this element occurrence (eo) lies within the Stony Man Summit ROMP site.
[3] Based on a previously documented record (DCR-DNH Biotics data). This eo has not been updated by DCR-DNH for this report.

SITE DESCRIPTION: This complex site features two large cliffs, two smaller outcrops, extensive talus, and two small cave-like rock shelters. The bedrock here is Catoctin Formation metabasalt.

An upper cliff faces west northwest to northwest at elevations between 1,049 m (3,440 ft) and 1,073 m (3,520 ft). The top of this cliff is about 100 m (328 ft) long. At the northern end, the exposure drops to the northwest in jumble of broken metabasalt columns and talus. To the south, the steep face extends to a height of about 21 m (70 ft) and supports numerous ledges.

Two small outcrops are located to the south and southwest of this cliff and are part of the same metabasalt flow. A very small outcrop, with only a few square meters of open top, is located about 35 m (ll5 ft) south of the southern end of the cliff. A larger outcrop, with an open top of about 250 m^2 (2,690 ft^2), is located about 40 m (131 ft) to the southwest of the cliff end.

A lower cliff faces northwest at elevations between about 1,000 m (3,280 ft) and 1,036 m (3,400 ft). Much of the 40 m (131 ft) top of this cliff is occupied by an overlook along the Passamaquoddy Trail. From this overlook, hikers look down about 40 m (131 ft) to what appears to be the base of this cliff. This is only a vegetated bench, however, that disguises an additional drop of perhaps 80 m (262 ft).

Numerous areas of metabasalt talus are found scattered throughout this site. An extensive area of talus flanks the southern end of the lower cliff, and smaller patches are found to the north of that cliff. Another large area of talus is found on the northeast-facing slope that begins at the northern end of the upper cliff. Much of this slope lies to the east of the site area. Talus fields in the area range from forested to fairly open.

Project geologist Eric Butler located two small rock shelters at this site. One of these is located on the northeast side of the outcrop located to the southwest of the upper cliff. The other is located about 20 m (66 ft) downslope from the overlook along the Passamaquoddy Trail. No known rare plants or animals are associated with these shelters.

This site area is a short distance from Skyline Drive and is accessed by two trails. The Appalachian Trail runs along the top of the upper cliff. This trail once also led to the outcrop to the southwest of the cliff, but has been rerouted further east. The top of this outcrop has been fenced off and closed to public access as a habitat restoration area. The fence has reduced by not entirely eliminated access to this outcrop.

The Passamaquoddy Trail runs along about 60 percent of the lower cliff where there is a heavily visited overlook. This trail continues to the south along the base of the upper cliff.

NATURAL COMMUNITIES: The gentler forested slopes along the eastern edge of this site are covered by Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type) and one small patch of Hemlock – Northern Hardwood Forest. Two globally rare community types occupy the more exposed outcrops and talus slopes of the site. The globally rare High-Elevation Greenstone Barren, which is endemic to several high-elevation sites in SHEN, occupies exposed ledges, outcrops, and cliff faces. This vegetation type is characterized by patchy thickets of low shrubs and tree saplings interspersed with large open rock surfaces with herbaceous species rooted in crevices and on mats of thin, organic-rich soil. Well-developed, undisturbed ledges and cliff tops are typically covered with a continuous turf of grasses and xerophytic forbs. The occurrence at Little Stony Man covers 0.25 ha (0.6 ac) in three patches, but has been heavily impacted by visitors (see Threats section below). Woody scrub characteristic of the community at this site includes *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Prunus pensylvanica* (pin cherry), *Photinia melanocarpa* (black chokeberry), *Spiraea alba* var. *latifolia* (broad-leaved meadowsweet), *Diervilla lonicera* (northern bush honeysuckle), *Kalmia latifolia* (mountain-laurel), *Sorbus americana* (American mountain-ash), *Gaylussacia baccata* (black huckleberry), *Prunus virginiana* (choke cherry), *Tsuga canadensis* (eastern hemlock), and *Betula alleghaniensis* (yellow birch). Dominant and characteristic herbs are *Solidago randii* (Rand's goldenrod), *Deschampsia flexuosa* (wavy hairgrass), *Polypodium appalachianum* (Appalachian rock polypody), *Houstonia longifolia* (longleaf bluets), *Selaginella rupestris* (rock spikemoss), *Sibbaldiopsis tridentata* (three-toothed cinquefoil), *Hylotelephium telephioides* (Allegheny stonecrop), *Carex pensylvanica* (Pennsylvania sedge), and *Phlox subulata* (moss phlox). A diverse assortment of lichens, including the circumboreal disjuncts *Rhizocarpon geographicum* and *Melanellia stygia*, is also present on the exposed outcrops. Quantitative plot data were collected from this occurrence in 1999 (plot SHNP021).

Portions of an extensive stand of Central Appalachian High-Elevation Boulderfield Forest occupy talus slopes immediately below the cliffs. The occurrence at this site is fairly typical of the community type, except that *Tsuga canadensis* was common in the overstory with *Betula alleghaniensis* and *Sorbus americana*. *Acer pensylvanicum* (striped maple), *Acer spicatum* (mountain maple), *Hydrangea*

arborescens (wild hydrangea) are common in the understory. Herbs are limited to scattered patches of *Dryopteris marginalis* (marginal woodfern), *Angelica triquinata* (filmy angelica), *Oclemena acuminata* (whorled aster), and *Polypodium appalachianum*. This community grades into an extensive stand of Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type) that occupies the more weathered bouldery slopes below the cliffs and extends well beyond the site along the western flank of the ridge. *Tsuga* was also an important component of this forest, but most individuals are now dead, following a severe outbreak of *Adelges tsugae* (hemlock woolly adelgid) in the 1990's.

RARE PLANTS: Four rare plants are known from this site. Previously known colonies of *Solidago randii*, *Sibbaldiopsis tridentata*, and *Rubus idaeus* ssp. *strigosus* (red raspberry) were relocated for this project, and a new colony of *Huperzia appalachiana* (Appalachian fir-clubmoss) was found.

Solidago randii is found at this site on both vertical cliffs and more level ledges. An estimated 400 clumps were found on the upper cliff. The stronghold for the species here is the cliff face. Plants are also found in the woodland edge behind the cliff top. Population numbers have been severely reduced on the open cliff top where this top is coterminous with the Appalachian Trail.

Plants have been almost totally eliminated from that part of the lower cliff top used by the Passamaquoddy Trail. A healthy number of plants were found on the nearly pristine portion of the cliff top to the north of the trail, however, and many additional plants were found on the face. An estimated count of 400 clumps was made for this cliff.

Solidago randii was also found on both of the two small outcrops south and southwest of the upper cliff. Only three clumps were found on the smaller of the two outcrops, but 100 clumps were estimated for the larger outcrop.

This larger outcrop was the only place where *Sibbaldiopsis tridentata* was found at this site. About 100 mats were found here in a 10 x 4 m (33 x 13 ft) area. This area has been fenced off for habitat restoration.

About 25 canes of *Rubus idaeus* ssp. *strigosus* were found in a 4 m^2 (43 ft^2) area in the woodland edge behind (east of) the upper cliff. Hundreds of additional canes were found in two colonies along both sides of the Passamaquoddy Trail. Each of these colonies extends outside of the site boundary. The favored habitat for *Rubus idaeus* ssp. *strigosus* here is metabasalt talus.

About 80 clumps of *Huperzia appalachiana* were found on a steep, north-facing, rocky, forested slope at the base of the small outcrop south of the upper cliff. These plants were found in a 6 x 13 m (20 x 44 ft) area, and most clumps were robust. Many of the clumps had sporangia.

Liatris turgida (= *Liatris helleri*, shale-barren blazing-star), a watchlist herb, was found at this site. In addition, the watchlist shrub *Amelanchier sanguinea* var. *sanguinea* (roundleaf serviceberry) was found along the top of the upper cliff.

There is a record for *Cyperus houghtonii* (Houghton's umbrella-sedge, G4?/SH) at this site from 1901. Attempts have been made over the years to relocate this population without success. The occurrence is now considered by DCR-DNH to be historical both at this site and throughout Virginia (DCR-DNH Biotics data).

RARE ANIMALS: *Plethodon shenandoah* (Shenandoah salamander) and a millipede, *Semionellus placidus*, were known from this site previous to 2006 DCR-DNH surveys. *Plethodon shenandoah*, endemic to SHEN, utilizes forested talus slopes and is known from only five locations. Pague (1991) and a map provided by SHEN (Sanders, 2005), suggest that *Plethodon shenandoah* occurs at both the northeastern and southwestern ends of this site. The USFWS recovery plan maps suggest that there is

suitable habitat both throughout and surrounding the ROMP site (USFWS, 1994). Opportunistic surveys by DCR-DNH for this salamander took place on 8 August 2006 along the Passamaquoddy Trail. A total of 20 individuals of *Plethodon shenandoah* were observed along the trail between (and including) the eastern edge of the ROMP site and where the trail turns south towards Furnace Spring. All were under damp cover objects such as logs or mossy rocks. *Plethodon cinereus* (red-backed salamander), a competitor with *Plethodon shenandoah* (see threats section below), was not observed until near Furnace Spring.

Little is known about the life history of *Semionellus placidus*. DCR-DNH biologists collected it in 1990 near the northeastern edge of the Little Stony Man ROMP boundary while surveying for *Plethodon shenandoah*. It is presumed to be from similar forested talus areas. Its presence was not reconfirmed by DCR-DNH during survey conducted for the present study.

In late March of 1994, there were reports of a pair of *Falco peregrinus* (Peregrine Falcon) near Little Stony Man. It is believed that they abandoned any nesting attempt that was made (Virginia Department of Game and Inland Fisheries, 1994).

One watchlist moth species was captured in a UV-trap on 3 August 2006: *Mesoleuca ruficillata* (white-ribboned carpet). In addition, the watchlist katydid, *Scudderia septentrionalis* (northern bush katydid), was captured in the UV-trap.

Plate 46. High-Elevation Greenstone Barren on a metabasalt clifftop at the southwest end of Little Stony Man.

THREATS: The condition of the High-Elevation Greenstone Barren community is variable. Most accessible ledges and cliff tops along both the Appalachian and Passaquamody Trails are severely impacted by long-term trampling and rock-climbing, with most soil and vegetation removed. Inaccessible ledges and cliff faces are generally pristine. Despite the loss of *Tsuga canadensis* (eastern hemlock), the condition of the Central Appalachian High-Elevation Boulderfield Forest is generally good.

Trampling of *Solidago randii* is severe where the Passamaquoddy Trail runs along the top of the lower cliff and where the AppalachianTrail traverses the top of the upper cliff. Climbing route(s) on the upper cliff threaten a portion of the *Solidago randii* population located on the face of that cliff. Trampling was formerly heavy on the small outcrop that supports both *Sibbaldiopsis tridentata* and *Solidago randii*; this area has now been fenced off for habitat restoration and receives much less visitation.

A dangerously steep social trail connecting the upper cliff with the Passamaquoddy Trail runs close to the *Huperzia appalachiana* colony. This trail occupies a chute between rock outcrops at the south end of the main cliff and serves as the main route for climbers to return to the staging area after an ascent. If this trail continues to be used and widened, it is likely that Appalachian fir-clubmoss plants will be trampled.

The aggressive native sedge *Juncus tenuis* (slender rush) was noted along the top of the upper cliff in the bed of the Appalachian Trail. The presence of this species is a symptom of disturbance caused by trampling and is likely to inhibit attempts to revegetate the trail corridor with *Solidago randii* and other cliff endemics.

Until recently, the primary threat to *Plethodon shenandoah* was thought to be inter-specific competition with *Plethodon cinereus* (red-backed salamander). In general terms, in the drier conditions typically found in talus, *Plethodon shenandoah* can compete with *Plethodon cinereus* (Thurow, 1976; Jaeger, 1974); however, it is believed that alterations in climatic conditions may tip the balance to favor *Plethodon cinereus*. In addition, natural succession of the talus, through weathering and soil formation, would also favor *Plethodon cinereus* (Jaeger, 1970). Recent thought is that there are also human-related factors that may adversely impact the rare species. These include acid deposition in the atmosphere and forest defoliation associated with introduced pest species. Further, there may be impacts from activities such as trail building and maintenance and camping that adversely impact *Plethodon shenandoah* either directly or by enabling *Plethodon cinereus* to out compete it (U.S. Fish and Wildlife Service, 1994).

There are no documented threats to *Semionellus placidus*; however, it is likely that habitat alterations that lead to changes in soil structure or moisture levels would adversely impact this species.

MANAGEMENT RECOMMENDATIONS: Little Stony Man is one of the most significant high-elevation sites in the Central Appalachians, containing three arctic-boreal disjunct plants and two very narrow endemic elements (High-Elevation Greenstone Barren, *Plethodon shenandoah*) whose global ranges are restricted to a few high-elevation areas in SHEN. For these and other biological resources, it merits the most vigorous protection feasible, despite its popularity with recreational users.

Reroute the Appalachian Trail away from upper cliff ledge. The original route of the Appalachian Trail did not go to the upper cliff. This section of trail should be re-routed to protect the outcrop from the heavy impact of day hikers. Although rock climbers will still use this trail, their number is a fraction of that of day hikers, who are also more likely to impact a larger area of an outcrop (Lawson et al. 2006). See Figure 56.

Install a permanent rappelling station. Such a station will remove the need for climbers to use the "chute" social trail.

Close the "chute" social trail and install a permanent rappelling station. Closing the trail is preferred over building stairs because stairs would attract day hikers to the upper cliff ledge and the low feasibility of construction and long-term maintenance of stairs. Re-routing the Appalachian Trail and closing the chute trail should significantly reduce visitation to the upper cliff ledge. See Figure 56.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor visitor use of outcrop, closed section of the Appalachian Trail, and the "chute" social trail. Annual qualitative assessments should be made to gauge changes in visitor use.

Monitor recovery of the rare plants and the health of the rare natural communities. Conduct a survey on a 3-5 year interval to assess rare plant populations and the health of natural community types. Include a survey for invasive plants.

Further inventories to determine the status of *Plethodon shenandoah* population at this site should be conducted. Long-term monitoring of this species is also recommended. Trail maintenance, camping, and fire management (fire break construction or fire suppression) should all be carefully considered in areas occupied by *Plethodon shenandoah*. Any compaction of soil, increase in barriers within the habitat (e.g., a trail that might preclude salamanders from crossing), or activities that would increase soil moisture should be avoided.

No specific management recommendations for *Semionellus placidus*. Little is know about this species. Relocating the species at this site and determining its range would be a positive first step to managing for it.

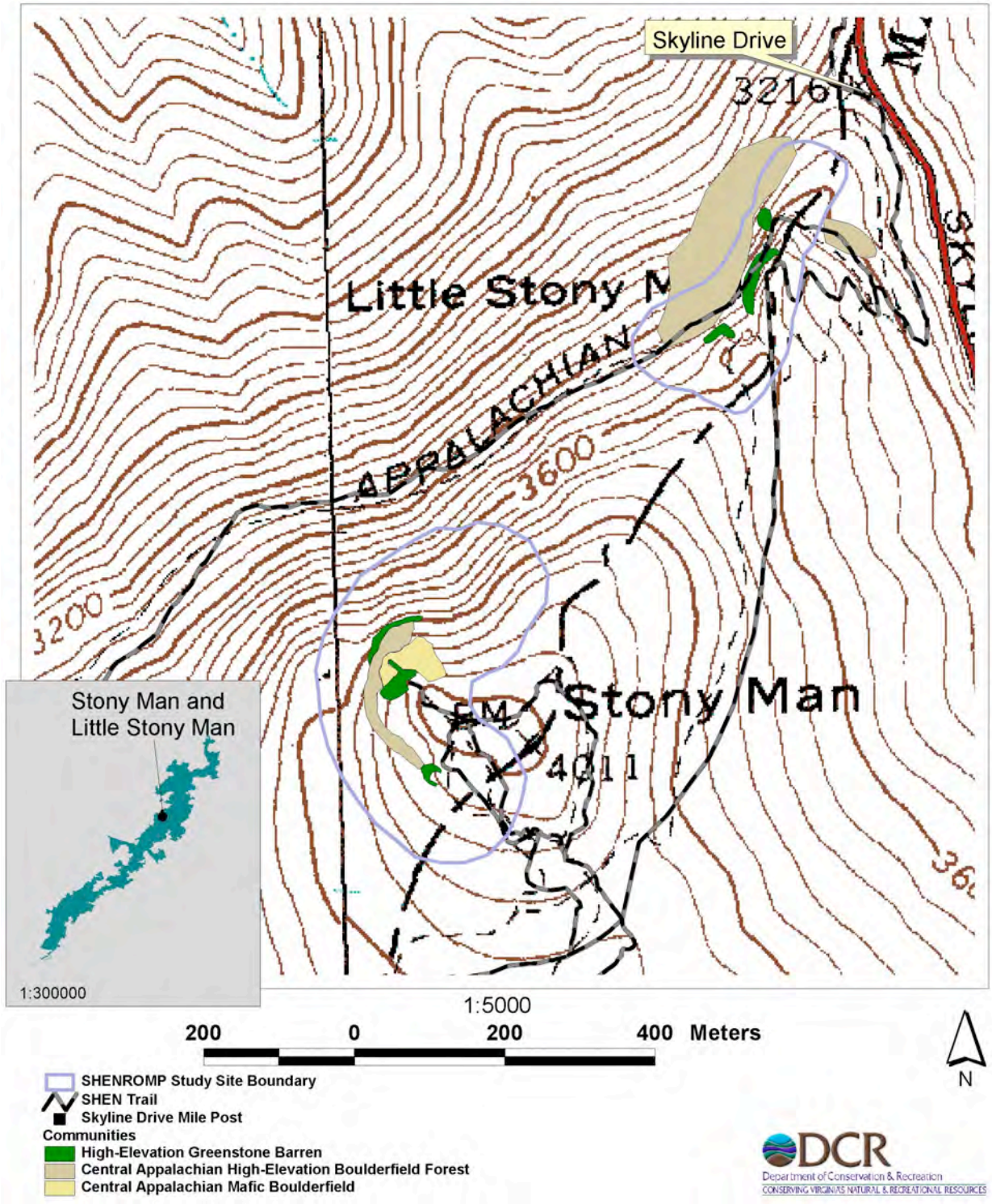


Fig. 50. Location of significant natural communites at Little Stony Man.

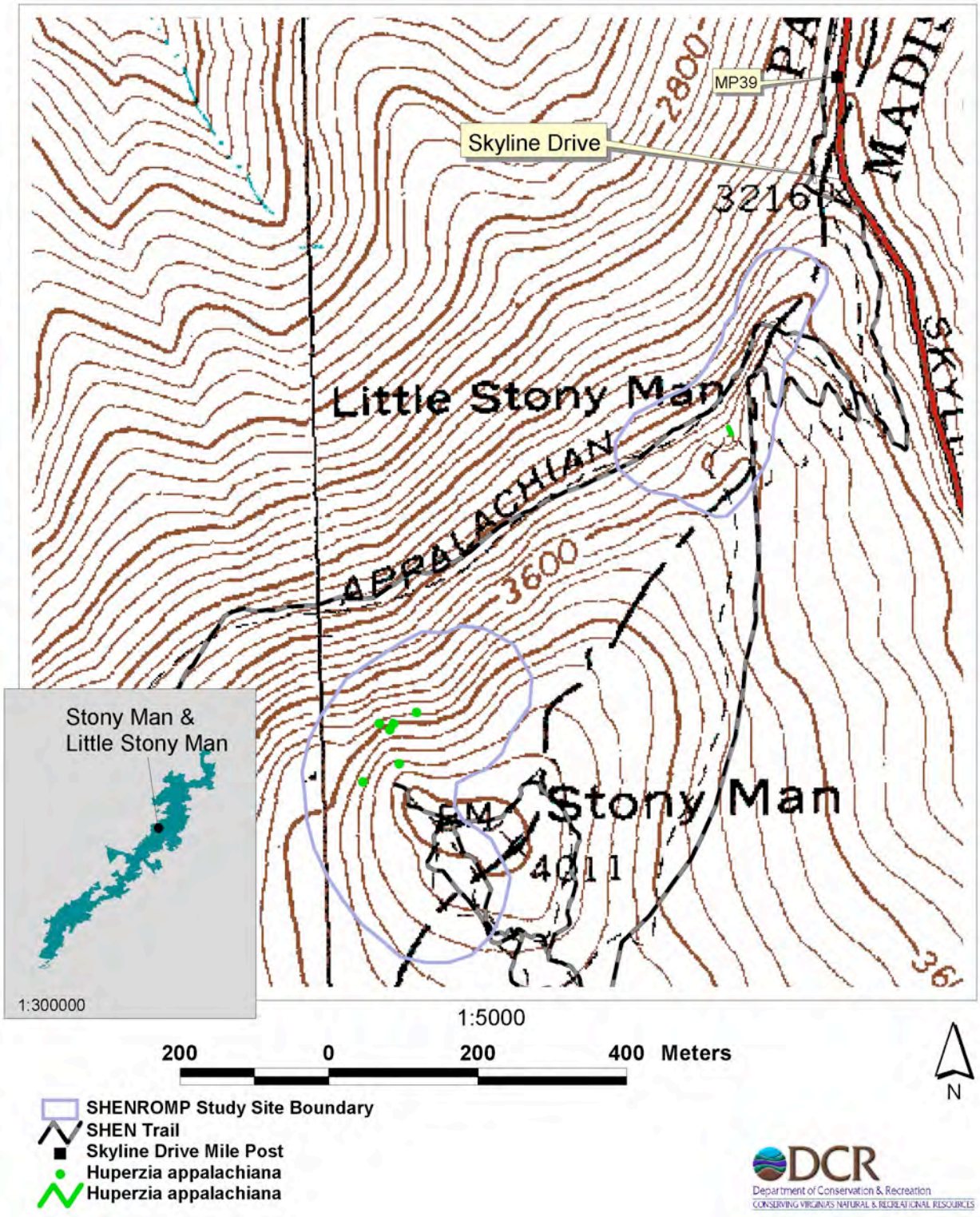


Fig. 51. Location of *Huperzia appalachiana* at Little Stony Man.

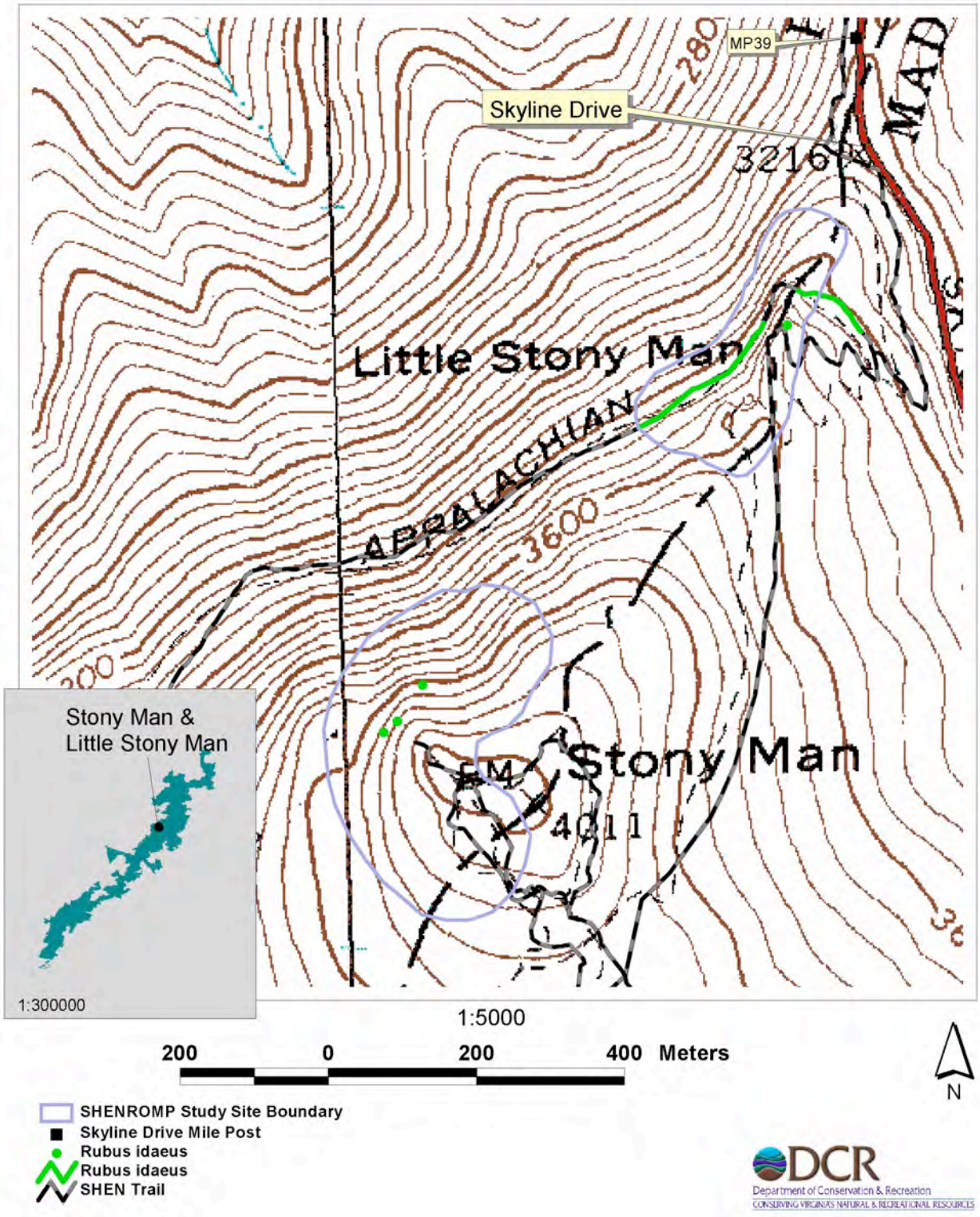


Fig. 52. Location of *Rubus idaeus* ssp. *strigosus* at Little Stony Man.

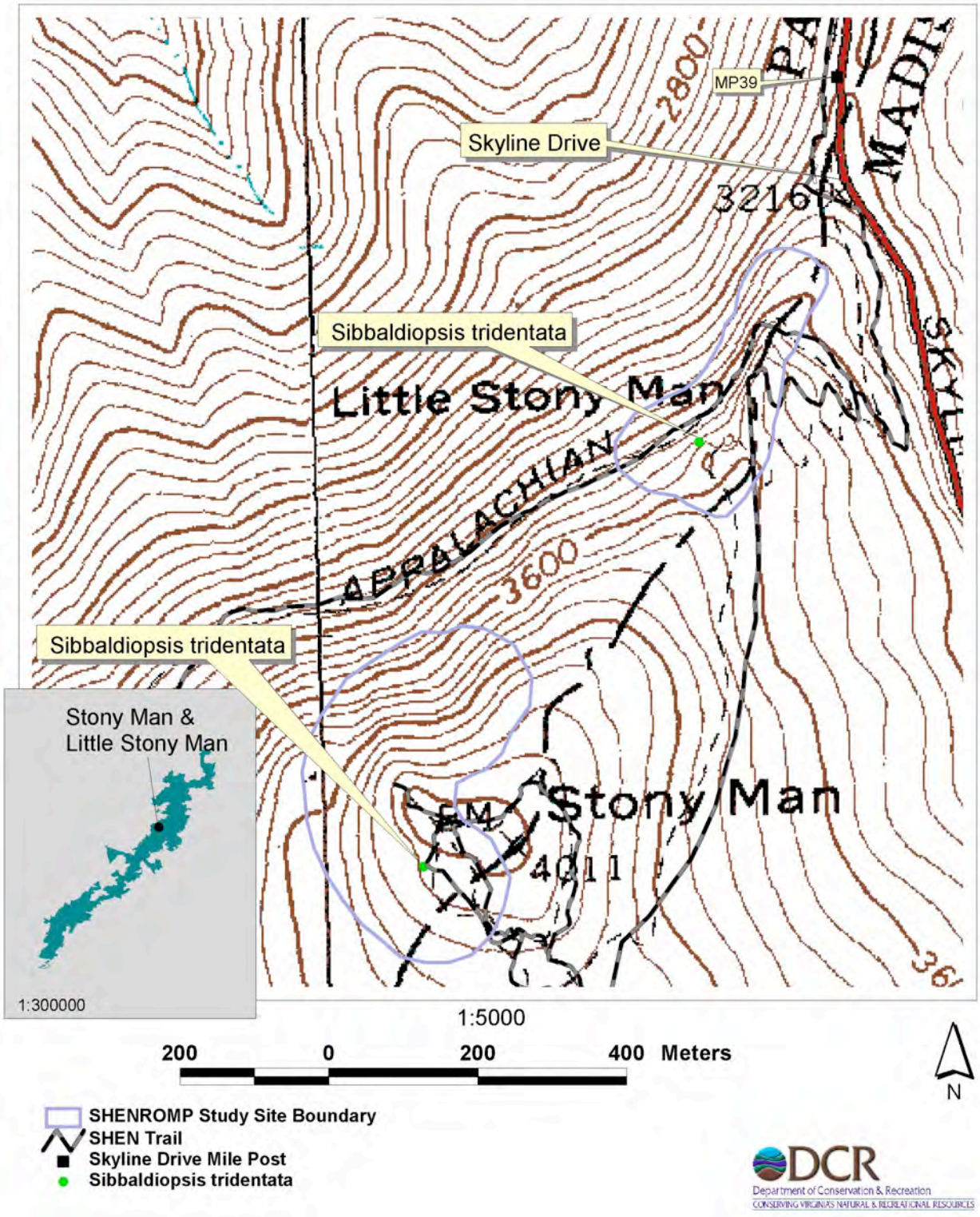


Fig. 53. Location of *Sibbaldiopsis tridentata* at Little Stony Man.

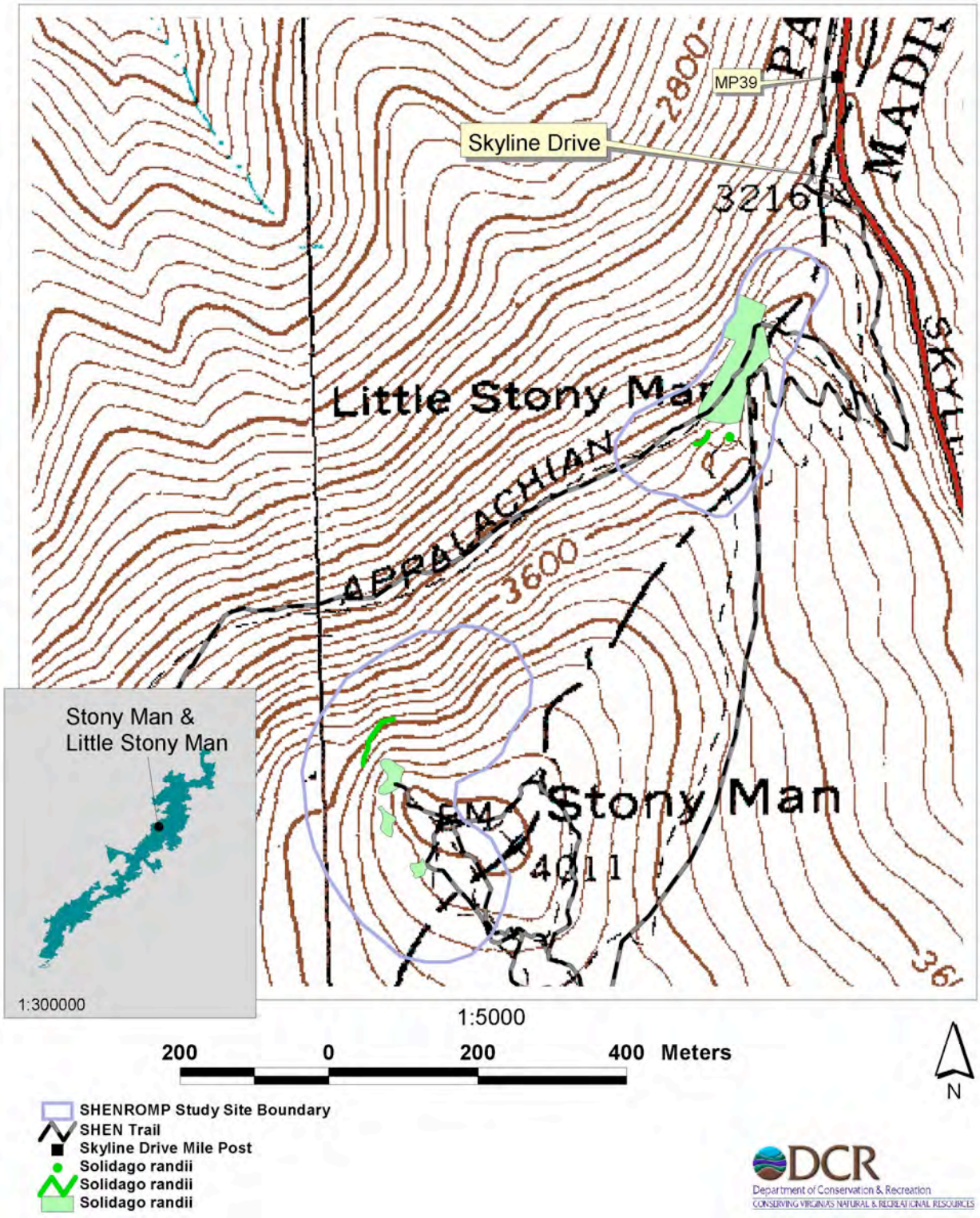


Fig. 54. Location of *Solidago randii* at Little Stony Man.

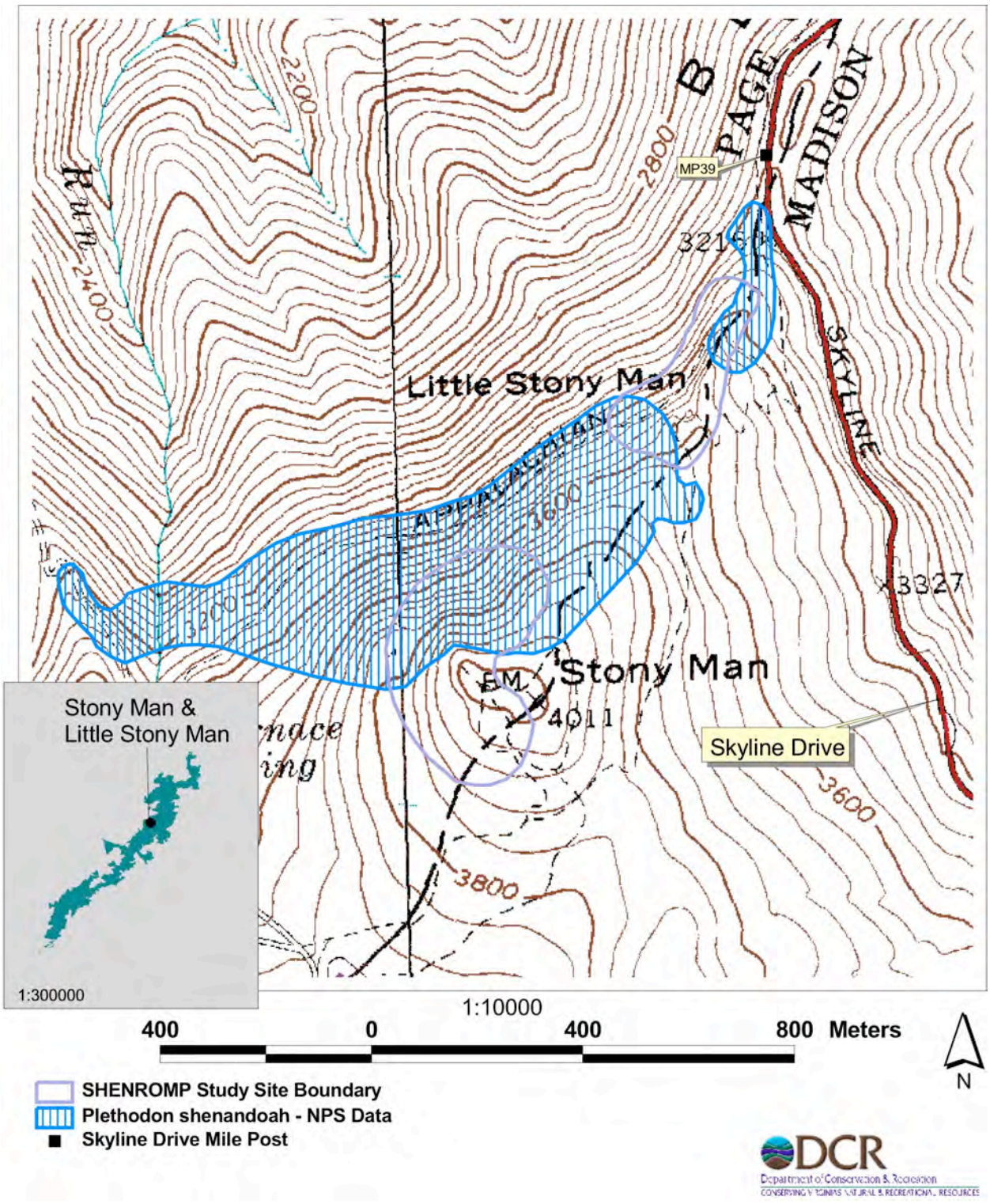


Fig. 55. Location of *Plethodon shenandoah* at Little Stony Man.

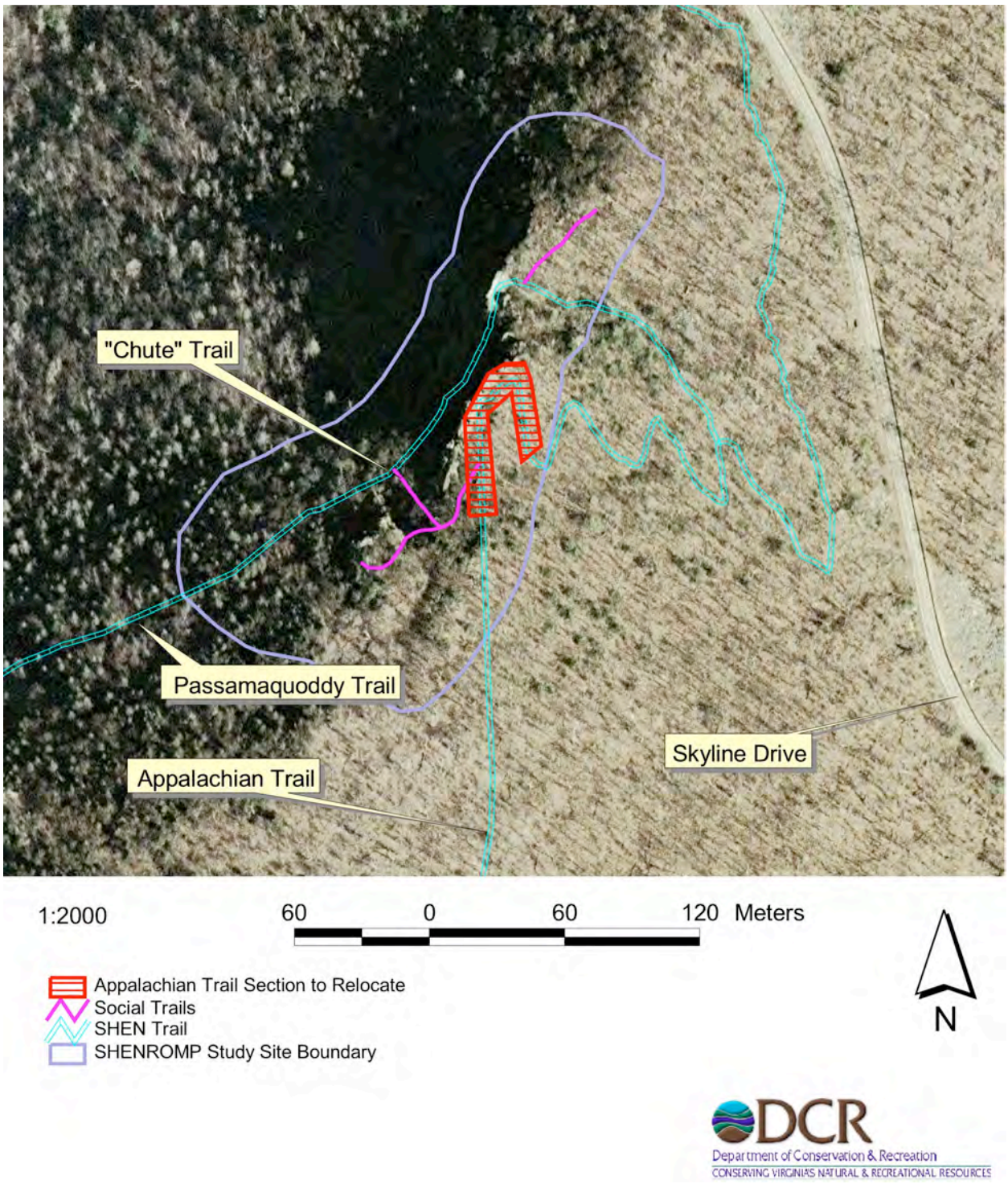


Fig 56. Site details for Little Stony Man, including section of the Appalachian Trail recommended for relocation and location of the "chute" social trail, which is recommended for closure.

STONY MAN SUMMIT (C47)

CONSERVATION SITE: Stony Man Mountain (B1) **THREAT RANK:** 4

LOCALITY: Page and Madison Counties **QUADRANGLE(S):** Big Meadows
Old Rag Mountain

LOCATION: Located west of Skyline Drive, this Central District site extends from 1.35 km (0.84 mi) to 1.80 km (1.12 mi) southwest of Stony Man Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum Forest[1]	Central Appalachian High-Elevation Boulderfield Forest	G2	S2	None	None	A
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation[2]	High-Elevation Greenstone Barren	G1	S1	None	None	B
Lasallia papulosa - Stereocaulon glaucescens – Chrysothryx chlorina Nonvascular Vegetation	Central Appalachian Mafic Boulderfield	G2?	S2?	None	None	B
Plants:						
Abies balsamea[3]	Balsam fir	G5	S1	None	None	CD
Conioselinum chinense	Hemlock parsley	G5	S1	None	None	C
Huperzia appalachiana[2]	Appalachian fir-clubmoss	G4G5	S2	None	None	B
Juncus trifidus	Highland rush	G5	S1	None	None	AB
Rubus idaeus ssp. *strigosus*[1]	Red raspberry	G5T5	S2	None	None	A
Sibbaldiopsis tridentata[2]	Three-toothed cinquefoil	G5	S2	None	None	C
Solidago randii[1]	Rand's goldenrod	G5T4	S2S3	None	None	A
Vaccinium myrtilloides[3]	Velvetleaf blueberry	G5	S1S2	None	None	C
Animals:						
Plethodon shenandoah[1,4]	Shenandoah salamander	G1	S1	LE	LE	A
Falco peregrinus[3,4]	Peregrine Falcon	G4	S1B S2N	None	LT	D
Kleptochthonius polychaetus[4]	Shenandoah pseudoscorpion	G1G3	S1S3	None	None	H

[1]Part of this eo lies within the Little Stony Man ROMP site and part lies outside of any ROMP site.
[2]Part of this eo lies within the Little Stony Man ROMP site.
[3]Part of this element occurrence (eo) lies outside of any ROMP site.
[4]Based on a previously documented record (DCR-DNH Biotics data). This eo was not reconfirmed by DCR-DNH in 2005.

SITE DESCRIPTION: This large, complex site includes four rock outcrops, a cliff, and large areas of talus. Rock exposures here are of the Catoctin Formation metabasalt.

From the summit of Stony Man Mountain at an elevation of 1,220 m (4,011 ft) a trail leads northwest for about 100 m (328 ft) to a spectacular overlook. From this area, two narrow spine-like outcrops descend at right angles to one another. One of these spines descends to the northwest from 1,207 m (3,960 ft) to about 1,183 m (3,880 ft); the other spine drops to the southwest from 1,207 m (3,960 ft) to 1,195 m (3,920 ft). A third spine begins about 50 m (214 ft) south of the overlook area, also at an elevation of 1,207 m (3,960 ft). This spine drops to the northwest to an elevation of 1,195 m (3,920 ft). This base of this spine ends near the base of the spine that angles southwest from the overlook, and these two spines are also at right angles to one another. For convenience, these spines will be referred to as the northern spine (dropping to the northwest), central spine (dropping to the southwest) and southern spine (dropping to the northwest). On aerial photographs, these three spines appear as a zigzag or z-shaped pattern.

The southern end of a steep metabasalt cliff is located just west of the base of the northern spine. The top of this cliff is at an elevation of about 1,170 m (3,840 ft) at that point, and it faces west-northwest. Over the course of about 80 m (262 ft), the cliff curves to face north, and the cliff top drops to an elevation of about 1,146 m (3,780 ft). Northeast of that point, the cliff dissipates into steep slopes of forested talus. Much of this cliff is 12-15 m (40-50 ft) high.

Another sizable outcrop is located about 70 m (230 ft) southwest of the Stony Man Mountain summit. This outcrop has a broad flat top about 12 m (39 ft) long and drops steeply to the west in a series of ledges and steps. It is located at elevations between about 1,213 m (3,980 ft) and 1,201 m (3, 940 ft).

Much of this site is covered by talus. Most impressive are extensive areas of open unvegetated talus flanking the northern and central spines. North of the northern spine, a steep slope of unvegetated talus descends towards the top of the cliff and is separated from it by a narrow strip of forested talus. Large areas of forested talus are found northeast of the cliff, and a belt of open talus runs along the base of this cliff.

Stony Man Mountain is a popular hiking destination and is accessed by several trails. The Appalachian Trail (AT) crosses the mountain a short distance to the southeast of the summit. A short trail connects the AT with the overlook to the northwest where the northern and central spines connect. From this point an informal trail descends through a gap between these two spines to the talus field below. Adventuresome hikers can push their way through a fringe of scrub to reach the top of the cliff. Another informal trail leads from the summit area to the top of the southern spine. Finally, the Stony Man Horse Trail crosses the top of the outcrop located about 70 m (230 ft) southwest of the summit.

NATURAL COMMUNITIES: Relatively gentle, wooded slopes in the southern part of this site are covered by Northern Red Oak Forest (Pennsylvania Sedge – Wavy Hairgrass Type), while the steep, bouldery slopes in the northern part of the site support Central Appalachian Northern Hardwood Forest (Yellow Birch – Northern Red Oak Type). The west- and north-facing slopes immediately below the summit support an impressive mosaic of three globally rare communities: High-Elevation Greenstone Barren, Central Appalachian Mafic Boulderfield, and Central Appalachian High-Elevation Boulderfield Forest.

The High-Elevation Greenstone Barren, which is endemic to several high-elevation sites in SHEN, occupies exposed all the metabasalt outcrops in the vicinity of the summit and the cliff below. The occurrence covers approximately 0.2 ha (0.5 ac) and has been partly degraded by heavy visitor trampling. This community contains a mosaic of shrub and herbaceous patches interspersed with lichen-covered rocks. The most important woody species at this site are stunted *Betula alleghaniensis* (yellow birch), *Diervilla lonicera* (northern bush-honeysuckle), *Sorbus americana* (American mountain-ash), *Menziesia pilosa* (minniebush), and stunted *Tsuga canadensis* (eastern hemlock). The most abundant herbs are

Deschampsia flexuosa var. *flexuosa* (wavy hairgrass), *Solidago randii* (Rand's goldenrod), *Hylotelephium telephioides* (Allegheny stonecrop), and *Saxifraga michauxii* (Michaux's saxifrage). Additional characteristic herbs include *Campanula divaricata* (southern hairbell), *Polypodium appalachianum* (Appalachian rock polypody), *Heuchera pubescens* (marbled alumroot), *Juncus trifidus* (highland rush), *Liatris scariosa* (large blazing-star), and *Dennstaedtia punctilobula* (hayscented fern). Quantitative plot data were collected from the typical expression of this occurrence, as described above, in 1990 (plot SHNP007) and again during the ROMP project (plot SHNP144).

A distinctive and unusual variant of the High-Elevation Greenstone Barren occurs in a concavity on the lower cliff that receives seasonal seepage from a spring on the cliff top. Although most of the typical species of the community type are present, this variant has high cover of *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Calamagrostis canadensis* var. *canadensis* (bluejoint reed grass), *Carex aestivalis* (summer sedge), *Angelica triquinata* (filmy angelica), and *Conioselinum chinense* (hemlock parsley). This variant was quantitatively documented by plot SHNP008 in 1990.

A large area (0.3 ha [0.75 ac]) of talus below the summit outcrops and spines is open and dominated by lichens, particularly *Stereocaulon glaucescens*. This is one of few known examples of the Central Appalachian Mafic Boulderfield community, and its lichen community has been partly destroyed by a popular and eroded social trail on the west side of the northern spine. Above lower cliff and extending in a narrow zone along the western slope is a 0.4 ha (1.0 ac) patch of Central Appalachian High-Elevation Boulderfield Forest dominated by *Betula alleghaniensis*, *Sorbus americana*, and *Acer spicatum* (mountain maple). This vegetation is in excellent condition and is part of a very significant occurrence that includes patches outside the boundaries of the ROMP site.

Lichens are very sparse on the heavily trampled rock surfaces, but densely cover protected faces. Characteristic species include *Rhizocarpon geographicum*, *Rhizocarpon* cf. *rubescens*, *Xanthoparmelia conspersa*, *Lasallia papulosa*, *Stereocaulon glaucescens*, *Rhizoplaca subdiscrepens*, *Melanelia stygia*, *Parmelia cf. omphaloides*, *Porpidia* sp., *Fuscidea recensa*, *Aspicilia cinerea*, and many other crusts.

RARE PLANTS: Eight rare plants were located at this site: *Abies balsamea* (balsam fir), *Conioselinum chinense*, *Huperzia appalachiana* (Appalachian fir-clubmoss), *Juncus trifidus*, *Rubus idaeus* ssp. *strigosus* (red raspberry), *Sibbaldiopsis tridentata* (three-toothed cinquefoil), *Solidago randii*, and *Vaccinium myrtilloides* (velvetleaf blueberry). All of these plants were known from the site prior to this study.

This site contains Virginia's only known populations of *Conioselinum chinese* and *Juncus trifidus*, both arctic-boreal disjuncts. Thirty-five individuals of *Conioselinum chinense* were counted in a 0.5 x 2.5 m (1.6 x 8.2 ft) area along the exposed top of the metabasalt cliff. Seventeen of the plants were flowering on the August 10, 2005, survey date. These population numbers have remained constant since the plant was first discovered in 1990. The plants are at the northeastern end of the cliff where the cliff faces north. This area provides an exceptionally cold microclimate that allows this boreal relict to survive. The plants grow in a mossy concavity which channels seepage from upslope over the cliff into a shady grotto below. No seepage was apparent at the time of the August 2005 inventory, and other recent surveys have also reported dry conditions. A few plants were seen at the base of the cliff in 1990, but have not been seen there since.

Juncus trifidus is found on the northern and central spines and on the cliff face. It grows on exposed ledges subject to severe winter weather. A count of 135 caespitose clumps made in 1990 remains accurate today.

Only one small individual of *Vaccinium myrtilloides* was located at this site. The plant covers a 15 x 20 cm (6 x 8 in) area along the top of the cliff in an area where the cliff faces west. Although earlier population data for *Vaccinium myrtilloides* at this site is vague, it appears that this colony has suffered a dramatic decline since the plant was first observed here in 1990.

Solidago randii is the most abundant and widespread of the rare plants at this site. It is found on exposed ledges on all three spines, on the open top and face of the cliff, and throughout the outcrop southwest of the summit. An estimate of 600-800 clumps was made for the northern spine, 150-200 clumps for the central spine, and 300 clumps for the southern spine. The cliff supports over 200 clumps, and an estimate of 300 clumps was made for the outcrop southwest of the summit.

Sibbaldiopsis tridentata is found only on the broad top of the outcrop southwest of the summit. About 100 mats of this rose family herb were found in a 6 x 12 m (20 x 39 ft) area.

A small colony of *Abies balsamea* begins just north of the *Sibbaldiopsis tridentata* station and extends north in a narrow band for about 52 m (171 ft). These plants are located along the top of a rocky escarpment at elevations between 1,207 m (3,960 ft) and 1,221 m (4,005 ft). Here they receive the full force of severe winter weather. An exact count was not made, but at least 20 trees were seen. The larger individuals had cones. This appears to be an indigenous stand, unlike stands on the southwest flank of Stony Man Mountain that were apparently planted by the Civilian Conservation Corps (C.E. Stevens, pers. com.).

Six colonies of *Huperzia appalachiana* were found at this site in 2005. A colony located on the exposed northeastern face of the northern spine consists of about 50 clumps in a 12 m^2 (129 ft^2) area. Most of these clumps are small, and several dead clumps were observed. A colony at the base of the cliff supports at least 10 clumps in an 8 m^2 (86 ft^2) area. Not all of the habitat in this area could be safely checked. The recent death of *Tsuga canadensis* (Eastern hemlock) has changed the microhabitat here, and conditions are drier and more open. Most of the *Huperzia appalachiana* plants in this area are chlorotic.

The other four colonies are in shaded habitats, and these plants appeared to be healthier. Many plants had sporangia. These colonies range in size from 20 to more than 100 clumps within areas of 4-8 m^2 (43-86 ft^2). The total count for *Huperzia appalachiana* at this site is estimated at 250-300 clumps. It is likely that other undiscovered colonies exist in the area.

Three small patches of *Rubus idaeus* ssp. *strigosus* were found at this site in partially shaded talus. Each patch consists of 30-40 canes in a 3-6 m^2 (32-65 ft^2) area.

A sizable population of the watchlist shrub *Taxus canadensis* (American yew) was found growing along the top of the cliff. The watchlist fern *Gymnocarpium appalachianum* (Appalachian oak fern) was found just upslope from the *Conioselinum chinense* population. In addition, the watchlist herb *Liatris turgida* (= *Liatris helleri*, shale-barren blazing star) occurs here.

There is a record for *Cornus rugosa* (roundleaf dogwood) at this site from 1942. Attempts have been made over the years to relocate this population without success. The occurrence is now considered by DCR-DNH to be historical (DCR-DNH Biotics data).

RARE ANIMALS: No new animal element occurrences or watchlist species where found at this site during DCR-DNH surveys in 2005.

This area is a previously known site for *Plethodon shenandoah* (Shenandoah salamander) (Pague, 1991; Sanders, 2005) and *Falco peregrinus* (Peregrine Falcon) (Virginia Department of Game and Inland

Fisheries, 1994). *Plethodon shenandoah*, endemic to SHEN, utilizes forested talus slopes and is known from only five locations. Pague (1991) and a map provided by SHEN (Sanders, 2005), and a map in the USFWS recovery plan (USFWS, 1994) all indicate that *Plethodon shenandoah* occurs through the northern half of the ROMP site. In addition, the type locality for *Kleptochthonius polychaetus* (Shenandoah pseudoscorpion) is known from the Stony Man Nature Trail, much of which is within the ROMP site (Muchmore, 1994). Initially captured in July 1969, to our knowledge its presence at the site has not been reverified since.

Falco peregrinus has been reintroduced to SHEN as part of the recovery plan for this species. In 1994 two young were fledged from a non-hacked nest site at Stony Man. This was the first natural nesting reported in the mountains of Virginia since 1962 (Virginia Department of Game and Inland Fisheries, 1994).

Plate 47. High-Elevation Greenstone Barren on an undisturbed outcrop face below the summit of Stony Man.

THREATS: Sizeable areas at the summit and on the flatrock by the horse trail 70 m southwest of the summit once supported the High-Elevation Greenstone Barren community but have suffered almost complete removal of soil mats and vegetation from decades of trampling. Other parts of this community have been impacted by trampling or social trails but are still in fair to good condition. Only the most inaccessible ledges and vertical faces supporting this vegetation are free from human disturbance. Trampling impacts extend to the Central Appalachian Mafic Boulderfield below the summit, where a much used social trail on the west side of the northern spine has caused the virtual destruction of many square meters of the boulderfield and its lichen community. The damage to this area has increased greatly since 1990.

The exotic invasive insect *Adelges piceae* (balsam wooly adelgid) is an ongoing threat to *Abies balsamea* in the park (Ceperley, 2002).

The *Vaccinium myrtilloides* population appears to have been trampled. Global warming may also be a factor in the decline of this population.

The colony of *Huperzia appalachiana* at the base of the cliff has apparently been negatively impacted by the death of *Tsuga canadensis*, which has caused a change to that area's microhabitat. The colony on the north spine also appears to be in poor health. This may be due to global warming.

The *Sibbaldiopsis tridentata* population has been severely trampled by hikers and equestrians. It is estimated that 90 percent of the population has been lost.

Solidago randii has been severely trampled on the outcrop to the southwest of the summit and at the overlook where the northern and central spines join. Trampling is moderate along the top of the cliff and at the top of the southern spine.

No apparent threats were noted for the *Conioselinum chinense*, *Juncus trifidus*, and *Rubus idaeus* ssp. *strigosus* populations.

The following exotic or aggressive native species were noted in rock outcrop areas: *Poa pratensis* (Kentucky bluegrass), *Poa compressa* (flat-stemmed bluegrass), *Trifolium repens* (white clover), *Plantago rugelii* (pale plantain), and *Achillea millefolium* (common yarrow). The exotics at this site are symptomatic of trampling disturbance but, with the exception of *Poa compressa*, are not direct threats to rare plant populations. They are, however, threats to the compositional integrity of the High-Elevation Greenstone Barren community, as well as barriers to the revegetation of potential rehabilitation areas by native species.

Until recently, the primary threat to *Plethodon shenandoah* was thought to be inter-specific competition with *Plethodon cinereus* (red-backed salamander). In general terms, in the drier conditions typically found in talus, *Plethodon shenandoah* can compete with *Plethodon cinereus* (Thurow, 1976; Jaeger, 1974); however, it is believed that alterations in climatic conditions may tip the balance to favor *Plethodon cinereus*. In addition, natural succession of the talus, through weathering and soil formation, would also favor *Plethodon cinereus* (Jaeger, 1970). Recent thought is that there are also human-related factors that may adversely impact the rare species. These include acid deposition in the atmosphere and forest defoliation associated with introduced pest species. Further, there may be impacts from activities such as trail building and maintenance and camping that adversely impact *Plethodon shenandoah* either directly or by enabling *Plethodon cinereus* to out compete it (U.S. Fish and Wildlife Service, 1994).

The main threat to all *Falco peregrinus* populations range-wide was once pesticide contamination leading to reproductive failure (USFWS, 1991). This threat seems to be diminishing (USFWS, 1991). Current

threats include direct human disturbance, which can cause individual nesting pairs to abandon their nest sites. In addition, predation, habitat destruction, and occasional poaching have been identified as threats (USFWS, 1991).

MANAGEMENT RECOMMENDATIONS: This site is one of the most important high-elevation areas in Virginia and the Central Appalachians, supporting narrow community and animal endemics, as well as a number of boreal disjuncts. It is one of only a few sites in the world (all in SHEN) for the High-Elevation Greenstone Barren community, the Central Appalachian Mafic Boulderfield community, and *Plethodon shenandoah*, and is the only known site in Virginia for both *Conioselinum chinense* and *Juncus trifidus*. This status clearly warrants the most vigorous level of protection possible, despite the popularity of the site among recreational users.

Contain visitation at the summit area to the uppermost outcrop overlook at the end of the trail. Permanently close lower outcrops to protect Peregrine Falcon habitat and to allow recovery of native vegetation. Currently, SHEN closes these outcrops during Peregrine nesting season. Extending the closure for protection and recovery of both animal and plant resources is a small step that will result in large conservation benefits. Park visitors will still be able to enjoy views from the uppermost outcrop. See Figure 68.

Close horse trail overlook to allow recovery of the rare the High-Elevation Greenstone Barren and associated rare plants. See Figure 68.

Monitor invasive species, particularly *Poa compressa*, and rare plant interactions and implement control if invasives increase in abundance. Herbicide is recommended for controlling these species because hand-pulling will create more soil disturbance and is labor-intensive. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the rare plants and the health of the rare natural communities. Initially, following implementation of management actions, conduct annual surveys to assess the condition of rare plant populations and the health of the significant natural communities. Include a survey for invasive plants. After management actions have achieved success, use a 3-5 year monitoring interval.

Conduct further inventories to determine the status of *Plethodon shenandoah* population at this site. Long-term monitoring of this species is also recommended. Trail maintenance, camping, and fire management (fire break construction or fire suppression) should all be carefully considered in areas occupied by *Plethodon shenandoah*. Any compaction of soil, increase in barriers within the habitat (e.g., a trail that might preclude salamanders from crossing), or activities that would increase soil moisture should be avoided.

Continue adherence to the recovery plan protocols (USFWS, 1991) for *Falco peregrinus*, including monitoring and additional survey work. Nesting areas should be protected from human disturbances.

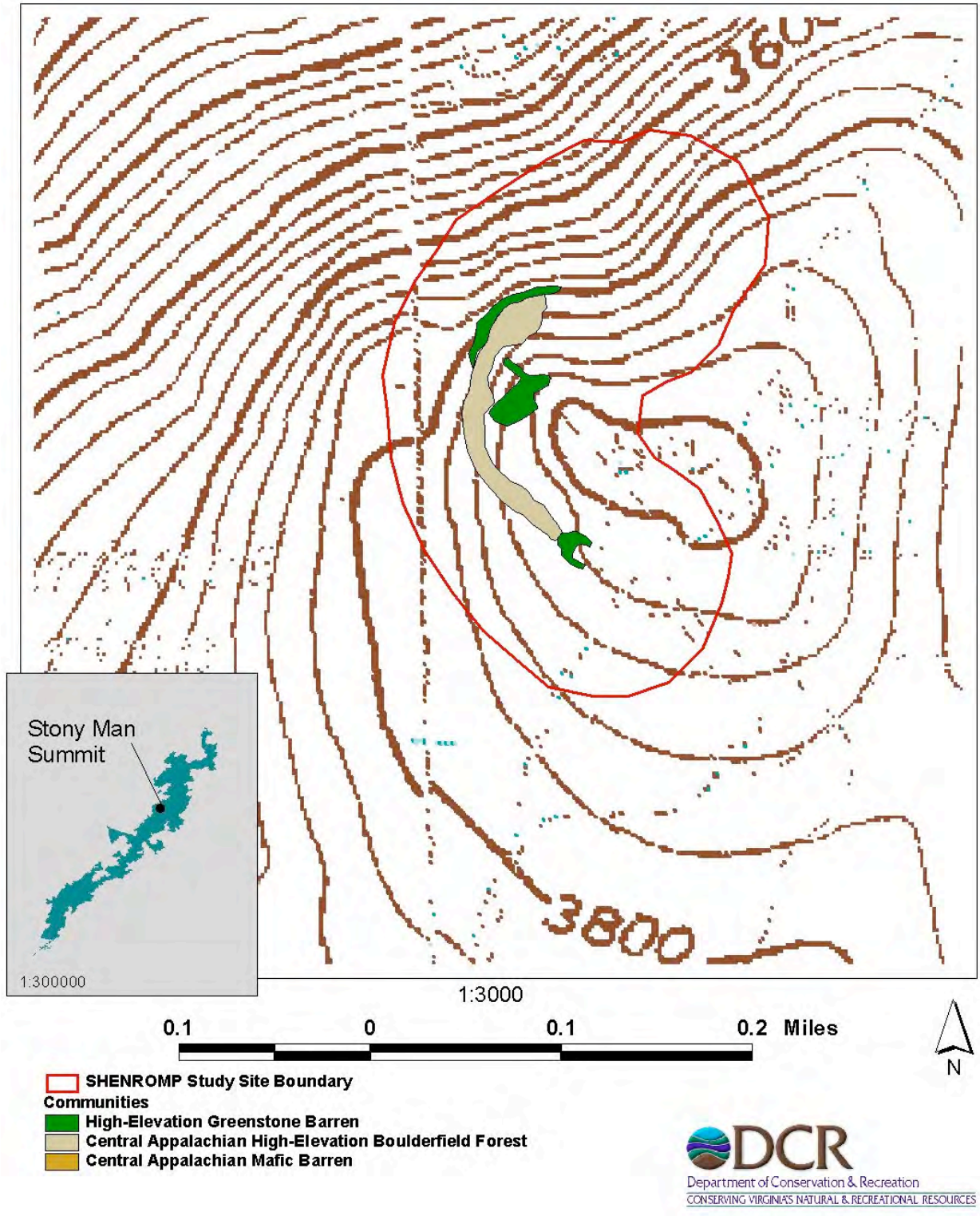


Fig. 57. Location of significant natural communities at Stony Man Summit.

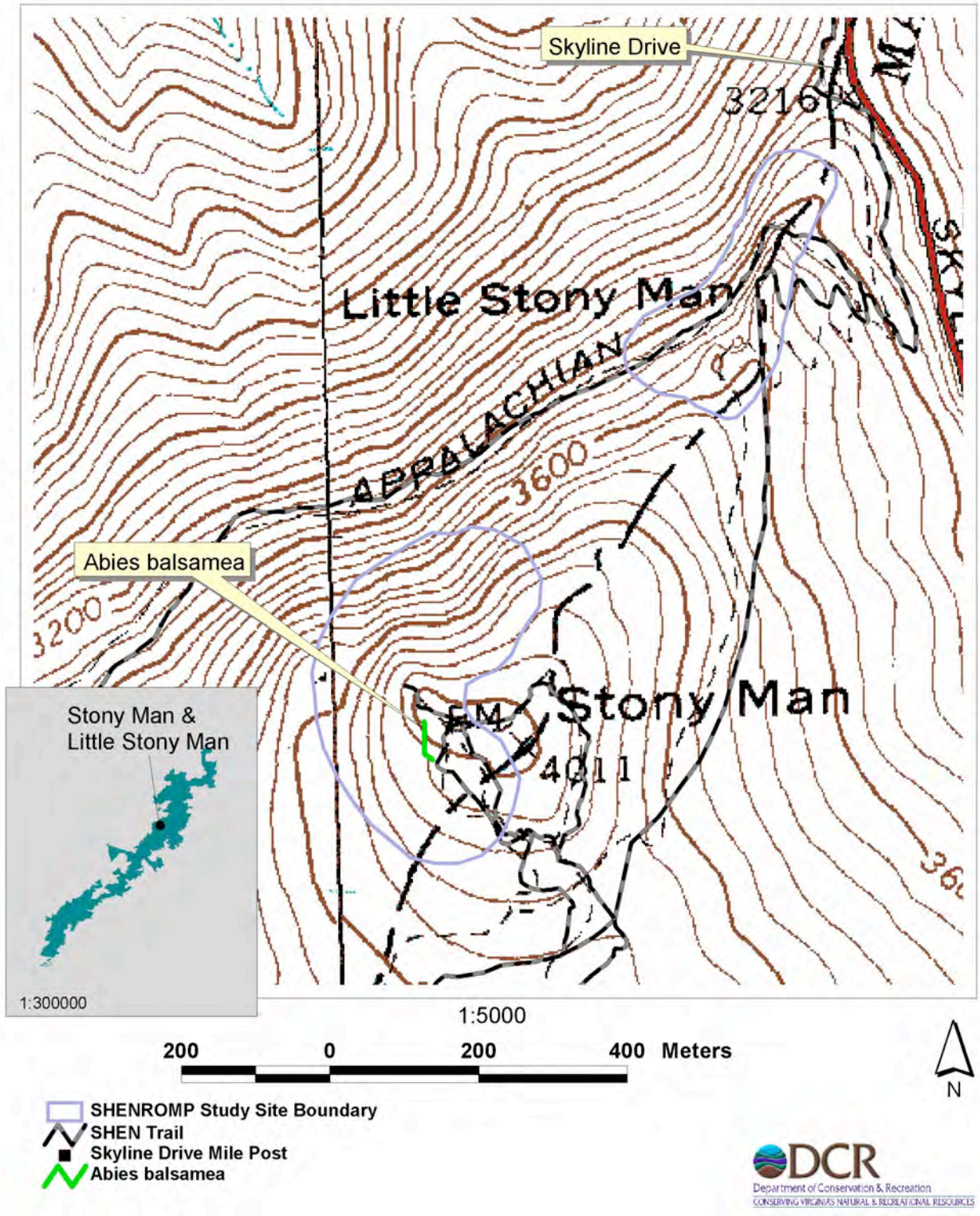


Fig. 58. Location of *Abies balsamea* at Stony Man Summit.

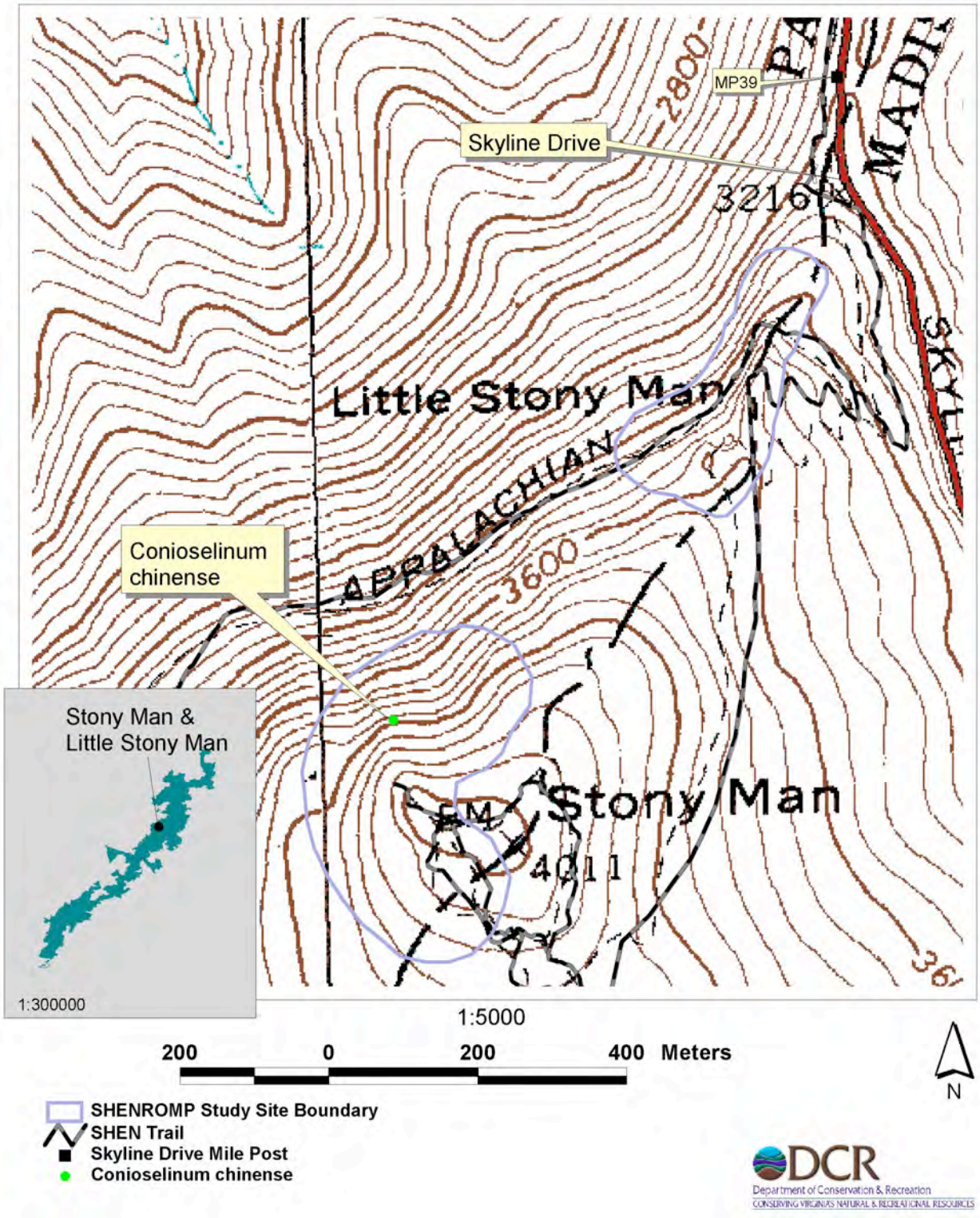


Fig 59. Location of *Conioselinum chinense* at Stony Man Summit.

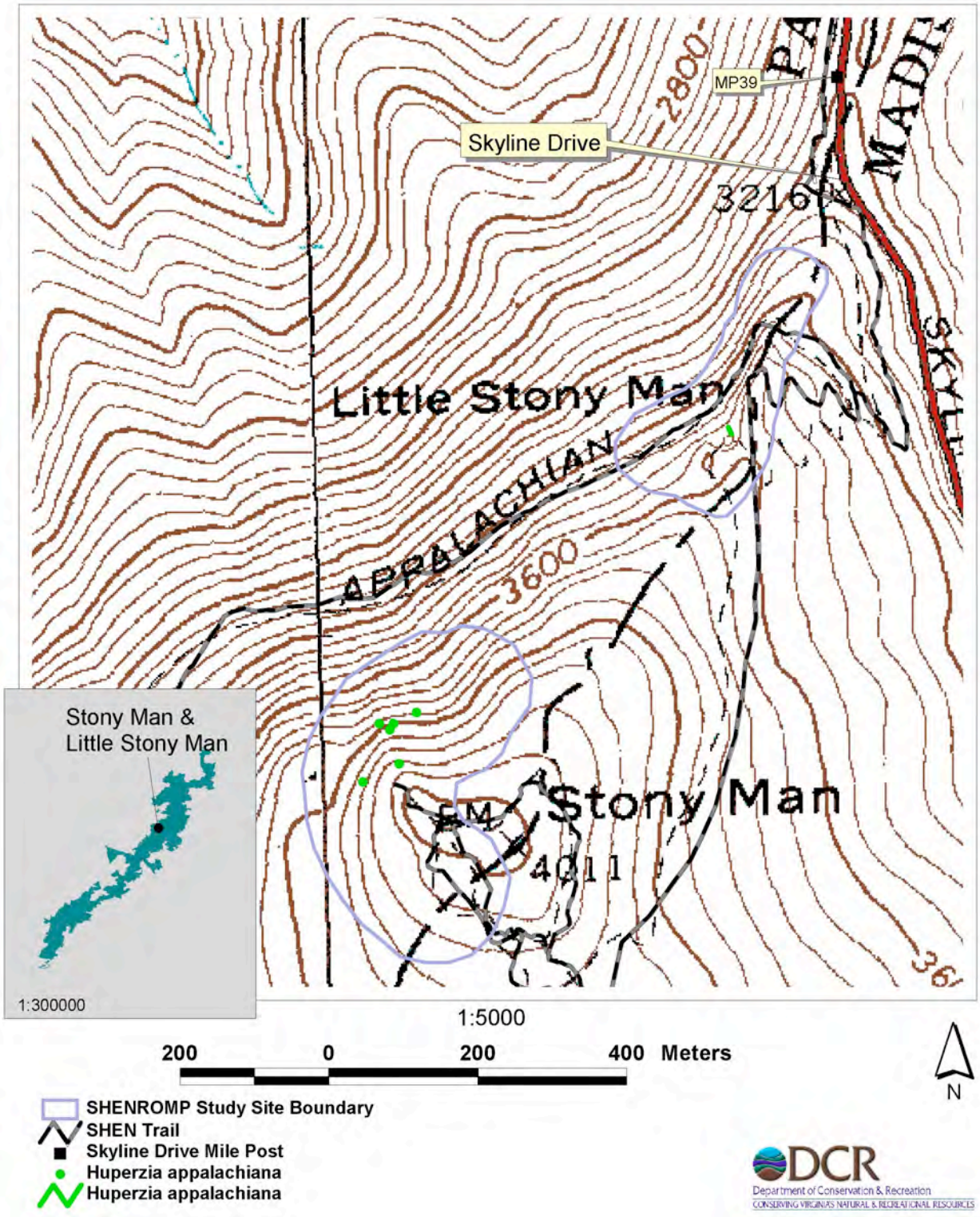


Fig. 60. Location of *Huperzia appalachiana* at Stony Man Summit.

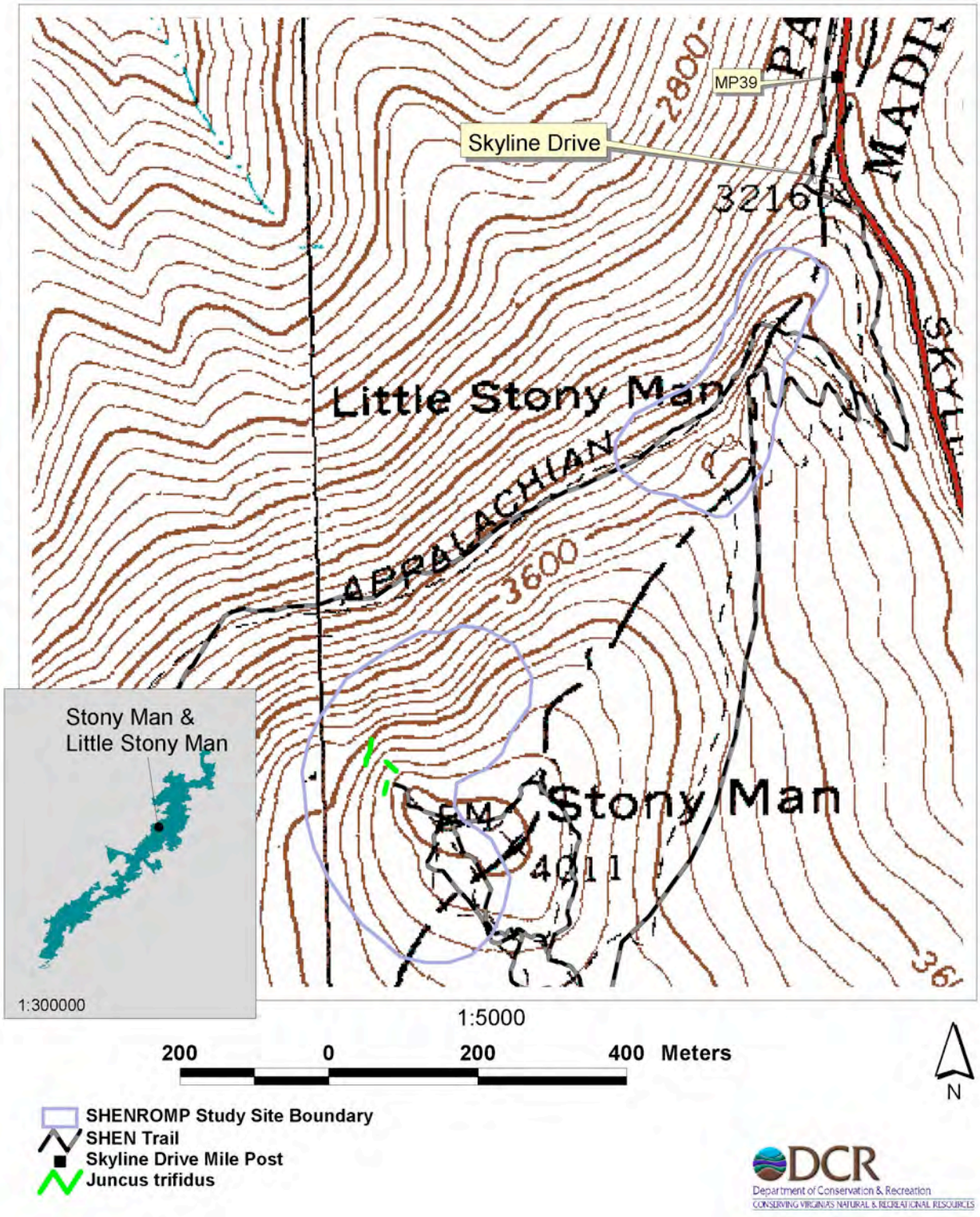


Fig. 61. Location of *Juncus trifidus* at Stony Man Summit.

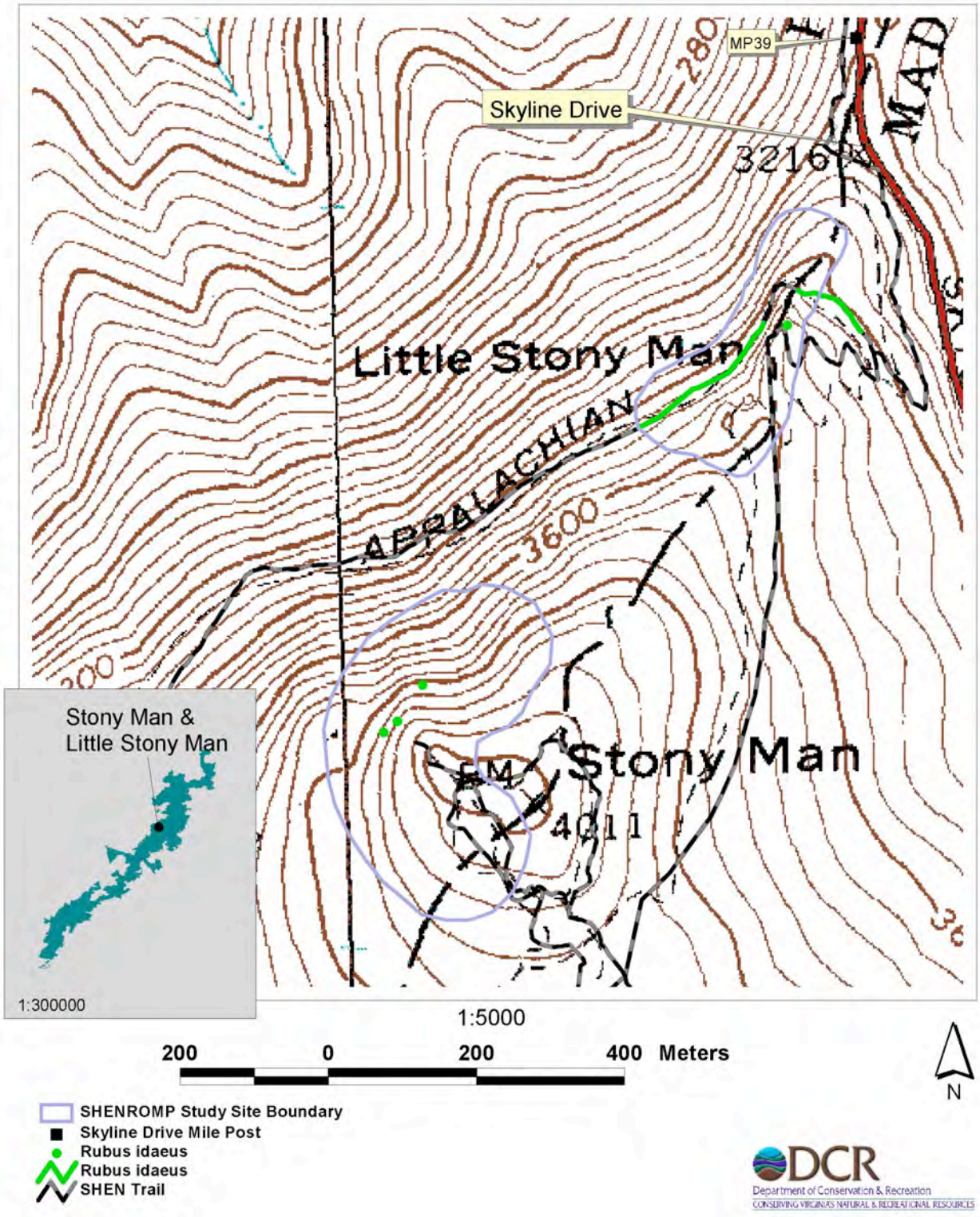


Fig. 62. Location of *Rubus idaeus* ssp. *strigosus* at Stony Man Summit.

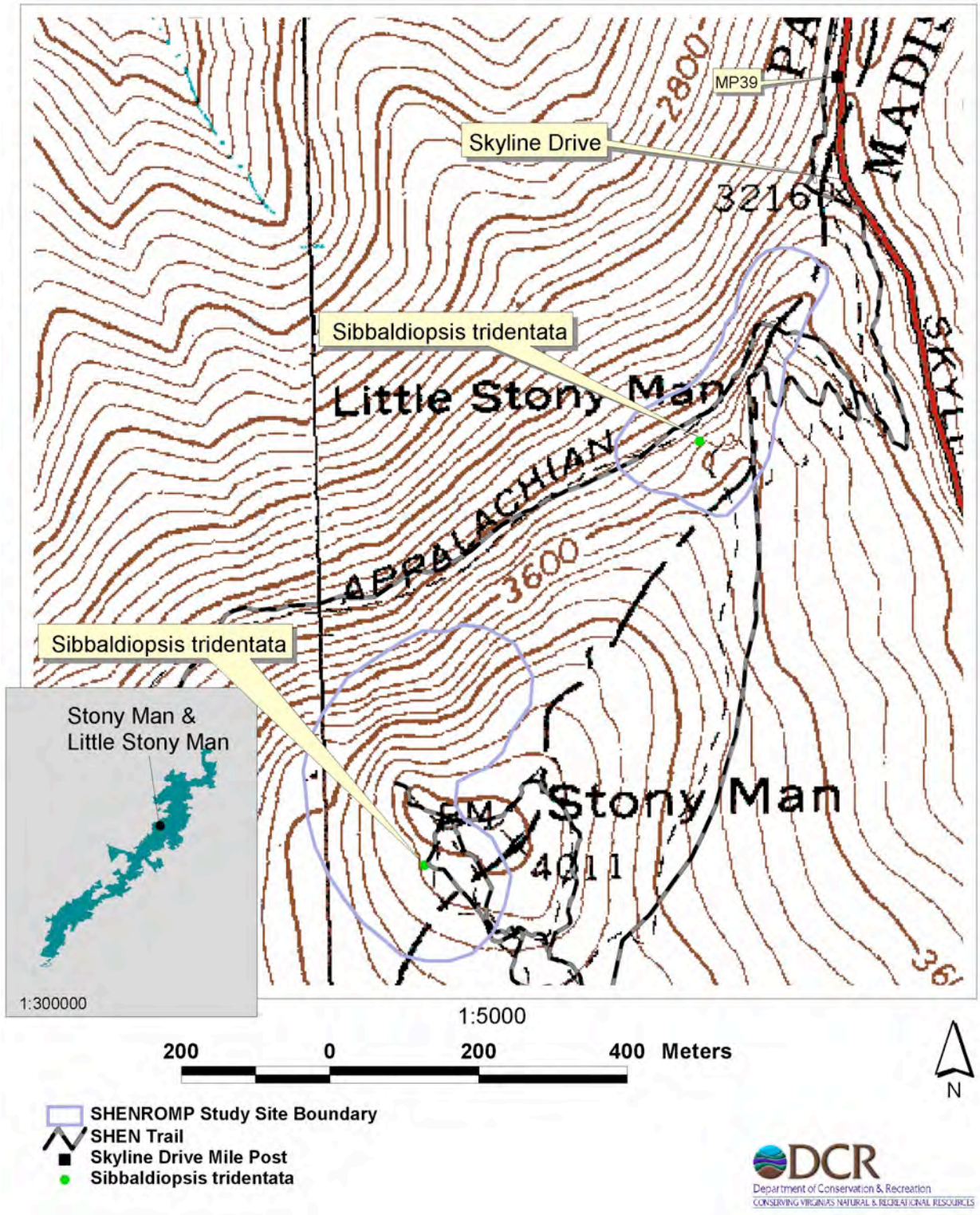


Fig. 63. Location of *Sibbaldiopsis tridentata* at Stony Man Summit.

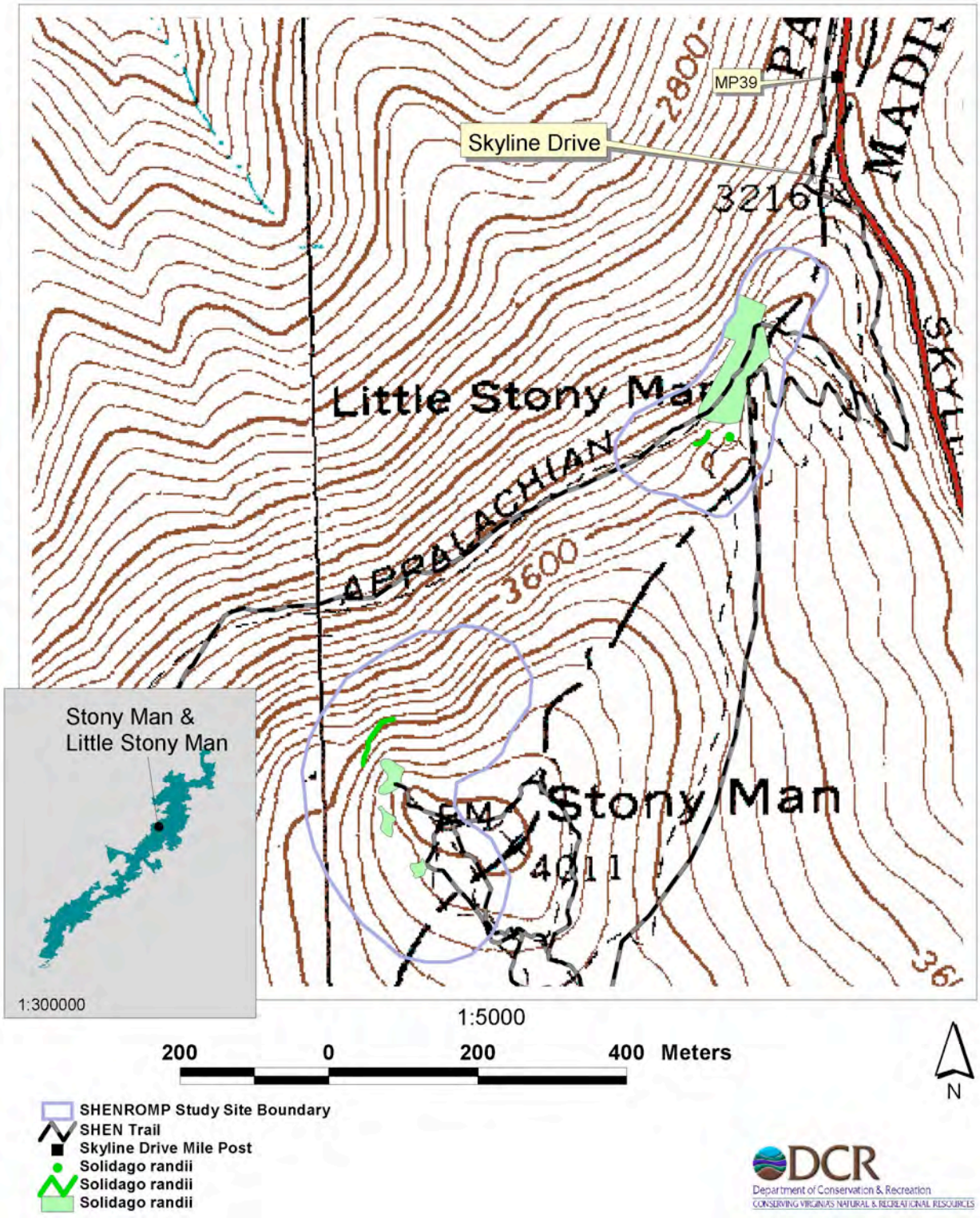


Fig 64. Location of *Solidago randii* at Stony Man Summit.

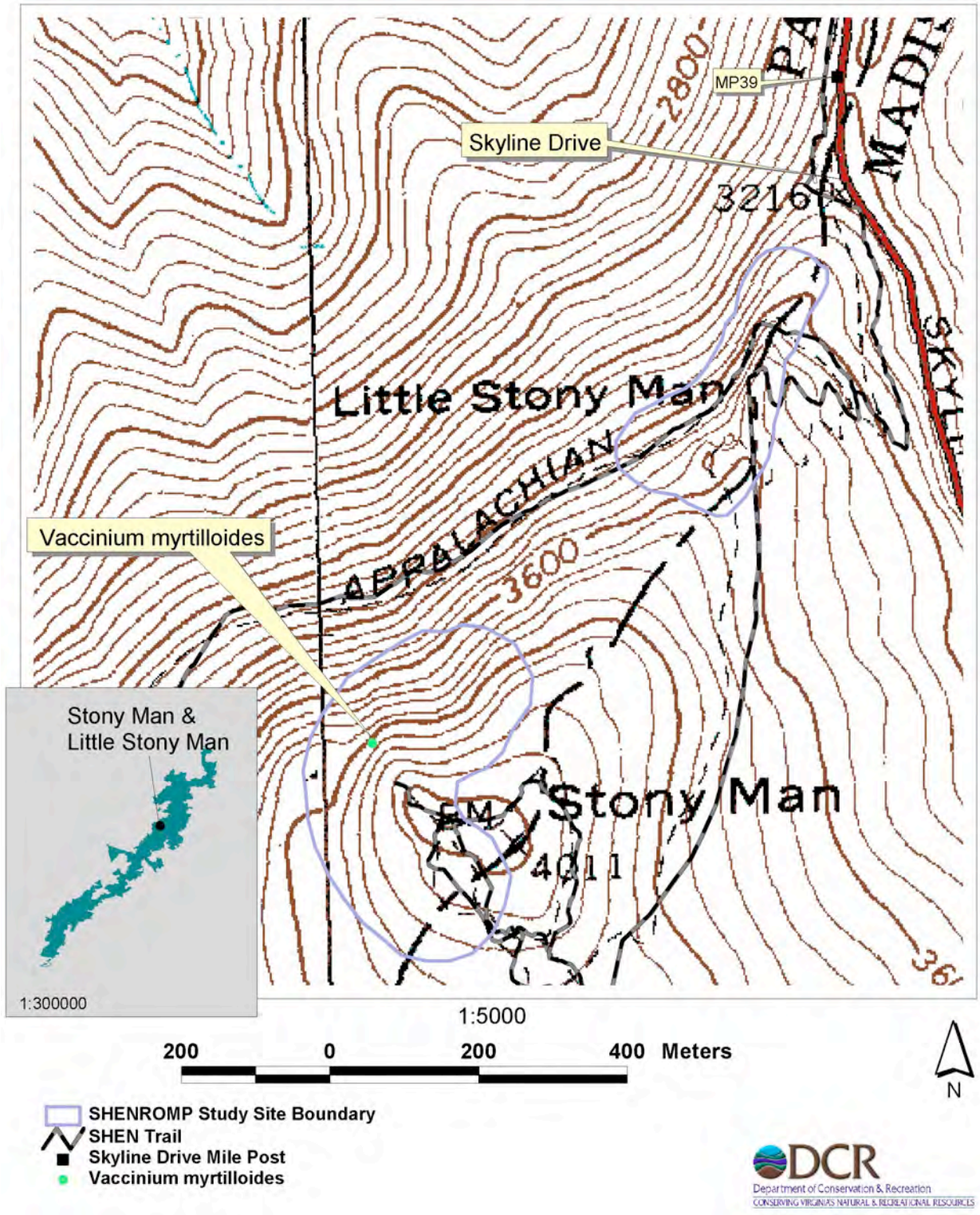


Fig. 65. Location of *Vaccinium myrtilloides* at Stony Man Summit.

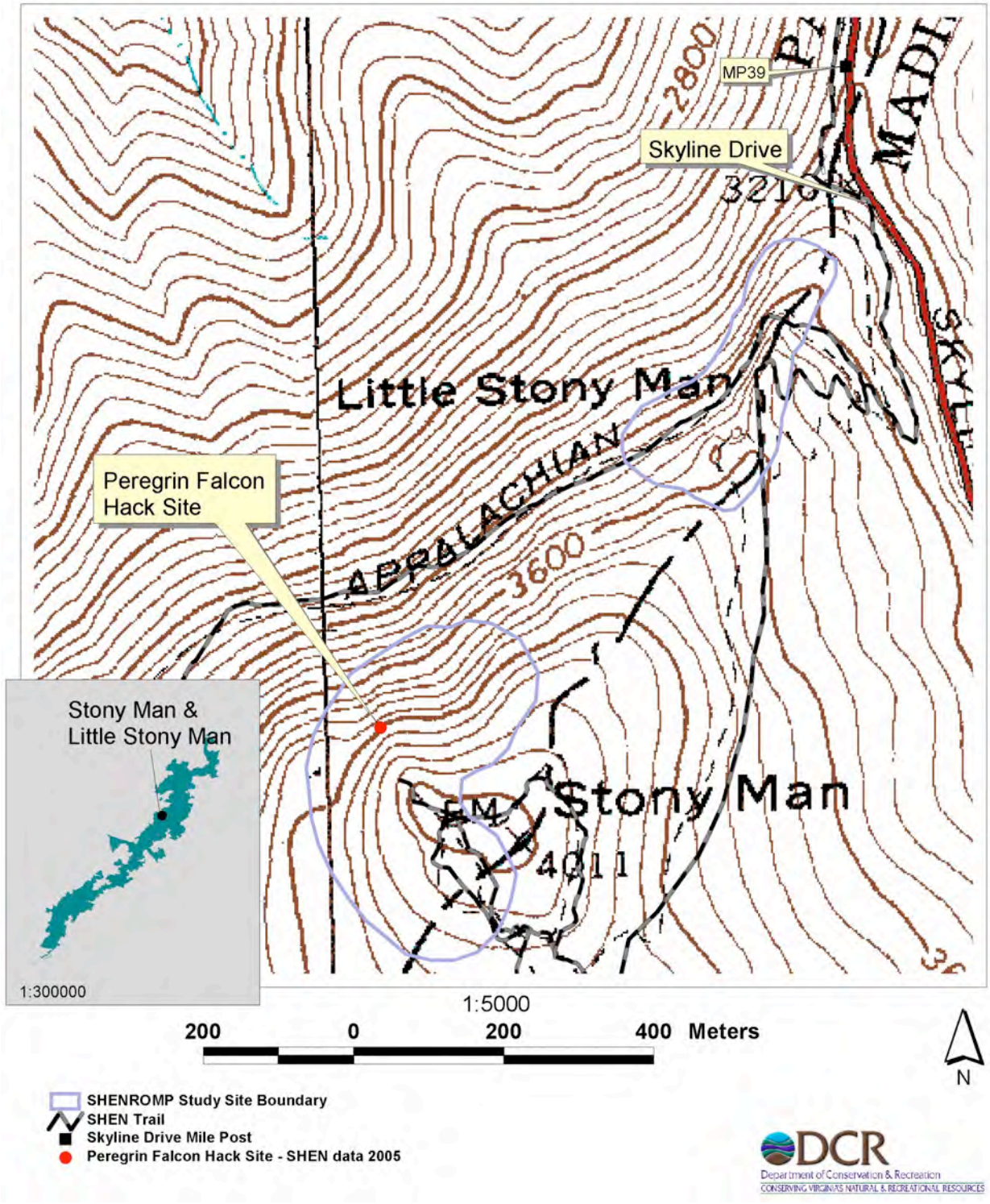


Fig 66. Location of *Falco peregrinus* at Stony Man Summit.

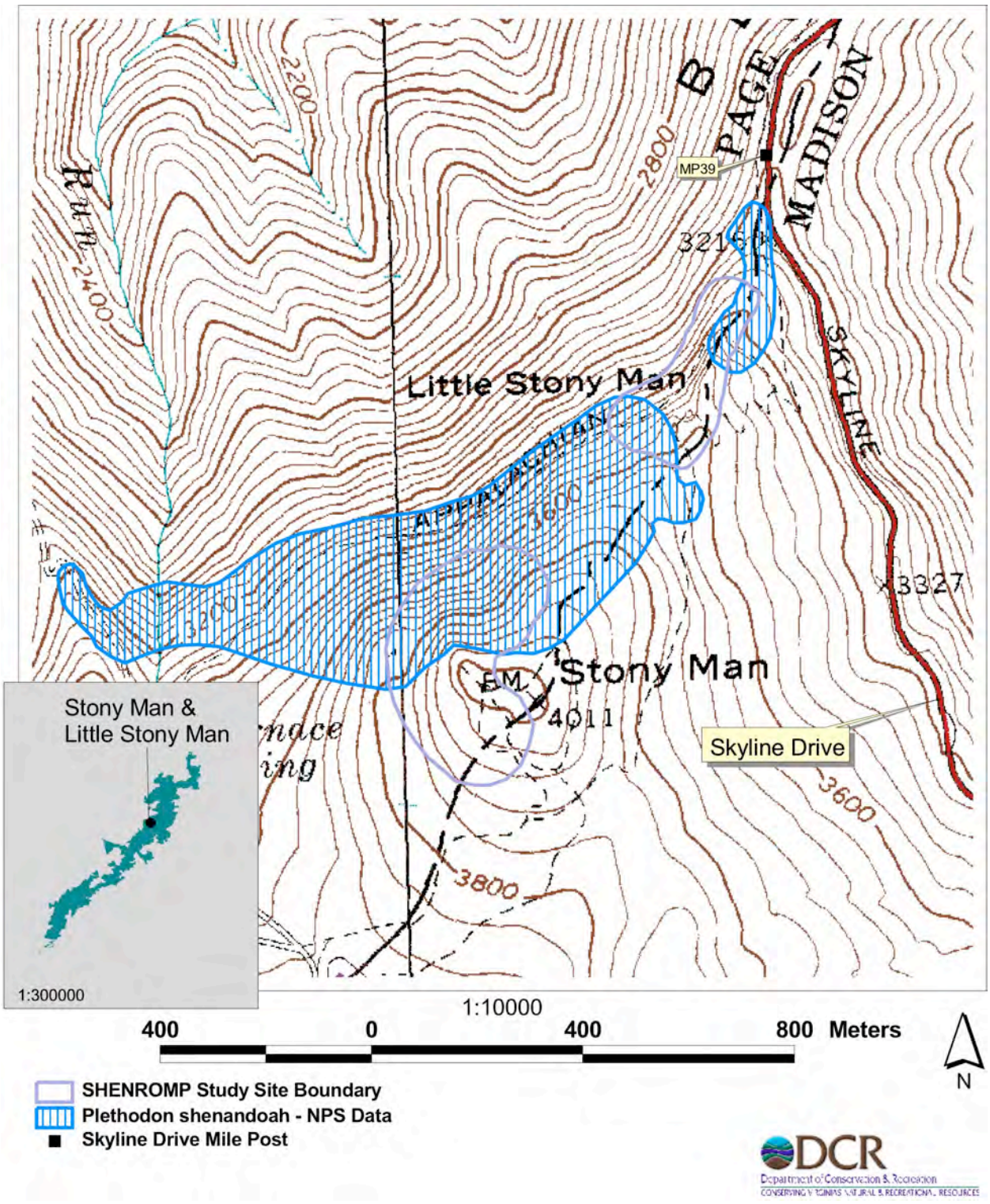


Fig. 67. Location of *Plethodon shenandoah* at Stony Man Summit.

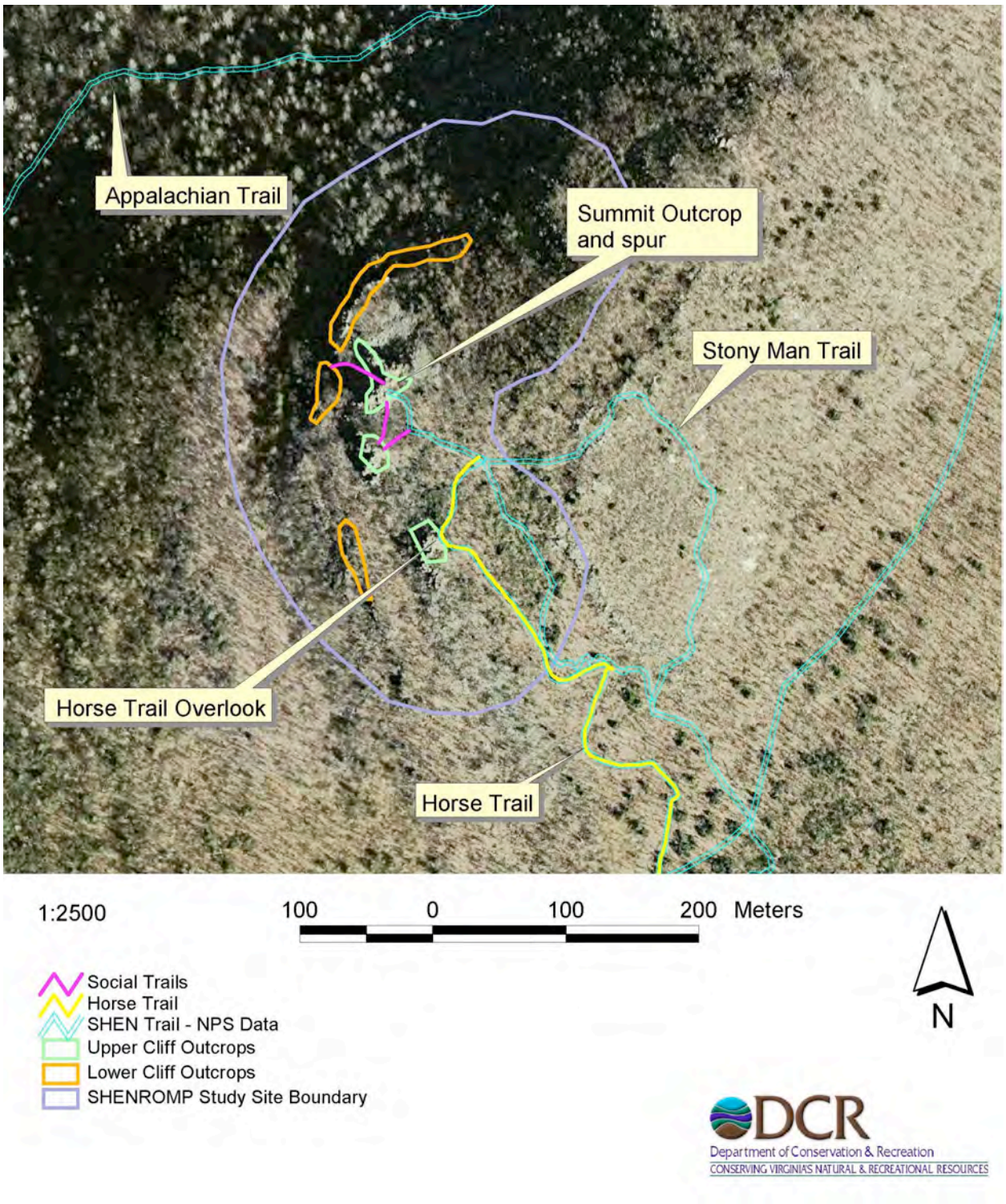


Fig 68. Site details for Stony Man Summit, including the location of the horse trail overlook, which is recommended for closure.

MLLERS HEAD (C32)

CONSERVATION SITE: Millers Head (B1) **THREAT RANK:** 0

LOCALITY: Page County **QUADRANGLE(S):** Big Meadows

LOCATION: This Central District site is located from 0.94 km (0.59 mi) to 1.15 km (0.72 mi) west of Skyland.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Fraxinus americana / *Physocarpus opulifolius* / *Carex pensylvanica* - *Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2	S2	None	None	AB
Quercus prinus - *Pinus virginiana* - (*Pinus pungens*) / *Schizachyrium scoparium* - *Dichanthelium depauperatum* Woodland	Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland	G2?	S2	None	None	A
Plants:						
Arctostaphylos uva-ursi	Bearberry	G5	S1	None	None	C
Animals:						
Plethodon shenandoah[1]	Shenandoah salamander	G1	S1	LE	LE	B

[1]Based on a previously documented record (DCR-DNH Biotics data). This element occurrence (eo) was not reconfirmed by DCR-DNH in 2005. Part of this eo lies outside of any ROMP site.

SITE DESCRIPTION: This site encompasses a group of closely aligned, highly weathered granite exposures on the southwestern face of Millers Head, a knob at the end of a narrow spur ridge leading west northwest from Bushytop. These open rock areas are mostly within a 0.50 ha (1.25 ac) area at elevations between 1,000-1,061 m (3,280-3,480 ft). The rock exposures here are mostly faces and ledges nearly flush with the surrounding topography, but a cliff about 15 m (49 ft) high extends along the base of the complex. Like other granitic rocks in SHEN, those here exhibit exfoliation, whereby fracturing creates a pattern of concentric layers which peel away like the sections of an onion.

The Bushytop Trail leads to a stone observation platform located just above the rock exposures at this site. A poorly defined social trail leads from the Bushytop Trail, winding around the south end of the platform and down to the open rock.

NATURAL COMMUNITIES: The Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest covers most of the wooded slopes of this site, except for a small area in the western portion where the Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest prevails. The forest cover is broken by two outcrop complexes that are separated by a narrow swath of trees. These outcrops vary considerably in topography and vegetation.

The upper outcrop below the viewing platform is relatively gentle to moderately steep and supports a stand of the relatively rich Central Appalachian Mafic Barren community type. The vegetation is predominantly herbaceous but also contains patches of shrubs. Dominant herbs here are *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Allium cernuum* (nodding onion), *Carex pensyvlanica* (Pennsylvania sedge), and *Schizachyrium scoparium* (little bluestem). The shrub thickets are composed of *Spiraea alba* var. *latifolia* (broad-leaved meadowsweet), *Rhus typhina* (staghorn sumac), *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Amelanchier sanguinea* var. *sanguinea* (roundleaf serviceberry), *Rosa virginiana* (Virginia rose), *Prunus virginiana* (choke cherry), and *Vaccinium stamineum* (deerberry). Other characteristic herbaceous species occurring at lower cover include *Helianthus divaricatus* (woodland sunflower), *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Solidago arguta* (cut-leaved goldenrod), *Selaginella rupestris* (ledge spikemoss), *Solidago erecta* (erect goldenrod), *Symphyotrichum laeve* var. *concinnum* (= *Aster laevis* var. *concinnus*, smooth aster), *Hylotelephium telephioides* (Allegheny stonecrop), *Liatris scariosa* var. *scariosa* (large blazing-star), *Woodsia obtusa* ssp. *obtusa* (blunt-lobed woodsia), and *Draba ramossisima* (rocktwist). Prominent lichens on exposed rock surfaces include *Umbilicaria muehlenbergii*, *Lasallia pensylvanica*, *Xanthoparmelia conspersa*, *Flavoparmelia baltimorensis*, *Rhizoplaca subdiscrepens*, and several white and gray crusts. Quantitative plot data were collected from this stand in 1999 (plot SHNP024).

The lower outcrop is very steep and has little soil development. The vegetation here is an open to very sparse (on the most massive rocks) woodland with low species-richness. The overstory consists of scrubby *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak), and *Pinus pungens* (table-mountain pine), with a little *Pinus virginiana* (Virginia pine) also present. Shrub patches of *Vaccinium pallidum* (early lowbush blueberry) and *Kalmia latifolia* (mountain-laurel) are interspersed with creeping mats of *Arctostaphylos uva-ursi* (bearberry) and pockets of xerophytic herbs such as *Schizachyrium scoparium*, *Danthonia spicata* (poverty oat-grass), *Dichanthelium depauperatum* (starved panic grass), *Carex pensylvanica*, *Viola sagittata* (arrow-leaved violet), and *Penstemon canescens* (gray beardtongue). The exposed outcrop surfaces are covered abundantly by the lichens *Lasallia pensylvanica*, *Lasallia papulosa*, and *Xanthoparmelia conspersa*. This occurrence was quantitatively documented by plot SHNP025 in 1999. It was previously classified with the Central Appalachian Heath Barren community but was reassigned to the Central Appalachian Xeric Chestnut Oak – Virginia Pine Woodland based on results of analysis conducted for the ROMP project.

RARE PLANTS: Virginia's only known population of *Arctostaphylos uva-ursi* occurs at this site. First found here in 1976, this boreal disjunct was relocated for this project on 20 June 2006. Scattered mats of the evergreen, prostrate shrub were found within a 20 x 30 m (66 x 98 ft) area. Total coverage of this species was estimated at about 60 m^2 (646 ft^2) in 1990; this coverage appears to have changed very little over the intervening years.

Habitats for the plant at this site include open rock faces and ledges, the top of the cliff at the downslope end of the site, and adjacent woodlands. Dead stems were common within the mats in 2006, presumably due to desiccation during a dry summer. No flowering or fruiting has ever been reported for this population, which appears to reproduce solely by vegetative means.

The watchist small tree *Crataegus pruinosa* (a hawthorn) and the watchlist shrub *Amelanchier sanguinea* var. *sangunea* (roundleaf serviceberry) are also found at this site.

RARE ANIMALS: *Plethodon shenandoah* (Shenandoah salamander) is known from this site. *Plethodon shenandoah*, endemic to SHEN, utilizes forested talus slopes and is known from only five locations. This occurrence roughly runs parallel to and north of Millers Head trail and enters the eastern edge of the ROMP site (Pague, 1991; Sanders, 2005). The USFWS recovery plan maps suggest that there is

additional suitable habitat within the ROMP site (USFWS, 1994). It should be assumed that it does occur more extensively within the site until further surveys can unequivocally determine otherwise.

Two watchlist moth species, *Leucania commoides* (a noctuid moth) and *Lithicodia concinnimacula* (red-spotted Lithacodia moth) were captured in a UV-trap on 6 June 2006. One watchlist katydid, *Scudderia septentrionalis* (northern bush katydid), was captured in a UV-trap on 3 August 2006.

Plate 48. Central Appalachian Mafic Barren on the upper outcrop at Millers Head.

THREATS: The significant natural communities, the rare plant, and their habitats at this site appear to receive little visitation despite the proximity of the Bushytop Trail. The viewing platform, which offers the best views in the area, appears to contain most hiking traffic. Even the upper barren, located immediately below the platform and visible from it, shows little evidence of trampling or damage to lichens and vegetation. However, several exotic and aggressive indigenous weeds are fairly common in the upper barren, including *Poa pratensis* (Kentucky bluegrass), *Bromus tectorum* (cheat grass), *Dactylis glomerata* (orchard grass), and seedlings of *Ailanthus altissima* (tree-of-heaven). While not currently dominant, these species represent a long-term threat to the compositional integrity of this community, especially if trampling disturbances should increase.

Until recently, the primary threat to *Plethodon shenandoah* was thought to be inter-specific competition with *Plethodon cinereus* (red-backed salamander). In general terms, in the drier conditions typically found in talus, *Plethodon shenandoah* can compete with *Plethodon cinereus* (Thurow, 1976; Jaeger, 1974); however, it is believed that alterations in climatic conditions may tip the balance to favor

Plethodon cinereus. In addition, natural succession of the talus, through weathering and soil formation, would also favor *Plethodon cinereus* (Jaeger, 1970). Recent thought is that there are also human-related factors that may adversely impact the rare species. These include acid deposition in the atmosphere and forest defoliation associated with introduced pest species. Further, there may be impacts from activities such as trail building and maintenance and camping that adversely impact *Plethodon shenandoah* either directly or by enabling *Plethodon cinereus* to out compete it (U.S. Fish and Wildlife Service, 1994).

MANAGEMENT RECOMMENDATIONS: The presence of the narrowly endemic *Plethodon shenandoah*, two globally rare natural communities, and the only Virginia colonies of *Arctostaphylos uva-ursi* make the vigorous protection of this site imperative. Moreover, relatively easy access makes needed management logistically feasible.

Manage invasive plants in the upper barren. Reduce cover of *Poa pratensis*, *Bromus tectorum*, *Dactylis glomerata*, and *Ailanthus altissima*. The use of herbicide is recommended for controlling these species because hand-pulling will create more soil disturbance and is labor-intensive. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Annually monitor the effectiveness of the invasive plant control effort. Continue monitoring for several years following treatment and assess need for further action.

Monitor recovery of the rare plant and the health of the two significant natural communities. Conduct surveys on a 3-5 year interval to assess the rare plant population and the health of the natural community types. Include a survey for invasive plants.

Conduct inventories to determine the status of *Plethodon shenandoah* population at this site. Long-term monitoring of this species is also recommended. Trail maintenance, camping, and fire management (fire break construction or fire suppression) should all be carefully considered in areas occupied by *Plethodon shenandoah*. Avoid any compaction of soil, increase in barriers within the habitat (e.g., a trail that might preclude *Plethodon shenandoah* salamanders from crossing), or activities that would increase soil moisture.

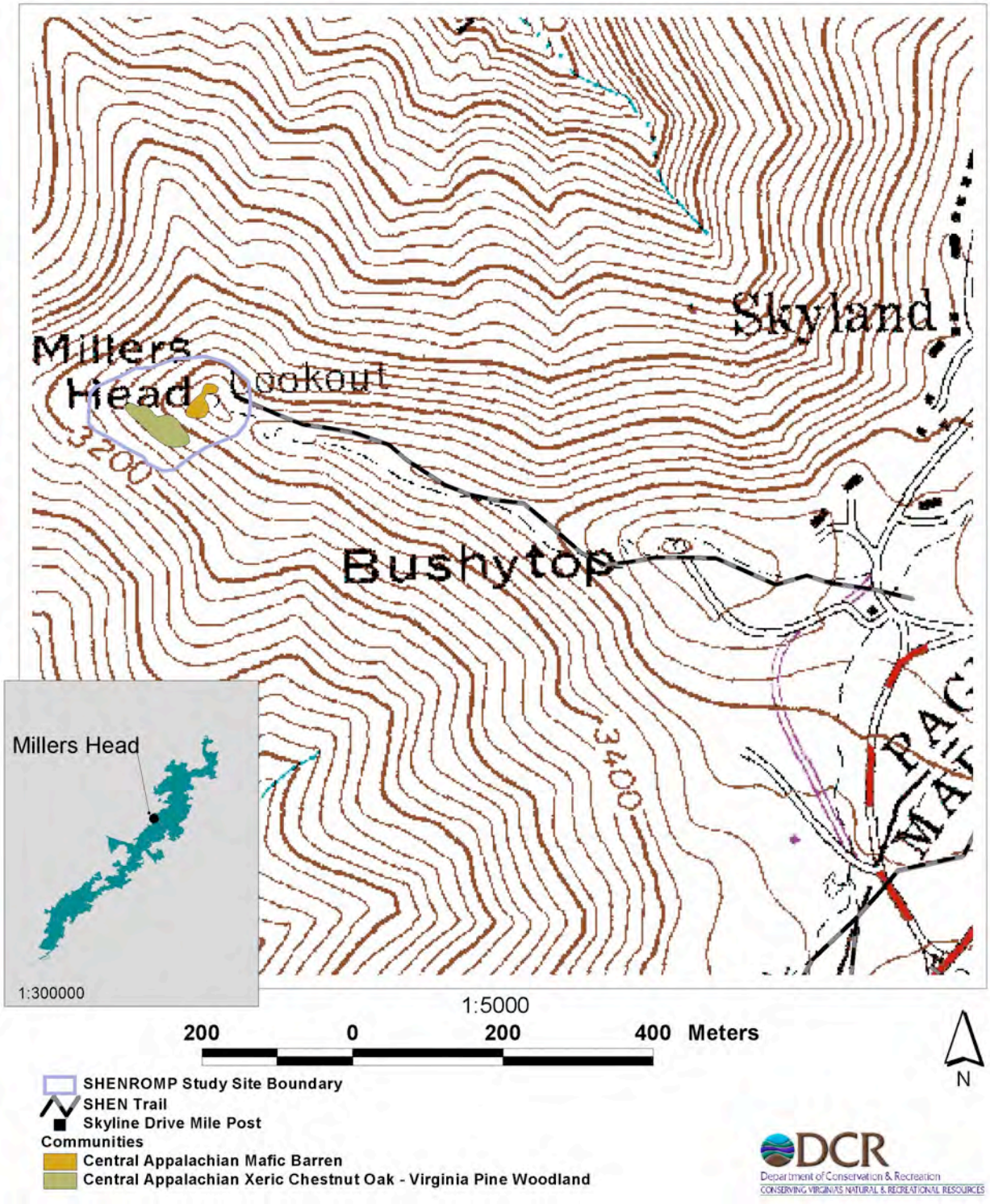


Fig. 69. Location of significant natural communities at Millers Head.

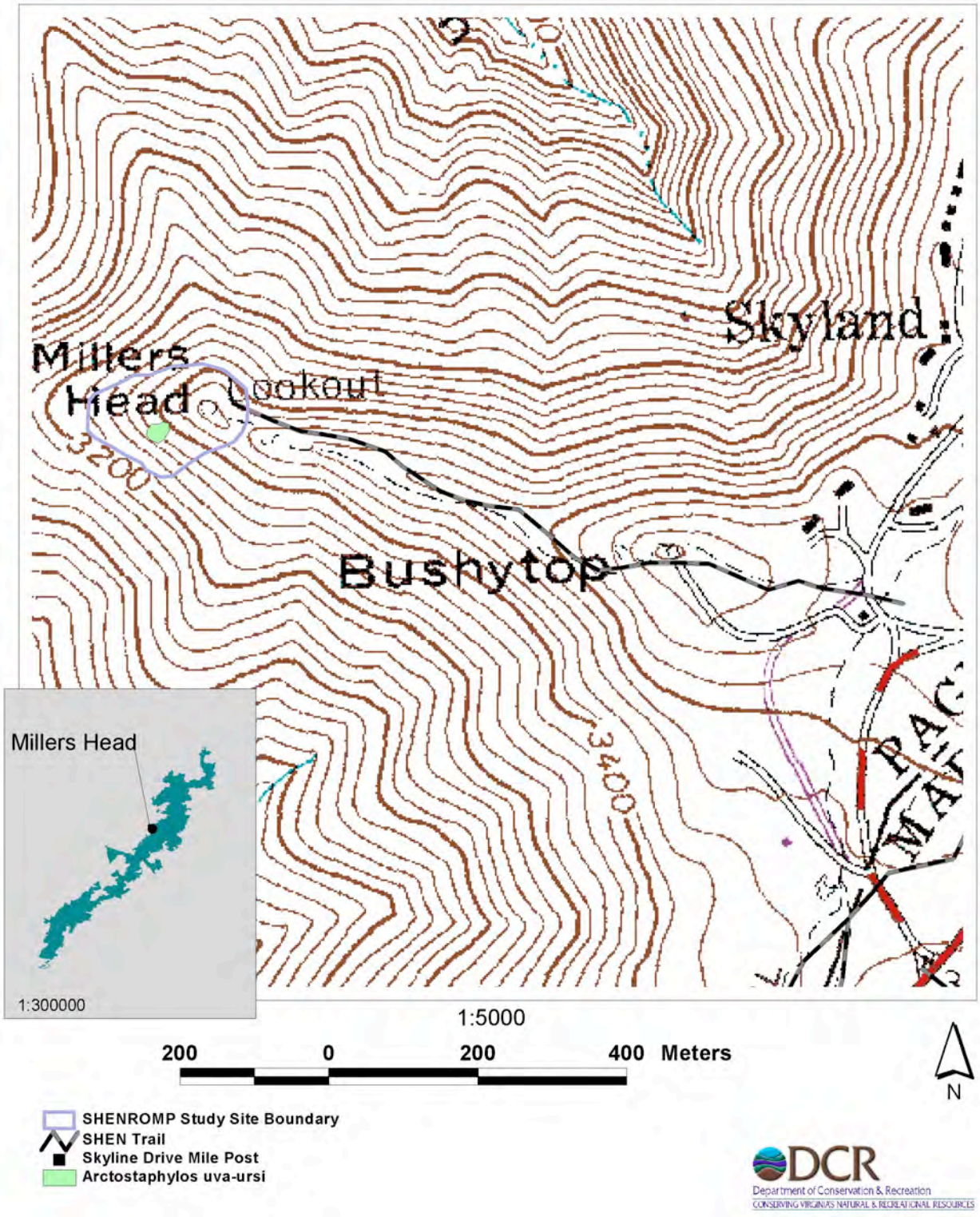


Fig. 70. Location of *Arctostaphylos uva-ursi* at Millers Head.

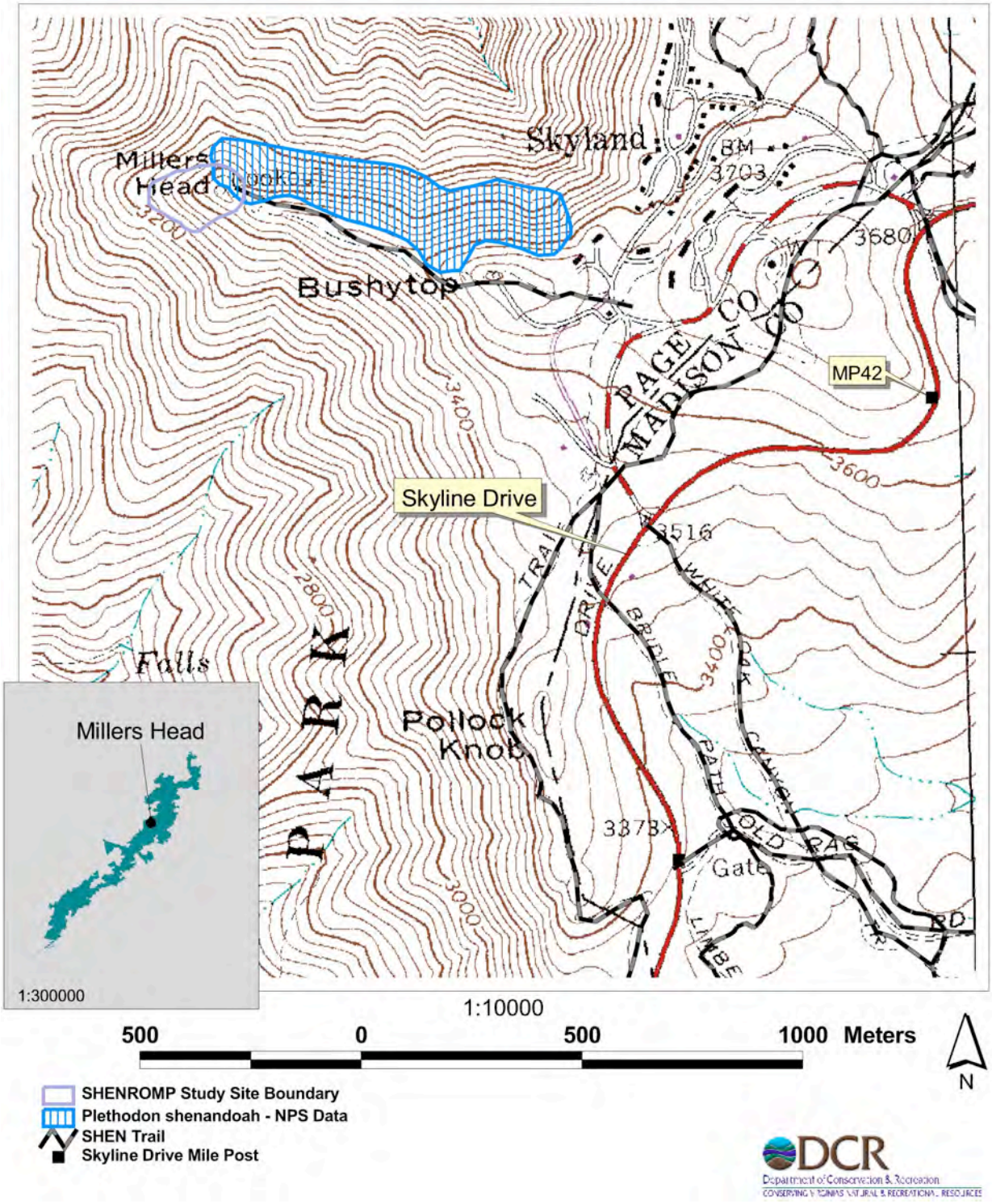


Fig. 71. Location of *Plethodon shenandoah* at Millers Head.

OLD RAG SUMMIT EAST (C37)

CONSERVATION SITE: Old Rag Mountain (B2) **THREAT RANK:** 3

LOCALITY: Madison County **QUADRANGLE(S):** Old Rag Mountain

LOCATION: This Central District site extends from 0.70 km (0.43 mi) east to 1.14 km (0.71 mi) east-northeast of the summit of Old Rag Mountain.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Fraxinus americana / *Physocarpus opulifolius* / *Carex pensylvanica* - *Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2	S2	None	None	BC
Plants:						
Aralia hispida	Bristly sarsaparilla	G5	S2	None	None	C
Populus tremuloides	Quaking aspen	G5	S2	None	None	D
Animals:						
Falco peregrinus[1]	Peregrine Falcon	G4	S1B S2N	None	LT	D

[1]Based on a previously documented record (DCR-DNH Biotics data). Part of this element occurrence (eo) lies within the Old Rag Summit West and Old Rag Southside ROMP sites and part lies outside of any ROMP site. This eo has not been updated by DCR-DNH for this report.

SITE DESCRIPTION: This site consists of the eastern portion of the summit ridge of Old Rag Mountain. The actual summit lies to the west within the Old Rag Summit West site. Old Rag Mountain is an isolated peak located several kilometers east of Skyline Drive and the mountains forming the main chain of the Blue Ridge.

Extensive areas of Old Rag Granite bedrock, the oldest geological formation in the park, are exposed at this site. This granite is composed mostly of quartz and orthoclase feldspar, minerals that weather slowly. The outcrops at this site have a smooth, domed appearance due to the process of exfoliation, whereby fracturing creates a pattern of concentric layers which peel away like the sections of an onion. Weathering along the widely spaced fractures that characterize this rock also produces large angular blocks. These blocks may weather in place to form spheroidal boulders that perch precariously on the smoothly undulating underlying mass of rock. Basaltic dykes from one to several meters wide occasionally cut through the granite mass. As basalt is a much softer rock than granite, these dykes erode out, forming trenches and slots.

The chief feature of this site is a northeast to southwest-trending granite ridge. From its northeastern end at an elevation of about 817 m (2,680 ft), the ridgecrest climbs to the southwest to an elevation of 908 m (2,980 ft) over a length of about 0.44 km (0.28 mi). A gap is located in the ridge about one-third of the way southwest from the northeastern end. The crest is narrow but with well-rounded shoulders and is capped with numerous spheroidal boulders. The sides of the ridge are steep to sheer and exfoliation is often apparent.

This site is crossed by the Ridge Trail, which traverses the top of the ridge. The Ridge Trail involves strenuous scrambles over granite boulders and tight squeezes though eroded out basaltic dykes. It is probably the most demanding trail in the park and also the most popular day hike.

NATURAL COMMUNITIES: Wooded slopes between and below the massive rock exposures contain a mosaic of Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest and Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. These forests have been heavily disturbed by gypsy moth outbreaks, several recent hurricanes and ice storms, and a large fire in 2000. Snags and downed wood are abundant, and regenerating understories are extremely dense in many places.

A scrubby, open, lithophytic variant of the Central Appalachian Pine – Oak / Heath Woodland occupies shallow soils and crevices on and around outcrops. *Pinus pungens* (table-mountain pine) is the characteristic dominant of these stands, but *Pinus strobus* (eastern white pine), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak), *Sassafras albidum* (Sassafras), *Betula lenta* (sweet birch), *Populus grandidentata* (bigtooth aspen), and other trees are also common. Patches of shrubs, e.g., *Gaylussacia baccata* (black huckleberry), *Kalmia latifolia* (mountain-laurel), *Photinia melanocarpa* (black chokeberry), and *Hamamelis virginiana* (witch-hazel), occur among the trees. Herbs are sparse but *Saxifraga michauxii* (Michaux's saxifrage) forms local colonies on protected shelves and in crevices.

The only significant natural community documented at this site is a stand of mixed herbaceous and shrub vegetation occupying a 0.1 ha (0.25 ac) sloping pavement at the west end of the site. This vegetation contrasts sharply with that found elsewhere on the summit of Old Rag and was assigned by inspection to the Central Appalachian Mafic Barren community type. *Rhus typhina* (staghorn sumac) is the dominant shrub, with minor associates of *Fraxinus americana* (white ash), *Sassafras albidum*, *Rubus allegheniensis* (Alleghany blackberry), and *Smilax glauca* (whiteleaf greenbrier). The herbaceous flora, which densely occupies several shallow fissures and crevices, consists of *Talinum teretifolium* (roundleaf fameflower), *Hylotelephium telephioides* (Allegheny stonecrop), *Saxifraga michauxii*, *Heuchera americana* (American alumroot), *Danthonia spicata* (poverty oat-grass), *Agrostis perennans* (autumn bentgrass), *Solidago puberula* var. *puberula* (downy goldenrod), *Corydalis sempervirens* (pink corydalis), and *Dichanthelium acuminatum* var. *acuminatum* (woolly panic grass). The bryophyte *Grimmia laevigata* is locally abundant on the pavement, suggesting that the habitat receives periodic run-off or seepage across the face. The lichens *Xanthoparmelia conspersa* and *Dimelaena oreina* are abundant on the drier outcrop surfaces.

RARE PLANTS: Two rare plants are known from this site. A population of *Aralia hispida* (bristly sarsaparilla), not documented from here since it was first discovered in 1938, was relocated on July 13, 2005. Two small colonies were located in thin soil at the edge of a massive northwest-facing granite exposure. The larger colony had 22 plants in a 4 x 12 (13 x 29 ft) area. About 15 m (49 ft) to the north-northeast, a second colony was found with 10 plants in a 4 m^2 (43 m^2). Most plants were in flower and early fruit on the survey date with a few vegetative plants also present. The plants receive ample sunlight, and evidence of a recent fire in the area was noted.

A previously known population of *Populus tremuloides* (quaking aspen) was relocated at this stie on May 24, 2006. The plants were found in a 2 x 10 m (6 x 30 ft) area, growing in the thin soil of a shallow depression on a southeast-facing granite pavement. Due to the propensity of this species to produce shoots from an extensive root system, it was not possible to determine the number of individuals present. Thirty trunks were counted, however, ranging from small seedlings about 0.3 m (1.0 ft) tall to trees with a height of 3 m (10 ft). Several dead trunks were also observed, as well as two trunks that had been broken off. The dieback of trunks should probably be expected here due to the stresses of winter exposure and summer droughts.

RARE ANIMALS: *Falco peregrinus* (Peregrine Falcon) is known from this area (Virginia Department of Game and Inland Fisheries, 1994). The area includes all of the Old Rag ROMP sites and extends past these into non-ROMP areas. *Falco peregrinus* has been reintroduced to SHEN as part of the recovery plan for this species. In 1994, a natural nest with two eggs was found abandoned in the Old Rag area, though specific locality information was not provided (Virginia Department of Game and Inland Fisheries, 1994).

One watchlist moth species, *Mesoleuca ruficillata* (white-ribboned carpet), was captured in a UV-trap on 10 August 2006.

Plate 49. A narrow ridge of massive, fractured granite is the principal feature of the Old Rag Summit East site.

THREATS: The small occurrence of Central Appalachian Mafic Barren is located immediately adjacent to the Ridge Trail and receives heavy visitation. Trampling is an ongoing threat, but the herbaceous plants are somewhat protected by their location in fissures on the pavement.

The *Aralia hispida* (bristly sarsaparilla) population is located only about 6 m (20 ft) downslope from the Ridge Trail, but trampling is not much of a concern here due to the steepness of the terrain. Recent fire has resulted in death of *Kalmia latifolia* and other woody species in the area adjacent to the *Aralia hispida* population. Bristly sarsaparilla is believed to be a fire tolerant species that does not compete as well with other species in the absence of periodic wildfire or prescribed burning.

The *Populus tremuloides* population is located about 15 m (50 ft) from the Ridge Trail. The population area appears to receive only minimal visitation.

No non-native species were observed at this site. Most common exotic species in the park grow poorly on the extremely acidic and nutrient-poor soils found here.

The main threat to all *Falco peregrinus* populations range-wide was once pesticide contamination leading to reproductive failure (USFWS, 1991). This threat appears to be diminishing (USFWS, 1991). Current threats include direct human disturbance, which can cause individual nesting pairs to abandon their nest sites. In addition, predation, habitat destruction, and occasional poaching have been identified as threats to this species (USFWS 1991).

MANAGEMENT RECOMMENDATIONS:

Direct visitors away from the sloping outcrop where the Central Appalachian Mafic Barren and the *Populus tremuloides* are located. These natural heritage resources are located south of the Ridge Trail at the west end of the site. Use barriers if necessary. See Figure 75.

Prohibit camping above 2,000 feet at this site. Currently, the prohibition on camping begins at 3,000 feet. Extending the prohibitions to a lower altitude will encompass and protect the rare Central Appalachian Mafic Barren.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the rare plants and the health of the sigificant natural community. Conduct a survey on a 3-5 year interval to assess the rare plant populations and the health of the Central Appalachian Mafic Barren. At the same time, conduct a survey and assessment of invasive plants.

Determine feasibility of allowing prescribed wildfire at this site. The rare plant *Aralia hispida* would benefit from a more frequent fire return interval. The SHEN fire manager should be consulted during the development of the rock outcrop management plan to determine feasibility of allowing wildfire to burn this site.

Continue adherence to the recovery plan protocols for *Falco peregrinus*, including monitoring and additional survey work. Nesting areas should be protected from human disturbances.

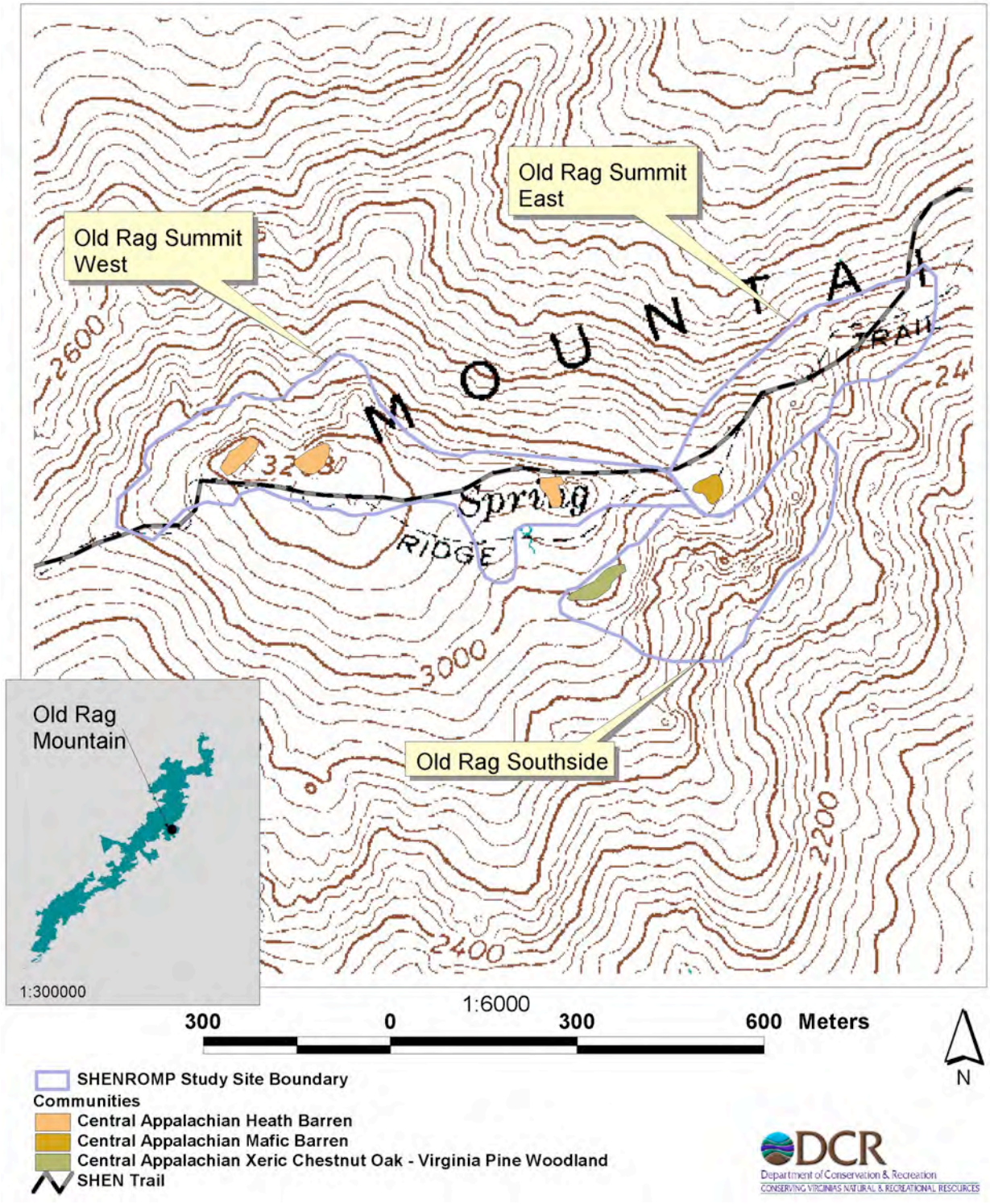


Fig. 72. Location of significant natural community at Old Rag Summit East.

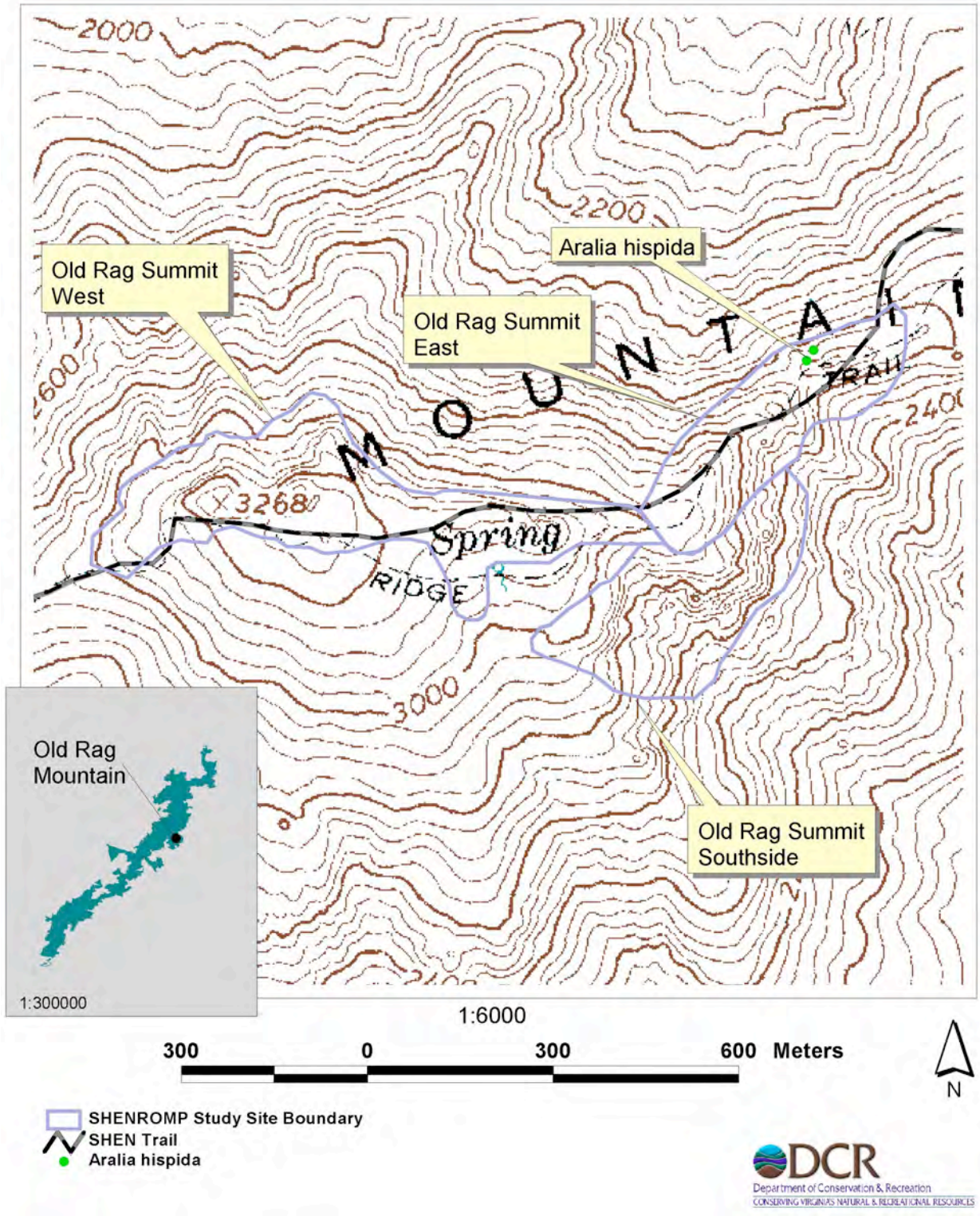


Fig. 73. Location of *Aralia hispida* at Old Rag Summit East.

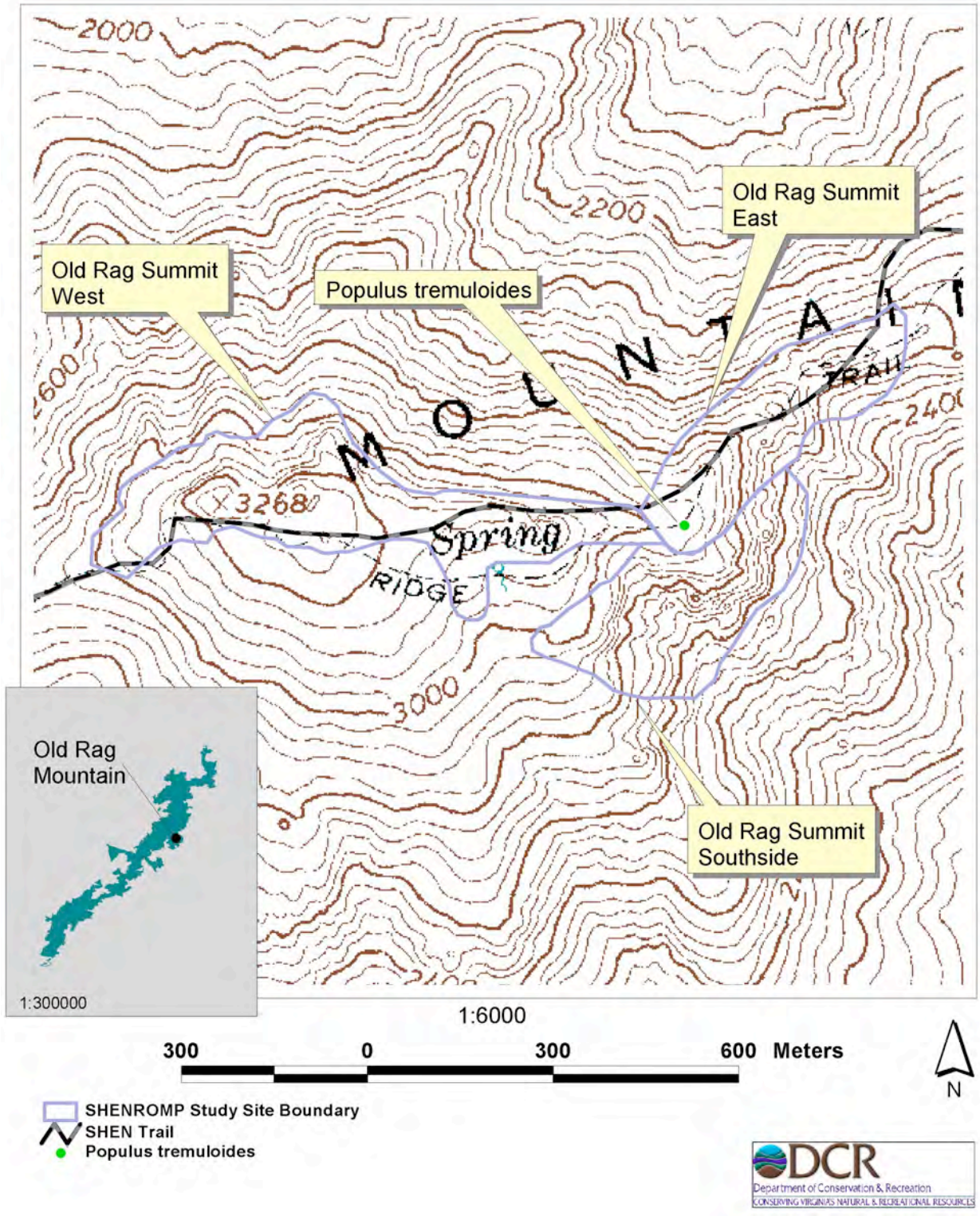


Fig. 74. Location of *Populus tremuloides* at Old Rag Summit East.

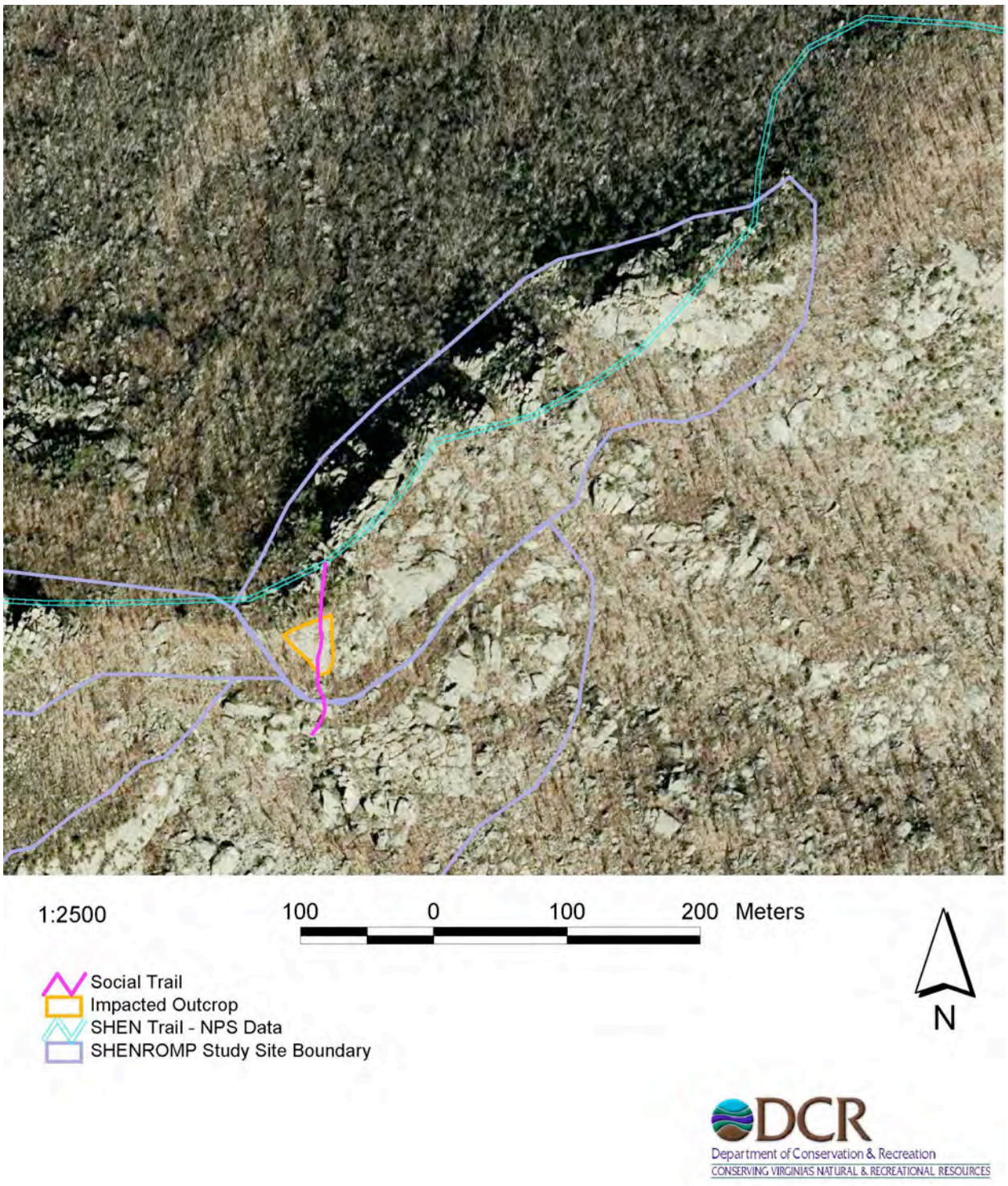


Fig. 75. Site details for Old Rag Summit East.

OLD RAG SUMMIT WEST (C62)

CONSERVATION SITE: Old Rag Mountain (B2) **THREAT RANK:** 3

LOCALITY: Madison County **QUADRANGLE(S):** Old rag Mountain

LOCATION: This Central District site includes the summit of Old Rag Mountain and extends from 0.23 km (0.14 mi) southwest to 0.72 km (0.45 mi) east of the summit.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Kalmia latifolia* - *Gaylussacia baccata* - *Vaccinium* (*angustifolium*, *pallidum*) - *Menziesia pilosa* Shrubland	Central Appalachian Heath Barren	G2	S1	None	None	B
Plants:						
Huperzia appalachiana	Appalachian fir-clubmoss	G4G5	S2	None	None	C
Minuartia groenlandica	Mountain sandwort	G5	S1	None	None	C
Animals:						
Falco peregrinus[1]	Peregrine Falcon	G4	S1B S2N	None	None	D

[1]Based on a previously documented record (DCR-DNH Biotics data). Part of this element occurrence (eo) lies within the Old Rag Summit East and Old Rag Southside ROMP sites and part lies outside of any ROMP site. This eo has not been updated by DCR-DNH for this report.

SITE DESCRIPTION: This site includes the summit of Old Rag Mountain – an isolated peak located several kilometers east of Skyline Drive and the mountains forming the main chain of the Blue Ridge. Large areas of Old Rag Granite bedrock, the oldest geological formation in the park, are exposed here, ranging from cliffs to gently inclined pavements nearly flush with the surrounding terrain.

Old Rag Granite is composed mostly of quartz and orthoclase feldspar, minerals that weather slowly. Large outcrops at this site have a smooth, domed appearance due to the process of exfoliation, whereby fracturing creates a pattern of concentric layers which peel away like the sections of an onion. Weathering along the widely spaced fractures that characterize this rock also produces large angular blocks. These blocks may weather in place to form spheroidal boulders that perch precariously on the smoothly undulating underlying mass of rock. Basaltic dykes from one to several meters wide occasionally cut through the granite mass. As basalt is a much softer rock than granite, these dykes erode out, forming trenches and slots.

This site consists of an east to west-trending ridge that supports four major rock exposures and numerous smaller outcrops. The dome-like summit exposure reaches an elevation of 1,003 m (3,291 ft). It descends gently to the south and east, but to the northwest drops about 30 m (100 ft) in a sheer cliff.

To the west lies another massive domed exposure, separated from the summit by a steep gap of jumbled boulders. This peak reaches an elevation of 996 m (3,268 ft), and also has a sheer cliff forming its northwest face. It has a broad rounded top.

An east-west trending granite ridge is situated about 0.23 km (0.14 mi) east southeast of the summit. This exposure is approximately 210 m (689 ft) in length and descends gently to the south. Its northern face is a steep cliff about 25 m (82 ft) high.

To the south of this ridge lies an extensive slope of gently to moderately inclined smooth, exfoliating granite. This exposure has a southern aspect and covers about 0.24 ha (0.60 ac). It lacks the weathered boulders found on the other three exposures.

This site is accessed by the Ridge Trail to the northeast and the Saddle Trail to the west. The Ridge Trail involves strenuous scrambles over granite boulders and tight squeezes though eroded out basaltic dykes. It is probably the most demanding trail in the park and also the most popular day hike. The Saddle Trail is steep but avoids rock scrambles. Most hikers make a loop by ascending the mountain via one trail and descending via the other.

This trail system runs just south of the summit peak and the slightly lower peak to the west. Most hikers go to the top of one or both of these peaks by short informal trails that are heavily used. The main trail crosses the granite ridge located east of the summit, but avoids the top of its north-facing cliff. The south-facing exposure lies south of the trail and receives little if any visitation.

NATURAL COMMUNITIES: This site lies almost entirely above 900 m (3,000 ft) elevation and has a number of northern and high-elevation floristic elements that are absent from the Old Rag Summit East site. Wooded slopes with deeper soils are generally covered by the Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest. These forests have been heavily disturbed by gypsy moth outbreaks, several recent hurricanes and ice storms, and a large fire in 2000. Snags and downed wood are abundant and regenerating understories are extremely dense in many places.

Sweet Birch – Chestnut Oak Talus Woodland covers substantial areas at the foot of cliffs and outcrops on the north slope of the ridge. Boulder deposits in these areas range up to room size and are extremely difficult to traverse. Characteristic species of this woodland include *Betula lenta* (sweet birch), *Quercus prinus* (chestnut oak), *Quercus rubra* (northern red oak), *Tilia americana* var. *americana* (American basswood), *Tsuga canadensis* (eastern hemlock), *Acer pensylvanicum* (striped maple), *Acer spicatum* (mountain maple), *Sambucus racemosa* var. *pubens* (red elderberry), *Ilex montana* (mountain holly), *Menziesia pilosa* (minniebush), *Ribes rotundifolium* (Appalachian gooseberry), *Parthenocissus quinquefolia* (Virginia creeper), *Dryopteris marginalis* (marginal wood-fern), and *Polypodium appalachianum* (Appalachian rock polypody).

Central Appalachian Pine – Oak / Heath Woodland occupies thin-soiled areas on the south slope of the ridge. An open, lithophytic variant of this woodland is characteristic of shallow soils and crevices on the south side of the summit outcrops. *Pinus pungens* (table-mountain pine) is the characteristic dominant of these stands, but *Pinus strobus* (eastern white pine), *Quercus prinus*, *Quercus rubra*, *Quercus coccinea* (scarlet oak), *Sassafras albidum* (sassafras), *Betula lenta*, *Populus grandidentata* (bigtooth aspen), and other trees are also common. Patches of shrubs, e.g., *Gaylussacia baccata* (black huckleberry), *Kalmia latifolia* (mountain-laurel), and *Vaccinium spp.* (blueberries), occur among the trees. Herbs are sparse but *Saxifraga michauxii* (Michaux's saxifrage) and *Solidago puberula* var. *puberula* (downy goldenrod) form local colonies on protected shelves and in crevices.

Vegetation on the north side of the summit rocks is subject to seasonally colder microclimates and stresses from winter winds and ice. Here, the Pine – Oak / Heath Woodland mostly gives way to the Central Appalachian Heath Barren community, a globally rare shrubland of rocky, high-elevation summits. This community type occurs in three large patches and numerous small patches along the north

side of the crest, covering at least 0.5 ha (1.2 ac). The largest stands occur on the two major summits at the west end of the site. Physiognomic expressions of this vegetation type vary from patchy to extremely dense, and the shrubs are usually multi-tiered. *Kalmia latifolia* typically has the highest cover but often shares dominance with *Sorbus americana* (American mountain-ash), *Gaylussacia baccata*, *Menziesia pilosa*, *Hamamelis virginiana* (witch-hazel), *Ilex montana*, and/or *Vaccinium pallidum* (early lowbush blueberry). Vegetation cover is usually broken by areas of open rock that support lichens or sparse herbaceous cover of *Minuartia groenlandica* (mountain sandwort), *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Saxifraga michauxii*, *Solidago puberula*, and *Bulbostylis capillaris* (common hairsedge). More mesophytic herbs such as *Aralia nudicaulis* (wild sarsaparilla) and *Dennstaedtia punctilobula* (hayscented fern) often occur in moss mats under the shrubs, especially in north-facing crevices and other protected sites. Saplings of *Quercus rubra*, *Tsuga canadensis*, *Prunus pensylvanica* (pin cherry), *Betula alleghaniensis* (yellow birch), and *Betula lenta* may also be scattered in the community. Quantitative plot data were collected from this occurrence in 1999 (plot SHNP035) and again during the ROMP project (SNHP147).

This site was one of four from which lichens were intensively collected and sent to specialists at the New York Botanical Garden for identification. The general lichen cover on massive rocks and boulders that are protected from trampling is dominated by *Xanthoparmelia plittii*, *Lasallia pensylvanica*, and several crusts, including *Acaraspora fuscata*, *Aspicilia cinerea*, *Fuscidea recensa*, and *Rhizoplaca subdiscrepens*. The arctic-boreal disjuncts *Melanelia stygia* and *Rhizocarpon geographicum* are both present, but not abundant. The most significant collections were of a *Fuscidea*, which may represent an undescribed species, and of an *Opegrapha* which may be *O. gyrocarpa* (only recently reported from North America) or an undescribed species. Also present are *Dimelaena oreina*, *Lasallia papulosa*, *Lepraria neglecta*, *Lecidia tessellata*, and *Melanelia culbersonii*. *Umbilicaria mamulata* and *Flavoparmelia baltimorensis* are common on more sheltered rocks, along with bryophytes such as *Polytrichum* spp. and *Bryum* sp.

The 0.24 ha (0.6 ac) exfoliating pavement on the upper south slope of this site does not support vascular plants, except around its edges. The bryophytes *Grimmia laevigata*, *Polytrichum* spp., and *Bryum* sp. are common on parts of the pavement that receive periodic moisture. *Xanthoparmlia conspersa*, *Dimelaena oreina*, *Lasallia papulosa*, *Physcia cf. subtilis*, *Cladonia* spp., and an unidentified gray crust are abundant on the drier rock surfaces.

RARE PLANTS: Previously known populations of *Minuartia groenlandica* and *Huperzia appalachiana* (Appalachian fir-clubmoss) were relocated at this site.

Minuartia groenlandica was found both on the summit peak and on the slightly lower peak to the west of the summit. On the summit, about 100 clumps were found in a 0.05 ha (0.12 ac) area. On the western peak, over 300 clumps were found in a 0.11 ha (0.27 ac) area. Plants were in flower on the June 15, 2005, survey date. This plant grows on gravelly substrates in shallow crevices and depressions on massive granite exposures. These areas are sparsely vegetated and receive plentiful sunlight.

Five colonies of *Huperzia appalachiana* were found in 2005 and 2006 – three of which were previously known. A single clump with four stems was found at the base of a jumble of large boulders about 6.0 m (20 ft) down the north face of the peak to the west of the summit. Two mature clumps with 10-20 stems each and several small juvenile plants were found at the northern end of a basaltic dike located just east of the summit. One of these mature clumps was chlorotic, and the other appeared to be nearly dead.

The remaining three *Huperzia appalachiana* colonies were found at the base of the sheer northern face of the granite ridge located about 0.23 km (0.14 mi) east southeast of the summit. A previously known colony situated about half way along the base of this cliff consisted of about 30 clumps of one to 20 stems each within a 6 m^2 (65 ft^2) area. Many of these clumps were stunted, trampled, and/or chlorotic.

A new colony of this pteridophyte was found further west along the base of the cliff. This station consisted of 60-70 clumps within a 4 x 12 m (13 x 39 ft) area. Many of these clumps were stunted, chlorotic and/or partially dead. A second new colony was located a short distance to the southwest up a small gap between the main cliff and a smaller outcrop west of the cliff. About 20 clumps were found here in an 8 m^2 (86 ft^2) area. These clumps were of average vigor.

There is a record for *Cornus rugosa* (roundleaf dogwood) at this site from 1967. Attempts have been made over the years to relocate this population without success. The occurrence is now considered by DCR-DNH to be historical (DCR-DNH Biotics data).

RARE ANIMALS: *Falco peregrinus* (Peregrine Falcon) is known from this area (Virginia Department of Game and Inland Fisheries, 1994). The area includes all the Old Rag ROMP sites and extends past these into non-ROMP areas. *Falco peregrinus* has been reintroduced to SHEN as part of the recovery plan for this species. In 1994, a natural nest with two eggs was found abandoned in the Old Rag area, though specific locality information was not provided (Virginia Department of Game and Inland Fisheries, 1994).

In addition, one watchlist katydid species, *Scudderia septentrionalis* (northern bush katydid), was collected in a UV-trap on 10 August 2006.

Plate 50. Weathered-in-place fractured outcrops and spheroidal boulders are characteristic of granitic exposures at the Old Rag western summit.

THREATS: Most patches of the heath barren shrubland have been impacted to some extent by trampling or social trails which cut through them. The worst damage is on the two major summits at the west end of the site, where some of the shrublands have essentially been destroyed. Damage on the

slightly lower, westernmost peak has increased dramatically over the past 15 years, with the dense, low shrubland being progressively reduced and destroyed around the rim of the level summit.

Severe trampling has also dramatically reduced both colonies of *Minuartia groenlandica*. The colony on the summit peak has been particularly impacted. There are two small strongholds left for this population, both of which are in areas difficult to access. On the summit peak, most remaining plants are in a deep slot between two massive outcrops. On the west peak, many plants are in a deep recess just below the top of the steep northwest face of the exposure.

The *Huperzia appalachiana* population at this site is also not doing well. At the three previously known colonies, 2005-06 population numbers are dramatically lower than those reported in 1990. Many sickly plants were observed. This may be due in part to the death of *Tsuga canadensis* (eastern hemlock) in the area, which has changed the microclimate, creating sunnier and drier conditions. Trampling is another problem; most of the colonies are located in areas used by climbers and/or hikers. Global warming may also be a factor in the apparent decline in the health of this population.

The main threat to all *Falco peregrinus* populations range-wide was once pesticide contamination leading to reproductive failure (USFWS, 1991). This threat appears to be diminishing (USFWS, 1991). Current threats include direct human disturbance, which can cause individual nesting pairs to abandon their nest sites. In addition, predation, habitat destruction, and occasional poaching have been identified as threats (USFWS, 1991).

MANAGEMENT RECOMMENDATIONS: This site is one of only five known Virginia sites for the globally rare Central Appalachian Heath Barren and one of only four Virginia sites for the arctic-boreal disjunct *Minuartia groenlandica*. As a relictual habitat for these high-elevation rarities and *Huperzia appalachiana*, the site merits more vigorous protection than it currently receives. New protection measures are critical to halt the ongoing destruction of the rare shrubland and *Minuartia* populations before they reach a non-recoverable condition.

Close western summit to visitation. Close social trail. Use signs to inform visitors of the sensitive resources and their conservation value. If necessary, use barriers to deter visitation. See Figure 79.

On eastern summit, use low barrier to limit trampling of the rare *Minuartia* plants on the cliff top areas where the plant occurs.

Continue the prohibition of camping at this site.

Re-route social trail at the base of the north facing cliff to prevent trampling of *Huperzia*. The trail was formed by rock climbers who climb the cliff face. A slight deviation of the social trail away from the base of the cliff at the *Huperzia* locations should protect this population. See Figure 79.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the rare plants and the health of the rare natural community. Conduct a survey on a 3-5 year interval to assess rare plant populations and the Central Appalachian Heath Barren. At the same time, conduct a survey and assessment of invasive plants.

Continue adherence to the recovery plan protocols for *Falco peregrinus*, including monitoring and additional survey work. Nesting areas should be protected from human disturbances.

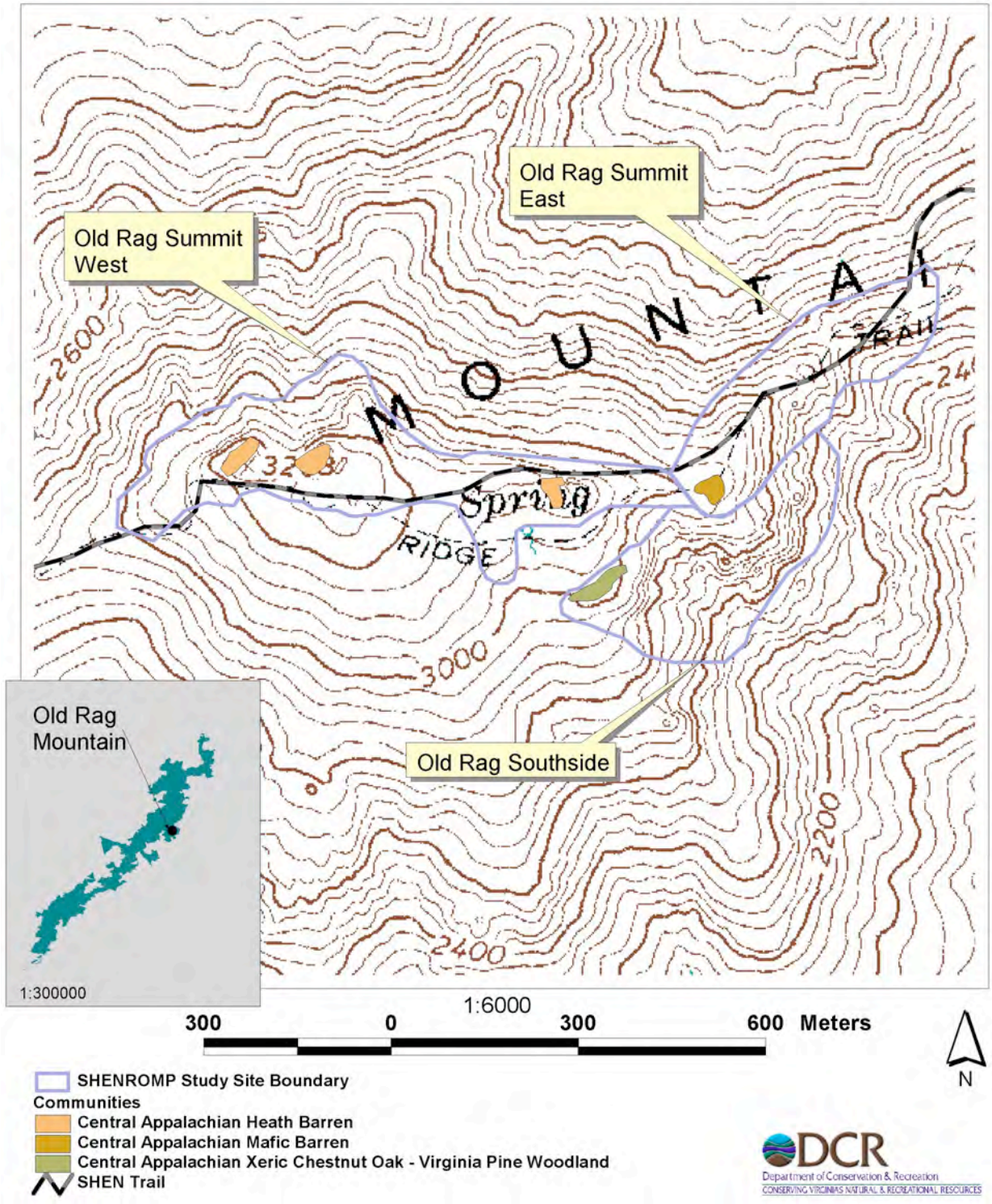


Fig. 76. Location of significant natural community at Old Rag Summit West.

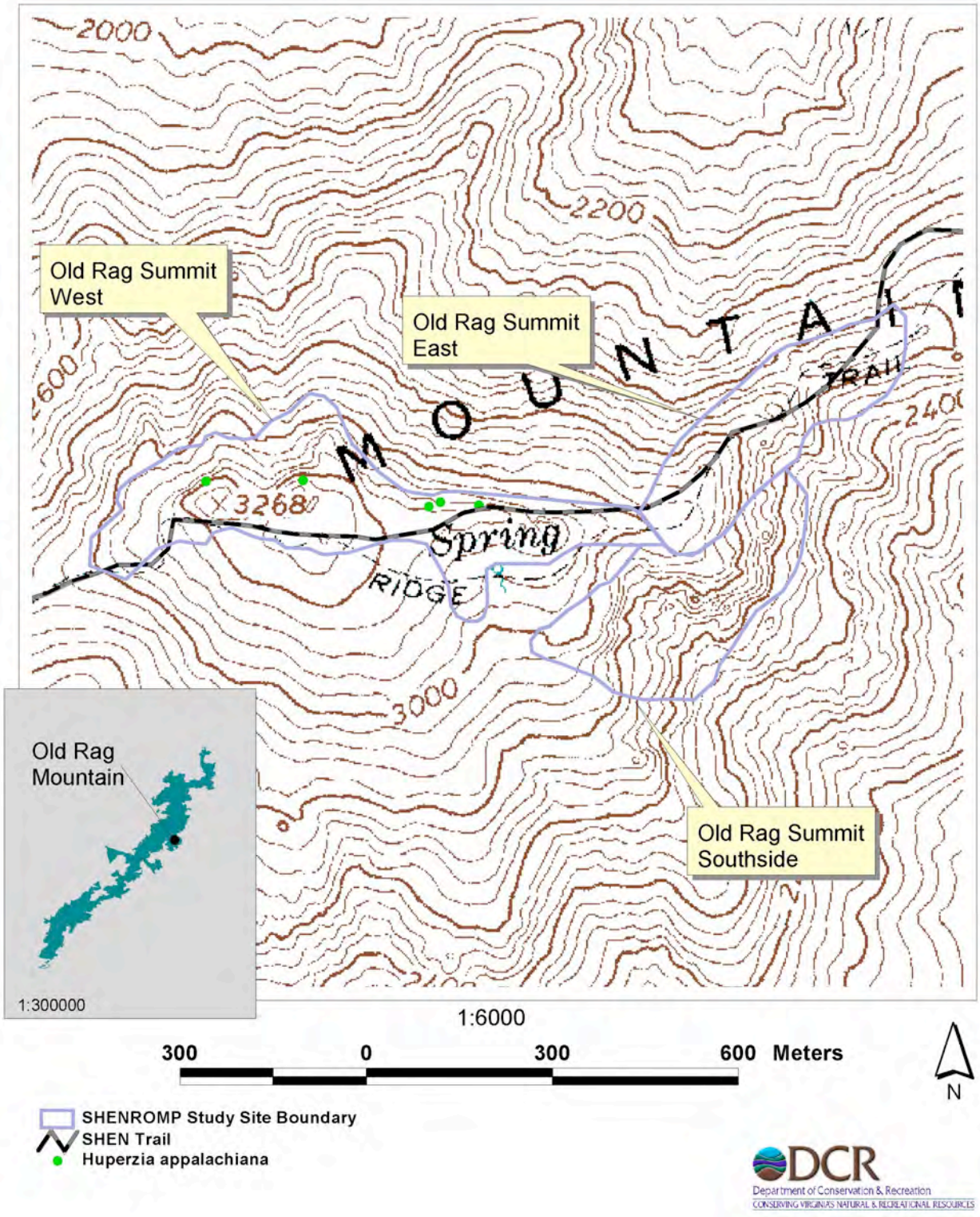


Fig. 77. Location of *Huperzia appalachiana* at Old Rag Summit West.

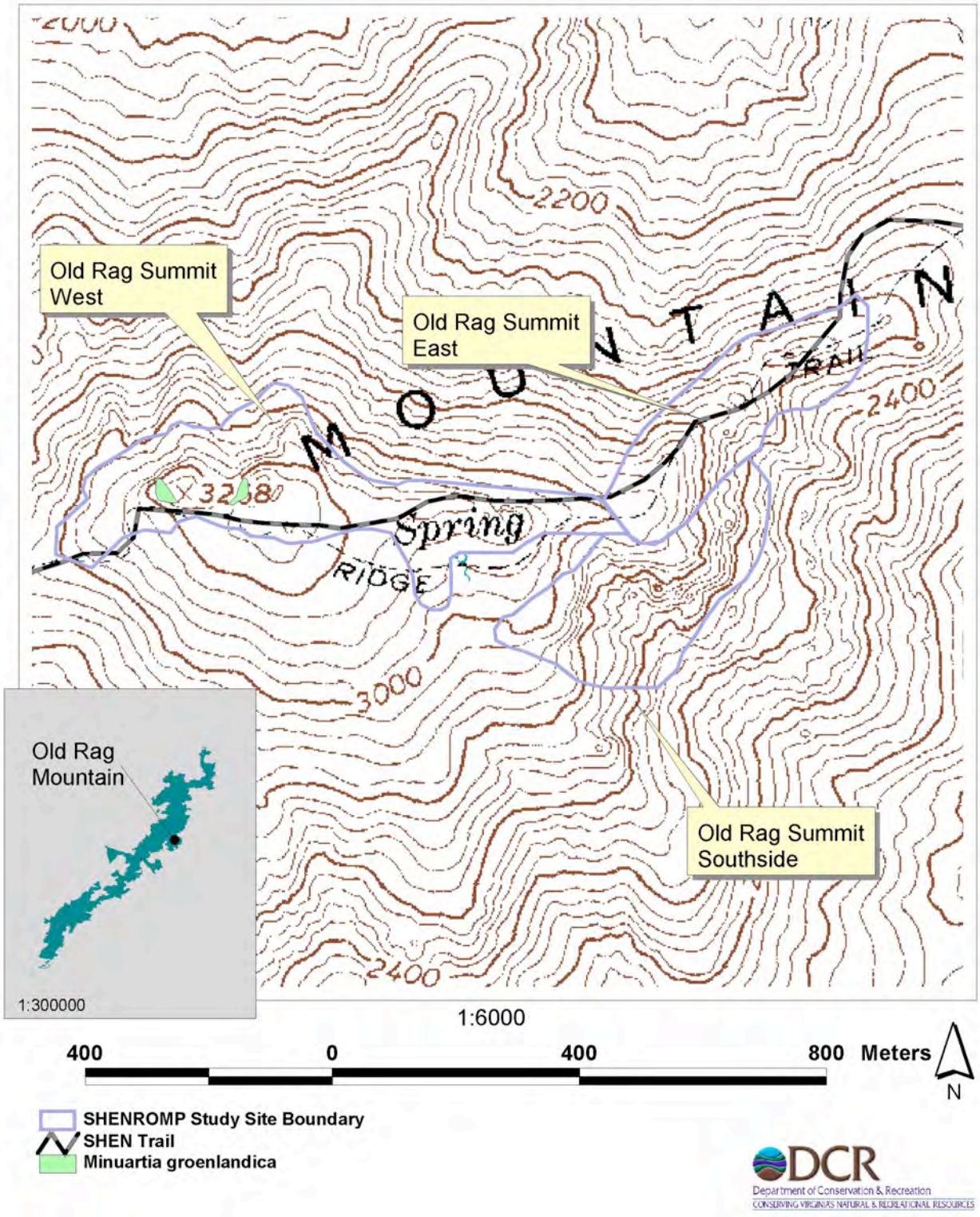


Fig. 78. Location of *Minuartia groenlandica* at Old Rag Summit West.

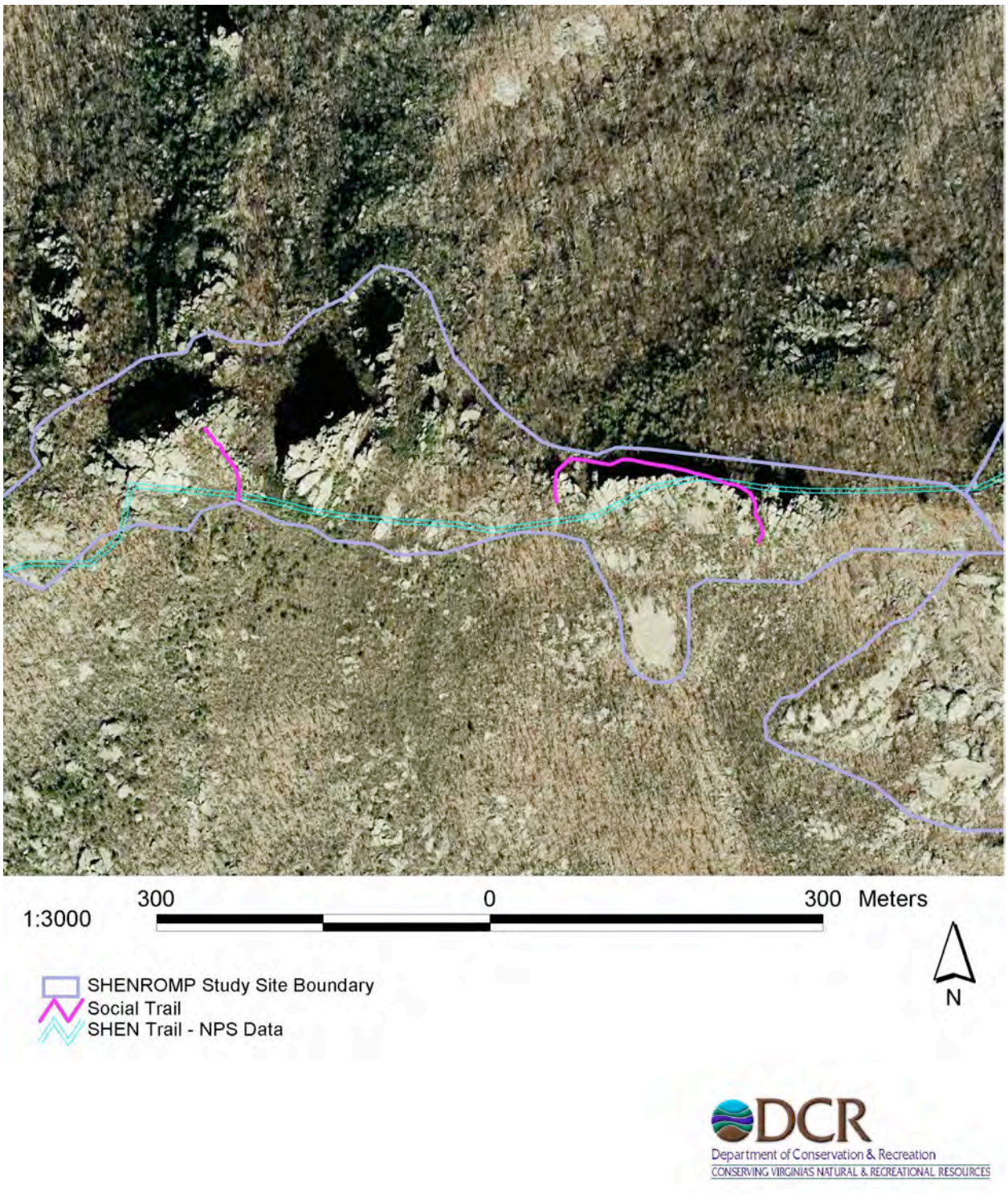


Fig. 79. Site details for Old Rag Summit West, including social trails recommended for closure.

OLD RAG SOUTHSIDE (C36)

CONSERVATION SITE: Old Rag Mountain (B4) **THREAT RANK:** 1

LOCALITY: Madison County **QUADRANGLE(S):** Old Rag Mountain

LOCATION: This Central District site extends from 0.56 km (0.34 mi) southeast to 0.94 km (0.59 mi) east of the summit of Old Rag Mountain.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Quercus prinus* - *Pinus virginiana* - (*Pinus pungens*) / *Schizachyrium scoparium* - *Dichanthelium depauperatum* Woodland	Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland	G2?	S2	None	None	A
Plants: None						
Animals: *Falco peregrinus*[1]	Peregrine Falcon	G4	S1B S2N	None	LT	D

[1]Based on a previously documented record (DCR-DNH Biotics data). Part of this element occurrence (eo) lies within the Old Rag Summit West and Old Rag Summit East ROMP sites and part lies outside of any ROMP site. This eo has not been updated by DCR-DNH for this report.

SITE DESCRIPTION: This site encompasses an upper portion of the steep southeastern flank of Old Rag Mountain – an isolated peak located several kilometers east of Skyline Drive and the mountains forming the main chain of the Blue Ridge. Large areas of Old Rag Granite bedrock, the oldest geological formation in the Park, are exposed here, ranging from cliffs to gently inclined pavements nearly flush with the surrounding terrain.

Old Rag Granite is composed mostly of quartz and orthoclase feldspar, minerals that weather slowly. Large outcrops at this site have a smooth, domed appearance due to the process of exfoliation, whereby fracturing creates a pattern of concentric layers which peel away like the sections of an onion. Weathering along the widely spaced fractures that characterize this rock also produces large angular blocks. These blocks may weather in place to form spheroidal boulders that perch precariously on the smoothly undulating underlying mass of rock.

This is a highly complex site. Its western end is dominated by a southeast-facing exposure known to the climbing community as the "Reflector Oven." The top of this formation is fairly level and extends for about 150 m (492 ft). Below the top, the exposure grades into a steep face which quickly becomes a sheer cliff. In other portions of the site, the convexly curved rock face has weathered into steeply pitched aggregations of huge boulders. Crevices and chutes between the boulders contain enough soil to support stunted woody vegetation.

This site is accessed by bushwhacking or using poorly defined social trails leading southeast from the Ridge Trail. Most of this site is dangerously steep and inaccessible and, thus, was not surveyed.

NATURAL COMMUNITIES: Massive, lichen-dominated outcrops lacking vascular plants cover a substantial portion of the site. Wooded slopes above and between the outcrops are mostly covered by a mosaic of Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest and Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. Sweet Birch – Chestnut Oak Talus Woodland occupies boulder deposits at the foot of the cliffs and large outcrops. Small patches of Central Appalachian Pine – Oak / Heath Woodland also occur on some of the outcrops. All forests of this site have been heavily disturbed by gypsy moth outbreaks, several recent hurricanes and ice storms, and a large fire in 2000. Snags and downed wood are abundant and regenerating understories are extremely dense in many places. Lichen assemblages are similar to those found elsewhere on Old Rag, with *Lasallia papulosa*, *Lasallia pensylvanica*, *Xanthoparmelia conspersa*, and *Dimelaena oreina* occurring abundantly on dry exposed rock surfaces.

A 0.2 ha (0.5 ac) stand of the Central Appalachian Xeric Chestnut Oak – Virginia Pine Woodland was found on a nearly level bench at the top of the massive cliff at the western end of the site. This rare community type is not known elsewhere on Old Rag and is known from only a few sites in the park. The occurrence at this site is somewhat atypical in that it lacks *Pinus virginiana* (Virginia pine). Here, *Pinus pungens* (table-mountain pine) is the sole evergreen, sharing dominance with *Quercus prinus* (chestnut oak) and *Quercus rubra* (northern red oak). The overstory is stunted, with the largest trees only 8 m (26 ft) in height. Other trees occurring at low cover include *Quercus velutina* (black oak), *Sassafras albidum* (sassafras), and *Robinia pseudoacacia* (black locust). Shrubs are patchy and cover less than 25% of the area. *Vaccinium pallidum* (early lowbush blueberry), *Vaccinium stamineum* (deerberry), and *Gaylussacia baccata* (black huckleberry) have the highest cover in the shrub layer, which also include *Comptonia peregrina* (sweet fern), *Kalmia latifolia* (mountain-laurel), *Rhus copallinum* (winged sumac), and *Spiraea betulifolia* var. *corymbosa* (dwarf spiraea). A graminoid-rich herb layer is fairly well developed, with *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (poverty oat-grass), and *Solidago puberula* var. *puberula* (downy goldenrod) most abundant. Other characteristic herbs include *Baptisia tinctoria* (yellow wild indigo), *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Dichanthelium depauperatum* (starved panic grass), *Viola sagittata* (arrow-leaved violet), *Coreopsis verticillata* (whorled coreopsis), *Solidago arguta* (cut-leaved goldenrod), *Lysimachia quadrifolia* (whorled loosestrife), *Agrostis perennans* (autumn bentgrass), *Hypericum stragulum* (low St. Andrew's cross), and *Corydalis sempervirens* (pink corydalis). A large fire in October 2000 burned this site extensively and probably contributed to the current vigor of herbaceous plants in this community. Quantitative plot data were collected from this stand during the ROMP project (plot SHNP151).

RARE PLANTS: No rare or watchlist plants were found at this site.

RARE ANIMALS: No new element occurrences were found during surveys in 2006. *Falco peregrinus* (Peregrine Falcon) is known from this area (Virginia Department of Game and Inland Fisheries, 1994). The area includes all the Old Rag ROMP sites and extends past these into non-ROMP areas. *Falco peregrinus* has been reintroduced to SHEN as part of the recovery plan for this species. In 1994, a natural nest with two eggs was found abandoned in the Old Rag area, though specific locality information was not provided (Virginia Department of Game and Inland Fisheries, 1994).

Plate 51. Much of the Old Rag south slope is extremely rugged and inaccessible.

THREATS: The cliff top supporting the significant woodland community receives some visitation, as evidenced by an old campfire ring in the area. However, impacts appear to be infrequent and minimal, and the community is currently in virtually pristine condition.

This outcrop is known to rock climbers as "The Reflector Oven," and does get some use by climbers. As of March 2007, rockclimbing.com users had posted a total of 19 climbing routes in the area. Abandoned gear and a campfire ring were found here in 2006.

The main threat to all *Falco peregrinus* populations range-wide was once pesticide contamination leading to reproductive failure (USFWS, 1991). This threat appears to be diminishing (USFWS, 1991). Current threats include direct human disturbance, which can cause individual nesting pairs to abandon their nest site. In addition, predation, habitat destruction, and occasional poaching have been identified as threats (USFWS, 1991).

MANAGEMENT RECOMMENDATIONS:

Continue the prohibition of camping at this site.

Monitor the health of the rare natural community. Conduct surveys on a 3-5 year interval to assess the

health of the natural community. At the same time, assess visitor use, and survey for invasive plants.

Continue adherence to the recovery plan protocols (USFWS, 1991) for *Falco peregrinus*, including monitoring and additional survey work. Nesting areas should be protected from human disturbances.

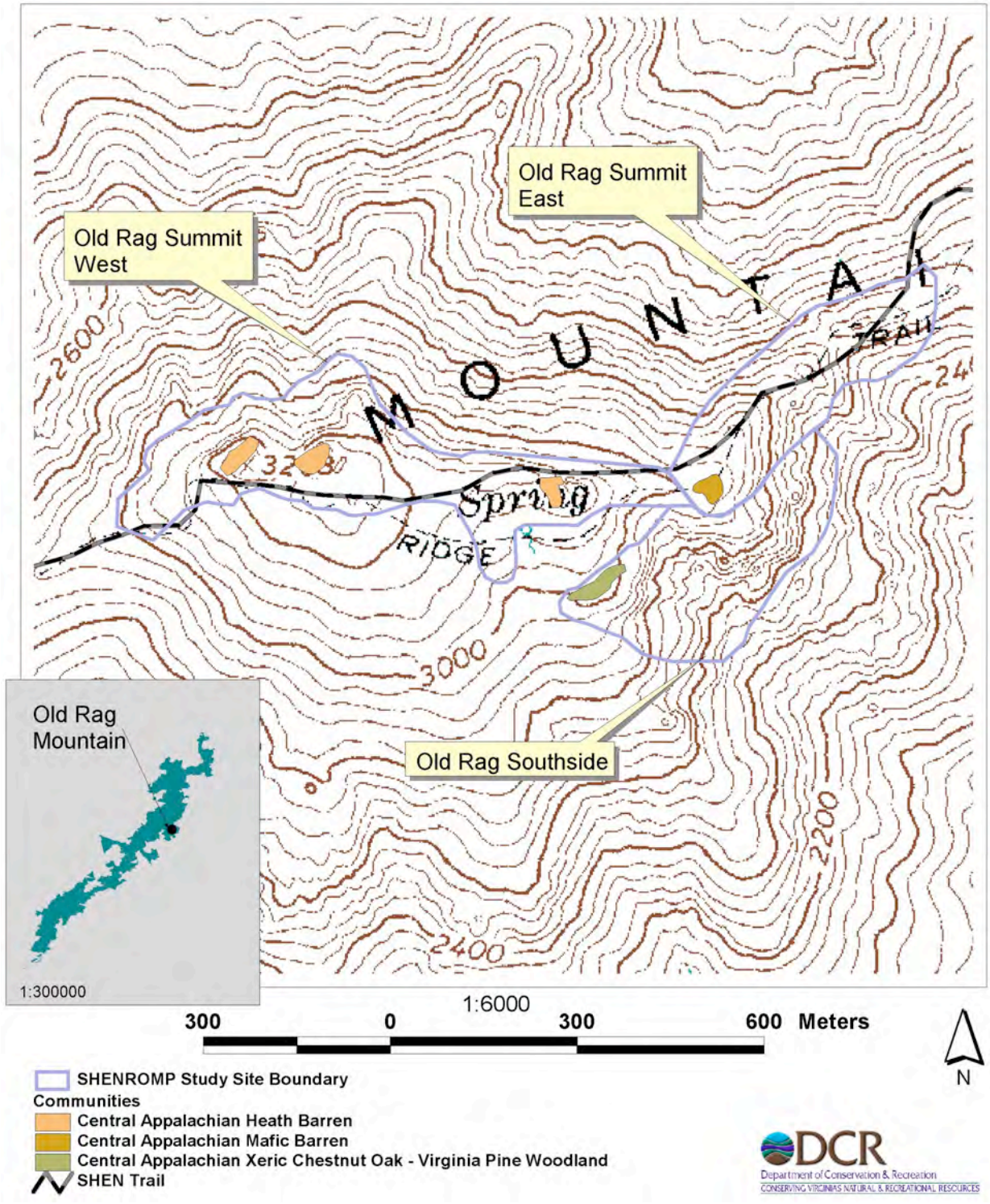


Fig. 80. Location of significant community at Old Rag Southside.

WHITEOAK CANYON (C69)

CONSERVATION SITE: Whiteoak Canyon (B2) **THREAT RANK:** 3

LOCALITY: Madison County **QUADRANGLE(S):** Old Rag Mountain

LOCATION: This Central District site is located about 2.1 km (1.3 mi) east of Skyline Drive. It extends from 1.1-1.3 km (0.7-0.8 mi) southeast of the junction of Whiteoak Canyon Fire Road and Whiteoak Canyon Trail.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Fraxinus americana - Carya glabra / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	B
Quercus prinus - Pinus virginiana - (*Pinus pungens*) / *Schizachyrium scoparium - Dichanthelium depauperatum* Woodland	Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland	G2?	S2	None	None	BC
Plants: None						
Animals:						
Properigea costa[1]	A notctuid moth	G4	S1S3	None	None	C

[1]Part of this element occurrence lies within the Halfmile Cliff ROMP site.

SITE DESCRIPTION: This site is unusual in that it encompasses both granitic and metabasalt exposures. At its western end is a steep granitic face – by far the largest exposure here. The convex top of this face reaches an elevation of about 570 m (1,880 ft). Below the top, the face quickly becomes a cliff, dropping off to the south southwest. This exposure continues outside of the site boundary to the southwest, where it shifts to an easterly aspect and forms the bed of a waterfall along the stream that plunges through Whiteoak Canyon.

The granitic rock at this site is composed mostly of quartz and plagioclase feldspar. It exhibits exfoliation, a process whereby concentric layers of rock peel away over time like the sections of an onion.

The eastern half of this site contains scattered metabasalt outcrops. Most of these are small and well-shaded. Metabasalt underlies most of Whiteoak Canyon.

The Whiteoak Canyon Trail traverses this sight, passing between metabasalt outcrops to the east and just upslope from the granitic face to the west. This popular trail accesses a series of waterfalls along Whiteoak Canyon.

NATURAL COMMUNITIES: Most of the matrix forest surrounding the two outcrop complexes belongs to the Central Appalachian Basic Oak – Hickory Forest (Submontane / Foothills Type). A small stand of Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest occurs near the eastern end of site. Two rare woodland communities are associated with the rock outcrops.

The complex of rounded, sloping granite outcrops in western portion of the site supports a 0.45 ha (1.1 ac) stand of Central Appalachian Basic Woodland. Its overstory varies from semi-closed in areas with some soil development to very open on the most massive outcrops. *Fraxinus americana* (white ash) is generally the most abundant tree, with associates of *Quercus prinus* (chestnut oak), *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Pinus virginiana* (Virginia pine), and *Carya glabra* (pignut hickory). The understory contains *Cercis canadensis* var. *canadensis* (eastern redbud), *Ostrya virginiana* (eastern hop-hornbeam), *Viburnum rafinesquianum* (downy arrow-wood), *Rosa carolina* var. *carolina* (pasture rose), *Rhus typhina* (staghorn sumac), and *Celtis occidentalis* (common hackberry). Herbs that attain relatively high cover in the stand are *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Allium cernuum* (nodding onion), *Pycnanthemum incanum* (hoary mountain-mint), *Helianthus divaricatus* (woodland sunflower), *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod), *Solidago arguta* var. *caroliniana* (cut-leaved goldenrod), *Schizachyrium scoparium* (little bluestem), *Ambrosia artemisiifolia* (common ragweed), and *Danthonia spicata* (poverty oat-grass). Other characteristic herbs occurring at low cover include *Bidens bipinnata* (spanish-needles), *Penstemon canescens* (gray beardtongue), *Asclepias verticillata* (whorled milkweed), *Anemone virginiana* var. *virginiana* (thimbleweed), *Heuchera americana* (American alumroot), *Woodsia obtusa* ssp. *obtusa* (blunt-lobed woodsia), *Acalypha virginica* (Virginia copperleaf), *Silene caroliniana* ssp. *pensylvanica* (wild pink), *Taenidia montana* (mountain pimpernel), *Houstonia longifolia* (longleaf bluets), *Muhlenbergia sobolifera* (cliff muhly), *Polygonum scandens* var. *cristatum* (crested false buckwheat), *Dichanthelium linearifolium* (narrow-leaf panic grass), *Potentilla canadensis* (Canada cinquefoil), *Antennaria plantaginifolia* (plantain-leaf pussytoes), and *Lespedeza intermedia* (wand bushclover). *Xanthoparmelia conspersa* is the most abundant and conspicuous lichen on the open rock surfaces in this community. The bryophyte *Grimmia laevigata* forms dense patches in slight crevices which receive periodic moisture. Quantitative plot data were collected from this stand during the ROMP project (plot SHNP149).

Shallow, rocky soils on and around ledgy metabasalt outcrops in the eastern portion of the site support a 0.6 ha (1.5 ac) stand of Central Appalachian Xeric Chestnut Oak – Virginia Pine Woodland. This vegetation is a semi-open to semi-closed woodland co-dominated by *Quercus prinus* and *Pinus virginiana*. Minor trees present include *Quercus rubra* (northern red oak), *Amelanchier arborea* (downy serviceberry), and *Fraxinus americana*. The most abundant shrubs are *Vaccinium pallidum* (early lowbush blueberry) and *Vaccinium stamineum* (deerberry), but scattered patches of *Spiraea betulifolia* var. *corymbosa* (dwarf spiraea), *Kalmia latifolia* (mountain-laurel), and *Vitis aestivalis* var. *bicolor* (silverleaf grape) also occur. Open, shallow soil and moss mats among the shrubs support a surprising number of low-cover herbaceous xerophytes, including *Aureolaria laevigata* (entire-leaved yellow foxglove), *Solidago erecta* (erect goldenrod), *Danthonia spicata* (poverty oat-grass), *Houstonia longifolia* (longleaf bluets), *Schizachyrium scoparium* (little bluestem), *Potentilla canadensis* (Canada cinquefoil), *Hieracium venosum* (rattlesnake-weed), *Carex pensylvanica* (Pennsylvania sedge), *Dichanthelium depauperatum* (starved panic grass), *Dichanthelium dichotomum* (small-fruited panic grass), and *Symphyotrichum undulatum* (= *Aster undulatus*, wavy-leaved aster). Quantitative plot data were collected from this stand during the ROMP project (plot SHNP150).

RARE PLANTS: Two watchlist plants occur here: *Amelanchier sanguinea* var. *sanguinea* (roundleaf serviceberry) and *Taenidia montana* (mountain pimpernel).

RARE ANIMALS: One animal element occurrence, *Properigea costa* (a noctuid moth), was captured in a UV-trap on 21 July 2006. Because of its close proximity to Halfmile Cliff ROMP site and the

continuity of forested habitat, this capture site and the one at Halfmile Cliff are considered one element occurrence, i.e., one interacting population; however, further research on the life history of this species may necessitate a reevaluation of this assessment.

Plate 52. One of several rounded, exfoliating exposures of granitic bedrock at the western end of the Whiteoak Canyon inventory site.

THREATS: The heavily used Whiteoak Canyon Trail traverses the interior of both significant natural community occurrences, causing a slight fragmentation and increasing the potential exposure of outcrops to visitor trampling and weeds. In addition, serious soil erosion resulting from very heavy use on steep slopes is evident in the trail bed. Nevertheless, the outcrops at this site appear to be relatively undisturbed. The large granitic face just below the Whiteoak Canyon Trail shows slight evidence of trampling on its upper edges where social trails lead from the main trail. However, views from the outcrops are not spectacular and the rocks provide no access to, or views of, the waterfalls below. Because the objective of most hikers passing through this site is to visit or view the waterfalls and stream, it is likely that many hikers simply pass by the outcrops en route to a more compelling attraction.

Commelina communis (Asiatic dayflower) is quite abundant in some of the herbaceous patches on the open granitic faces of the site. This species is a direct competitor to some native outcrop species and degrades the compositional integrity of the Basic Woodland community.

Little is known about the life history of *Properigea costa* or its potential threats. The primary threat to this species may be the use of pesticides for gypsy moth or other insect control.

MANAGEMENT RECOMMENDATIONS:

Re-route trail away from the outcrops in this site. Close trail to discourage use. Consider a new route that affords a view of falls in adjacent tributary to the east before connecting back to the Whiteoak Canyon Trail beyond the significant outcrop communities. See Figure 83.

Manage invasive plant *Commelina communis*. The use of herbicide is recommended for controlling this species. Hand-pulling will create more soil disturbance and is labor-intensive; therefore, it is not recommended. Sponge or glove herbicide application methods are recommended to minimize non-target impacts that may accompany spray application.

Annually monitor the effectiveness of the invasive plant control effort. Continue monitoring *Commelina* for several years following treatment and assess need for further action.

Monitor the health of the significant natural communities. Conduct a survey on a 3-5 year interval to assess the recovery of the natural community types. Include a survey for invasive plants.

No specific management recommendations exist for *Properigea costa*. Almost nothing is known about its life history, making management recommendations difficult. General conservation measures to protect large tracks of land may provide indirect positive benefits for this species. It is unlikely to be impacted by management decisions specifically targeting cliffs and rock outcrops; however, caution should be used if gypsy moth or other insect suppression is contemplated in the area, as certain pesticides have broad effects on non-targeted invertebrate species.

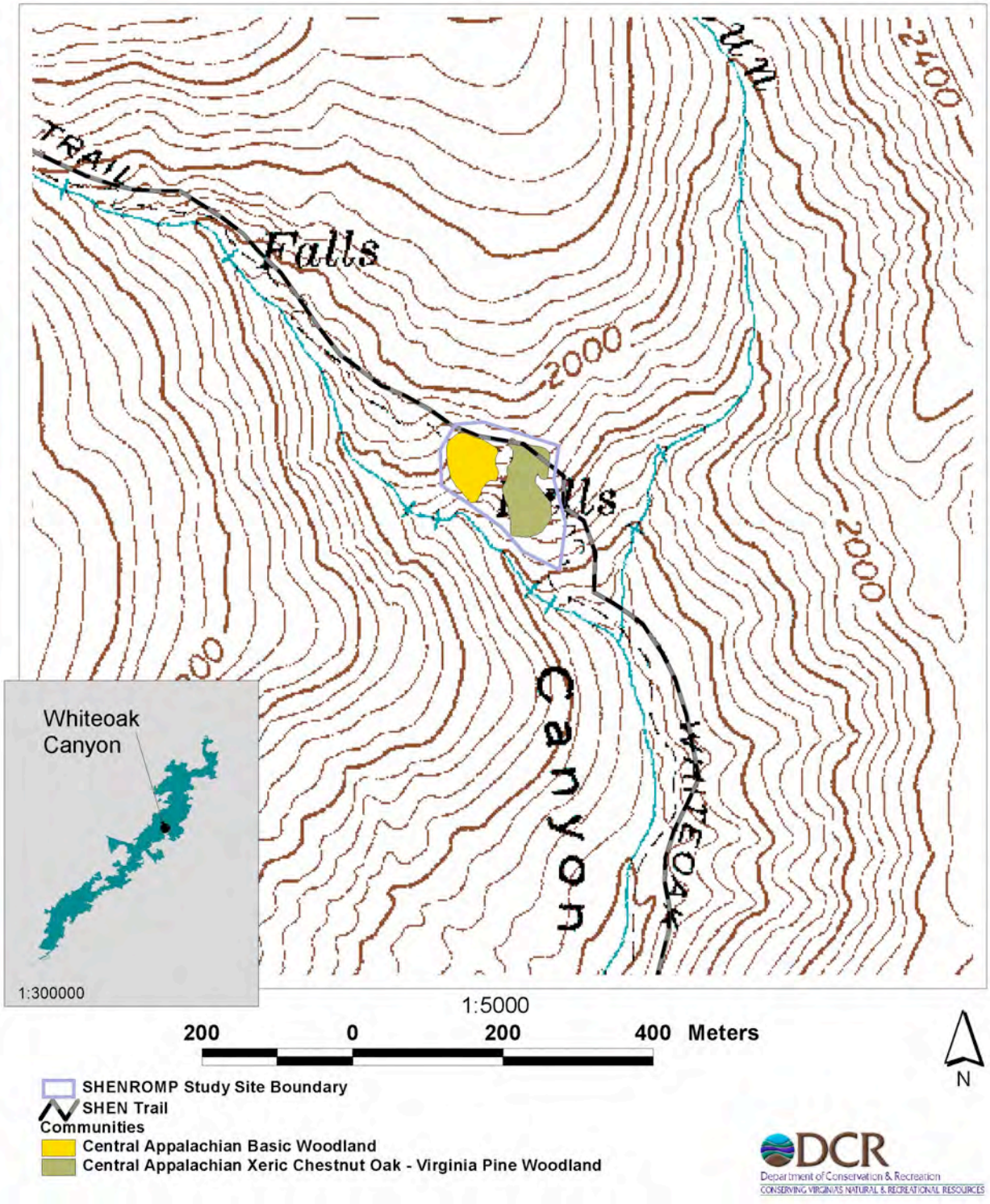


Fig. 81. Location of significant natural communities at Whiteoak Canyon.

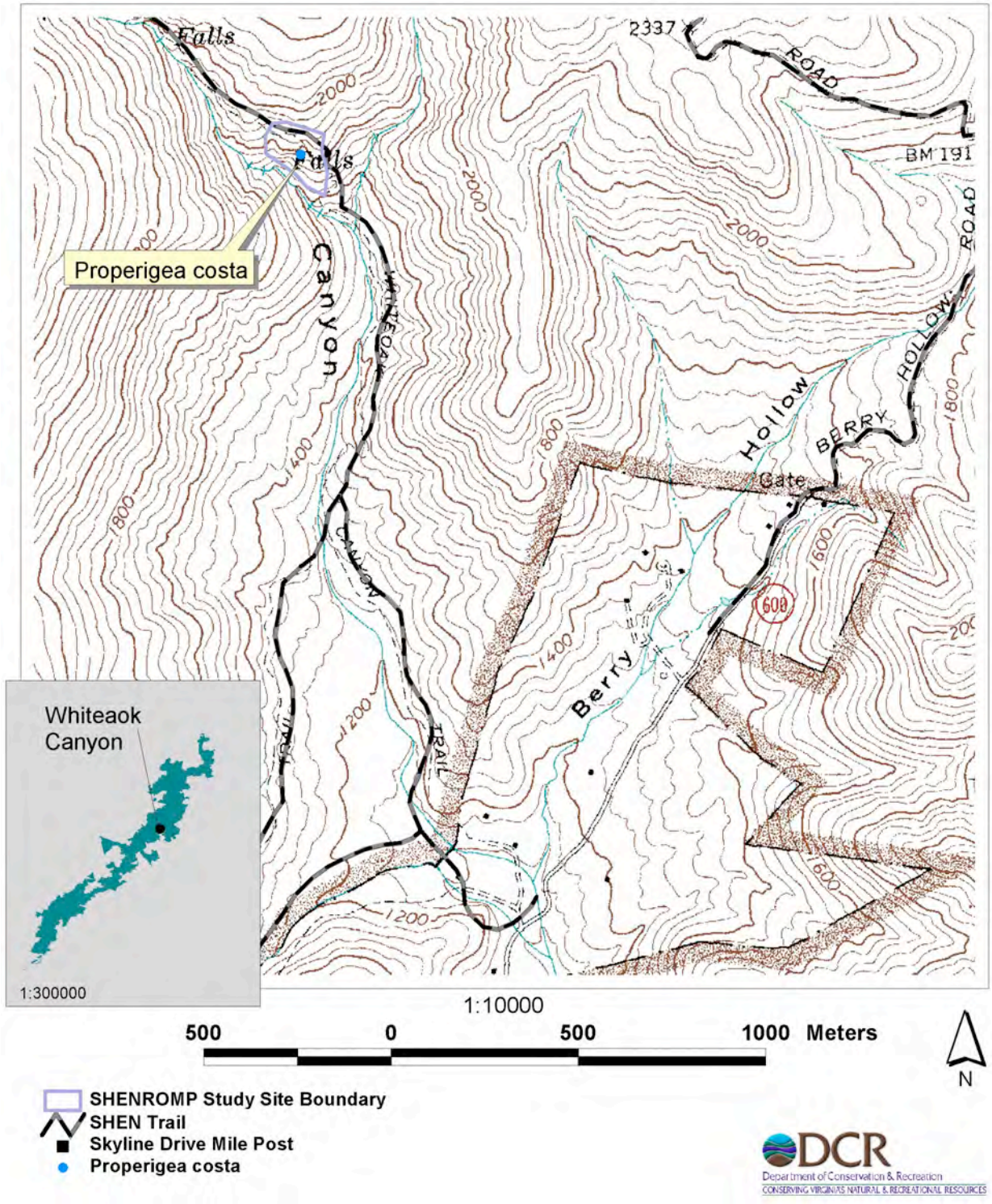


Fig. 82. Location of *Properigera costa* at Whiteoak Canyon.

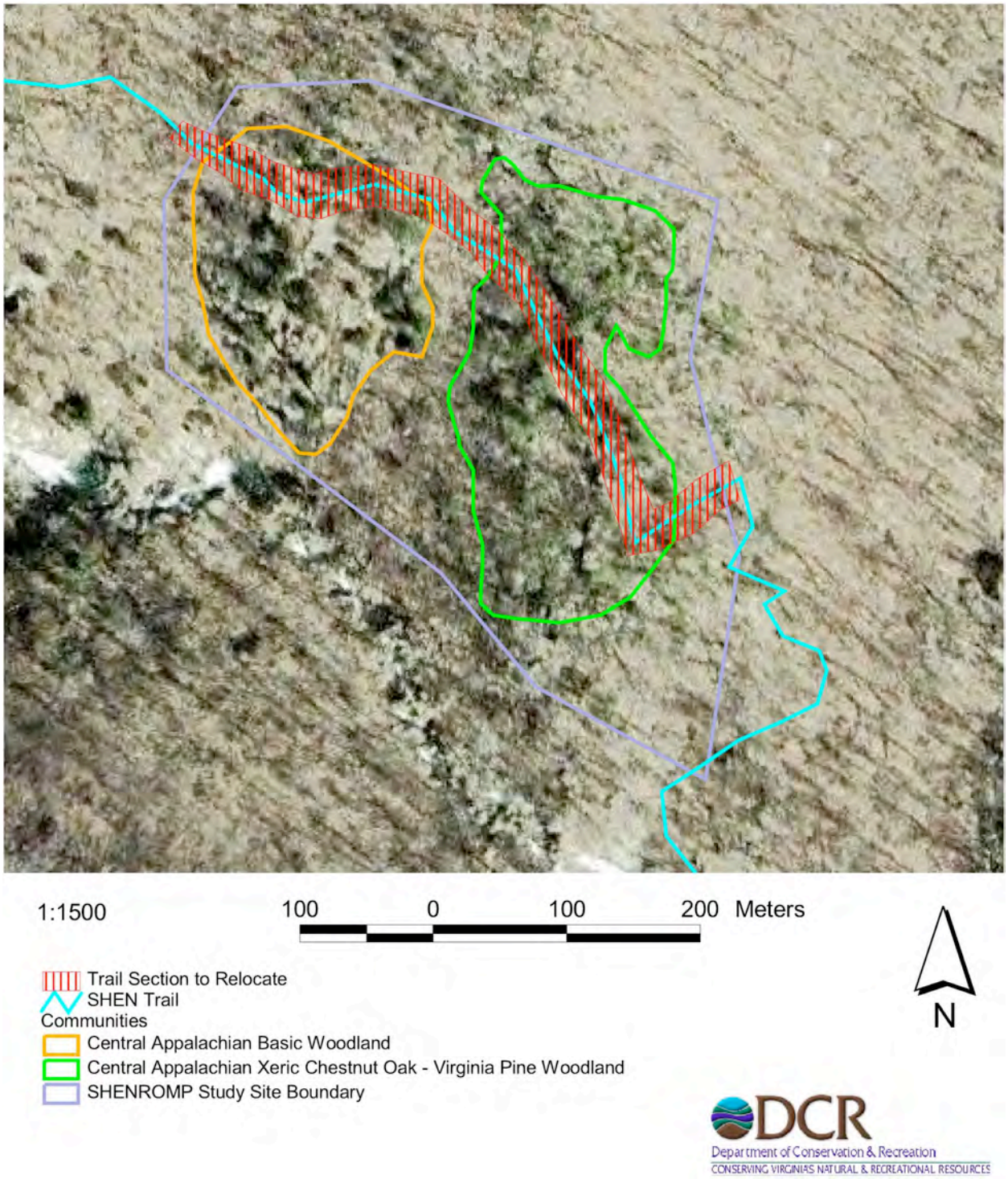


Fig. 83. Site details and recommended trail relocation for Whiteoak Canyon.

BETTYS ROCK (C02)

CONSERVATION SITE: Hawksbill Mountain-Crescent Rock (B1)

THREAT RANK: 5

LOCALITY: Page County

QUADRANGLE(S): Big Meadows

LOCATION: This site is located in the Central District from about 0.4-0.6 km (0.3-0.4 mi) north of the Crescent Rock Overlook parking area.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation	High-Elevation Greenstone Barren	G1	S1	None	None	C
Plants:						
Cuscuta coryli	Hazel dodder	G5	S2?	None	None	D
Rubus idaeus ssp. *strigosus*[1]	Red raspberry	G5T5	S2	None	None	B
Sibbaldiopsis tridentata[2]	Three-toothed cinquefoil	G5	S2	None	None	A
Solidago randii[2]	Rand's goldenrod	G5T4	S2S3	None	None	A
Animals: None						

[1]Part of this element occurrence (eo) lies within the Crescent Rock South ROMP site and part lies outside of any ROMP site.
[2]Parts of this eo lie within the Crescent Rock Overlook and Crescent Rock South ROMP sites and part lies outside of any ROMP site.

SITE DESCRIPTION: This site contains a single small outcrop of Catoctin Formation metabasalt that juts out of the surrounding slope. This outcrop is situated on the upper (brow) portion of an exposed knob along the Blue Ridge summit, with a west-northwest aspect. At its summit, the outcrop has a broad open ledge that extends for 35 m (115 ft) at an elevation of about 1,120 m (3,680 ft). From this top, it drops steeply to the west-northwest for 6-7 m (20-23 feet) in a series of small ledges. Small areas of forested talus are found at the outcrop's base and flanks.

Bettys Rock is easily accessed by a short, signed trail leading north from the Crescent Rock Overlook parking area. The trail runs along the top of the outcrop.

NATURAL COMMUNITIES: The exposed rock at this site occurs within a matrix of hardwood forest – Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type) on the gentle slopes above the outcrop and Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type) on the bouldery slopes below. The open outcrop itself supports a small (0.06 ha [0.15 ac]) occurrence of the globally rare High-Elevation Greenstone Barren community, which is endemic to several high-elevation sites in SHEN. This vegetation type is characterized by patchy thickets of low shrubs and tree saplings interspersed with large open rock surfaces with herbaceous species rooted in crevices and on mats of thin, organic-rich soil. Well-developed, undisturbed ledges and cliff tops are typically covered with a continuous turf of grasses and xerophytic forbs. Woody scrub characteristic of the community at this site includes *Prunus pensylvanica* (pin cherry), *Diervilla*

lonicera (northern bush honeysuckle), *Sorbus americana* (American mountain-ash), *Gaylussacia baccata* (black huckleberry), *Hamamelis virginiana* (witch-hazel), *Menziesia pilosa* (minniebush), *Prunus virginiana* (choke-cherry), and *Betula alleghaniensis* (yellow birch). Dominant and characteristic herbs are *Solidago randii* (Rand's goldenrod), *Sibbaldiopsis tridentata* (three-toothed cinquefoil), *Deschampsia flexuosa* (wavy hairgrass), *Dennstaedtia punctilobula* (hayscented fern), *Houstonia longifolia* (longleaf bluets), *Carex pensylvanica* (Pennsylvania sedge), *Heuchera pubescens* (marbled alumroot), *Danthonia spicata* (poverty oat grass), and *Phlox subulata* (moss phlox). A diverse assortment of lichens, including *Lasallia papulosa*, *Umbilicaria muehlenbergii*, *Dimelaena oreina*, and the circumboreal disjunct *Rhizocarpon geographicum* occurs on the outcrop faces. Quantitative plot data were collected from this occurrence in 2001 (plot SHNP112).

RARE PLANTS: Four rare plants were located at this site. Previously known colonies of *Sibbaldiopsis tridentata* and *Solidago randii* were relocated, and new colonies of *Rubus idaeus* ssp. *strigosus* (red raspberry) and *Cuscuta coryli* (hazel dodder) were found.

Sibbaldiopsis tridentata was restricted to the top of the outcrop where mats of this species occupied about five percent of a 3 x 26 m (10 x 85 ft) area. *Solidago randii* was located throughout the outcrop, but the strongholds for this species here were ledges on the face of the cliff and a fringe of woodland edge just behind (east of) the cliff top. The colony size was estimated at 400 clumps. *Cuscuta coryli* (hazel dodder) was found at this site in 2006 but not in 2005. It occupied a 1 m^2 (11 ft^2) area of the cliff top where it parasitized *Solidago randii*. About 8 twining stems were present, probably all part of a single plant. About 75 canes of *Rubus idaeus* ssp. *strigosus* were scattered within an 8 x 35 m (26 x 115 ft) area in forested talus at the base of the cliff.

The watchlist herb *Liatris turgida* (= *Liatris helleri*, shale-barren blazing-star) also occurs at this site.

RARE ANIMALS: No rare animal element occurrences were found during DCR-DNH surveys in 2005 or 2006. Three watchlist moth species were captured in 2005: *Autographa ampla* (large looper moth, n = 1), *Euchlaena tigrinaria* (mottled Euchlaena moth, n = 1), and *Xanthorhoe labradorensis* (Labrador carpet, n = 1). Three additional watchlist moths were captured in 2006: *Lithacodia concinnimacula* (red-spotted Lithacodia moth, n = 1), *Metarranthis mestusata* (a geometrid moth, n = 1), and *Nemoria mimosaria* (an emerald moth, n= 4).

Plate 53. High-Elevation Greenstone Barren on Bettys Rock.

THREATS: The condition of the significant community is very poor on the gentle, easily accessible cliff top, which has been severely damaged by decades of trampling, soil compaction, and soil removal. However, the portion of the community occupying the nearly vertical cliff face is virtually undisturbed.

Sibbaldiopsis tridentata is found at this site only along the open cliff top. An estimated 75 percent of the colony has been lost due to trampling. The *Solidago randii* population has also been seriously damaged along the cliff top and in a few places on the cliff face where people can easily climb down.

The *Cuscuta coryli* population is also found along the open cliff top where it is vulnerable to trampling. It is a parasite on other herbaceous plants, which are becoming scarce as the area is denuded of vegetation. *Cuscuta coryli* is an annual, and populations may appear only in years when conditions are optimal. Therefore, the absence of this species from a known site in any given year is not in itself cause for alarm.

Eight clumps of *Centaurea biebersteinii* (spotted knapweed) were observed at the south end of the cliff top, west of the trail. Several stems of *Ailanthus altissima* (tree-of-heaven) were found growing out of a cluster of shrubs where the trail from the parking area emerges onto the cliff. Both species are ranked as "highly invasive" by DCR-DNH.

MANAGEMENT RECOMMENDATIONS: Bettys Rock is a very significant site that harbors four rare plants and a globally rare natural community. The High-Elevation Greenstone Barren is confined to less than 30 discrete outcrops covering less than 4 ha (10 ac), all of it in four high-elevation areas of the Park. As a result, even the smallest occurrence (such as the one at this site) becomes a priority for conservation and protection.

Close trail from Crescent Rock Overlook parking area to Bettys Rock. Direct visitors to similar views at Crescent Rock Overlook.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include print and electronic literature and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the rare plants and the health of the High-Elevation Greenstone Barren. For several years following management actions, conduct annual monitoring to assess rare plant populations, natural community, and visitation patterns. Thereafter, conduct surveys on a 3-5 year interval. Include a survey for invasive plants.

Control *Ailanthus altissima* and *Centaurea biebersteinii* on the outcrop. Herbicide is recommended. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application. Hand-pulling plants will create soil disturbance, which benefits these species.

Annually monitor the effectiveness of the invasive plant control effort. Continue monitoring *Ailanthus* and *Centaurea* for several years following treatment and assess need for further action. Once invasive have been controlled, include invasive plant survey in 3-5 year interval site monitoring.

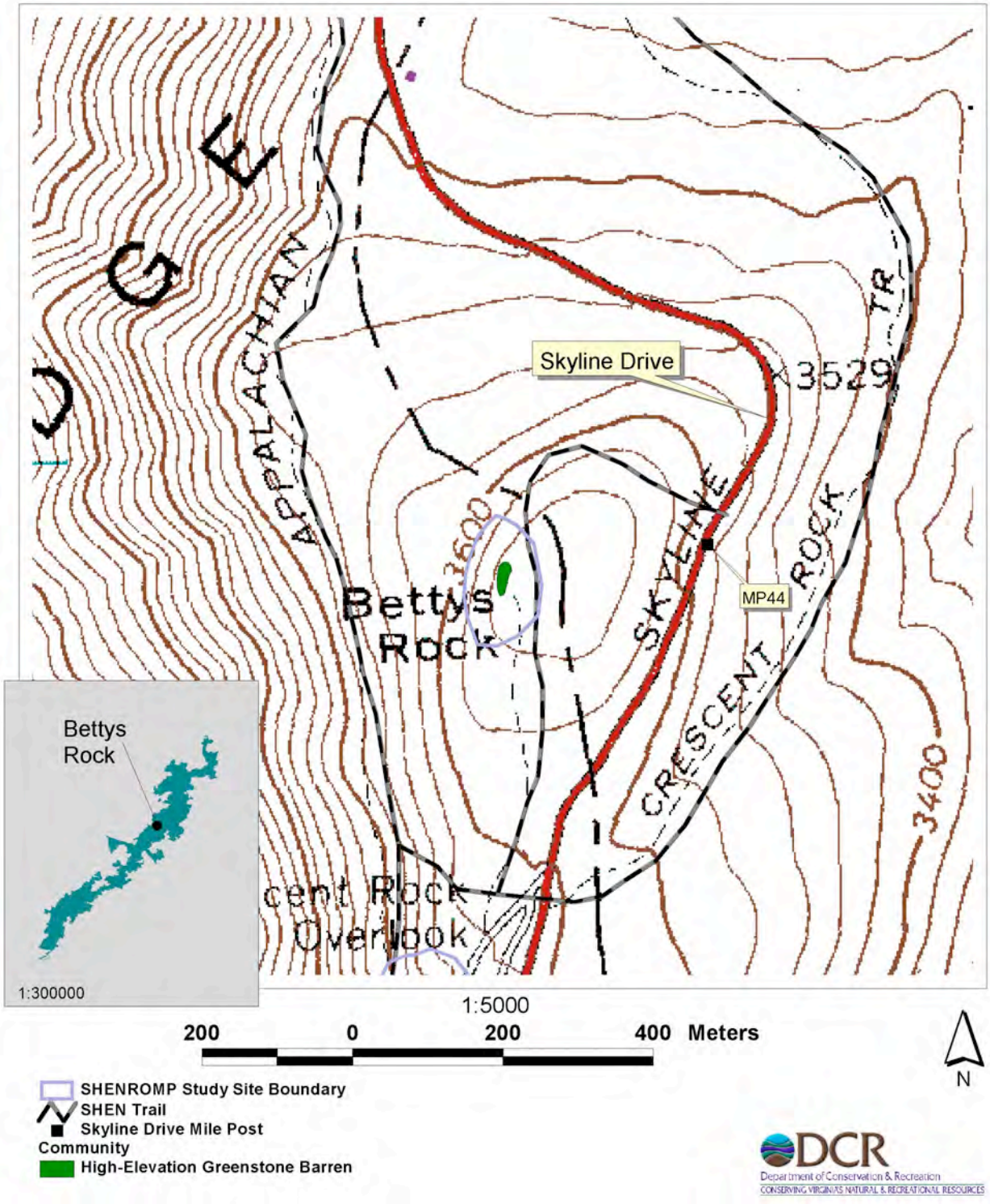


Fig. 84. Location of significant natural community at Bettys Rock.

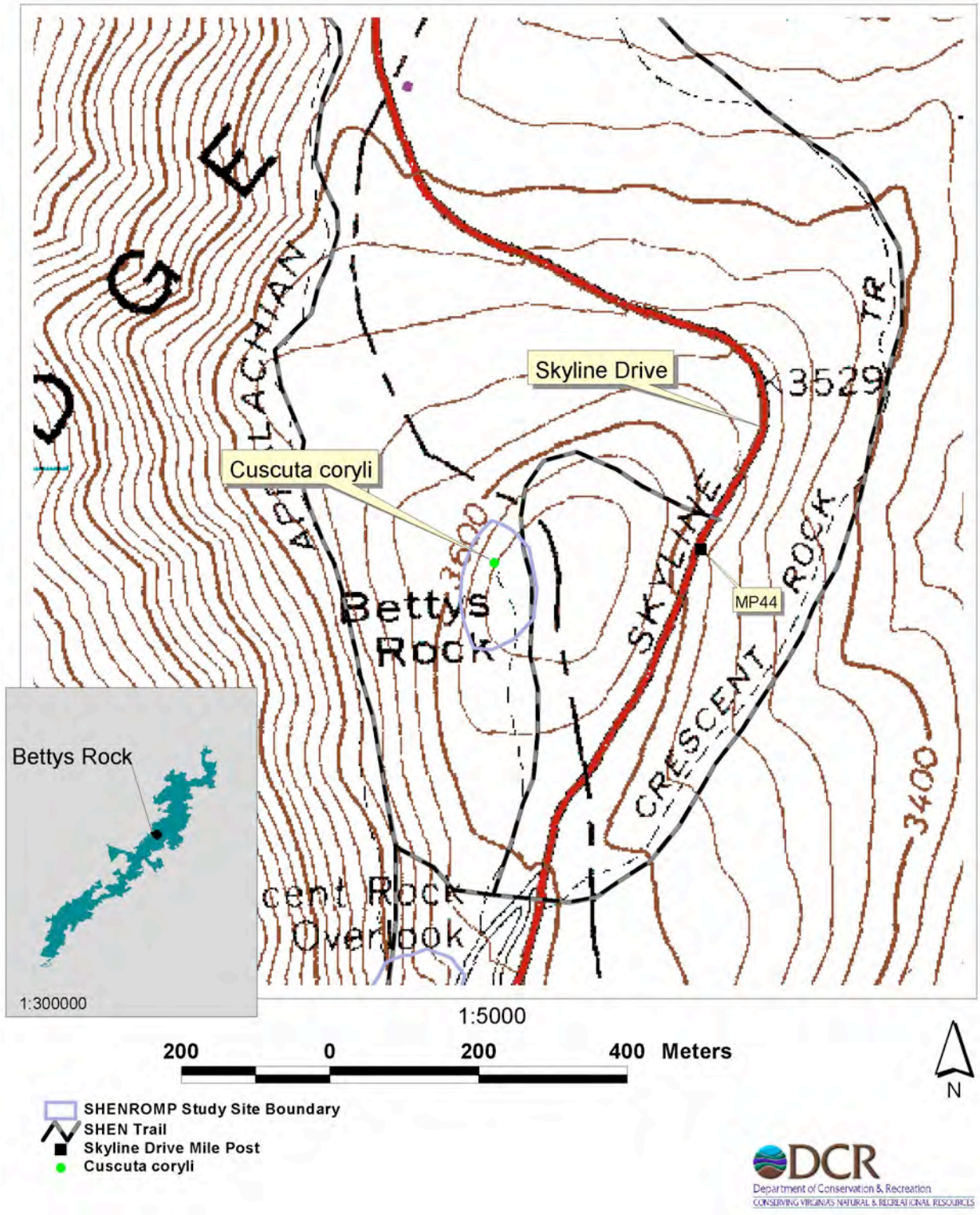


Fig. 85. Location of *Cuscuta coryli* at Bettys Rock.

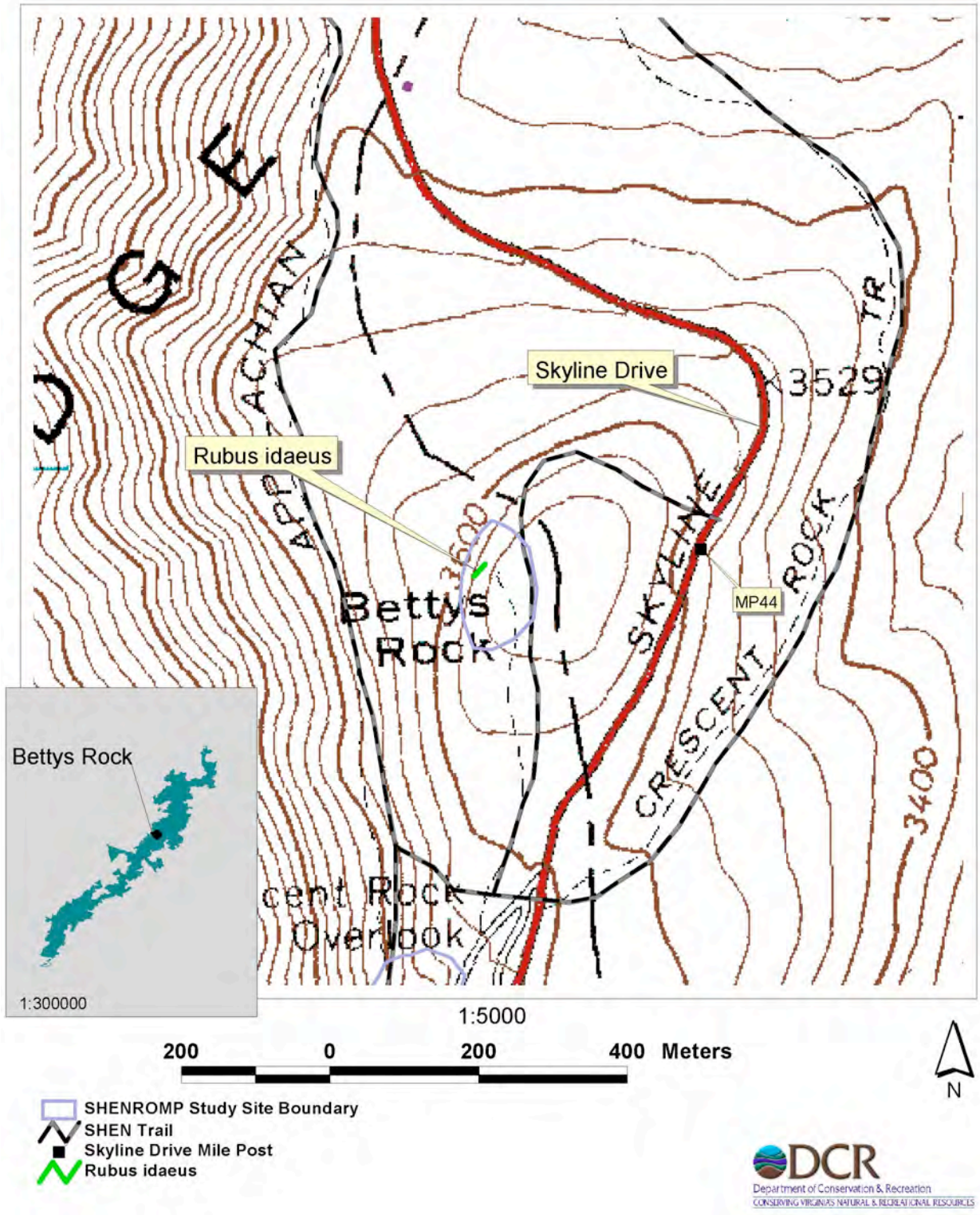


Fig. 86. Location of *Rubus idaeus* ssp. *strigosus* at Bettys Rock.

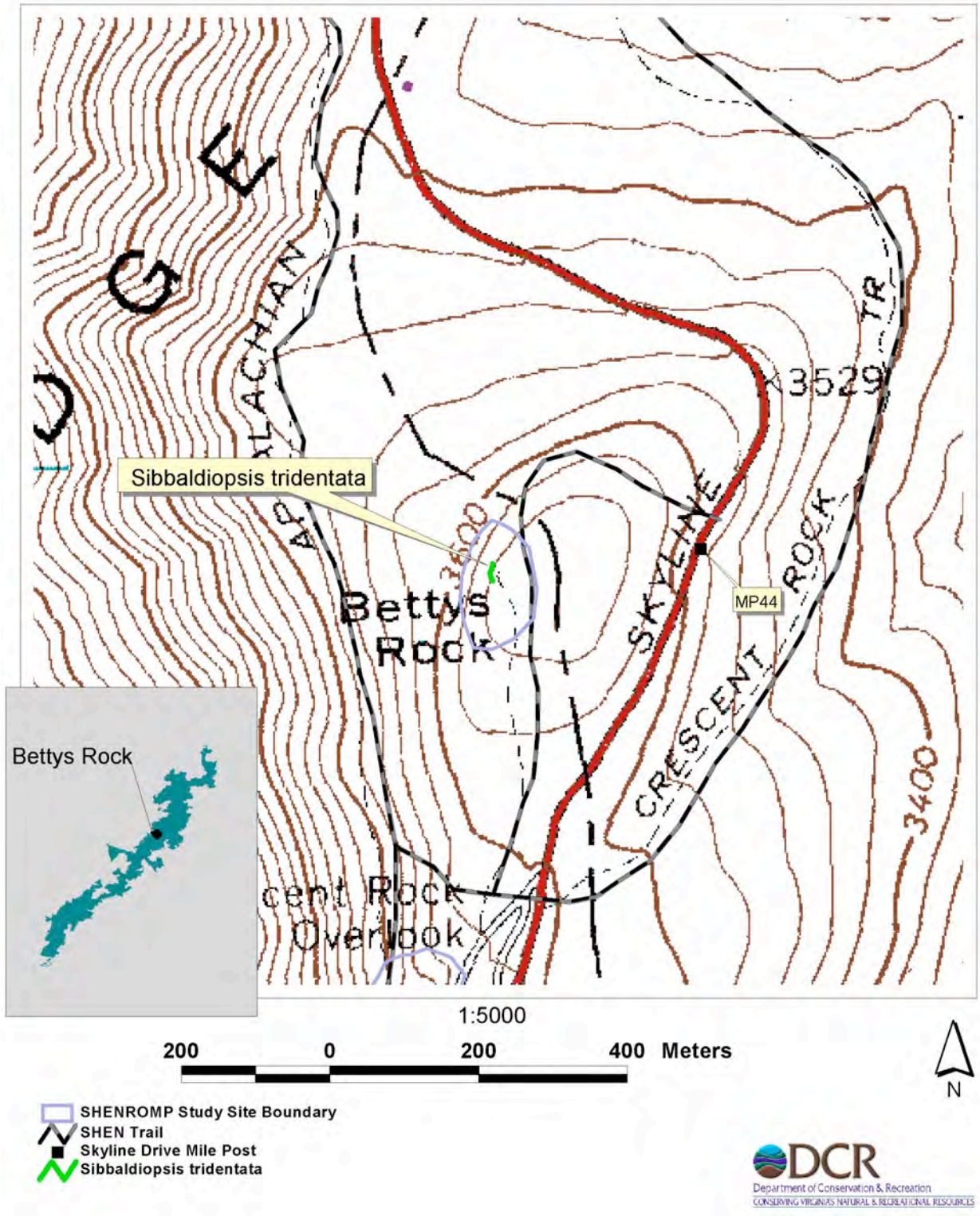


Fig. 87. Location of *Sibbaldiopsis tridentata* at Bettys Rock.

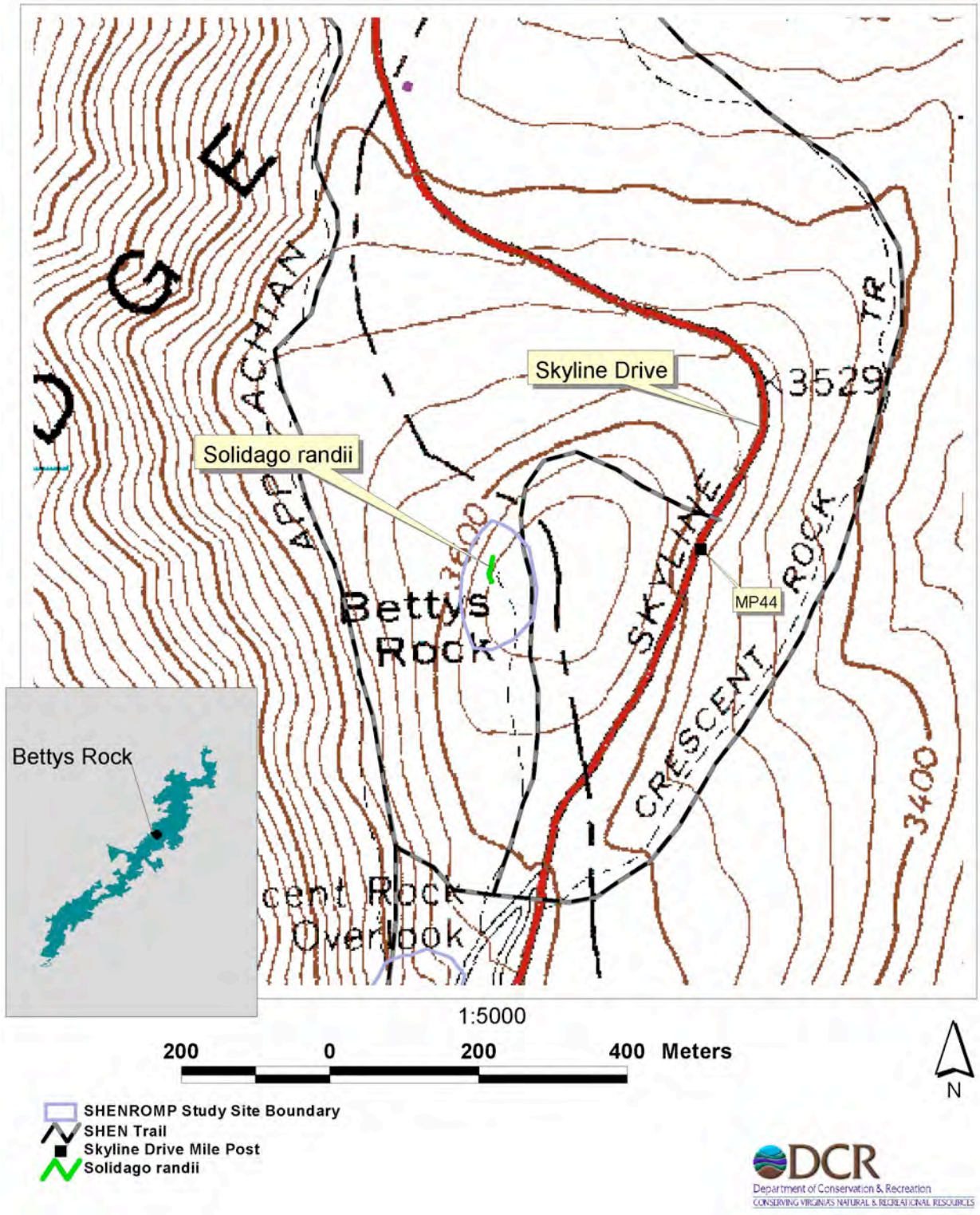


Fig. 88. Location of *Solidago randii* at Bettys Rock.

CRESCENT ROCK OVERLOOK (C10)

CONSERVATION SITE: Hawksbill Mountain-Crescent Rock (B1) **THREAT RANK:** 5

LOCALITY: Page County **QUADRANGLE(S):** Big Meadows

LOCATION: This Central District site is situated immediately west of Skyline Drive and extends from the Crescent Rock Overlook parking area to the southwest about 0.27 km (0.17 mi).

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation	High-Elevation Greenstone Barren	G1	S1	None	None	C
Plants:						
Abies balsamea[1]	Balsam fir	G5	S1	None	None	CD
Muhlenbergia glomerata	Marsh muhly	G5	S2	None	None	D
Sibbaldiopsis tridentata[2]	Three-toothed cinquefoil	G5	S2	None	None	A
Solidago randii[2]	Rand's goldenrod	G5T4	S2S3	None	None	A
Animals:						
Itame ribearia	Currant spanworm moth	G4	S1S3	None	None	E
Sphaeroderus schaumii[3]	Shaum's ground beetle	G4	S2	None	None	E

[1]Part of this element occurrence (eo) lies within the Crescent Rock South ROMP site and part lies outside of any ROMP site.
[2]Parts of this eo lie within the Bettys Rock and Crescent Rock South ROMP sites and part lies outside of any site.
[3] Parts of this eo lie within the Crescent Rock South and Hawksbill North Slope Talus ROMP sites, and part lies outside of any ROMP site. This eo was not confirmed by DCR-DNH in 2005.

SITE DESCRIPTION: This site encompasses several significant features: a large cliff, a smaller outcrop to the south of this cliff, an open seep to the northeast of the cliff, and an extensive area of talus and small cliffs and outcrops below (west of) the cliff. The bedrock in this area is Catoctin Formation metabasalt.

The cliff (Crescent Rock) is estimated at 36 m (118 ft) high and has a length of about 100 m (360 ft). It generally faces west-northwest, but curves at the southern end to face northwest and at the northern end to face southwest, thereby forming the crescent shape for which it is named. At the northern end, the cliff top drops in a series of stairsteps, and the face of the cliff supports numerous crevices and small ledges where plants can establish a toehold. A short, signed trail leads to the top of Crescent Rock from the Crescent Rock Overlook parking area to the northeast.

To the south of Crescent Rock is a small metabasalt outcrop. Facing west-northwest, this outcrop is about 25 m (82 ft) long and 9 m (30 ft) high. This outcrop is a short distance to the west of Skyline Drive, and woody vegetation between the outcrop and the road has been cleared to enhance the view. No trail leads to this outcrop and, although it is close to Skyline Drive, it appears to receive little visitation.

Northeast of Crescent Rock is the Crescent Rock Overlook parking area. West of this parking area woody vegetation has been cleared to create the overlook viewshed. Within this cleared area and just below the overlook wall is a short line of metabasalt cliff 2-3 m (7-10 ft) high. A small perennial spring emerges at the top of this cliff near its southern end and drains down the cliff face and across the cleared viewshed area into the forest below.

Downslope from Crescent Rock, and extending west to the site boundary, is an extensive area of metabasalt talus, small cliffs, and outcrops. The Appalachian Trail traverses this area.

NATURAL COMMUNITIES: Bouldery Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type) covers the lowest part of the site near the Appalachian Trail, grading into cleared or naturally open talus below the overlook and Crescent Rock proper. At the upslope edge of the site, a small knob supports a patch of rich, weedy Central Appalachian Montane Oak-Hickory Forest (Basic Type) dominated by *Quercus rubra* (northern red oak), *Fraxinus americana* (white ash), and *Acer saccharum* (sugar maple). Crescent Rock proper supports a sizeable (0.4 ha [1.0 ac]) stand of the globally rare High-Elevation Greenstone Barren community, which is endemic to several high-elevation sites in SHEN. This vegetation type is characterized by patchy thickets of low shrubs and tree saplings interspersed with large open rock surfaces with herbaceous species rooted in crevices and on mats of thin, organic-rich soil. Well-developed, undisturbed ledges and cliff tops are typically covered with a continuous turf of grasses and xerophytic forbs. Woody scrub occurring mostly on the vertical faces at this site includes *Sorbus americana* (American mountain-ash), *Photinia melanocarpa* (black chokeberry), *Kalmia latifolia* (mountain-laurel), *Hamamelis virginiana* (witch-hazel), and *Betula alleghaniensis* (yellow birch). A large thicket of *Prunus virginiana* (choke-cherry) borders the backside of the cliff-top ledge. Cliff faces have large areas of lichen-covered rock, with herbaceous plants rooted on ledges and in crevices. Dominant and characteristic herbs are *Solidago randii* (Rand's goldenrod), *Sibbaldiopsis tridentata* (three-toothed cinquefoil), *Deschampsia flexuosa* (wavy hairgrass), *Hylotelephium telephioides* (Allegheny stonecrop), *Agrostis perennans* (autumn bentgrass), *Houstonia longifolia* (longleaf bluets), *Campanula divaricata* (southern harebell), and *Polypodium appalachianum* (Appalachian rock polypody).

RARE PLANTS: Five rare plants were located at this site. Previously known colonies of *Sibbaldiopsis tridentata* and *Solidago randii* were located at Crescent Rock and, in addition, a new colony of *Abies balsamea* (balsam fir) was found there. New colonies of *Sibbaldiopsis tridentata* and *Solidago randii* were located at the small outcrop south of Crescent Rock, and new colonies of *Solidago randii* were found along the Appalachian Trail below Crescent Rock overlook. At the seep by the Crescent Rock Overlook parking area, previously known stations for *Muhlenbergia glomerata* (marsh muhly) and *Abies balsamea* were relocated. A colony of *Rubus idaeus* ssp. *strigosus* located along the Appalachian Trail within the Crescent Rock South site had previously been mapped as extending north into the Crescent Rock Overlook site. No plants were found within the Crescent Rock Overlook site in 2005, however, and the colony may have previously been mapped incorrectly.

At Crescent Rock, *Sibbaldiopsis tridentata*, is found along the northern 60 m (197 ft) of cliff top and extends at least one-forth of the way down the cliff face. Population numbers here are estimated at over 400 mats or more than 3,000 flowering stems. *Solidago randii* is found throughout both the top and face of the cliff. More than 1,000 clumps are believed to be present here. Two wind-sculpted individuals of *Abies balsamea* were found just back from the top of the cliff near the northern end. Each tree was about 3 m (10 ft) high, and one of the trees had numerous male and female cones.

The small outcrop south of Crescent Rock supports more than 100 mats of *Sibbaldiopsis tridentata* and about 100 clumps of *Solidago randii* within a 5 x 13 m (16 x 47 ft) area. These plants are located in full sun at or near the top of the outcrop.

The spring seep near the Crescent Rock Overlook parking area supports a population of *Muhlenbergia glomerata* that appears to be in decline. Only nine flowering stems were seen here within a 0.25 x 1 m (1 x 3 ft) area on a flat shelf at the top of the small metabasalt cliff. In 1990, a total of 65 stems were counted in three small colonies. A similar-looking more common species of grass, *Muhlenbergia mexicana* (Mexican muhly) is also found in the area. A single wind-pruned and chlorotic individual of *Abies balsamea* was located nearby along the top of the cliff. This tree was about 3.5 m (11 ft) high and had numerous male and female cones.

Two small colonies of *Solidago randii* were found in two locations along open rocky areas of the Appalachian Trail (AT) below Crescent Rock Overlook. A small outcrop along the AT in the southern section supported 11 clumps, and, about 60 m (197 ft) to the north of this, eight clumps grew along 2 m (7 ft) of rocky outer trail edge.

RARE ANIMALS: A UV-trap was set at Crescent Rocks Overlook on 13 July, 2005, ran overnight, and picked up on 14 July, 2005. The light was placed about 125 m (410 ft) south of the Crescent Rock parking area and about 5 m (16 ft) from Skyline Drive. It overlooked the hardwood forest to the west as well as the southernmost portion of the cliff face. Included in the capture was one specimen of *Itame ribearia* (currant spanworm moth).

There is a record of *Sphaeroderus shaumii* (Shaum's ground beetle) from this area. The record is based on one specimen from 1991 that was presumably captured in a pitfall trap. The exact location of its collection is not known, but the possible distribution area includes Crescent Rocks Overlook, Crescent Rocks South, and Hawksbill North Slope Talus as well as non-ROMP site areas, primarily east of Skyline Drive.

Several watchlist moth species have also been identified from this site. In 2005, five species were captured: *Darapsa versicolor* (Hydrangea sphinx), *Eulithis molliculata* (dimorphis Eulithis moth), *Itame abrupta* (a geometrid moth), *Itame subcessaria* (barred Itame moth), and *Mesoleuca ruficillata* (white-ribboned carpet). In 2006, two more watchlist moth species were captured: *Lithacodia concinnimacula* (red=spotted Lithacodia moth) and *Metarranthis mestusata* (a geometrid moth).

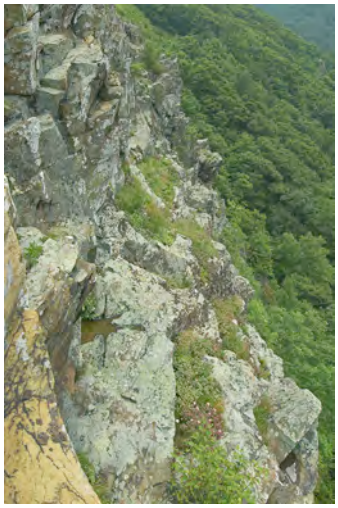


Plate 54. High-Elevation Greenstone Barren on inaccessible metabasalt ledges and faces at Crescent Rock Overlook.

THREATS: On the accessible cliff-top ledges, the condition of the High-Elevation Greenstone Barren community is poor following decades of trampling, soil compaction and removal of both soil and lichens. Trampling is most severe where the trail from the parking lot comes out onto the top of the cliff. No *Sibbaldiopsis tridentata* is left in this area, and *Solidago randii* persists only in protected crevices. Less accessible ledges at the north and south end of the cliff are in good to excellent condition. The cliff face is currently undisturbed, but this site has the potential to become a popular rock-climbing site because of its accessibility and challenging vertical cliff face.

The following exotics or aggressive native species were located on Crescent Rock: *Poa compressa* (flat-stemmed bluegrass), *Ailanthus altissima* (tree-of-heaven), *Polygonum caespitosum* var. *longisetum* (long-bristled smartweed), *Poa annua* (annual bluegrass), *Poa pratensis* (Kentucky bluegrass), *Taraxacum officinale* (common dandelion), *Achillea millifolium* (common yarrow), *Rumex acetosella* (sheep sorrel), *Veronica arvensis* (corn speedwell), *Polygonum aviculare* (creeping knotweed), *Portulaca oleracea* (common purslane), and *Muhlenbergia frondosa* (wirestem muhly). These exotics are symptomatic of trampling disturbances and degrade the compositional integrity of the rare barrens community. In addition, in areas that may be protected and rehabilitated in the future, some of these weeds (particularly the tough perennials *Poa compressa* and *Rumex acetosella*) will be direct competitive threats to the re-establishment of rare natives such as *Solidago randii*.

The following exotics or aggressive native species were found at the seep containing the *Muhlenbergia glomerata* population: *Poa pratensis*, *Phlem pratense* (meadow timothy), *Plantago rugelii* (pale plantain), *Achillea millefolium* (common yarrow), *Trifolium pratense* (red clover), and *Rumex crispus* (curly dock).

Rock climbing or other visitor uses probably have little impact on *Itame ribearia*. Little is known about the life history of *Sphaeroderus shaumii* or its potential threats. The primary threat to both of these animals may be the use of pesticides for gypsy moth or other insect control.

MANAGEMENT RECOMMENDATIONS: Because it supports an extremely rare natural community and several rare plants and animals, this site is a priority for management to reduce or eliminate ongoing disturbances.

Close access to outcrops by using a wall or viewing platform to allow natural vegetation recovery on trampled outcrop and protect pristine areas. Contain visitors to the immediate vicinity of the overlook area at the end of the trail. See Figure 95.

Inform viewshed maintenance crews of the presence of the rare plant species *Muhlenbergia glomerata* and *Abies balsamea* at the overlook, and adjust maintenance activities to facilitate the protection and management of these species.

Monitor the recovery of the rare plants and the health of the rare natural community. Conduct a survey on a 3-5 year interval to assess rare plant populations and the health of High-Elevation Greenstone Barren. At the same time, conduct a survey and assessment of invasive plants.

Manage invasive plants *Poa compressa* and *Rumex acetosella*. The use of herbicide is recommended for controlling these species because hand-pulling will create more soil disturbance and is labor-intensive. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Annually monitor the effectiveness of the invasive plant control effort. Continue monitoring *Poa* and *Rumex* for several years following treatment and assess need for further action. Once invasive have been controlled, include invasive plant survey in 3-5 year interval site surveys.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

There are no specific management recommendations regarding rock climbing or other visitor uses for the rare moth or ground beetle. Further sampling is recommended to determine the ranges for these species within the park. Target-specific pesticides should be used for gypsy moth or other insect control.

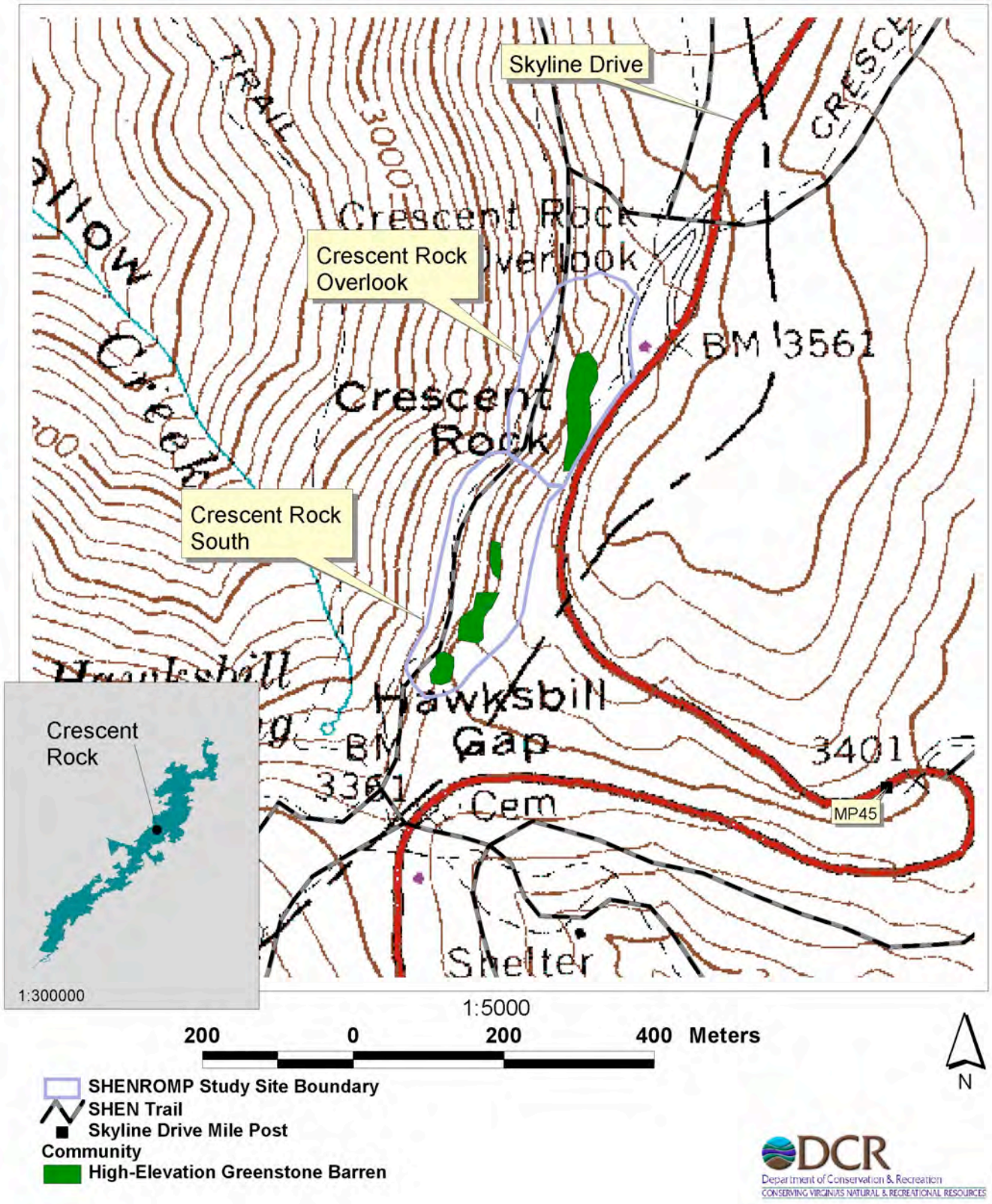


Fig. 89. Location of significant natural community at Crescent Rock Overlook.

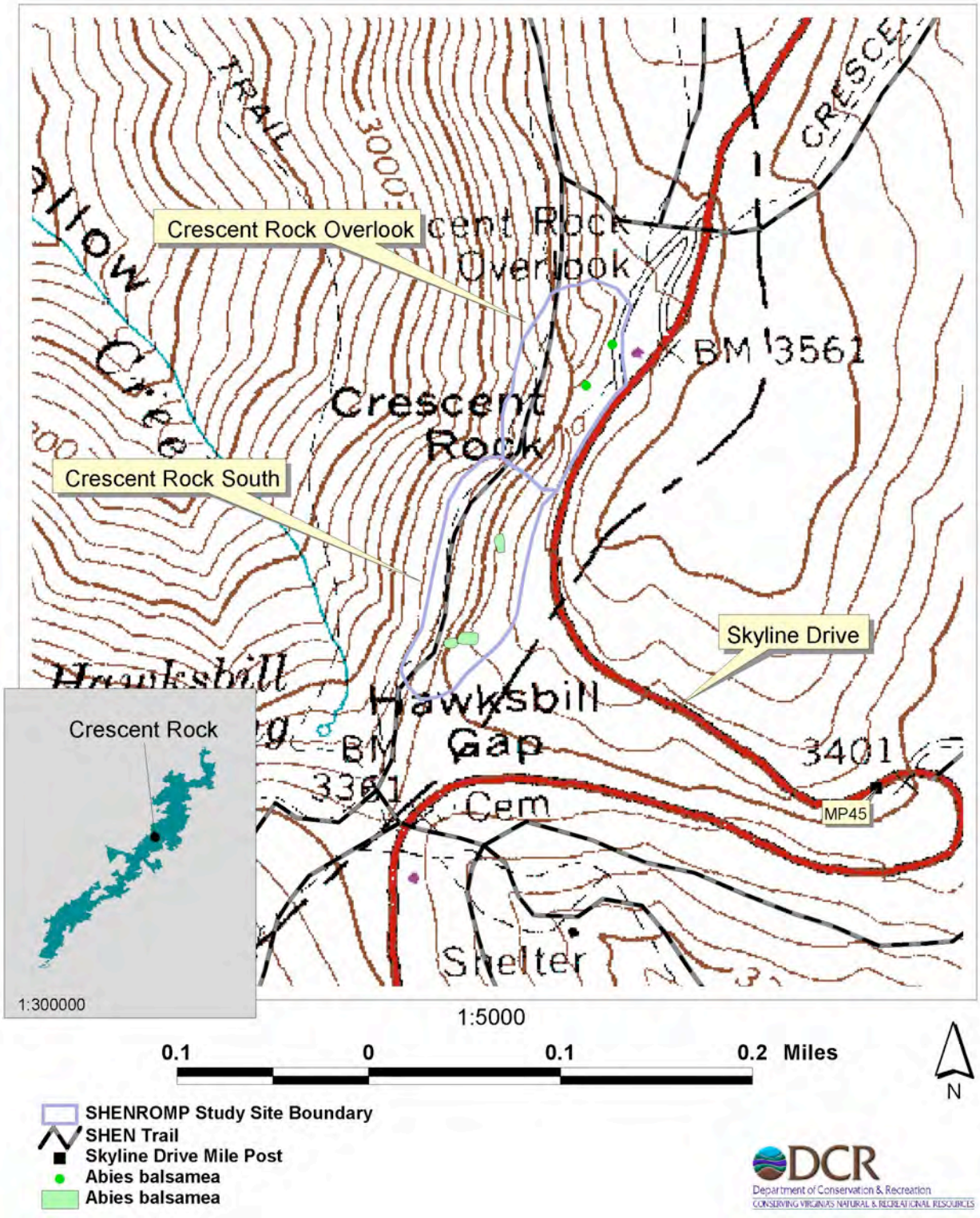


Fig. 90. Location of *Abies balsamea* at Crescent Rock Overlook.

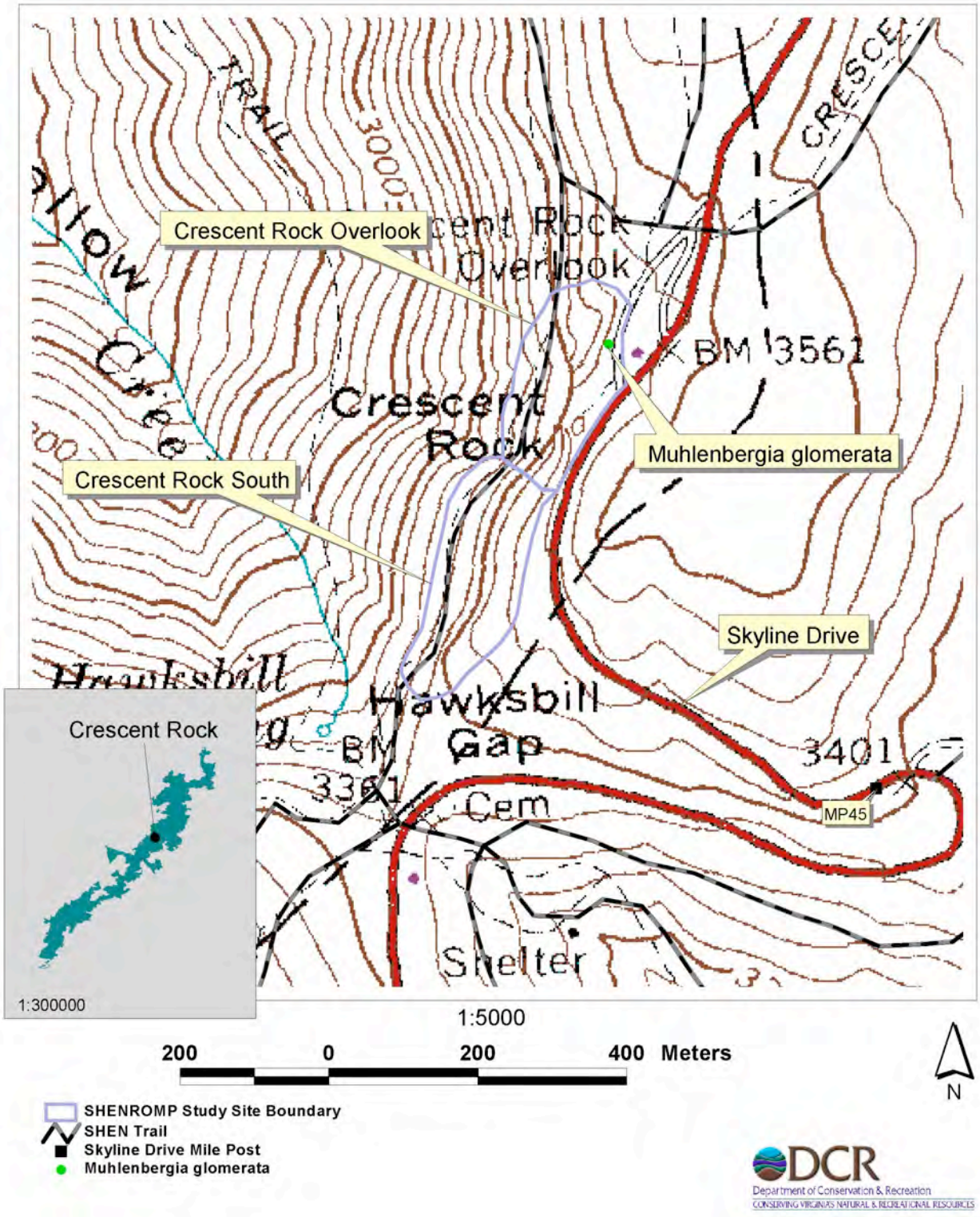


Fig. 91. Location of *Muhlenbergia glomerata* at Crescent Rock Overlook.

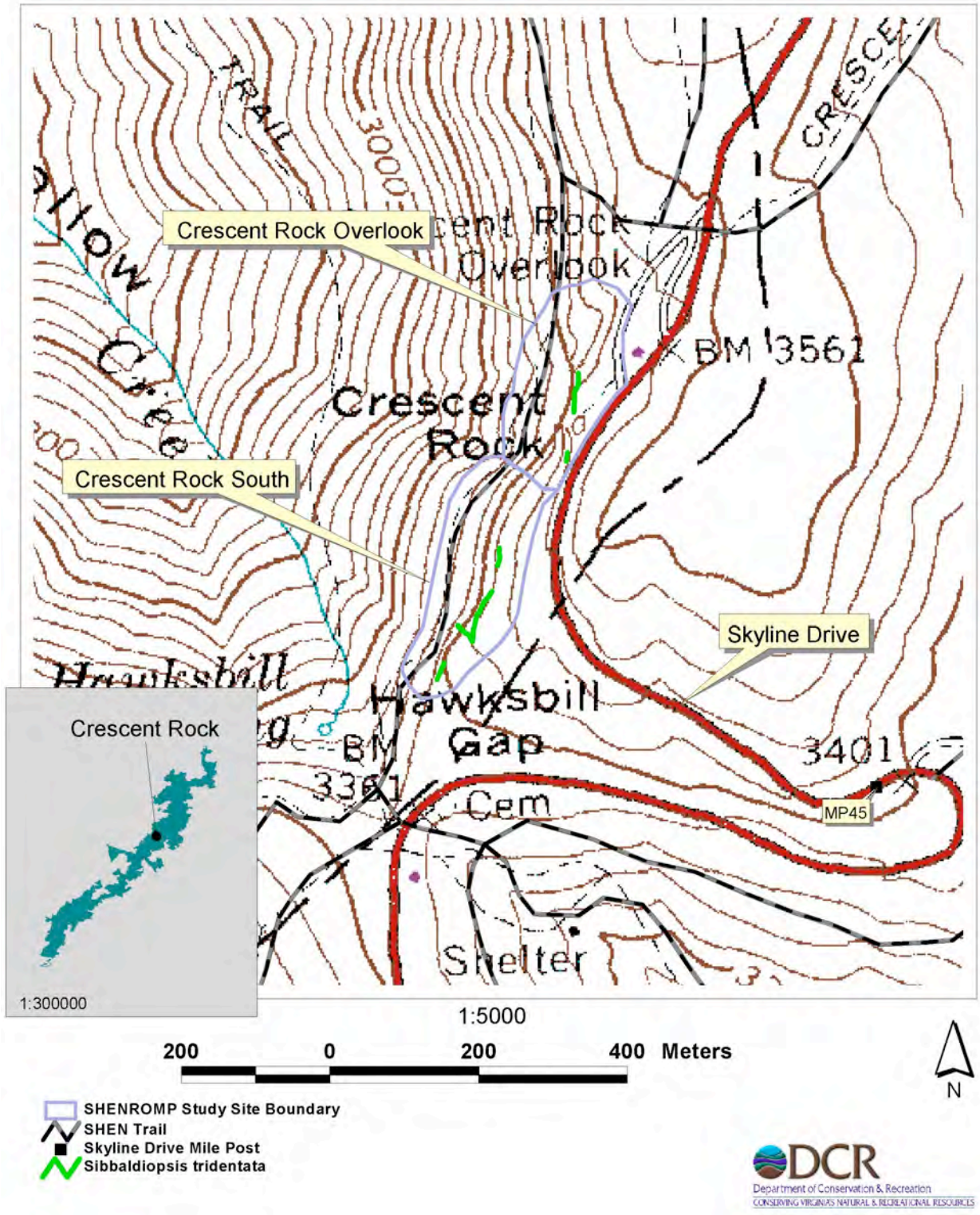


Fig. 92. Location of *Sibbaldiopsis tridentata* at Crescent Rock Overlook.

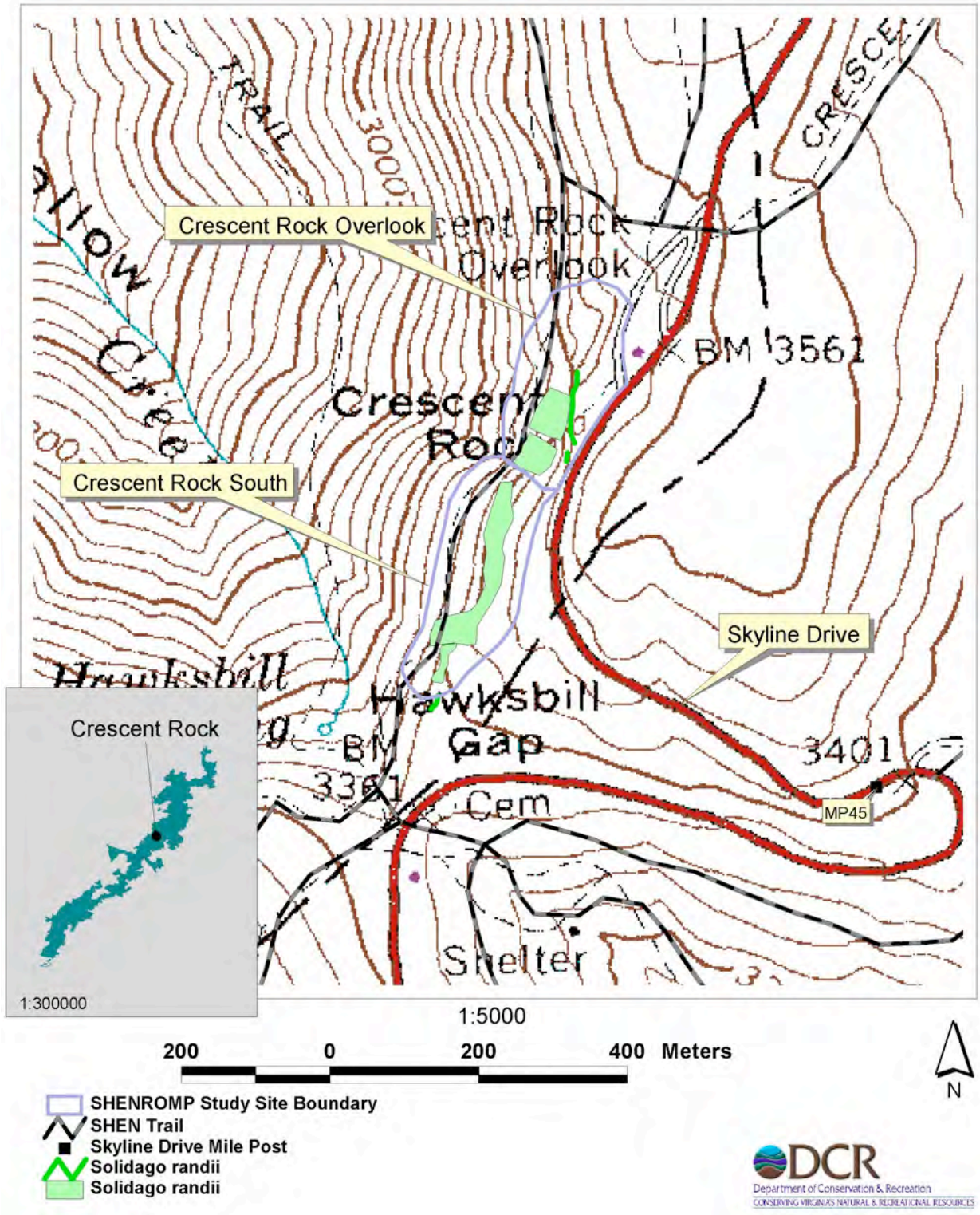


Fig. 93. Location of *Solidago randii* at Crescent Rock Overlook.

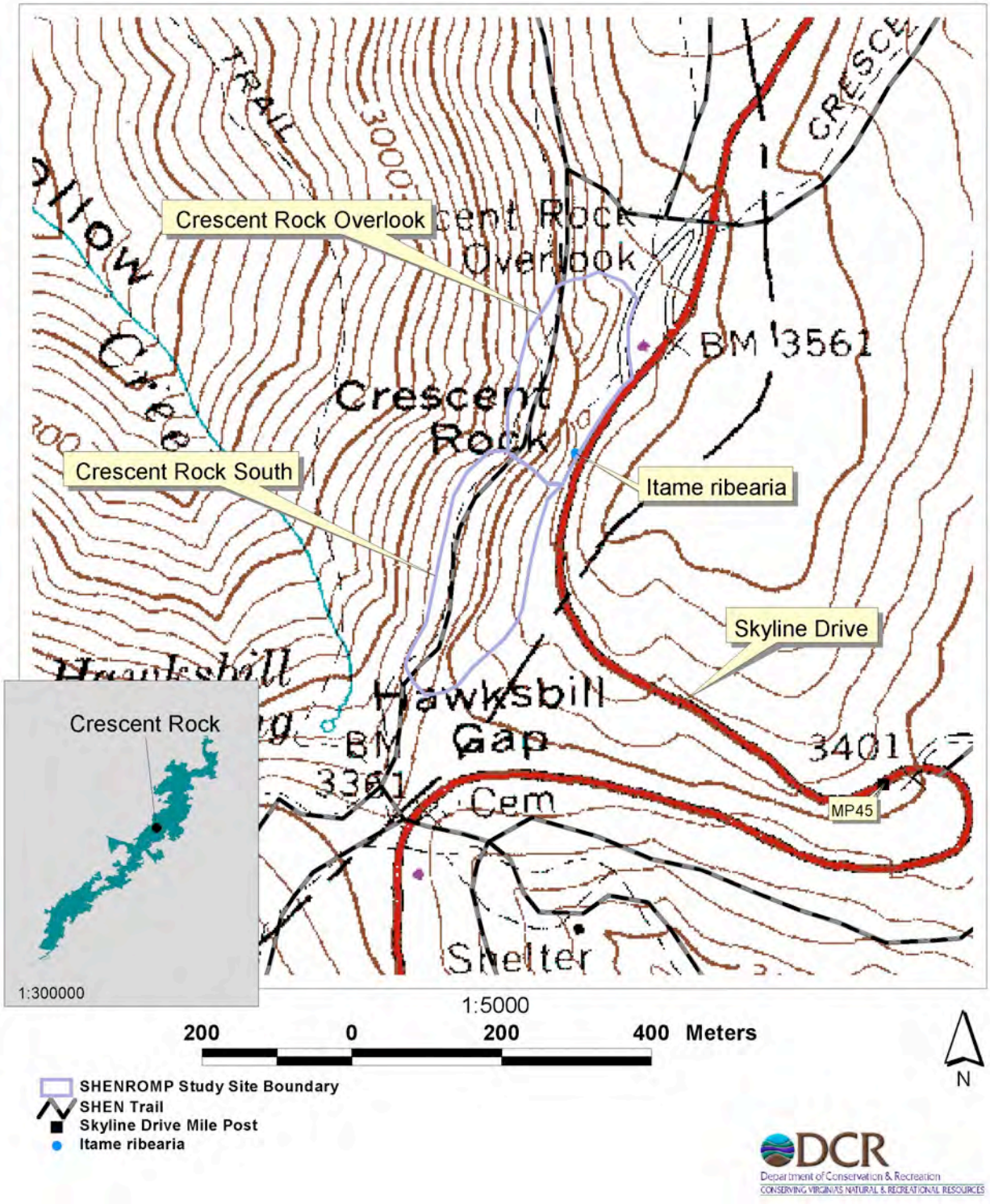


Fig. 94. Location of *Itame ribearia* at Crescent Rock Overlook.

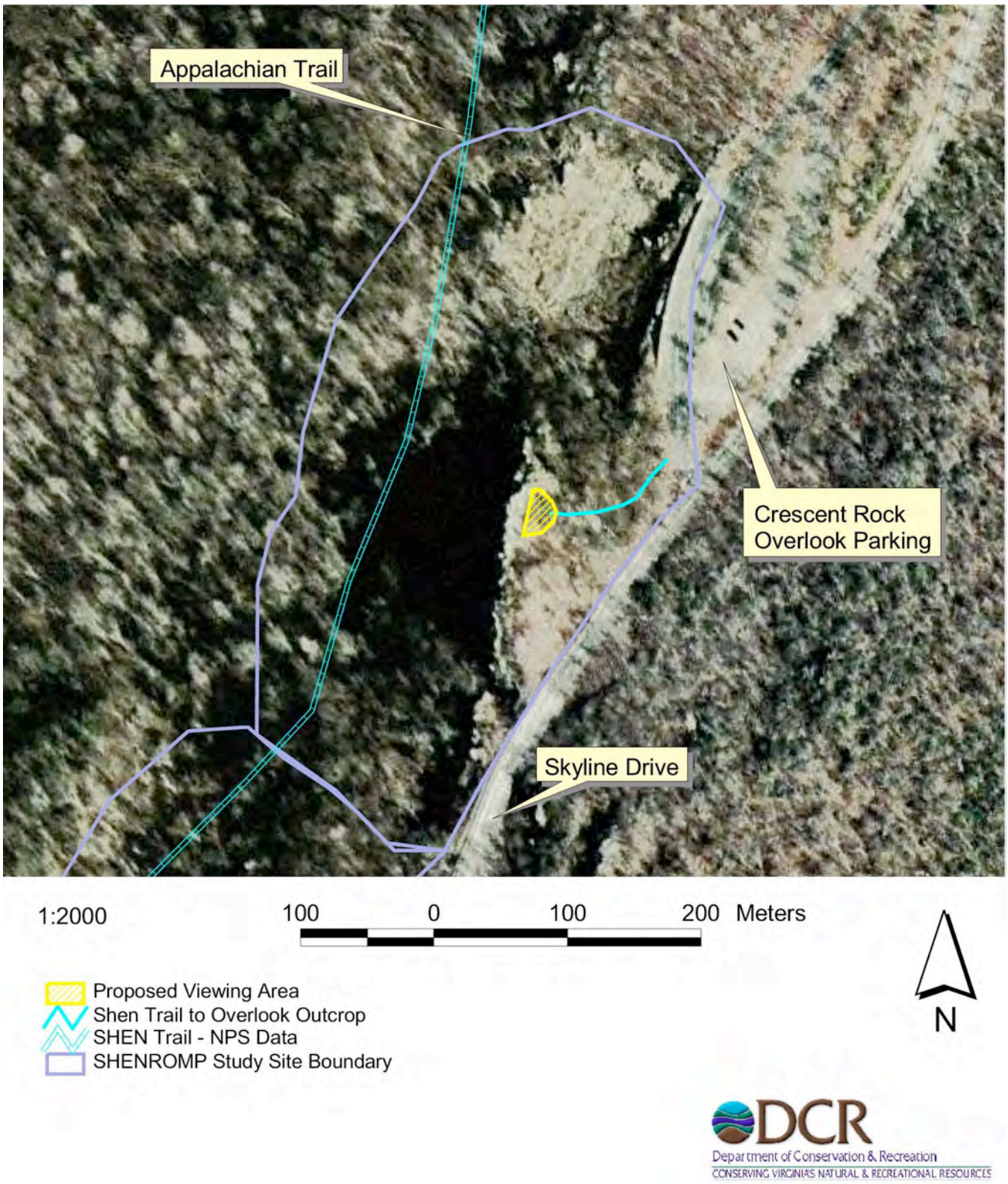


Fig. 95. Site details for Crescent Rock Overlook, including recommended viewing area.

CRESCENT ROCK SOUTH (C11)

CONSERVATION SITE: Hawksbill Mountain
Crescent Rock (B1)

THREAT RANK: 2

LOCALITY: Page County

QUADRANGLE(S): Big Meadows

LOCATION: This Central District site is located west of Skyline Drive. It extends from 0.27-0.60 km (0.18-0.38 mi) southwest of Crescent Rock Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation	High-Elevation Greenstone Barren	G1	S1	None	None	A
Plants:						
Abies balsamea[1]	Balsam fir	G5	S1	None	None	CD
Clematis occidentalis var. occidentalis	Purple clematis	G5T5	S2	None	None	B
Huperzia appalachiana	Appalachian fir-clubmoss	G4G5	S2	None	None	B
Rubus idaeus ssp. strigosus[2]	Red raspberry	G5T5	S2	None	None	B
Sibbaldiopsis tridentata[3]	Three-toothed cinquefoil	G5	S2	None	None	A
Solidago randii[3]	Rand's goldenrod	G5T4	S2S3	None	None	A
Lichens:						
Buellia stellulata	a lichen	GNR	S1	None	None	E
Porpidia lowiana	a lichen	G2G3	S1	None	None	E
Porpidia tuberculosa	a lichen	G2G4	S1	None	None	E
Animals:						
Sphaeroderus schaumii[4]	Shaum's ground beetle	G4	S2	None	None	E

[1] Part of this element occurrence (eo) lies within the Crescent Rock Overlook ROMP site and part lies outside of any ROMP site.
[2] Part of this eo lies within the Bettys Rock ROMP site and part lies outside of any ROMP site.
[3] Parts of this eo lie within the Crescent Rock Overlook and Bettys Rock ROMP sites and part lies outside of any ROMP site.
[4] Parts of this eo lie within the Crescent Rock Overlook and Hawksbill North Slope Talus ROMP sites and part lies outside of any ROMP site. This eo was not confirmed by DCR-DNH in 2005.

SITE DESCRIPTION: This site contains an irregular line of metabasalt cliffs stretching between Crescent Rock Overlook and Hawksbill Gap. This escarpment is situated on the upper slope of the Blue Ridge with a west-northwest aspect and is frequently buffeted by strong winter winds, low temperatures, and ice. The escarpment is more or less continuous, with occasional breaks that separate individual bedrock exposures. The lower faces of the cliffs are generally shaded and mossy, with numerous small shelves covered by organic colluvium. The tops of the cliffs have larger ledges and shelves, several of which are open. At the highest elevation (about 1,061 m [3440 ft]), an open, 10 m (33 ft) wide ledge runs for about 80 m (262 ft) along the top of the outcrops. The forested slope between the cliff tops and

Skyline Drive is fairly gentle, with some areas covered by loose talus. At the foot of the cliffs, the forested slope is steeper and more generally covered by bouldery colluvium.

The Appalachian Trail runs along the base of the outcrops at this site, providing relatively easy access in several places where slopes can be scrambled up to reach the cliff tops. The ledges at the top of the escarpment are also easily accessed by following the ridge directly north of Hawksbill Gap, although few visitors would likely do this.

NATURAL COMMUNITIES: The escarpment of outcrops at this site occurs within a matrix of several deciduous forest communities. Upslope of the cliffs, the forest is a mosaic of Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type) and Central Appalachian Montane Oak-Hickory Forest (Basic Type), which occupy convex and concave slopes respectively. Bouldery slopes at the base of the cliffs support Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type) except on several very rocky, convex spurs, where a variant of Northern Red Oak Forest with a dense *Kalmia latifolia* (mountain-laurel) shrub layer occurs.

The open outcrops support a large occurrence of the globally rare High-Elevation Greenstone Barren community, which is endemic to several high-elevation sites in SHEN. This vegetation type is characterized by patchy thickets of low shrubs and tree saplings interspersed with large open rock surfaces with herbaceous species rooted in crevices and on mats of thin, organic-rich soil. The occurrence at Crescent Rock South covers approximately 0.35 ha (0.9 ac) in three patches separated by patches of forest. It has a well-developed, continuous turf of grasses and xerophytic forbs on the summit ledges. The dominant species of this turf are *Deschampsia flexuosa* (wavy hairgrass), *Solidago randii* (Rand's goldenrod), and *Sibbaldiopsis tridentata* (three-toothed cinquefoil), with *Hypericum gentianoides* (orange-grass), *Hylotelephium telephioides* (Allegheny stonecrop), *Houstonia longifolia* (longleaf bluets), *Zizia aptera* (heartleaf golden-alexanders), *Allium cernuum* (nodding onion), *Liatris turgida* (shale-barren blazing-star), *Potentilla canadensis* (Canada cinquefoil), and *Carex pensylvanica* (Pennsylvania sedge) also common. Thickets of *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Abies balsamea* (balsam fir), *Gaylussacia baccata* (black huckleberry), *Smilax tamnoides* (bristly greenbrier), *Sorbus americana* (American mountain-ash), and *Betula alleghaniensis* (yellow birch) occur in crevices and along the edge of the cliff top. Exposed vertical faces of the cliff have a sparser herb flora and a greater representation of woody scrub. Additional species recorded from the faces include *Hamamelis virginiana* (witch-hazel), *Menziesia pilosa* (minniebush), *Prunus pensylvanica* (pin cherry), *Photinia melanocarpa* (black chokeberry), *Kalmia latifolia*, *Polypodium appalachianum* (Appalachian rock polypody), and *Dennstaedtia punctilobula* (hay-scented fern). Quantitative plot data were collected from this occurrence in 1999 (plot SHNP013) and again during the ROMP project (plot SHNP145).

This site was one of four from which lichens were intensively collected and sent to specialists at the New York Botanical Garden for identification. Significant collections from this site include *Buellia stellulata* (not previously reported from the eastern U.S.), *Melanelia stygia* (boreal disjunct), *Porpidia lowiana* (rare northern species), *Porpidia tuberculosa* (rare boreal-alpine species), and *Rhizocarpon geographicum* (boreal disjunct). Common species include *Lasallia pensylvanica*, *Rhizoplaca subdiscrepens*, *Porpidia* spp., *Rhizocarpon reductum*, *Rhizocarpon hochstetteri*, *Rhizocarpon rubescens*, *Asplicia cinerea*, *Fuscidea recensa*, *Ochrolechia yasudae*, *Xanthoparmelia plittii*, *Xanthoparmelia angustiphylla*, *Acarospora fuscata*, and *Cladonia* spp.

The Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type), occupying lower elevations along the Appalachian Trail, is part of one of the largest and finest stands of this community type. Much of the occurrence, which occupies an extensive area on the north flank of the Hawksbill Mountain - Crescent Rock area, is subject to frequent natural disturbances of ice and wind damage. Many trees are somewhat gnarled and short statured, but have relatively large diameters,

suggesting that they may be quite old. The possibility that this is an old-growth stand needs further investigation, but is plausible since few of these trees would ever have been commercially viable. The overstory dominant of this forest is *Betula alleghaniensis*, with *Quercus rubra* (northern red oak) frequently co-dominant. Minor overstory associates include *Fraxinus americana* (white ash), *Tilia americana* (American basswood), *Betula lenta* (sweet birch), *Acer saccharum* (sugar maple), *Prunus serotina* (black cherry), and *Acer rubrum* (red maple). Characteristic small trees and shrubs include *Acer spicatum* (mountain maple), *Acer pensylvanicum* (striped maple), *Ilex montana* (mountain holly), *Sambucus racemosa* ssp. *pubens* (red elderberry), *Hamamelis virginiana*, *Ribes rotundifolium* (Appalachian gooseberry), *Sorbus americana*, and *Ostrya virginiana* (eastern hophornbeam). The herb layer is often sparse (in very rocky areas), but varies to quite lush in areas with some soil accumulation. Characteristic herbs include *Angelica triquinata* (filmy angelica), *Aralia nudicaulis* (wild sarsaparilla), *Oclemena acuminatus* (whorled aster), *Clintonia borealis* (bluebead lily), *Carex aestivalis* (summer sedge), *Maianthemum canadense* (Canada mayflower), *Dryopteris marginalis* (marginal woodfern), *Dryopteris intermedia* (evergreen woodfern), *Impatiens pallida* (yellow jewelweed), *Arisaema triphyllum* (jack-in-the-pulpit), *Polygonatum pubescens* (downy Solomon's-seal), and *Ageratina altissima* (white snakeroot). Bryophtye cover is usually high.

RARE PLANTS: Six rare plant species are known for this site: *Abies balsamea*, *Clematis occidentalis* var. *occidentalis* (purple clematis), *Huperzia appalachiana* (Appalachian fir-clubmoss), *Rubus idaeus* ssp. *strigosus* (red raspberry), *Sibbaldiopsis tridentata*, and *Solidago randii*. The watchlist shrub *Taxus canadensis* (Canada yew) is present on slopes along the Appalachian Trail within this site. The watchlist herb *Liatris turgida* (= *Liatris helleri*, shale-barren blazing-star) is also found here.

Abies balsamea occurs at two locations within the site. Seven trees 3-6 m (10- 20 ft) tall, with cones, and two trees less than 3 m (10 ft) tall, without cones, were located along the cliff top. Two additional mature trees were located in this same area just below the top of the cliff. A 2006 survey of additional rock outcrops south and downslope from the highest cliff documented four more mature trees, a continuation of this colony. A single additional tree in the 3-6 m (10-20 ft) height range was located on a forested cliff top edge approximately 130 m (426 ft) north of this main group. Dead branches were present on all of the trees observed in 2005.

Clematis occidentalis var. *occidentalis* was found at the site for the first time in 2005. One patch of sprawling, fruiting stems covering 1 m^2 (11 ft^2) was located on the upper, shrubby edge of an open outcrop bordering a *Quercus rubra* (red oak)-dominated forest.

Three colonies of *Huperzia appalachiana* totalling 101 clumps were observed in 2005. Two new colonies were found at the northern end of the site. The westernmost of these consisted of three clumps at the base of a cliff. The easternmost consisted of 48 mosly juvenile clumps located in soil pockets on a narrow, forested talus slope between two cliffs. To the south of these new colonies, a previously known colony was reclocated. Fifty clumps were found here within a 5 m^2 (54 ft^2) area of talus 10 m (33 ft) east of the Appalachian Trail. Most of these clumps had sporangia.

At least 100 canes of *Rubus idaeus* ssp. *strigosus* were seen along a 0.4 km (0.24 mi) section of the Appalachian Trail. Plants were found on both sides of the trail. A small number had immature fruit. A zone of no more than 20 m (66 ft) on either side of the trail was surveyed, so the population area could be wider. In addition to the large trailside subpopulation, three other colonies were documented in the eastern, upslope portion of the site. From north to south, these consisted of eight canes within a 15 m^2 (161 ft^2) area, 13 canes within a 0.5 m^2 (5 ft^2) area, and 21 canes within a 3 m^2 (32 ft^2) area. Plants were found along cliff tops or at the base of talus slopes above the line of cliffs.
Thousands of stems of *Sibbaldiopsis tridentata* occur within this site. Two small patches were found in the central portion of the site: the northernmost with several mats in a 0.5 x 2 m (2 x 7 ft) area and the

southernmost with mats occupying less than 0.5 m^2 (5 ft^2). Hundreds of mats were found further south along 150 m (492 ft) of cliff top and extending down the cliff face in areas that receive ample sun. Another 48 m (158 ft) southwest and downslope from the cliff top, additional *Sibbaldiopsis tridentata* was found covering no more than 1 m^2, but distributed in 5 patches within a 20 x 3 m (66 x 10 ft) area in soil pockets on two small outcrops and the more vegetated "saddle" area between them. Many plants were flowering or fruiting on the June-July survey dates.

Hundreds of clumps of *Solidago randii* were found at this site in 2005 within approximately the same area where the plant had been previously documented by DCR-DNH. A 2006 survey of small outcrops in the southern section of the site and just beyond the site boundary extended the population area to include colonies on several small outcrops. The plant is found on most open rock outcrops within the site, including cliff tops and faces, but is generally absent from talus. It often extends into sunny woodland areas adjacent to open outcrops. It is a dominant species in some outcrop areas.

RARE LICHENS: The assemblage of lichens at this site contains three species currently considered rare in Virginia: *Buellia stellulata*, *Porpidia lowiana*, and *Porpidia tuberculosa*. *Buellia stellulata*, which has not been previously reported from the eastern U.S. (R. Harris, NYBG, pers. comm. to SHEN), was also collected at the Blackrock South District ROMP site. The arctic-boreal disjuncts *Porpidia lowiana* and *Porpidia tuberculosa*, which are also known from Roan Mountain, North Carolina, are both considered uncommon to possibly rare globally.

RARE ANIMALS: No new animal element occurrences were found during DCR-DNH surveys in 2005. There is a record of *Sphaeroderus shaumii* (Shaum's ground beetle) from this area. The record is based on one specimen from 1991 that was presumably captured in a pitfall trap. The exact location of its collection is not known, but the possible distribution area includes Crescent Rock Overlook, Crescent Rock South, and Hawksbill North Slopes Talus as well as non-ROMP site areas, primarily east of Skyline Drive.

Plethodon shenandoah (Shenandoah salamander) has occurrences just to the west and southwest of the ROMP site (Sanders, 2005). Further inventory may reveal its presence within the site.

Plate 55. High-Elevation Greenstone Barren at Crescent Rock South. The large, pinnacle-like outcrop is an outstanding example of columnar jointing in the Catoctin metabasalt.

THREATS: Although located close to the Appalachian Trail (AT) and a major parking area, this site has no social trails leading directly to it and it is not directly visible from the trail. However, there is evidence

of occasional visitation and camping on the cliff top, and several fire rings have been found here since 2001. Some visitors may have discovered this site from the very clear view of it from the Appalachian Trail where this trail crosses the large, open boulderfields on the north flank of Hawksbill. Currently, the vegetation and rare plant populations of this site are in nearly pristine condition, but this site is clearly vulnerable to disturbance. The exotic weeds *Poa compressa* and *Rumex acetosella* occur at low cover among native species on the summit ledges.

Little is known about the life history of *Sphaeroderus shaumii* or its potential threats. Rock climbing or other visitor uses probably have little impact on this species. The primary threat may be the use of pesticides for gypsy moth or other insect control.

MANAGEMENT RECOMMENDATIONS: Crescent Rock South contains some of the finest and most pristine patches of the extremely rare High-Elevation Greenstone Barren community, which is endemic to fewer than 30 outcrops covering less than 10 acres, all in a few areas of Shenandoah National Park. The presence of arctic-boreal disjuncts such as *Abies balsamea*, *Sibbaldiopsis tridentata*, and *Huperzia appalachiana* adds to regional significance of the site. Remediation of all existing "social trail" access to the outcrops and vigorous, frequent monitoring to detect increases in visitation requiring more drastic management should be implemented immediately. The populations of *Poa compressa* and *Rumex acetosella* should be monitored, and remedial action taken if these exotics increase significantly.

Regularly monitor for visitor use. If visitation increases, consider use of barriers or signs to deter use. Close any social trails that may develop.

Monitor the rare plants and the health of the rare natural community. Conduct a survey on a 3-5 year interval to assess rare plant populations and the health of High-Elevation Greenstone Barren.

Monitor invasive plants, particularly *Poa compressa* and *Rumex acetosella*. Conduct a survey on a 3-5 year interval to assess the population trend of these species. Current abundance does not warrant any treatement, which would likely have more impact on native species. However, if abundance of the invasive species increases significantly, implement control actions. The use of herbicide is recommended for controlling these species because hand-pulling will create more soil disturbance and is labor-intensive. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

There are no specific management recommendations regarding rock climbing or other visitor uses for the ground beetle. Further sampling is recommended to determine the species' range within the park. The use of target specific pesticides is recommended for gypsy moth or other insect control.

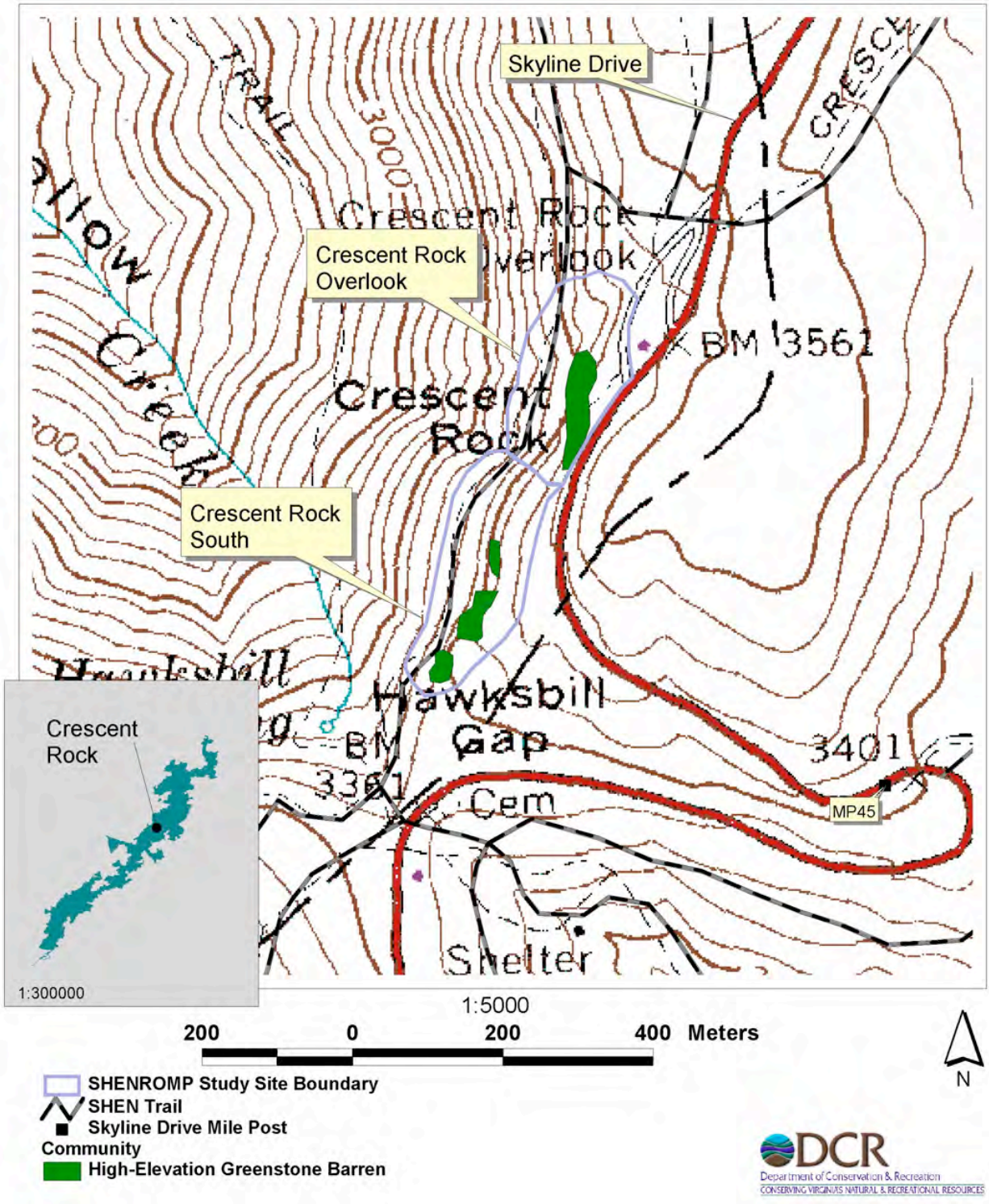


Fig. 96. Location of significant natural community at Crescent Rock South.

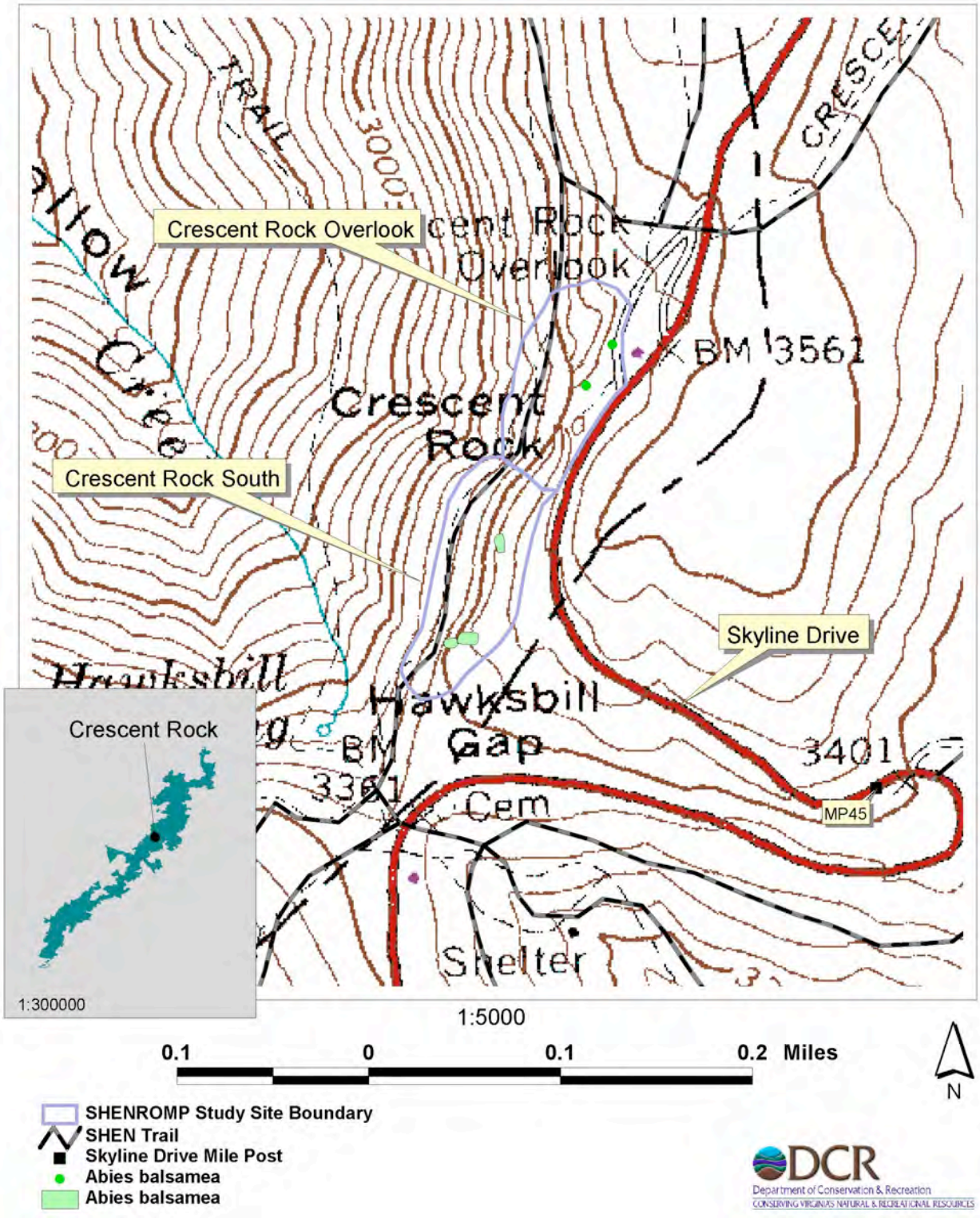


Fig. 97. Location of *Abies balsamea* at Crescent Rock South.

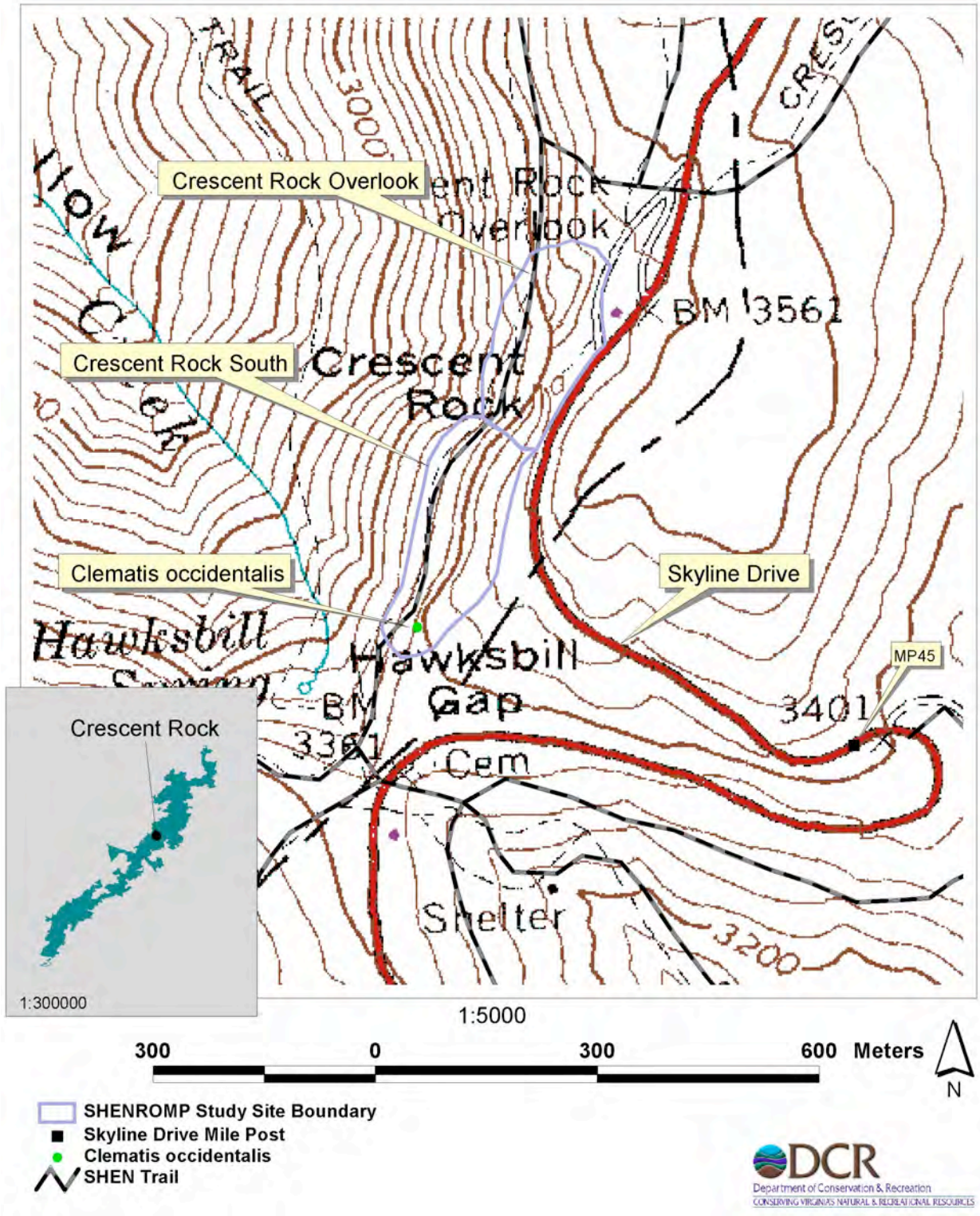


Fig. 98. Location of *Clematis occidentalis* var. *occidentalis* at Crescent Rock South.

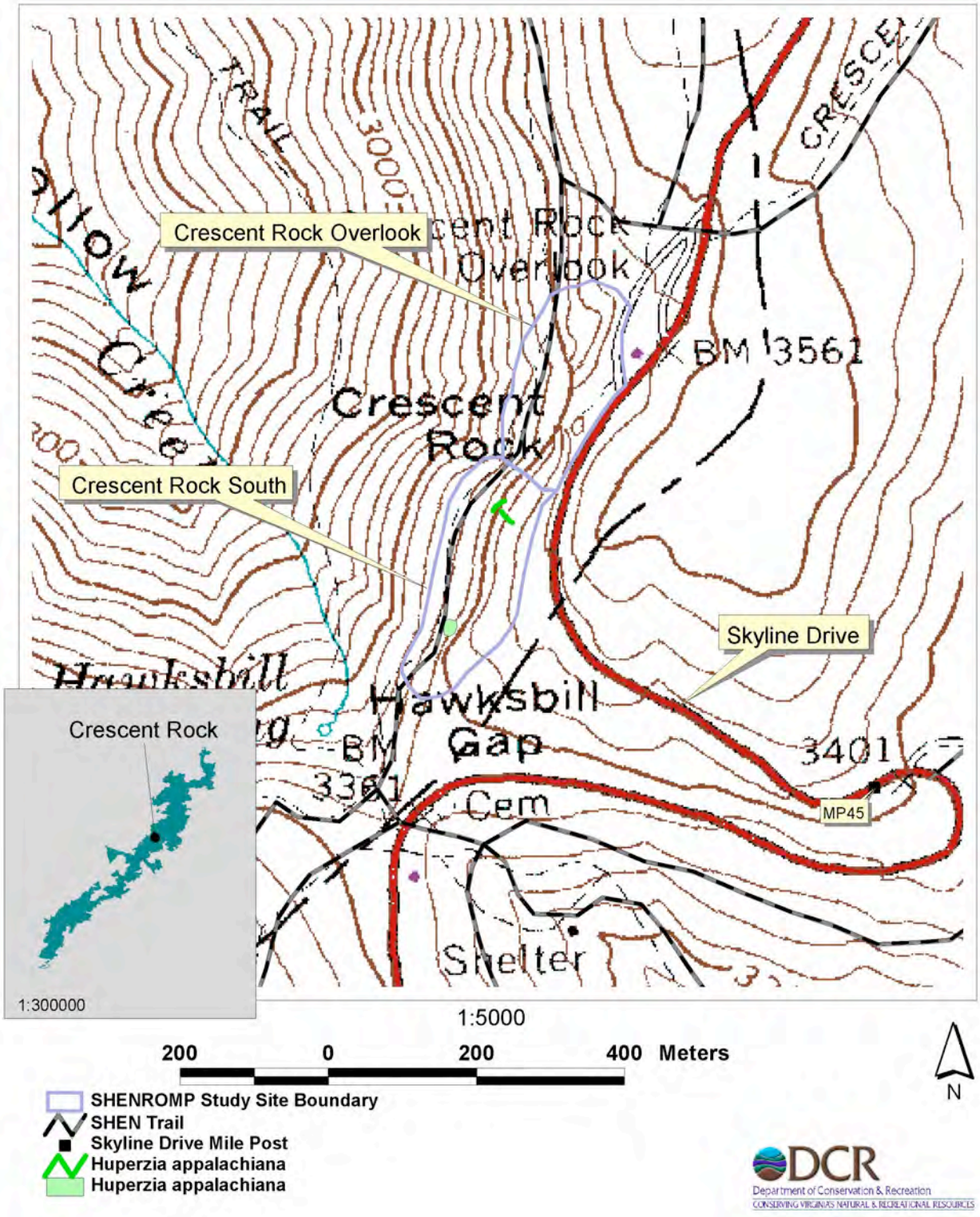


Fig. 99. Location of *Huperzia appalachiana* at Crescent Rock South.

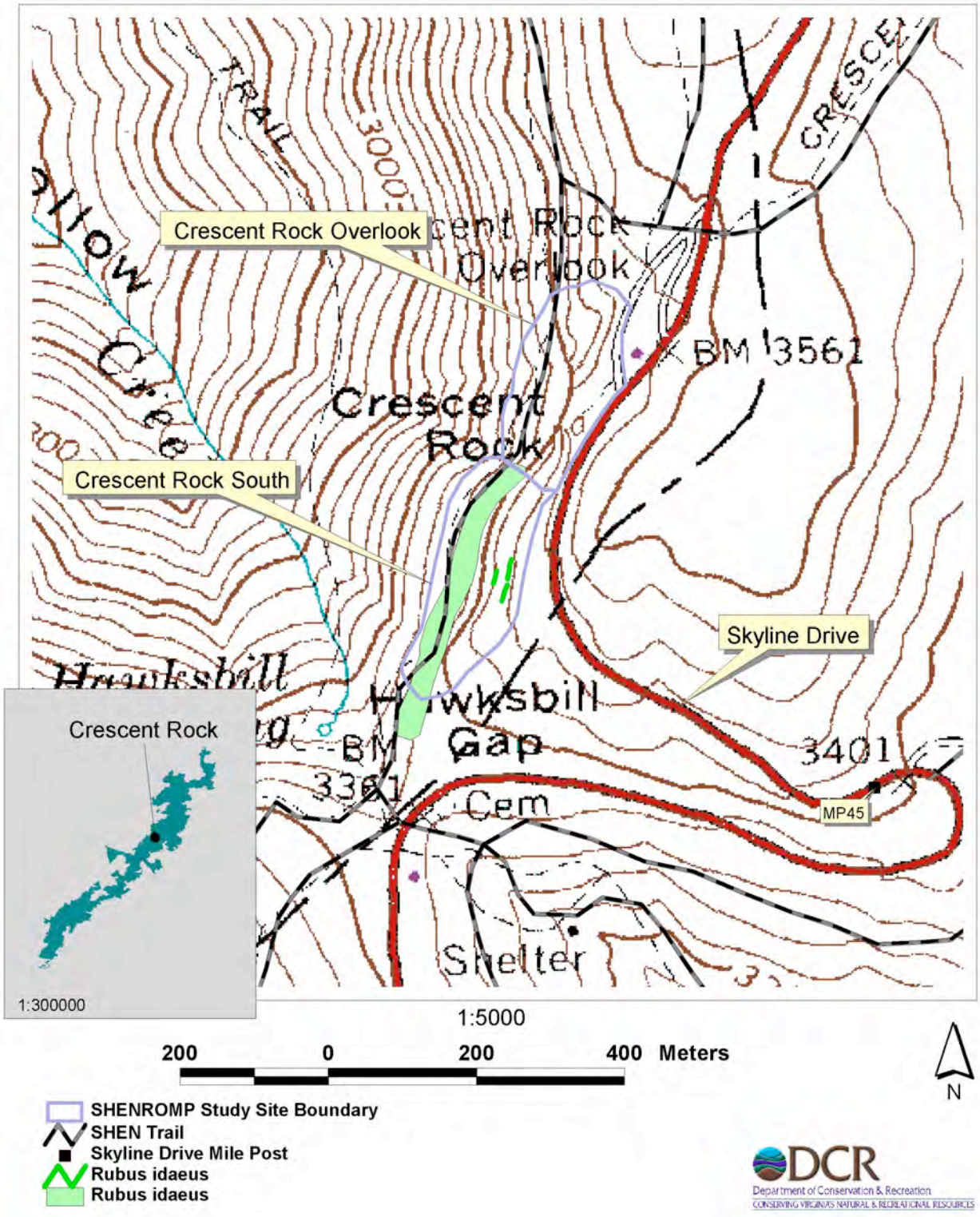


Fig. 100. Location of *Rubus idaeus* spp. *strigosus* at Crescent Rock South.

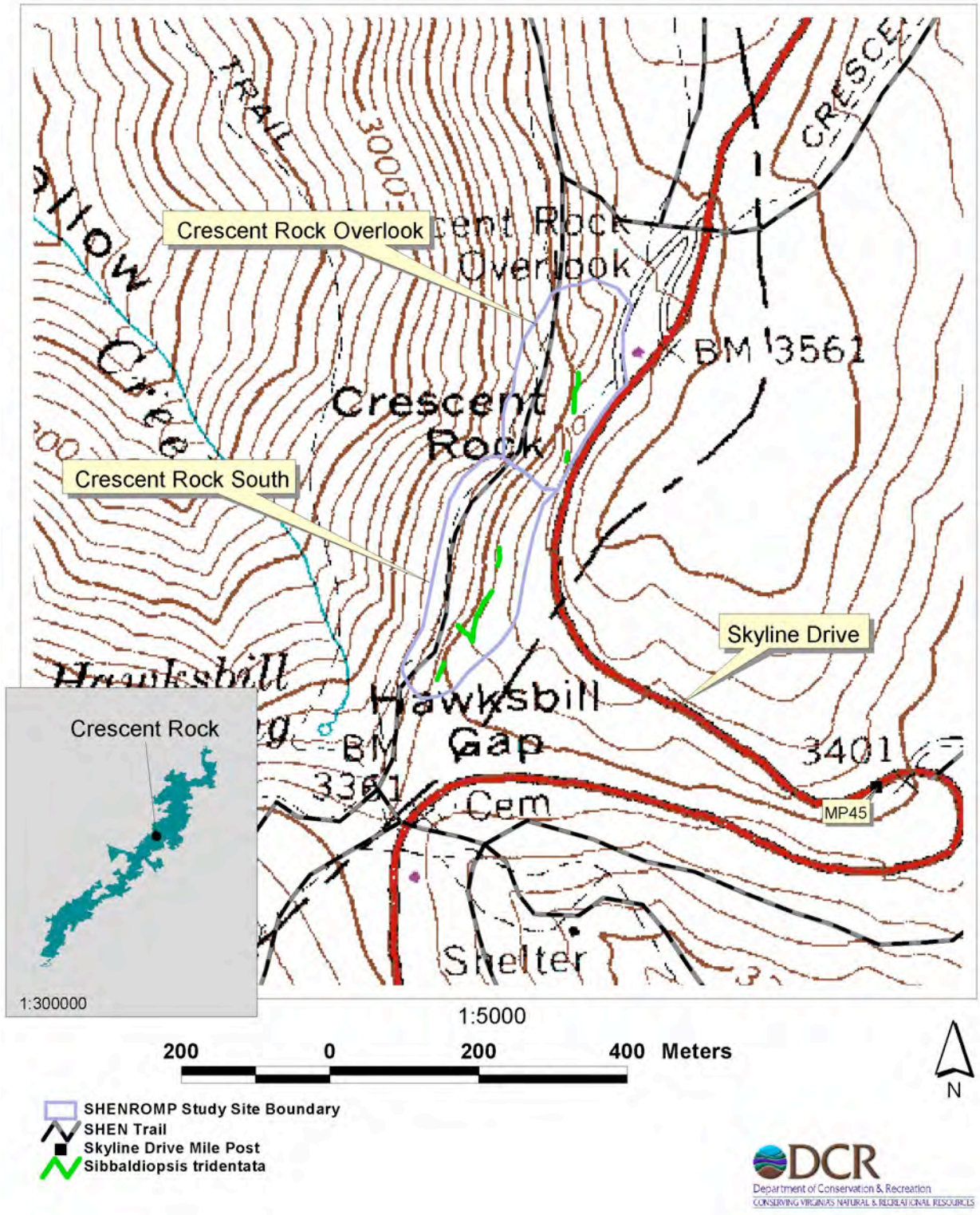


Fig. 101. Location of *Sibbaldiopsis tridentata* at Crescent Rock South.

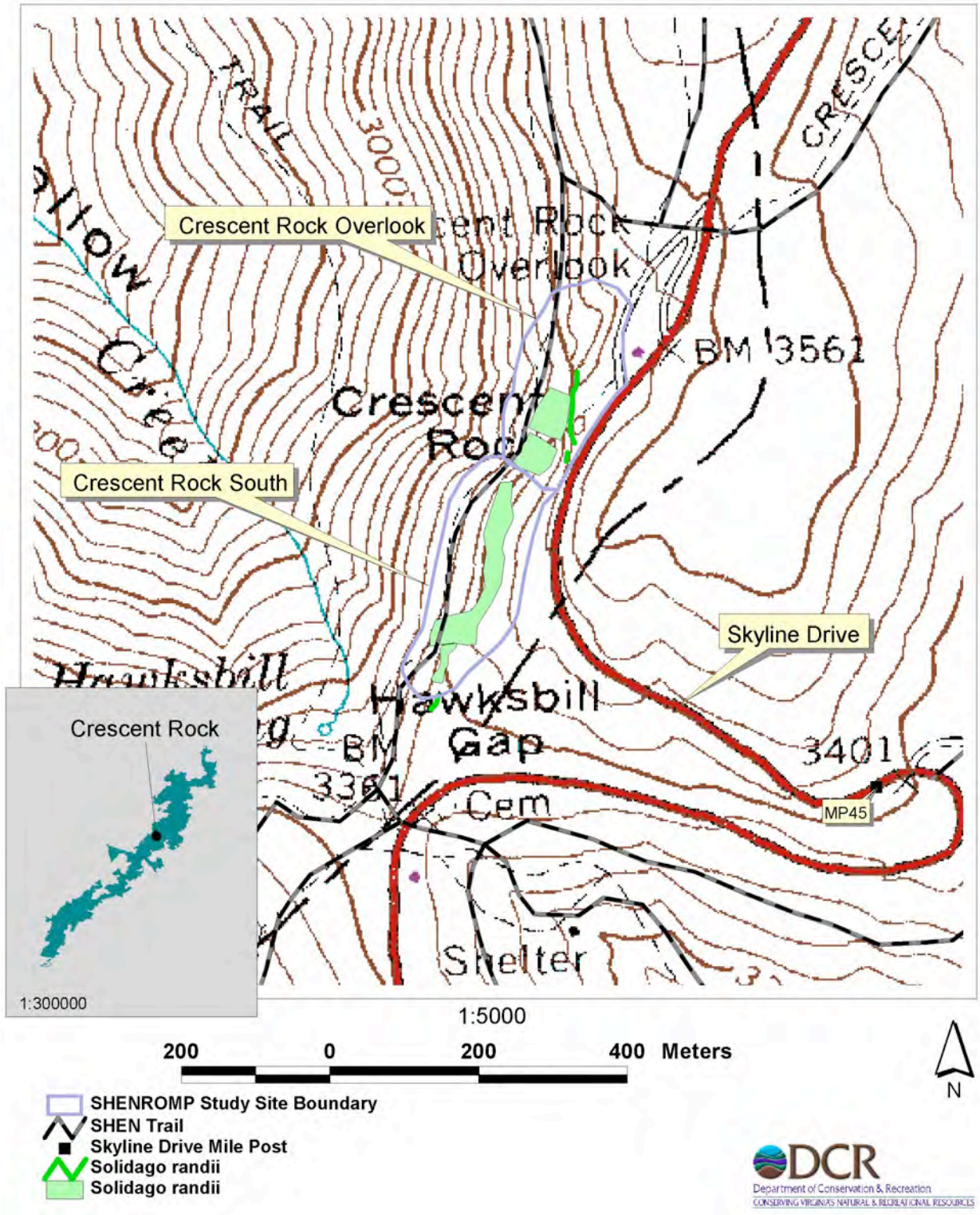


Fig. 102. Location of *Solidago randii* at Crescent Rock South.

HALFMILE CLIFF (C20)

CONSERVATION SITE: Cedar Run-Halfmile Cliff (B2) **THREAT RANK:** 0

LOCALITY: Madison County **QUADRANGLE(S):** Old Rag Mountain

LOCATION: This Central District site extends from 2.05-3.36 km (1.28-2.10 mi) southeast of Hawksbill Gap on Skyline Drive.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Fraxinus americana - Carya glabra / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	A
Juniperus virginiana - Fraxinus americana / *Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation	Central Appalachian Circumneutral Barren	G2	S2	None	None	A
Plants:						
Cuscuta coryli[1]	Hazel dodder	G5	S2?	None	None	B
Animals:						
Properigea costa[2]	A noctuid moth	G4	S1S3	None	None	C

[1]This element occurrence (eo) was sought but not relocated for this project. The eo was last seen by DNH in 1990.
[2]Part of this eo lies within the Whiteoak Canyon ROMP site.

SITE DESCRIPTION: This site, containing a portion of the northeastern flank of the deep ravine cut by Cedar Run, consists of an extensive complex of cliffs and bedrock exposures of varying sizes on steep slopes ranging in aspect from southeast through south to southwest. The bedrock exposures vary also in their character with most containing sizeable areas of woody scrub intermixed with ledgy openings occupied by graminoids and other crevice or flatrock-inhabiting plant species. Most exposures are xeric but the large opening in the lower southeast section of the site has considerable vernal seepage. The bedrock here is Catoctin Formation metabasalt.

Access to this site is from the Cedar Run Trail, which skirts the site's southern and southwestern borders. The very steep rocky terrain discourages visitation, and the condition of habitats and vegetation appears pristine.

NATURAL COMMUNITIES: The forest vegetation on deeper soils of this site consists mostly of Central Appalachian Basic Oak-Hickory Forest (Submontane / Foothills Type). A linear area of more mesic forest, primarily the Central Appalachian Rich Cove Forest, occurs on the lowest slopes along Cedar Run except where cliffs subtend the stream.

Seven open metabasalt outcrops in three clusters support a pristine occurrence of the Central Appalachian Circumneutral Barrens community covering 1.0 ha (2.5 ac) in aggregate. These barrens have scattered, stunted trees and shrubs, patches of lithophytic herbaceous vegetation, and areas of lichen-covered rock lacking vascular plants. Characteristic trees and shrubs are *Juniperus virginiana* var. *virginiana* (eastern redcedar), *Fraxinus americana* (white ash), *Pinus virginiana* (Virginia pine), *Viburnum rafinesquianum* (downy arrow-wood), *Rhus typhina* (staghorn sumac), and *Celtis occidentalis* (common hackberry). Herbaceous cover ranges up to about 50% and varies considerably in composition. *Schizachyrium scoparium* (little bluestem) and *Danthonia spicata* (poverty oat-grass) dominate some herbaceous patches, while the mat-forming *Selaginella rupestris* (ledge spike-moss) is prevalent in others. Additional characteristic herbs in this community are *Acalypha virginica* (Virginia copperleaf), *Allium cernuum* (nodding onion), *Ambrosia artemisiifolia* (common ragweed), *Asclepias verticillata* (whorled milkweed), *Cheilanthes lanosa* (hairy lipfern), *Helianthus divaricatus* (woodland sunflower), *Phacelia dubia* var. *dubia* (Appalachian phacelia), *Phlox subulata* (moss phlox), *Polygonum tenue* (slender knotweed), and *Talinum teretifolium* (round-leaf fameflower). Quantitative plot data were collected from this occurrence in 1999 (plot SHNP066).

Two large patches of Central Appalachian Basic Woodland covering 5 ha (13 ac) and 3 ha (7 ac) occupy very rocky, thin-soiled slopes around the barrens in the central and southern parts of the site. The soils occupied by vegetation have moderate to high calcium and magnesium concentrations, and vary from superficial veneers and interstitial colluvium to weathered in place with distinct profiles. This exceptionally large woodland occurrence is in excellent, undisturbed condition. It has an open to semi-closed canopy of stunted (mostly < 15 m tall) *Fraxinus americana*, *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), and *Juniperus virginiana* var. *virginiana*. Small trees and shrubs such as *Cercis canadensis* var. *canadensis* (eastern redbud), *Ostrya virginiana* (eastern hop-hornbeam), *Ulmus rubra* (slippery elm), *Celtis occidentalis*, *Rosa carolina* var. *carolina* (pasture rose), *Viburnum rafinesquianum*, and *Viburnum prunifolium* (smooth black haw) are also characteristic. The herb layer is species-rich, with *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod), *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Muhlenbergia sobolifera* (cliff muhly), *Danthonia spicata*, *Pycnanthemum incanum* (hoary mountain-mint), *Dichanthelium boscii* (Bosc's panic grass), *Bromus pubescens* (common eastern brome grass), *Carex pensylvanica* (Pennsylvania sedge), *Woodsia obtusa* ssp. *obtusa* (blunt-lobed woodsia), *Dichanthelium linearifolium* (narrow-leaf panic grass), *Polymnia canadensis* (white-flower leafcup), *Lespedeza intermedia* (wand bushclover), and *Packera obovata* (= *Senecio obovatus*, round-leaved ragwort) particularly abundant or characteristic. Quantitative plot data were collected from this occurrence in 1999 (plots SHNP067 and SHNP068).

RARE PLANTS: *Cuscuta coryli* (hazel dodder) was documented the eastern portion of the site in 1990. Two small colonies of this parasitic herb were seen, each covering only a few square meters. The site was searched for this species in August 2005 and again in August 2006, but the rare plant was not relocated.

RARE ANIMALS: One animal element occurrence, *Properigea costa* (a noctuid moth), was captured in a UV-trap on 21 July 2006. Because of its close proximity to Whiteoak Canyon ROMP site and the continuity of forested habitat, this capture site and the one at Whiteoak Canyon are considered one element occurrence, i.e., one interacting population; however, further research on the life history of this species may necessitate a reevaluation of this assessment.

In addition, one watchlist katydid species, *Scudderia septentrionalis* (Northern bush katydid), was captured in the UV-trap on 21 July 2006.

Plate 56. Central Appalachian Circumneutral Barren on metabasalt outcrops at Halfmile Cliff.

THREATS: No trails access this site and evidence of visitation was not found. The two significant natural communities are in essentially pristine condition. Although exotic weeds (e.g., *Commelina communis* [Asiatic dayflower]) are present at most of the outcrops, much of the site is entirely free of introduced species.

Little is known about the life history of *Properigea costa* or potential threats to it. The primary threat to this species may be the use of pesticides for gypsy moth and other insect control.

Cuscuta coryli is an annual, and populations may appear only in years when conditions are optimal. Therefore, the absence of this species from a known site in any given year is not in itself cause for alarm.

MANAGEMENT RECOMMENDATIONS:

Monitor this site on a 5-10 year interval to assess the rare plant and rare natural communities, invasive plants, and signs of visitor use.

There are no management recommendations offered for *Properigea costa*. Almost nothing is known about its life history, making management recommendations difficult. General conservation measures to protect large tracks of land may provide indirect positive benefits for this species. It is unlikely to be impacted by management decisions specifically targeting cliffs and rock outcrops; however, caution should be used if gypsy moth or other insect suppression is contemplated in the area, as certain pesticides have broad effects on non-targeted invertebrate species.

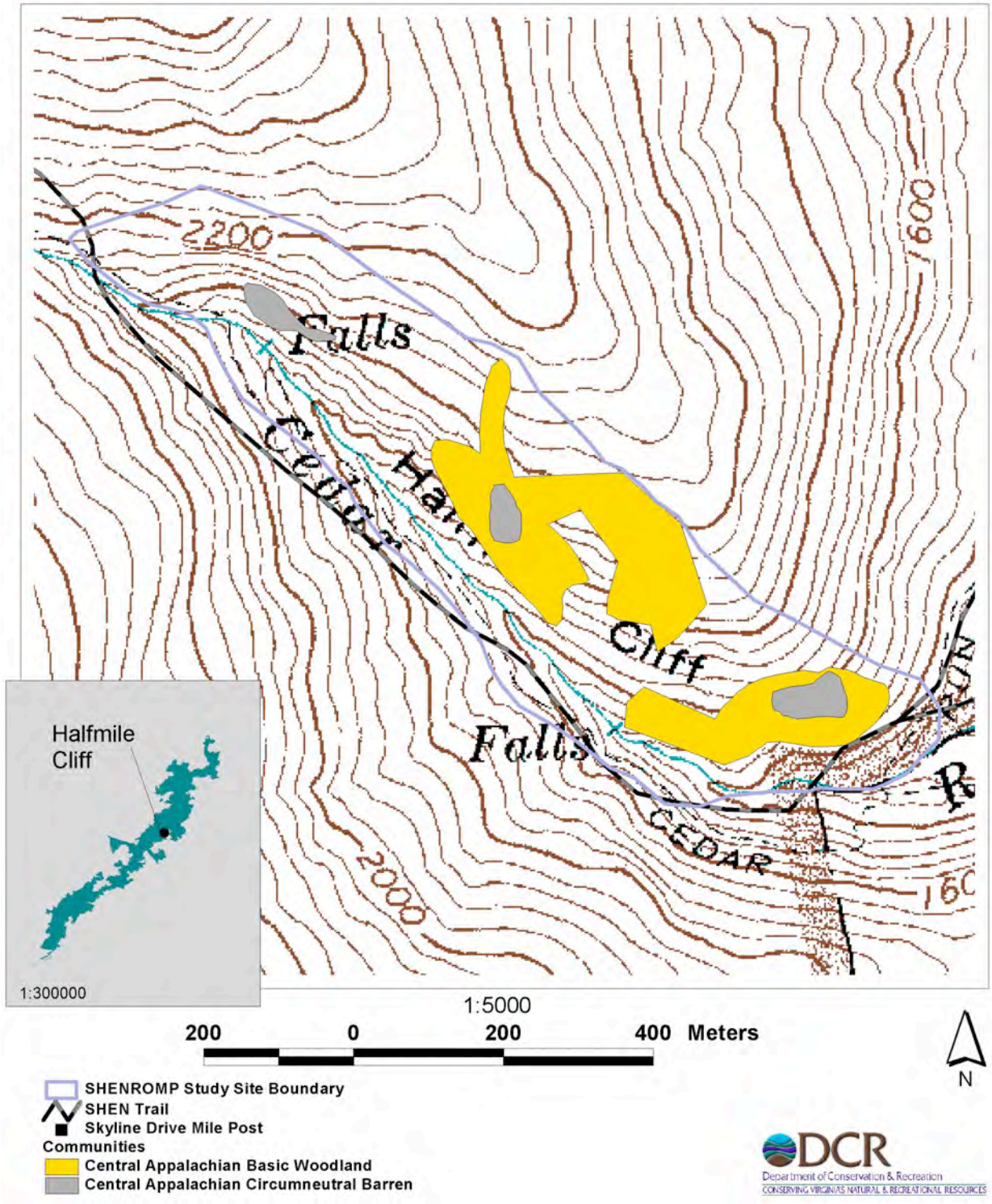


Fig. 103. Location of significant natural communities at Halfmile Cliff.

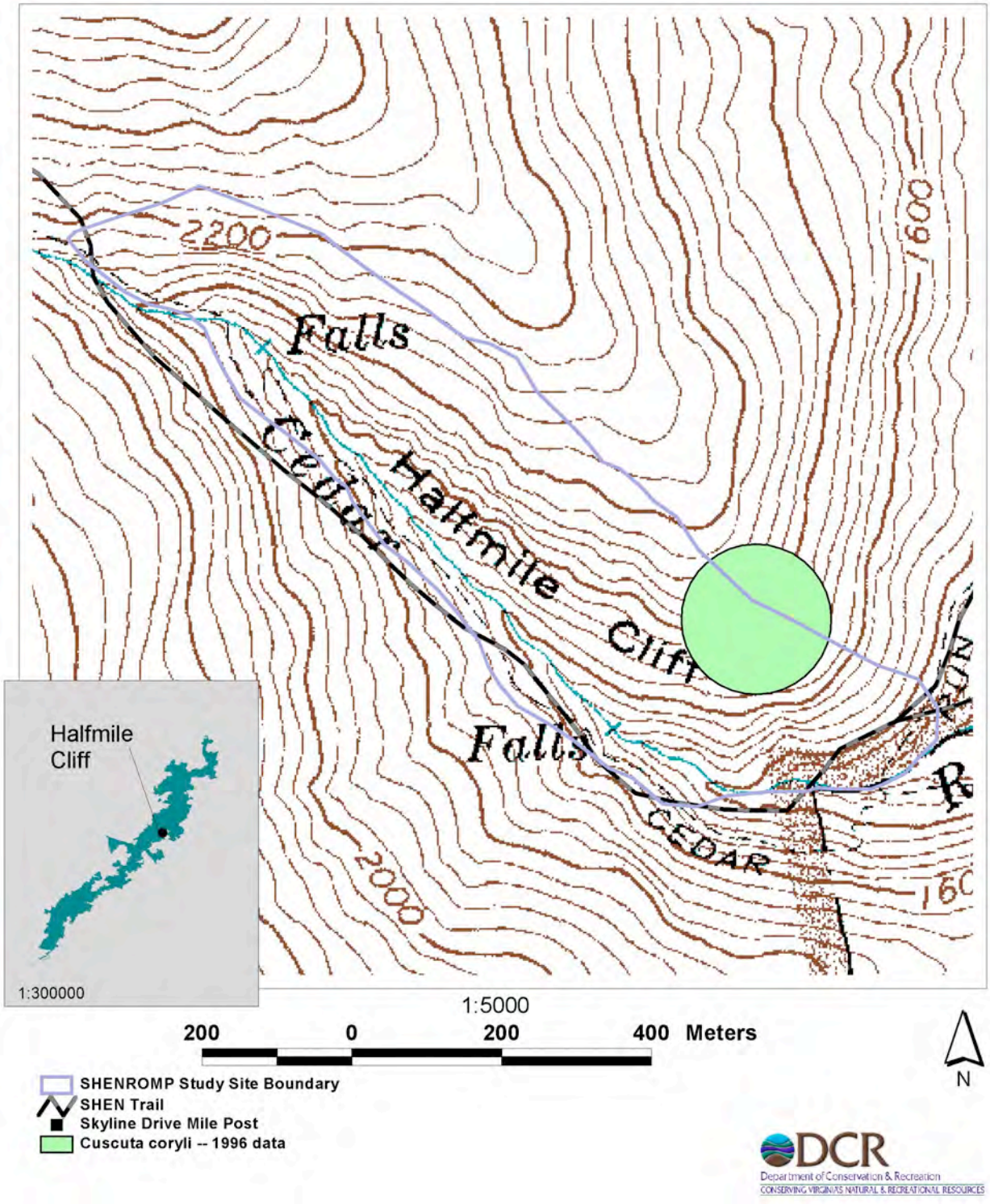


Fig. 104. Location of 1996 occurrence of *Solidago randii* at Halfmile Cliff.

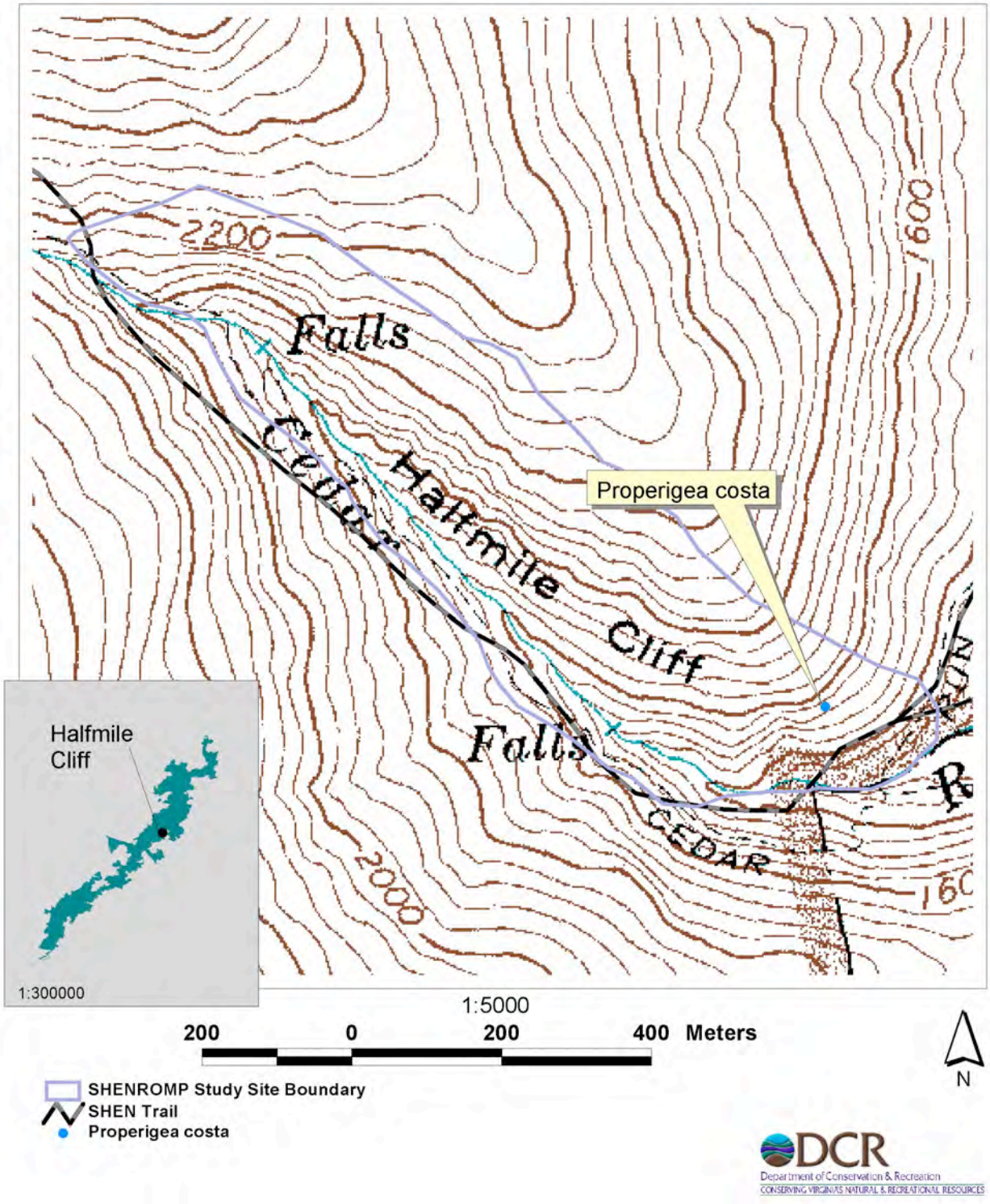


Fig 105. Location of *Properigea costa* at Halfmile Cliff.

HAWKSBILL NORTH SLOPE OUTCROPS (C21)

CONSERVATION SITE: Hawksbill Mountain-Crescent Rock (B1) **THREAT RANK:** 0

LOCALITY: Page County **QUADRANGLE(S):** Big Meadows

LOCATION: This Central District site is extends from 0.56-0.77 km (0.34-0.48 mi) west of Hawksbill Gap on Skyline Drive. It is located immediately south of the Hawksbill North Slope Talus site.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation[1]	High-Elevation Greenstone Barren	G1	S1	None	None	A
Plants:						
Abies balsamea[2]	Balsam fir	G5	S1	None	None	C
Huperzia appalachiana[1]	Appalachian fir-clubmoss	G4G5	S2	None	None	AB
Rubus idaeus ssp. *strigosus*[2]	Red raspberry	G5T5	S2	None	None	A
Sibbaldiopsis tridentata[3]	Three-toothed cinquefoil	G5	S2	None	None	BC
Solidago randii[1]	Rand's goldenrod	G5T4	S2S3	None	None	A
Trisetum spicatum	Narrow False Oats	G5	S1	None	None	B
Animals:						
Plethodon shenandoah[4,5]	Shenandoah salamander	G1	S1	LE	LE	A

[1]Parts of this element occurrence (eo) lie within the Hawksbill North Slope Talus and Hawksbill Summit ROMP sites.
[2]Parts of this eo lie within the Hawksbill North Slope Talus and Hawksbill Summit ROMP sites and part lies outside of any ROMP site.
[3]Part of this eo lies within the Hawksbill Summit ROMP site.
[4]Part of this eo lies within the Hawksbill North Slope Talus ROMP site and part lies outside of any ROMP site.
[5]Based on a previously documented record (DCR-DNH Biotics data). This eo has not been updated by DCR-DNH for this report.

SITE DESCRIPTION: This site encompasses a series of Catoctin Formation exposures on Hawksbill's steep northeastern face. The site is sandwiched between the Hawksbill North Slope Talus (downslope) and Hawksbill Summit (upslope) ROMP sites at elevations between 1,122-1,195 m (3,680-3,920 ft).

Most of the outcrops at this site are narrow, vertical spines of metabasalt that protrude from the surrounding landscape. These outcrops support numerous ledges. A more dramatic feature is found at the site's northwestern quadrant, where the lowest faces of a massive cliff converge to form a semicircular amphitheater.

The Appalachian Trail traverses a boulderfield located downslope from this site. Other trails lead to the Hawksbill summit area located upslope from the site. The rugged terrain and treacherous footing in this area prevent most off-trail explorers from reaching the site, however. Unfortunately, a few individuals have the potential to cause significant damage. Eric Butler noted linear scratches gouged into the rock and lichen cover in several areas, apparently the work of ice climbers' crampons.

NATURAL COMMUNITIES: Several massive, metabasalt outcrops on this very steep slope support patches of the globally rare High-Elevation Greenstone Barren community, which is endemic to a few high-elevation sites in SHEN. This occurrence, which covers approximately 0.5 ha (1.0 ac) in aggregate, is one of the largest known and is in pristine condition because of its remote, relatively inaccessible setting. Much of it occupies rather dry, exposed, north-facing outcrops. However, a portion is located on the concave face of the northwestern outcrop, which is more sheltered and cliff-like and has well developed turfs of organic matter and moss that receive frequent seepage.

Vegetation of the High-Elevation Greenstone Barren is predominantly herbaceous but contains patches of shrubs and stunted tree saplings which may be quite dense in places. The most characteristic woody species at this site are *Betula alleghaniensis* (yellow birch), *Sorbus americana* (American mountain-ash), *Menziesia pilosa* (minniebush), *Spiraea alba* var. *latifolia* (broad-leaved meadowsweet), *Diervilla lonicera* (northern bush-honeysuckle), and *Abies balsamea* (balsam fir). The most abundant and characteristic herbaceous species are *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Saxifraga michauxii* (Michaux's saxifrage), *Polypodium appalachianum* (Appalachian rock polypody), *Solidago randii* (Rand's goldenrod), *Hylotelephium telephioides* (Allegheny stonecrop), *Sibbaldopsis tridentata* (three-toothed cinquefoil), and *Dennstaedtia punctilobula* (hayscented fern). Exposed outcrops that are not covered by organic and moss mats support dense assemblages of lichens, including *Umbilicaria muehlenbergii* (abundant), *Lasallia papulosa*, *Stereocaulon glaucescens*, *Xanthoparmelia conspersa*, *Acarospora fuscata*, *Rhizocarpon geographicum*, *Lasallia pensylvanica*, *Rhizoplaca subdiscrepens*, *Parmelia sulcata*, *Parmelia cf. omphalodes*, and several gray and white crusts. The typical "dry" variant of the High-Elevation Greenstone Barren, as described above, was documented by quantitative plot data during the ROMP project (plots SHNP152, and SHNP153).

The composition and setting of this community are somewhat different on the lower concave face of the large, cliff-like western outcrop where frequent seepage contributes to locally thick organic turfs. This area also receives less direct sun and has a larger proportion of woody scrub, primarily *Sorbus americana*, *Diervilla lonicera*, and *Physocarpus opulifolius* var. *opulifolius* (ninebark). Although most of the typical species of the community type are present, additional species not found on the drier sites are prominent, including *Angelica triquinata* (filmy angelica), *Oclemena acuminata* (= *Aster acuminatus*, whorled aster), *Gymnocarpium appalachianum* (Appalachian oak fern), *Huperzia appalachiana* (Appalachian fir-clubmoss), and *Trisetum spicatum* (narrow false oats). The brilliant yellow lichen *Chrysothryx chlorina* is also abundant on the moist, sheltered, vertical rock faces. Quantitative plot data were collected from this variant in 1990 (plot SHNP003)

Most of this site is covered by Central Appalachian Northern Hardwood Forest (Yellow Birch – Northern Red Oak Type) that occupies well-weathered bouldery colluvium between the three massive exposed outcrops. This forest is part of a larger stand, extending well outside the ROMP site boundary and considered one of the finest occurrences of the type. This forest is subject to frequent natural disturbances of ice and wind damage. Many of its dominant trees are somewhat gnarled and short statured, but have relatively large diameters, suggesting that they may be quite old. The possibility that this is an old-growth stand needs further investigation, but is plausible since few of these trees would ever have been commercially viable. The overstory dominant of this forest is *Betula alleghaniensis*, with *Quercus rubra* (northern red oak) frequently co-dominant. Minor overstory associates include *Fraxinus americana* (white ash), *Tilia americana* (American basswood), *Betula lenta* (sweet birch), *Acer saccharum* (sugar maple), *Prunus serotina* (black cherry), and *Acer rubrum* (red maple). Characteristic small trees and shrubs include *Acer spicatum* (mountain maple) *Acer pensylvanicum* (striped maple), *Ilex montana* (mountain holly), *Sambucus racemosa* ssp. *pubens* (red elderberry), *Hamamelis virginiana* (witch-hazel), *Ribes rotundifolium* (Appalachian gooseberry), and *Ostrya virginiana* (eastern hophornbeam). The herb layer is often sparse (in very rocky areas), but varies to quite lush in areas with some soil accumulation.

Characteristic herbs include *Angelica triquinata* (filmy angelica), *Aralia nudicaulis* (wild sarsaparilla), *Oclemena acuminata* (whorled aster), *Clintonia borealis* (bluebead lily), *Carex aestivalis* (summer sedge), *Maianthemum canadense* (Canada mayflower), *Dryopteris marginalis* (marginal woodfern), *Dryopteris intermedia* (evergreen woodfern), *Impatiens pallida* (yellow jewelweed), *Arisaema triphyllum* (jack-in-the-pulpit), *Polygonatum pubescens* (downy Solomon's-seal), and *Ageratina altissima* (white snakeroot). Bryophtye cover is usually high.

RARE PLANTS: Six rare plants are known for this site: *Abies balsamea*, *Huperzia appalachiana* (Appalachian fir-clubmoss), *Rubus idaeus* ssp. *strigosus* (red raspberry), *Sibbaldiopsis tridentata*, *Solidago randii*, and *Trisetum spicatum*.

The *Abies balsamea* within this site is a small part of a large occurrence covering a broad area of Hawksbill Mountain within and beyond the three Hawksbill Mountain ROMP sites. *Abies balsamea* was observed in two areas within the Hawksbill North Slope Outcrops site. In the southwestern section, four trees were observed along the rocky spine located above the cliff and in a canopy opening above that spine. Three of the four had cones and most had patches of dying needles. The other concentration was located to the east, where 20 –25 small trees grew on the edges of an outcrop.

Approximately 140 clumps of *Huperzia appalachiana* were observed along outcrops, ledges, and cliff bases within this site. Most were mature clumps, although scattered young plants were also present. The clumps were generally healthy and some had sporophylls and/or gemmae. Habitats ranged from deeply shaded, such as the base of north-facing cliffs, to more exposed, such as crevices and small ledges higher up on outcrops. However, even in the more exposed habitats, the colonies were usually sheltered by a higher rock to the south or by shrubs.

The *Rubus idaeus* ssp. *strigosus* within this site is part of a large occurrence that covers a wide area on Hawksbill Mountain within and beyond the boundaries of the Hawksbill ROMP sites. At least one hundred stems, a mix of floricanes and primocanes, were observed throughout the site, extending from the boundary with Hawksbill Summit to the boundary with Hawksbill North Slope Talus. Plants were found on the edges of outcrops, on the edges of open, bouldery areas, and in canopy openings within forested areas. Floricanes were in bud on the survey date.

Sibbaldiopsis tridentata was found at two locations within this site. A newly discovered colony on an outcrop at the eastern end of the site covered 5-10 m^2 (54 -108 ft^2) in 2006. This was a vigorous, healthy colony; plants had fruited by the time of the site visit in late August. A previously known colony to the west covered at least 10 m^2 (108 ft^2) within a 4 x 15 m (13 x 49 ft) area extending across mid to lower outcrop slopes. These plants, many of which flowered in mid-June, were distributed both in patches confined to narrow crevices and in wider mats.

Several hundred clumps of *Solidago randii* were observed within this site. They are part of a larger occurrence on open outcrops and talus at Hawksbill Mountain. Plants were growing on the exposed ledges and crevices of the major outcrops and also on smaller outcrops where the canopy was open. Plants had not yet bolted at the time of a June visit, but most were flowering at the time of late August visits.

The *Trisetum spicatum* population within this site is the only known Virginia occurrence of this grass, which has a mainly circumboreal to arctic-alpine distribution. Approximately 50 clumps were found within a 0.064 ha (0.16 acre) area on the outcrops forming the semicircular amphitheater in the northwestern quadrant of the site. About one-half of the clumps had flowered or fruited by early August. Plants were growing in seasonally damp to wet moss and turfy ledges and crevices on lower cliff faces.

The watchlist fern *Gymnocarpium appalachianum* (Appalachian oak fern) was also found at this site, where it occurs on the lower face of an outcrop at the site's western edge and under canopy cover above that outcrop.

RARE ANIMALS: No new element occurrences were found during surveys in 2006. *Plethodon shenandoah* (Shenandoah salamander) is known from this site. *Plethodon shenandoah*, endemic to SHEN, utilizes forested talus slopes and is known from only five locations. This occurrence enters the northern edge of the ROMP site (Pague, 1991; Sanders, 2005; USFWS, 1994).

Plate 57. DCR-DNH ecologist Kristin Taverna conducting vegetation sampling on one of several plunging, spine-like metabasalt outcrops on Hawksbill north face.

THREATS: Because of its very rugged topography, this site receives little visitation and no impacts on the significant natural communities were noted during two visits in 2006. However, while conducting geologic surveys during the winter of 2006, Eric Butler documented deep linear scratches in one of the upper outcrops that appeared to be from an ice climber's crampons. He also found footprints nearby and encountered a visitor who was scouting the area for ice climbing sites. The impact of this activity on natural heritage resources is not clear, but could be permanently destructive to rock-face lichens and vegetation. In addition, scars in the rock surface like the ones observed are conspicuous and cannot be remediated.

The only exotic weed noted at this site was *Poa compressa* (flat-stemmed bluegrass) which is present in low numbers in a few patches of the High-Elevation Greenstone Barren, including in close proximity to a few

clumps of the rare plant *Trisetum spicatum* on a ledge at the very base of the cliff. At present, this species does not appear to be a threat to this community or its constituent rare plants.

Until recently, the primary threat to *Plethodon shenandoah* was thought to be inter-specific competition with *Plethodon cinereus* (red-backed salamander). In general terms, in the drier conditions typically found in talus, *Plethodon shenandoah* can compete with *Plethodon cinereus* (Thurow, 1976; Jaeger, 1974); however, it is believed that alterations in climatic conditions may tip the balance to favor *Plethodon cinereus*. In addition, natural succession of the talus, through weathering and soil formation, would also favor *Plethodon cinereus* (Jaeger, 1970). Recent thought is that there are also human-related factors that may adversely impact the rare species. These include acid deposition in the atmosphere and forest defoliation associated with introduced pest species. Further, there may be impacts from activities such as trail building and maintenance and camping that adversely impact *Plethodon shenandoah* either directly or by enabling *Plethodon cinereus* to out compete it (U.S. Fish and Wildlife Service, 1994).

MANAGEMENT RECOMMENDATIONS: This is a spectacular and important site that, because of its ruggedness, has almost entirely escaped from visitor impacts. Supporting a narrowly endemic and Federally Listed salamander, some of the best examples in the world of the High-Elevation Greenstone Barren community, and a host of northern and boreal plant disjuncts, the Hawksbill North Slope is unquestionably one of the most significant high-elevation sites in the Central Appalachians. Although it may appear to require little, if any, attention from resource managers, Eric Butler's experience with the ice climber is a reminder that even remote and rugged sites like this one are vulnerable to some types of disturbance. Management recommendations for the Hawksbill North Slope Outcrops focus on maintaining the pristine condition of habitats and vegetation by keeping disturbance impacts at a negligible level.

Prohibit rock climbing, ice climbing, and camping at this site.

Visit this site on a 1-3 year interval to assess the rare plants and rare natural communities, conduct a survey and assessment of invasive plants, and monitor signs of visitor use and impacts.

Further inventories to determine the status of *Plethodon shenandoah* population at this site should be conducted. Long-term monitoring of this species is also recommended. Trail maintenance, camping, and fire management (fire break construction or fire suppression) should all be carefully considered in areas occupied by *Plethodon shenandoah*. Any compaction of soil, increase in barriers within the habitat (e.g., a trail that might preclude salamanders from crossing), or activities that would increase soil moisture should be avoided.

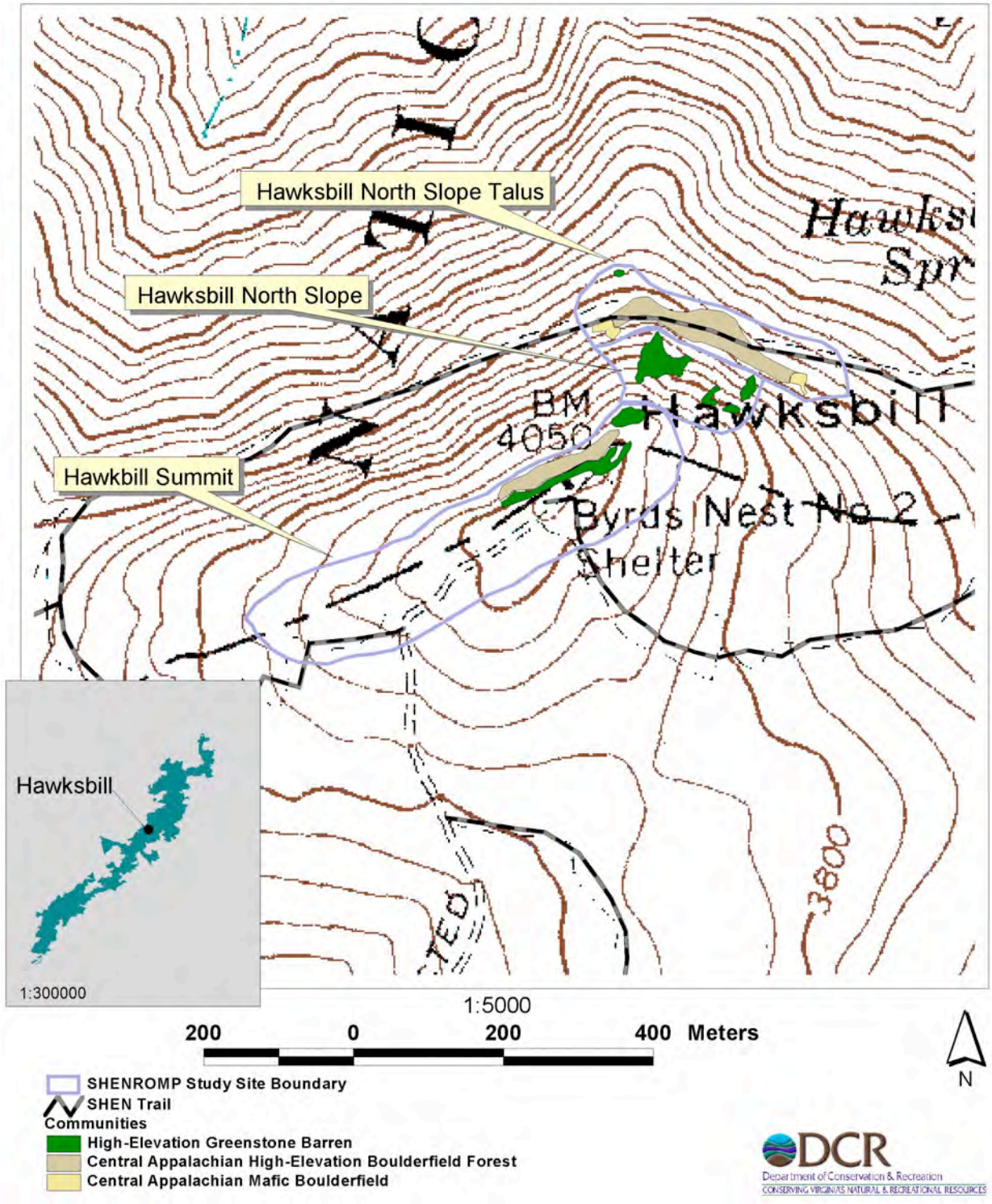


Fig. 106. Location of significant natural community at Hawksbill North Slope Outcrops.

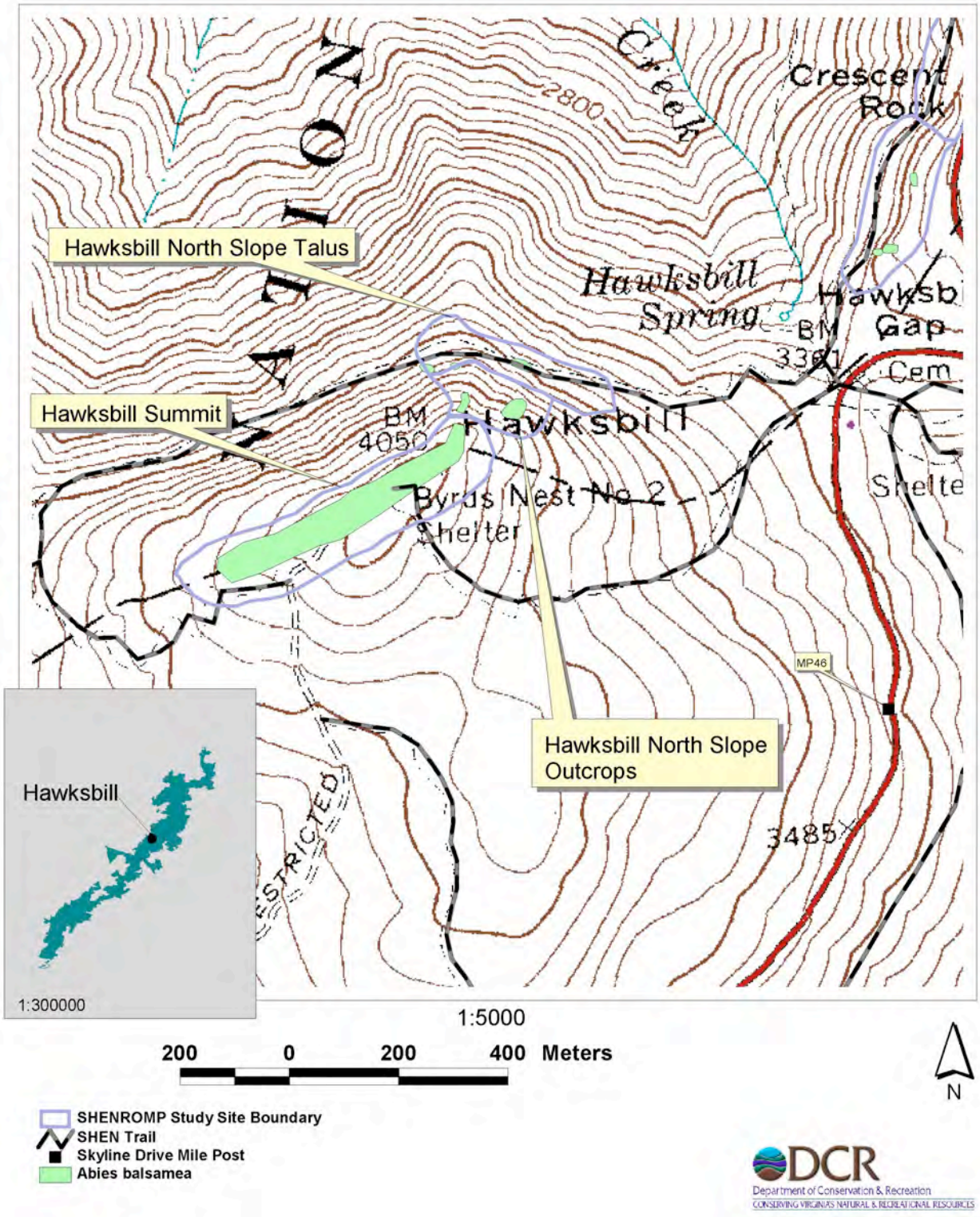


Fig. 107. Location of *Abies balsamea* at Hawksbill North Slope Outcrops.

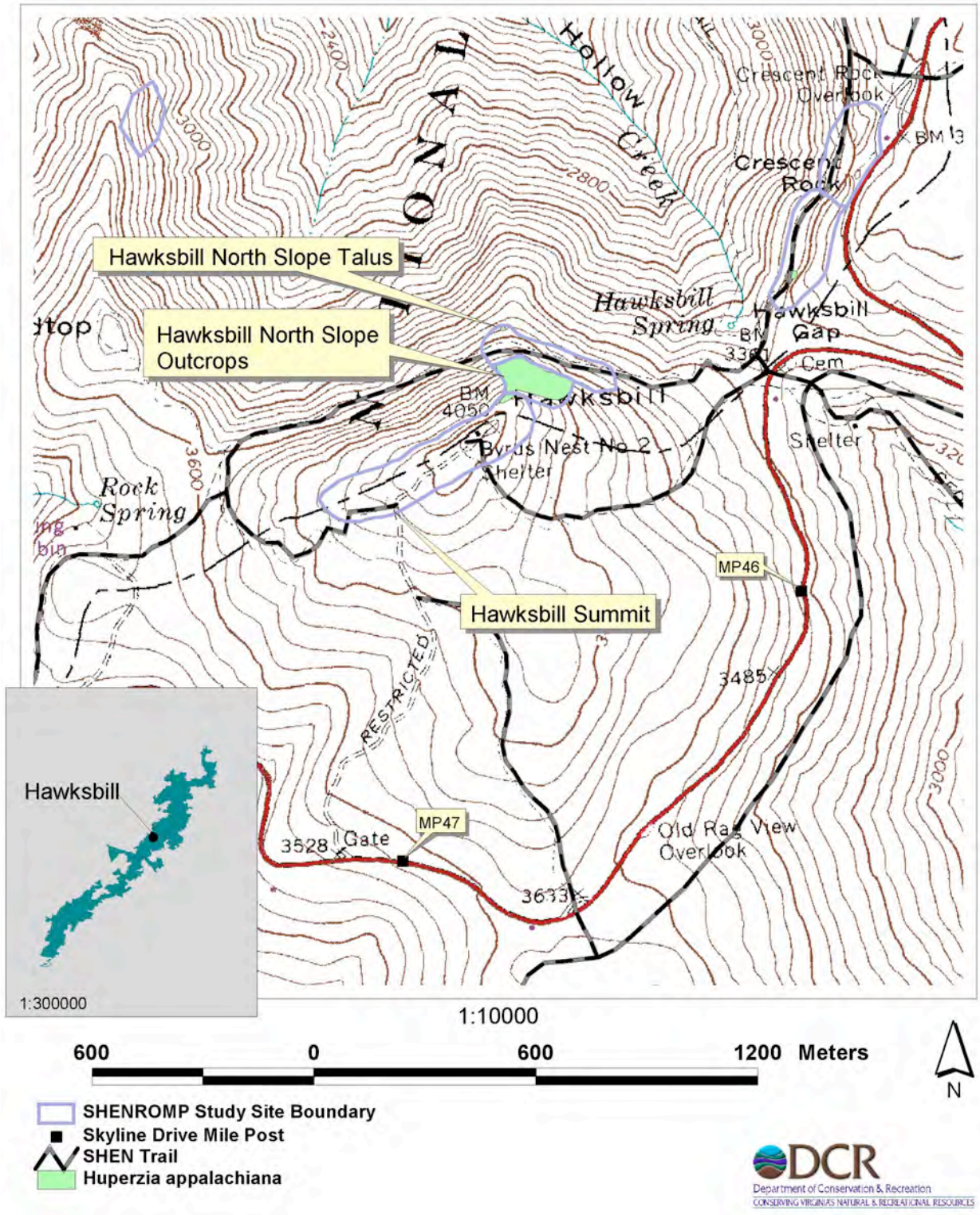


Fig. 108. Location of *Huperzia appalachiana* at Hawksbill North Slope Outcrops.

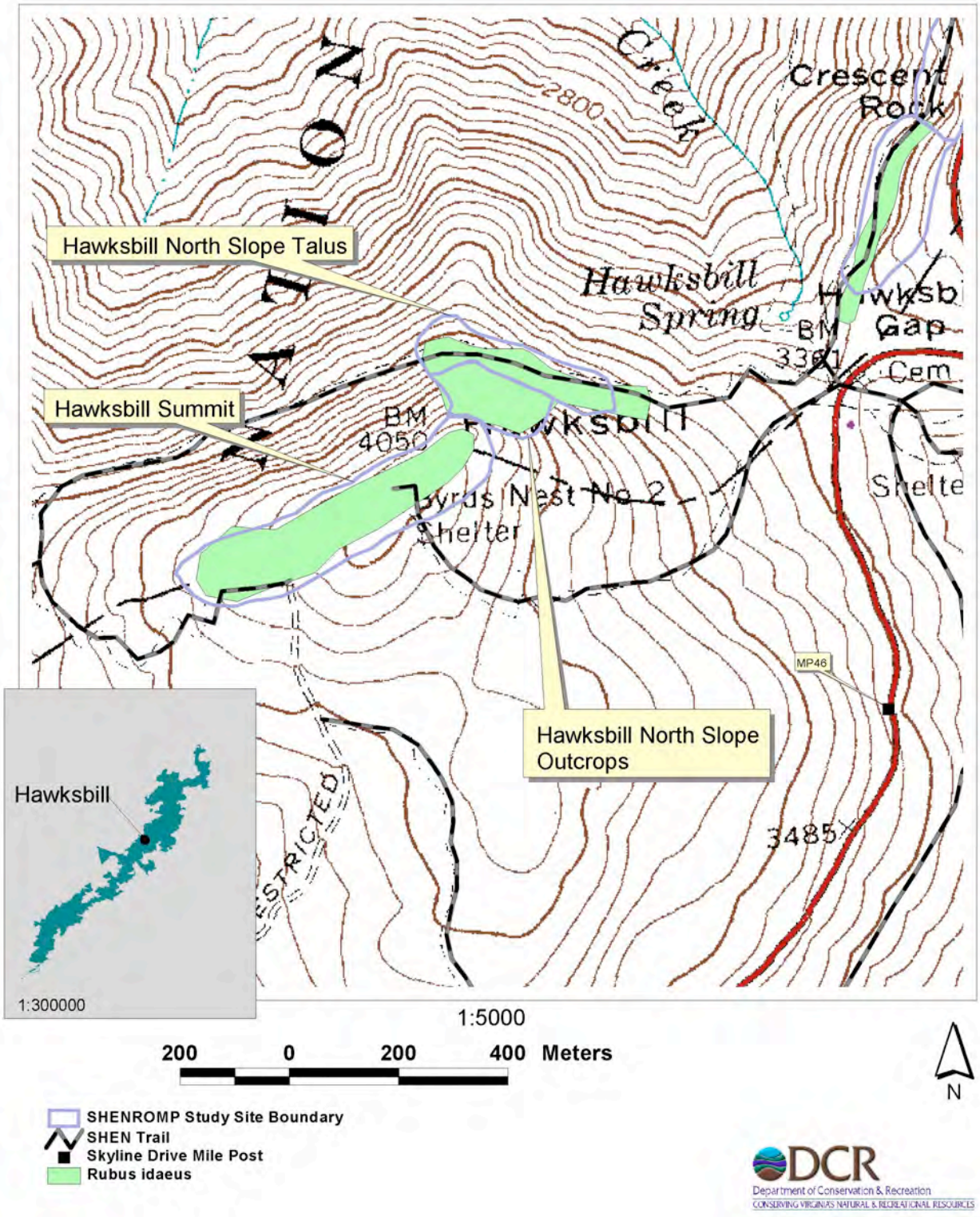


Fig. 109. Location of *Rubus idaeus* ssp. *strigosus* at Hawksbill North Slope Outcrops.

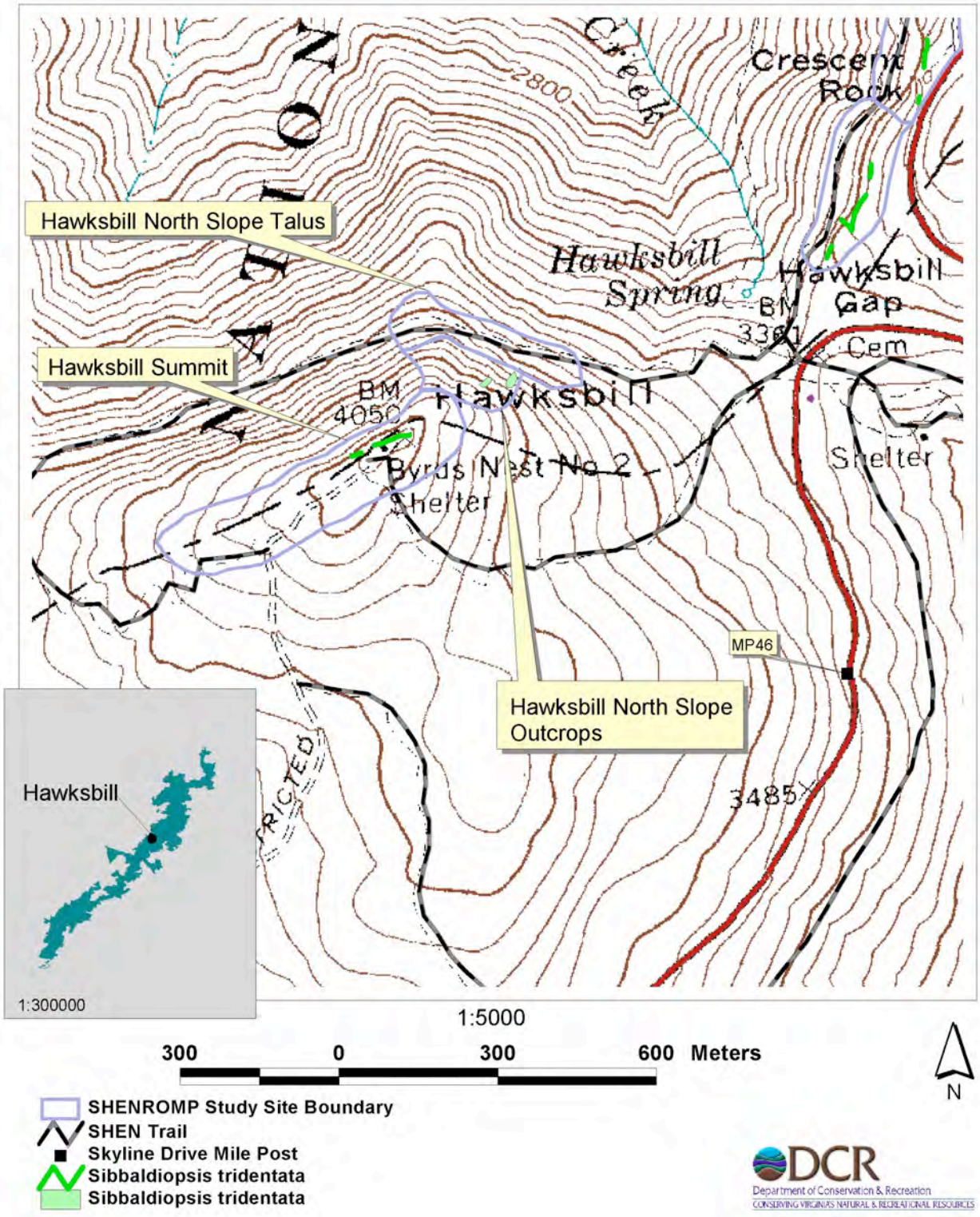


Fig. 110. Location of *Sibbaldiopsis tridentata* at Hawksbill North Slope Outcrops.

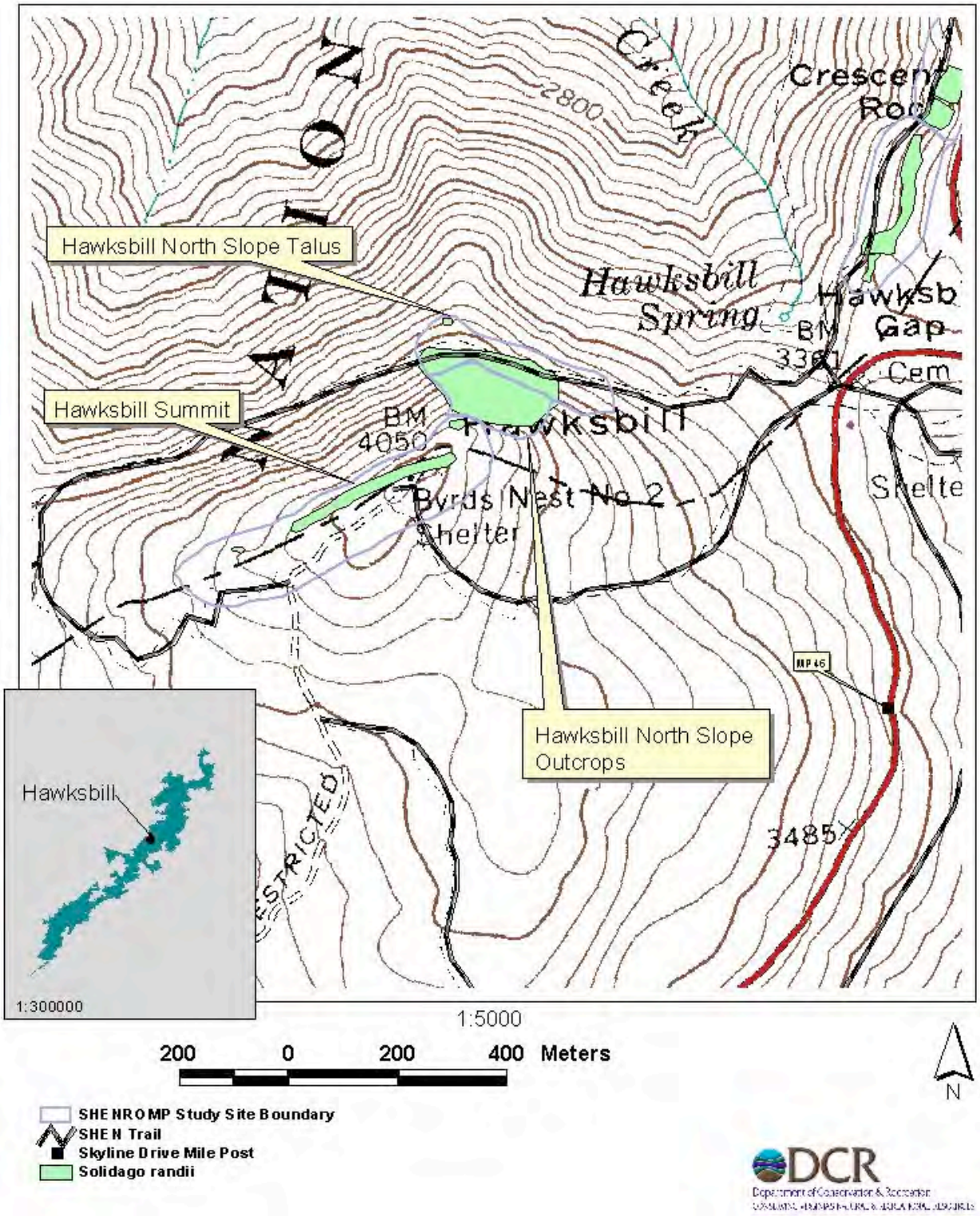


Fig. 111. Location of *Solidago randii* at Hawksbill North Slope Outcrops.

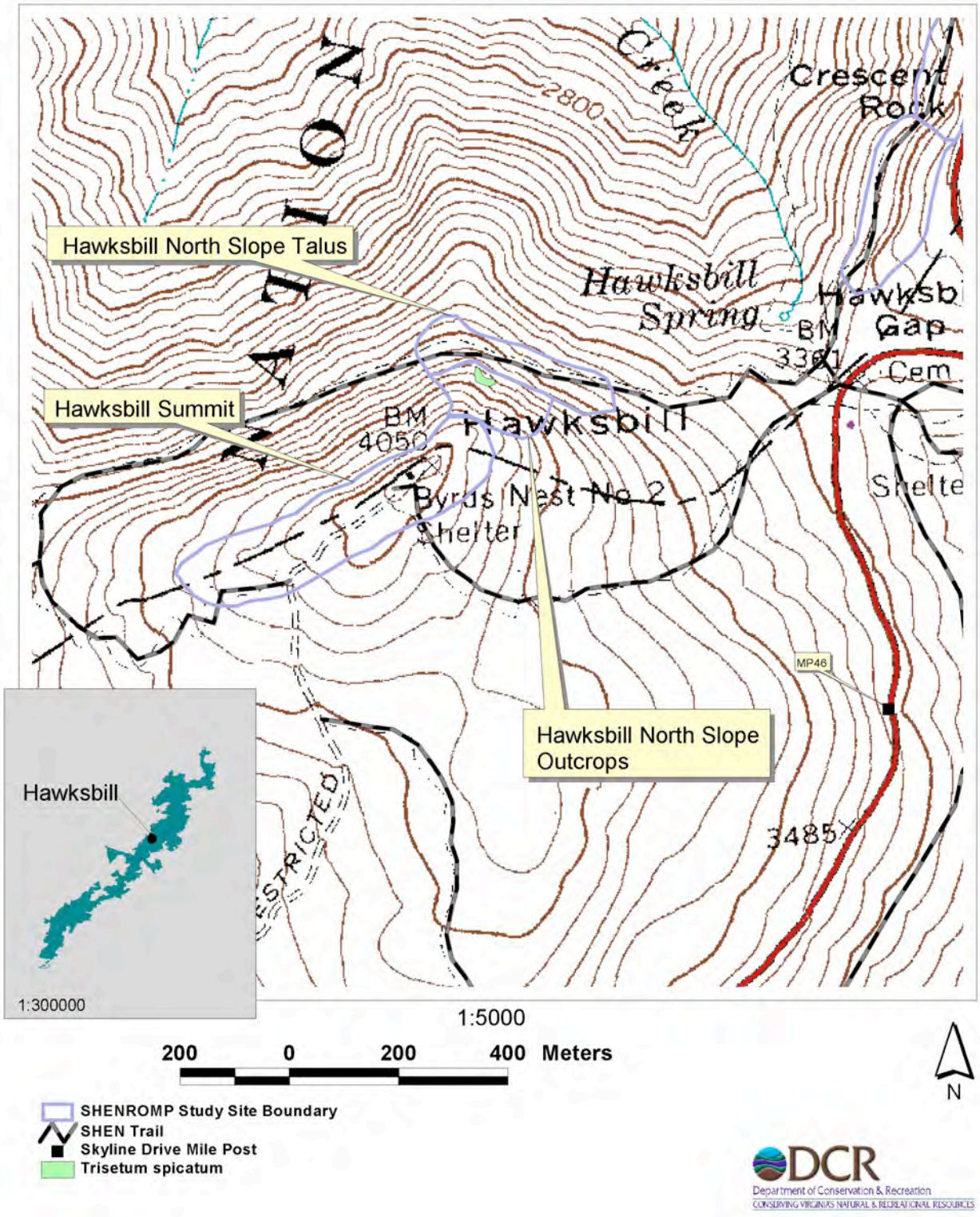


Fig. 112. Location of *Trisetum spicatum* at Hawksbill North Slope Outcrops.

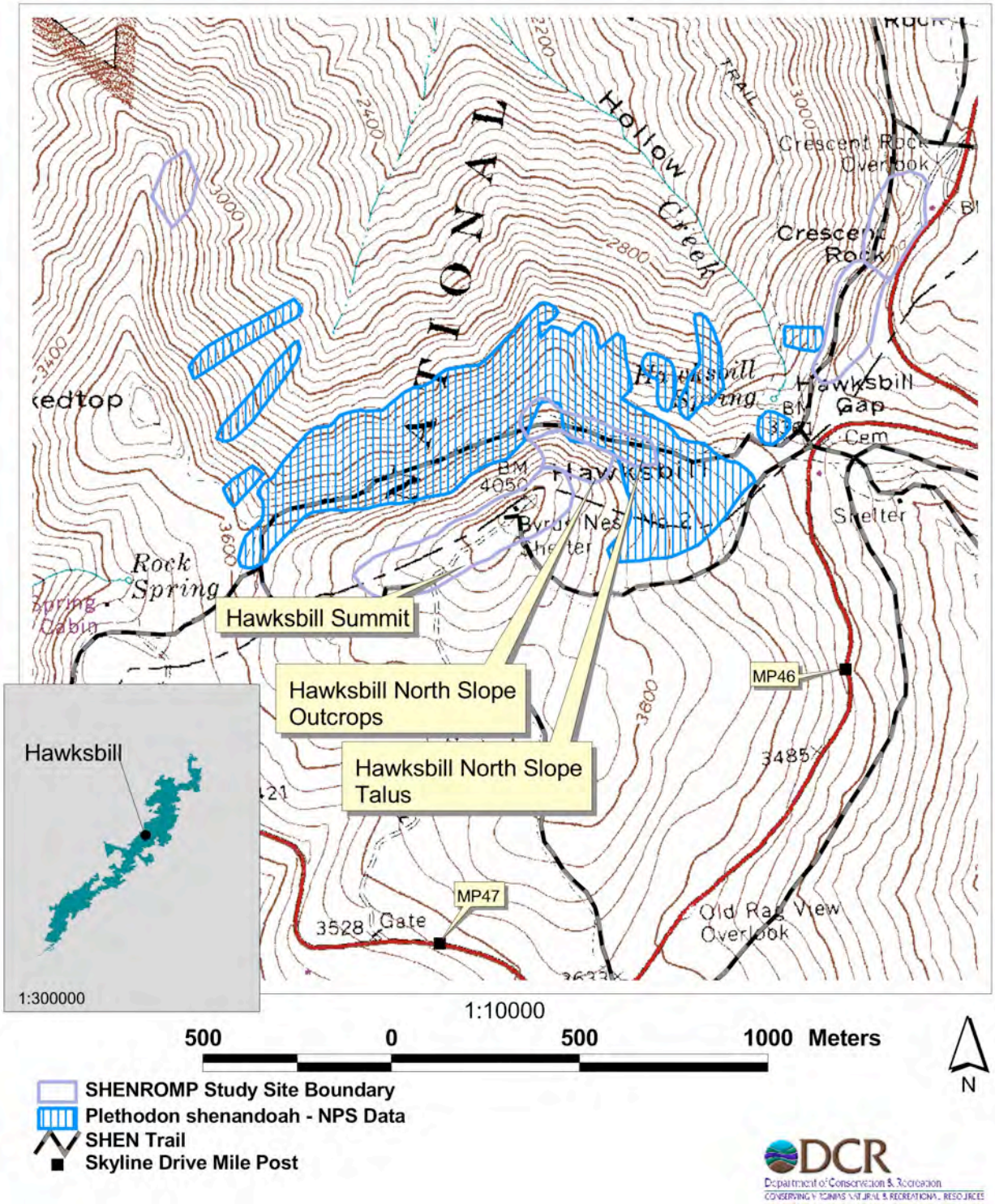


Fig. 113. Locaton of *Plethodon shenandoah* at Hawksbill North Slope Outcrops.

HAWKSBILL NORTH SLOPE TALUS (C60)

CONSERVATION SITE: Hawksbill Mountain-Crescent Rock (B1) **THREAT RANK:** 1

LOCALITY: Page County **QUADRANGLE(S):** Big Meadows

LOCATION: This Central District site extends from 0.37-0.80 km (0.23-0.50 mi) west of Hawksbill Gap on Skyline Drive. It is located immediately north of the Hawksbill North Slope Outcrops site.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula alleghaniensis / *Sorbus americana* - *Acer spicatum* / *Polypodium appalachianum* Forest[1]	Central Appalachian High-Elevation Boulderfield Forest	G2	S2	None	None	A
Diervilla lonicera - *Solidago randii* - *Deschampsia flexuosa* - *Hylotelephium telephioides* - *Saxifraga michauxii* Herbaceous Vegetation[2]	High-Elevation Greenstone Barren	G1	S1	None	None	A
Lasallia papulosa - *Stereocaulon glaucescens* – *Chrysothryx chlorina* Nonvascular Vegetation	Central Appalachian Mafic Boulderfield	G2?	S2?	None	None	A
Plants:						
Abies balsamea[3]	Balsam fir	G5	S1	None	None	C
Huperzia appalachiana[2]	Appalachian fir-clubmoss	G4G5	S2	None	None	AB
Rubus idaeus ssp. *strigosus*[3]	Red raspberry	G5T5	S2	None	None	A
Solidago randii[2]	Rand's goldenrod	G5T4	S2S3	None	None	A
Lichens:						
Cladonia coccifera	a lichen	G5	S1?	None	None	E
Parmelia omphalodes	a lichen	G2G4	S2?	None	None	E
Porpidia lowiana	a lichen	G2G3	S1	None	None	E
Porpidia tuberculosa	a lichen	G2G4	S1	None	None	E
Animals:						
Plethodon shenandoah[4,6]	Shenandoah salamander	G1	S1	LE	LE	A
Sphaeroderus schaumii[5,6]	Schaum's ground beetle	G4	S2	None	None	E

[1]Part of this element occurrence (eo) lies within the Hawksbill Summit ROMP site.
[2]Parts of this eo lie within the Hawksbill North Slope Outcrops and Hawksbill Summit ROMP sites.
[3]Parts of this eo lie within the Hawksbill North Slope Outcrops and Hawksbill Summit ROMP sites and part lies outside of any ROMP site.
[4]Part of this eo lies within the Hawksbill North Slope Outcrops ROMP site and part lies outside of any ROMP site.
[5]Parts of this eo lie within the Crescent Rock (CR) Overlook and CR South ROMP sites and part lies outside of any ROMP site.
[6]Based on a previously documented record (DCR-DNH Biotics data). This eo has not been updated by DCR-DNH for this report.

SITE DESCRIPTION: This site is characterized by steep, extensive deposits of large-block talus weathered from cliffs of Catoctin Formation metabasalt on the north flank of Hawksbill. Although some areas of small, rather unstable scree are present, much of the talus is relatively stable and is open to sparsely shaded by stunted trees. This site is located at a fairly high elevation (about 1,061-1128 m [3480-3700 ft]) and has a north-northwest aspect. It is frequently buffeted by strong winter winds, low temperatures, and ice. This boulderfield and others in SHEN may be the products of periglacial processes active during the last (Wisconsin) glaciation, when extreme climatic conditions probably accelerated physical weathering of the rocks. Most metabasalt boulderfields in the park are now well weathered and invaded by trees. However, near the highest elevations, more or less open boulderfields have persisted locally, perhaps due to microclimatic influences and/or the physical character of the metabasalt beds in these locations.

Immediately upslope of the boulderfield deposits are massive metabasalt cliffs and outcrops, as well as some bouldery forested slopes. Downslope, the open and sparsely wooded boulderfield grades fairly abruptly into more heavily forested slopes covered by weathered bouldery colluvium. The Appalachian Trail runs along the lower edge of the main boulderfields, providing ready access. However, due to the rough nature of the terrain, it appears that few hikers leave the trail in this area.

NATURAL COMMUNITIES: Open, lichen-dominated vegetation belonging to the Central Appalachian Mafic Boulderfield community occupies deeply piled metabasalt boulder talus, covering at least 0.2 ha (0.5 ac) in three patches. Dominant and/or characteristic lichen species include *Stereocaulon glaucescens*, *Lasallia papulosa*, *Umbilicaria muehlenbergii*, *Chrysothryx chlorina*, *Parmelia sulcata*, *Flavoparmelia baltimorensis*, *Ramalina intermedia*, and *Usnea halei*. Many crustose species occur, including *Aspicilia cinerea*, *Fuscidia rescensa*, *Lepraria* spp., *Porpidia* spp., *Psilolechia lucida*, *Rhizocarpon rubescens*, and *Trapeliopsis granulosa*. Flat surfaces and interstices that have thin deposits of organic matter often support a variety of fruticose lichens, including *Cladonia rangiferina*, *Cladonia stellaris*, *Cladonia subtenuis*, *Cladonia crispata*, *Cladonia furcata*, *Cladonia macilenta*, *Cladonia pleurota*, and *Cladonia squamosa*. A number of characteristic arctic-boreal lichens occur at this high-elevation site, including *Cladonia coccifera*, *Microcalicium arenarium*, *Parmelia omphalodes*, *Porpidia lowiana*, and *Porpidia tuberculosa*. Occasional patches of *Polypoodium appalachianum* (Appalachian rock polypody), *Hylotelephium telephioides* (Allegheny stonecrop), and other vascular lithophytes are present near the edges of the habitat. The condition of this community is pristine, except that one of the patches is slightly fragmented by the Appalachian Trail. Fully open, nonvascular metabasalt (and similar mafic) boulderfields are extremely rare in the mid-Atlantic region.

The open boulderfields occur within a matrix of Central Appalachian High-Elevation Boulderfield Forest covering approximately 0.8 ha (2.0 ac) in aggregate. This community is a stunted, gnarled forest or woodland with trees less than 10 m (33 ft) tall. The dominant overstory species are *Betula alleghaniensis* (yellow birch) and *Sorbus americana* (American mountain-ash). The understory varies from quite open to dense, with thicket-like growths of *Acer spicatum* (mountain maple), *Acer pensylvanicum* (striped maple), *Prunus pensylvanica* (pin cherry), *Rubus idaeus* ssp. *strigosus* (red raspberry), *Menziesia pilosa* (minnie-bush), and other shrubs. The herb layer is variable with species distributions and abundances controlled by microhabitat conditions. *Polypodium appalachianum*, *Hylotelephium telephioides*, *Carex brunnescens* ssp. *sphaerostachya* (brownish sedge), and *Heuchera pubescens* (marbled alum-root) are particularly characteristic species. Quantitative plot data were collected from this occurrence in 1999 (plot SHNP032).

At the east, west, and north edges of the site, the boulderfield woodland grades into Central Appalachian Northern Hardwood Forest (Yellow Birch - Northern Red Oak Type), which occupies an extensive area on the north flank of the Hawksbill Mountain - Crescent Rock area. This stand is one of the largest and finest known occurrences of this community type, and is subject to frequent natural disturbances of ice

and wind damage. Many trees are somewhat gnarled and short statured, but have relatively large diameters, suggesting that they may be quite old. The possibility that this is an old-growth stand needs further investigation, but is plausible since few of these trees would ever have been commercially viable. The overstory dominant of this forest is *Betula alleghaniensis*, with *Quercus rubra* (northern red oak) frequently co-dominant. Minor overstory associates include *Fraxinus americana* (white ash), *Tilia americana* (American basswood), *Betula lenta* (sweet birch), *Acer saccharum* (sugar maple), *Prunus serotina* (black cherry), and *Acer rubrum* (red maple). Characteristic small trees and shrubs include *Acer spicatum*, *Acer pensylvanicum*, *Ilex montana* (mountain holly), *Sambucus racemosa* ssp. *pubens* (red elderberry), *Hamamelis virginiana*, *Ribes rotundifolium* (Appalachian gooseberry), and *Ostrya virginiana* (eastern hophornbeam). The herb layer is often sparse (in very rocky areas), but varies to quite lush in areas with some soil accumulation. Characteristic herbs include *Angelica triquinata* (filmy angelica), *Aralia nudicaulis* (wild sarsaparilla), *Oclemena acuminata* (whorled aster), *Clintonia borealis* (bluebead lily), *Carex aestivalis* (summer sedge), *Maianthemum canadense* (Canada mayflower), *Dryopteris marginalis* (marginal woodfern), *Dryopteris intermedia* (evergreen woodfern), *Impatiens pallida* (yellow jewelweed), *Arisaema triphyllum* (jack-in-the-pulpit), *Polygonatum pubescens* (downy Solomon's-seal), and *Ageratina altissima* (white snakeroot). Bryophtye cover is usually high.

A small, exposed cliff at the northwest edge of the site, below the Appalachian Trail, harbors a small occurrence of the globally rare High-Elevation Greenstone Barren community, which is endemic to the Park. The cliff is rather abrupt and lacks a well developed summit ledge. Most of the barren is situated on the very steeply sloping face of the cliff and covers approximately 200 m^2. This stand contains most of the characteristic species of the community, including *Solidago randii* (Rand's goldenrod), *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Diervilla lonicera* (northern bush-honeysuckle), *Hylotelephium telephioides* (Allegheny stonecrop), and *Saxifraga michauxii* (Michaux's saxifrage).

RARE PLANTS: Four rare plants are known for this site: *Abies balsamea* (balsam fir), *Huperzia appalachiana* (Appalachian fir-clubmoss), *Rubus idaeus* ssp. *strigosus*, and *Solidago randii*.

The *Abies balsamea* within this site is part of a large occurrence extending over a wide area on Hawksbill Mountain. Within this site, *Abies balsamea* was observed in three scattered groupings, each with one or two young or stunted trees. Two trees less than 2 m (7 ft) tall were located immediately upslope from the Appalachian Trail in the center of the site, and one tree less than 1 m (3 ft) tall was found on the edge of an open talus slope at the boundary with the North Slope Outcrop site. The remaining two trees were found in the forest at the western edge of the site. One mature tree about 5 m (16 ft) tall with cones and one tree 1 m (3 ft) tall were found here, separated by 20 meters (65 ft). Due to the shady habitat in which they grow, these two trees had few needles on their lower branches, but upper branches appeared healthy.

A few healthy clumps of *Huperzia appalachiana* were observed on semi-exposed shelves of the small High-Elevation Barren Community at the northwestern edge of the site downslope from the Appalachian Trail.

The *Rubus idaeus* ssp. *strigosus* within this site is part of a large occurrence spreading over a wide area on Hawksbill Mountain. Several hundred stems, a mix of floricanes and primocanes, were observed along the open to partially shaded edges of the talus slopes, along the Appalachian Trail, and under forest cover. Older stems were in bud or flower on the survey date. The population area extends the full east-west width of the site and continues beyond it. Although some stems were found downslope from the Appalachian Trail, most occur upslope from the trail to the boundary with the Hawksbill North Slope Outcrops site.

The *Solidago randii* population within this site is part of a large occurrence associated with rock outcrops on Hawksbill Mountain. Within the talus slope site, hundreds of individuals of *Solidago randii* were observed along open-canopy sections of the Appalachian Trail as it passes through the boulderfield communities, on talus extending upslope and downslope from the trail, on the upper open edges of the talus slopes, and on minor outcrops. This population area covers most of the western two-thirds of the site. Most of the plants occur within a few meters upslope or downslope from the Appalachian Trail, with more scattered clusters of plants upslope on the edge of the open talus and minor outcrops. In addition, a small colony of less than 10 clumps was scattered wthin a 10 x 10 m (33 x 33 ft) area on ledges and the sloping cliff face of the High-Elevation Greenstone Barren community on the isolated outcrop in the northwestern edge of the site.

RARE LICHENS: The assemblage of lichens at this site contains four species currently considered rare in Virginia: *Cladonia coccifera*, *Parmelia omphalodes*, *Porpidia lowiana*, and *Porpidia tuberculosa*. All four are boreal species that are disjunct in cold, high-elevation Appalachian habitats.

RARE ANIMALS: No new animal element occurrences were found during surveys in 2006; however, *Plethodon shenandoah* (Shenandoah salamander) is known from this site. The Shenandoah salamander, endemic to SHEN, utilizes forested talus slopes and is known from only five locations. This occurrence covers the entire ROMP site (Pague,1991; Sanders, 2005).

There is a record of *Sphaeroderus schaumii* (Schaum's ground beetle) from this area. The record is based on one specimen from 1991 that was presumably captured in a pitfall trap. The exact location of its collection is not known, but the possible distribution area includes Crescent Rocks Overlook, Crescent Rocks South, and Hawksbill North Slopes Talus as well as non-ROMP site area, primarily east of Skyline Drive.

In addition, one watchlist moth species, *Eulithis molliculata* (dimorphic Eulithis moth) was captured in a UV-trap on 8 August 2006.

Plate 58. Lichen-dominated boulderfield above the Appalachian Trail on the Hawksbill north slope.

THREATS: The Appalachian Trail crosses or borders all three boulderfield patches at the site, greatly increasing the potential for off-trail human disturbances. However, because of the very steep, irregular, and locally unstable substrate, it appears that very few hikers leave the trail in this area. Except for the slight fragmentation introduced by the trail, all three of the significant community occurrences at the site are in pristine condition.

The *Solidago randii* is the only one of the four rare plants at this site to suffer any impacts from human disturbance and this is restricted to rosettes within the Appalachian Trail that have been trampled.

Until recently, the primary threat to *Plethodon shenandoah* was thought to be inter-specific competition with *Plethodon cinereus* (red-backed salamander). In general terms, in the drier conditions typically found in talus, *Plethodon shenandoah* can compete with *Plethodon cinereus* (Thurow, 1976; Jaeger, 1974); however, it is believed that alterations in climatic conditions may tip the balance to favor *Plethodon cinereus*. In addition, natural succession of the talus, through weathering and soil formation, would also favor *Plethodon cinereus* (Jaeger, 1970). Recent thought is that there are also human-related factors that may adversely impact the rare species. These include acid deposition in the atmosphere and forest defoliation associated with introduced pest species. Further, there may be impacts from activities such as trail building and maintenance and camping that adversely impact *Plethodon shenandoah* either directly or by enabling *Plethodon cinereus* to out compete it (U.S. Fish and Wildlife Service, 1994).

Little is known about the life history of *Sphaeroderus schaumii* or its potential threats. Rock climbing or other visitor uses probably have little impact on this species. The primary threat may be the use of pesticides for gypsy moth and other insect control.

MANAGEMENT RECOMMENDATIONS: This site contains probably the finest non-vascular boulderfields on non-siliciclastic rocks in the central Appalachians. It is one of five known sites in the world for both the Central Appalachian Mafic Boulderfield community and Plethodon shenandoah. These elements alone make its protection a very high priority. Currently, there appear to be few problems at this site, but regular, frequent monitoring should be undertaken along the Appalachian Trail to detect changes in visitor uses and impacts.

Inform trail maintenance crews of the presence of rare plant species *Solidago randii* and *Rubus ideaus* along the trail through this site.

Further inventories to determine the status of *Plethodon shenandoah* population at this site should be conducted. Long-term monitoring of this species is also recommended. Trail maintenance, camping, and fire management (fire break construction or fire suppression) should all be carefully considered in areas occupied by *Plethodon shenandoah*. Any compaction of soil, increase in barriers within the habitat (e.g., a trail that might preclude salamanders from crossing), or activities that would increase soil moisture should be avoided.

There are no specific management recommendations regarding rock climbing or other visitor uses for the ground beetle. Further sampling is recommended to determine the species' range within the park. Target specific pesticides should be used for gypsy moth and other insect control.

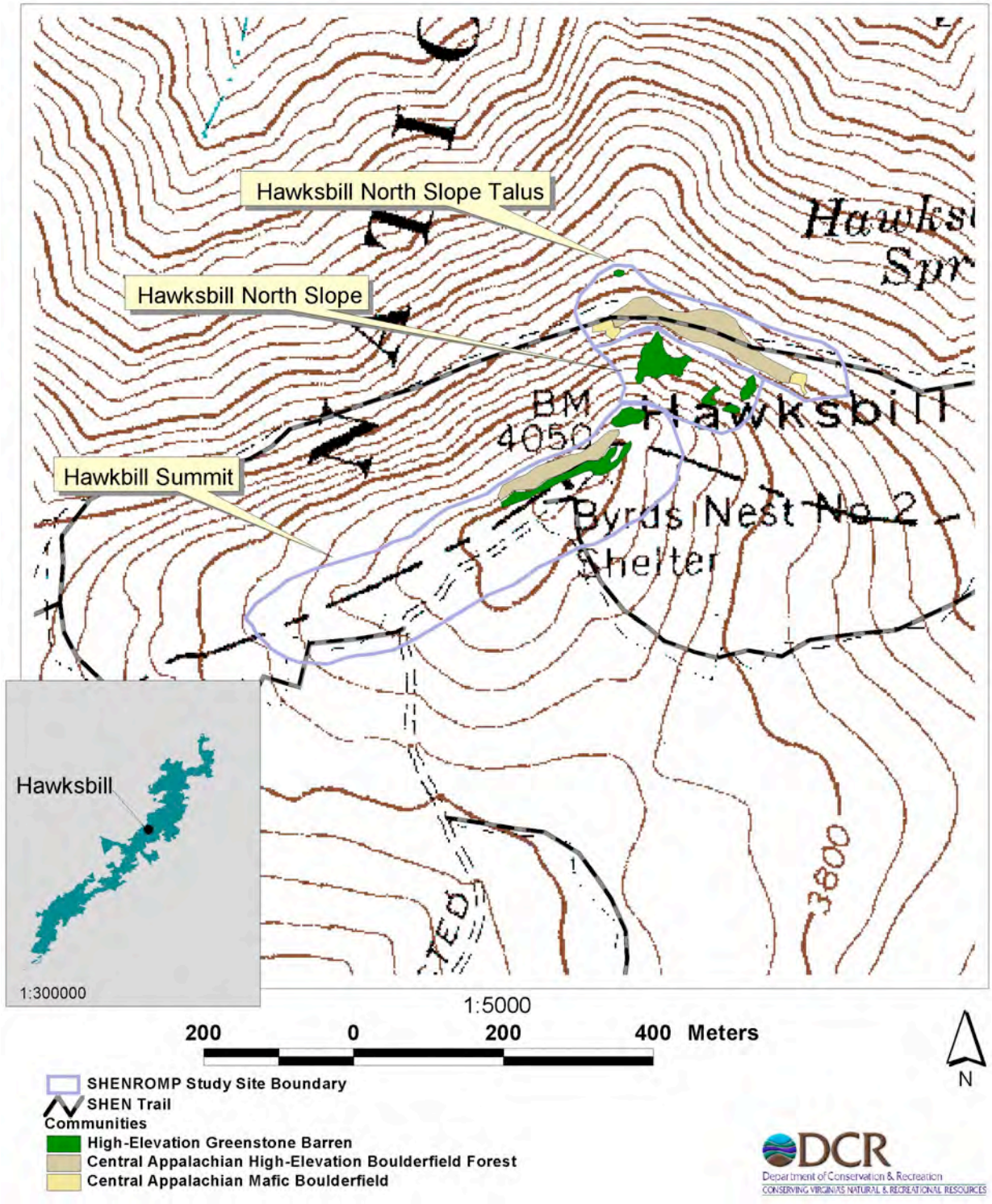


Fig. 114. Location of significant natural communities at Hawksbill North Slope Talus.

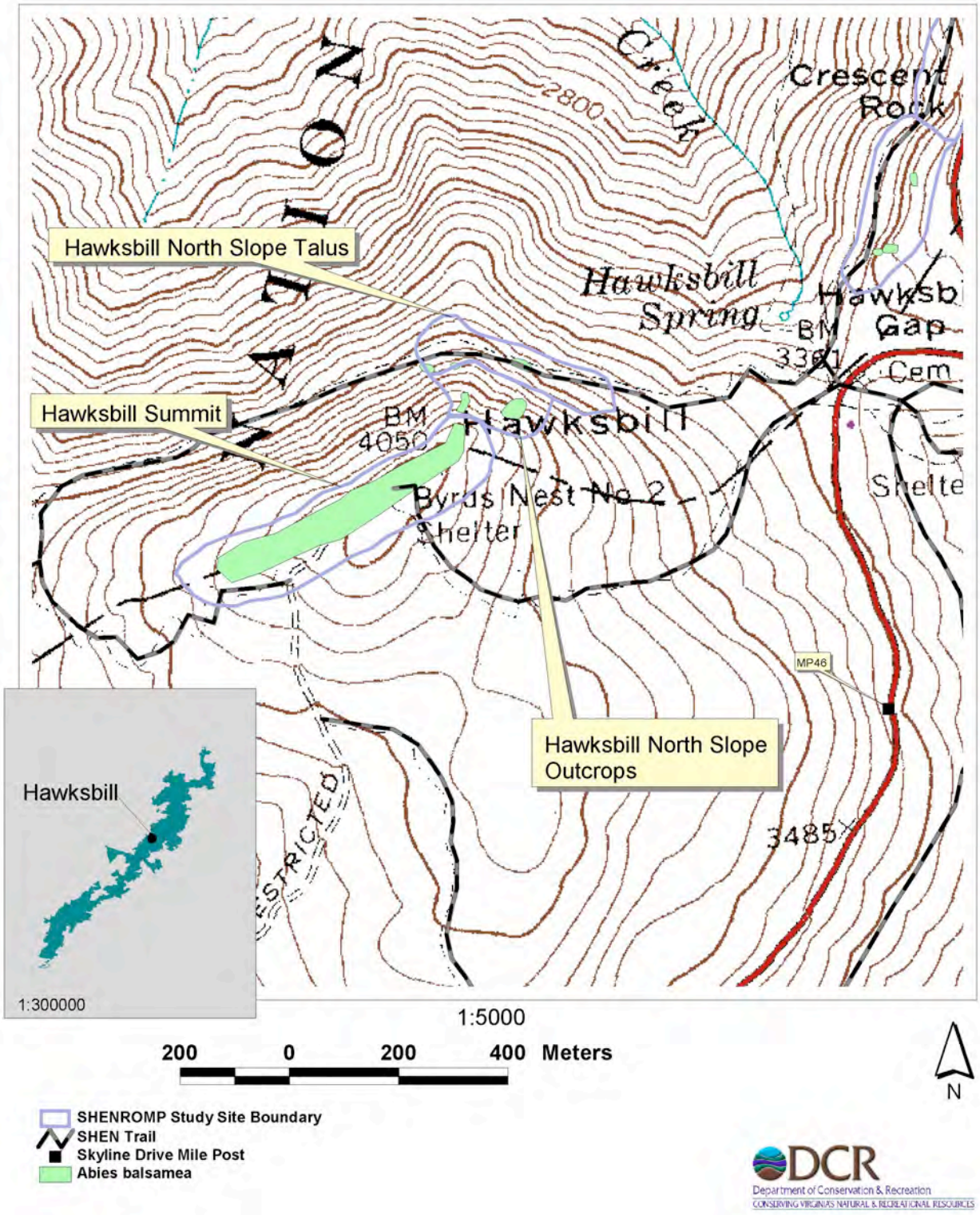


Fig. 115. Location of *Abies balsamea* at Hawksbill North Slope Talus.

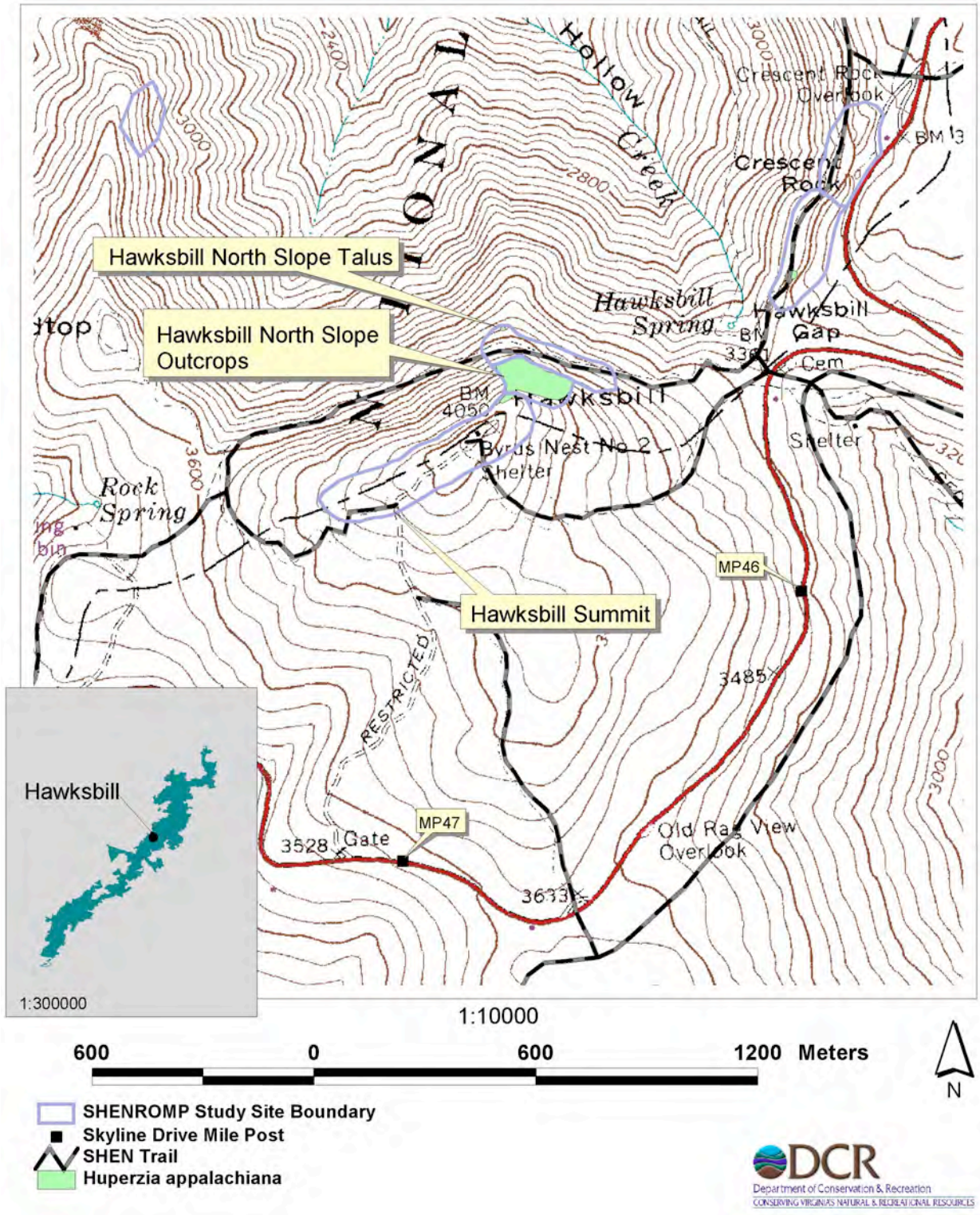


Fig. 116. Location of *Huperzia appalachiana* at Hawksbill North Slope Talus.

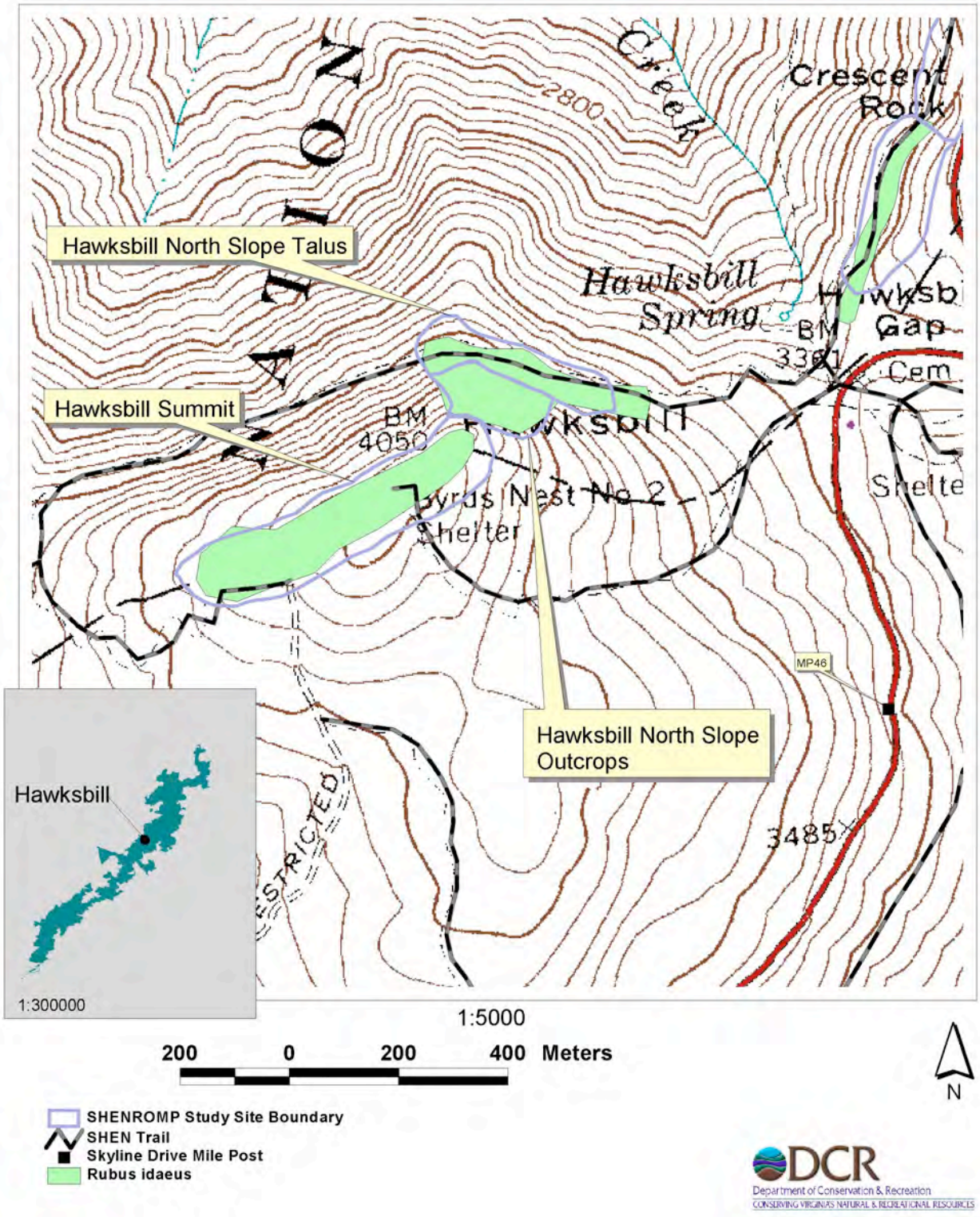


Fig. 117. Location of *Rubus idaeus* ssp *strigosus* at Hawksbill North Slope Talus.

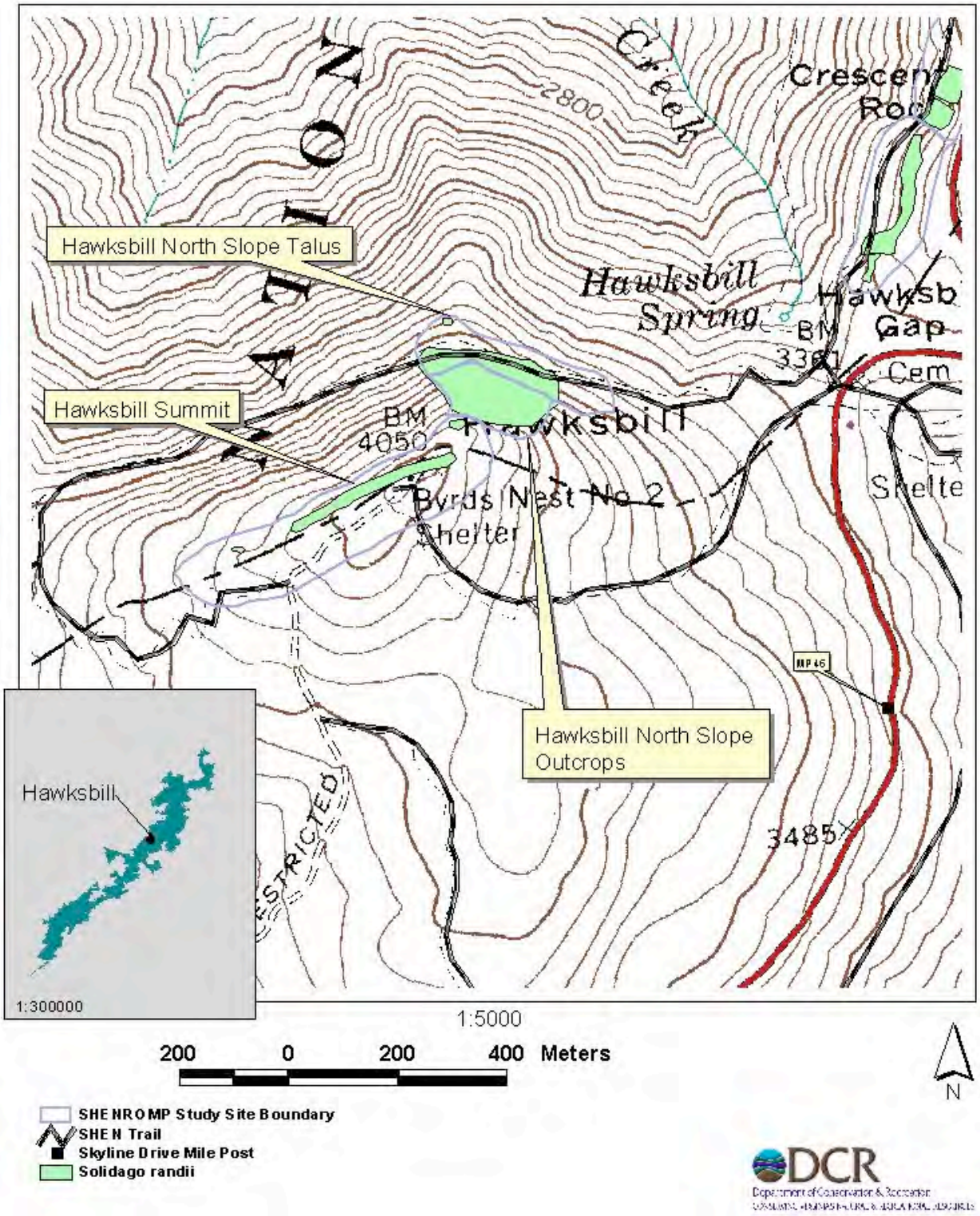


Fig. 118. Location of *Solidago randii* at Hawksbill North Slope Talus.

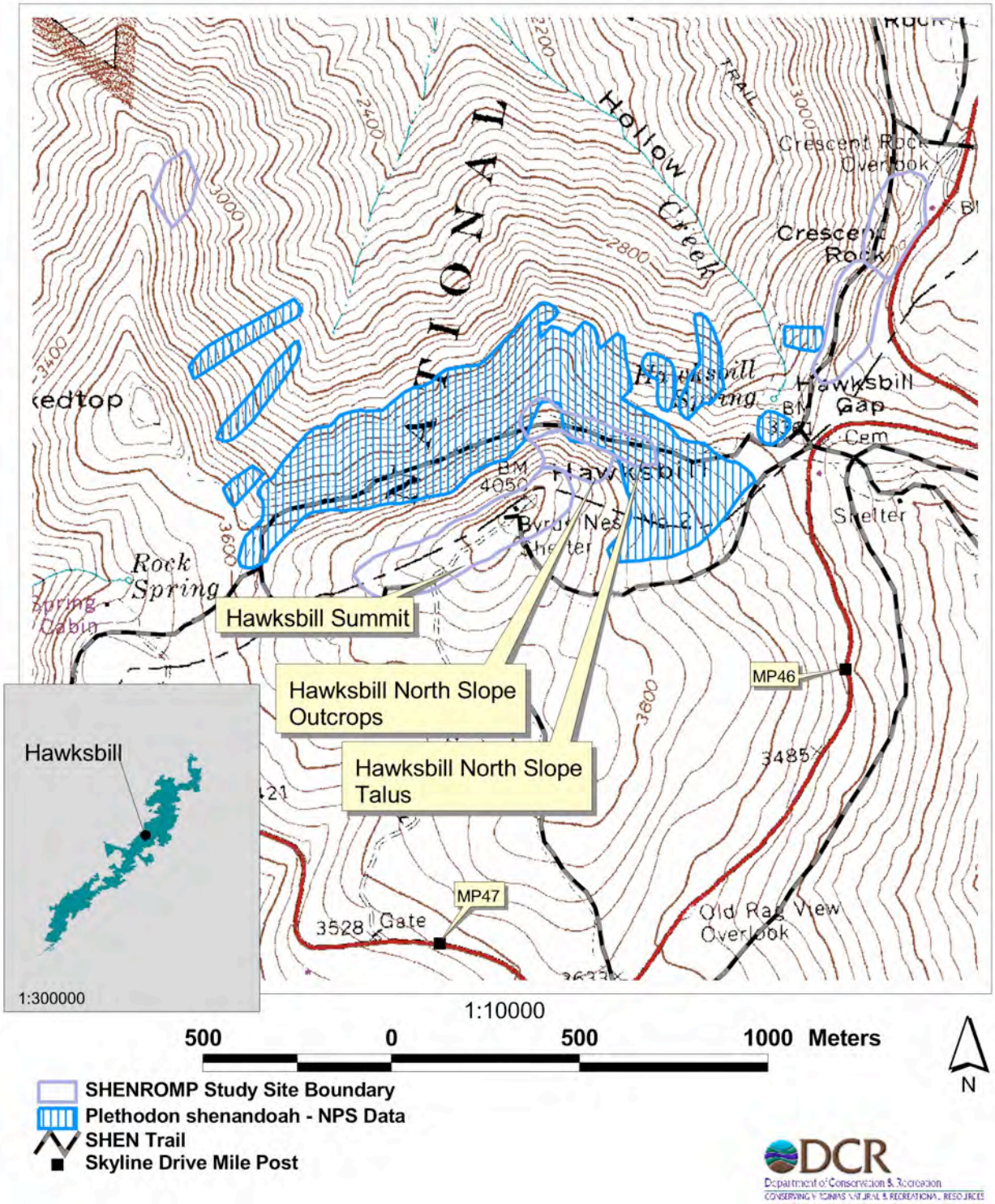


Fig. 119. Location of *Plethodon shenandoah* at Hawksbill North Slope Talus.

HAWKSBILL SUMMIT (C22)

CONSERVATION SITE: Hawksbill Mountain-Crescent Rock (B1) **THREAT RANK:** 4

LOCALITY: Page and Madison Counties **QUADRANGLE(S):** Big Meadows

LOCATION: This Central District site spans the summit area of Hawksbill Mountain and extends from 0.67-1.28 km west of Hawksbill Gap on Skyline Drive and immediately upslope and southwest of the Hawksbill North Slope Outcrops site.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula alleghaniensis / *Sorbus americana - Acer spicatum* / *Polypodium appalachianum* Forest[1]	Central Appalachian High-Elevation Boulderfield Forest	G2	S2	None	None	A
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation[2]	High-Elevation Greenstone Barren	G1	S1	None	None	B
Plants:						
Abies balsamea[3]	Balsam fir	G5	S1	None	None	C
Clematis occidentalis var. occidentalis	Purple clematis	G5T5	S2	None	None	CD
Huperzia appalachiana[2,5]	Appalachian fir-clubmoss	G4G5	S2	None	None	AB
Rubus idaeus ssp. strigosus[3]	Red raspberry	G5T5	S2	None	None	A
Sibbaldiopsis tridentata[4]	Three-toothed cinquefoil	G5	S2	None	None	BC
Solidago randii[2]	Rand's goldenrod	G5T4	S2S3	None	None	A
Animals:						
Falco peregrinus[6]	Peregrine Falcon	G4	S1B S2N	None	LT	E
Troglodytes troglodytes[7]	Winter Wren	G5	S2B S4N	None	SC	E
Semionellus placidus[6]	A millipede	G3	S2	None	None	E

[1]Part of this element occurrence (eo) lies within the Hawksbill North Slope Talus ROMP site.
[2]Parts of this eo lie within the Hawksbill North Slope Outcrops and Hawksbill North Slope Talus ROMP sites.
[3]Parts of this eo lie within the Hawksbill North Slope Outcrops and Hawksbill North Slope Talus ROMP sites and part lies outside of any ROMP site.
[4]Part of this eo lies within the Hawksbill North Slope Outcrops ROMP site.
[5]The portion of the eo included in this site was not found during this project; it was last observed by DCR-DNH in 1990.
[6]Based on previously known record (DCR-DNH Biotics data). This eo has not been updated by DCR-DNH for this report.
[7]Based on a previously known record (DCR-DNH Biotics data). This eo was not confirmed in 2006.

SITE DESCRIPTION: The principal feature of this site is an escarpment of Catoctin Formation metabasalt that runs continuously from just east of the summit of Hawksbill, the highest elevation in SHEN at 1,234 m (4050 ft), for about 400 m (1,312 ft) to the southwest. The cliffs have a north-

northwest aspect and are frequently buffeted by strong winter winds, low temperatures, and ice. The tops of the cliffs have numerous ledges and shelves, several of which are open. At the foot of the cliffs is a steep, forested slope covered by talus deposits. On the forested ridge crest just southeast of the cliffs, topography is gentle. An additional open outcrop ledge and small cliff is located about 24 m (80 ft) in elevation below the main line of cliffs at the east end of the site.

The Hawksbill summit area is the destination point for several trails and fire roads that lead to a viewing platform and to the old Byrds Nest No. 2 shelter. Critical habitats in this site are all easily accessed either by trails that pass over them, or by short off-trail jaunts.

NATURAL COMMUNITIES: The escarpment of outcrops at this site occurs in a matrix of deciduous forests and woodlands. The relatively gentle topography of this summit ridge and its upper southeast slope is occupied by Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type), while a band of Central Appalachian High-Elevation Boulderfield Forest occupies the talus deposits at the foot of the cliffs on the upper northwest slope of the ridge.

The globally rare (G1) High-Elevation Greenstone Barren, which is endemic to several high-elevation sites in Shenandoah National Park, occupies most of the open escarpment ledges, covering about 0.3 ha (0.75 ac) in two major patches separated by 24 m (80 ft) in elevation. Its vegetation consists of patchy scrub thickets interspersed with large open rock surfaces with herbaceous species rooted in crevices and on mats of thin, organic-rich soil. Characteristic woody species at this site include *Sorbus americana* (American mountain-ash), *Betula alleghaniensis* (yellow birch), *Spiraea alba* var. *latifolia* (broad-leaved meadowsweet), *Prunus pensylvanica* (pin cherry), *Diervilla lonicera* (northern bush honeysuckle), *Abies balsamea* (balsam fir), and *Rubus idaeus* ssp. *strigosus* (red raspberry). Characteristic herbaceous species include *Deschampsia flexuosa* (wavy hairgrass), *Solidago randii* (Rand's goldenrod), *Sibbaldiopsis tridentata* (three-toothed cinquefoil), *Saxifraga michauxii* (Michaux's saxifrage), *Hylotelephium telephioides* (Allegheny stonecrop), *Carex pensylvanica* (Pennsylvania sedge), *Agrostis perennans* (autumn bentgrass), *Clematis occidentalis* var. *occidentalis* (purple clematis), *Heuchera pubescens* (marbled alumroot), *Polypodium appalachianum* (Appalachian rock polypody), and *Dennstaedtia punctilobula* (hay-scented fern). Exposed vertical faces of the cliff have a sparser herb flora and a greater representation of woody scrub. The boreal lichens *Rhizocarpon geographicum* and *Melanelia stygia* occur on the exposed rocks. Quantitative plot data were collected from this occurrence in 1999 (plot SHNP023).

The Central Appalachian High-Elevation Boulderfield Forest is dominated by scrubby *Betula alleghaniensis*, *Sorbus americana*, and *Acer spicatum* (mountain maple). It gives way quickly downslope to a large stand of Central Appalachian Northern Hardwood Forest lying mostly within the Hawksbill North Slope Outcrops ROMP site.

RARE PLANTS: Six rare plant species are known for this site: *Abies balsamea*, *Clematis occidentalis* var. *occidentalis*, *Huperzia appalachiana* (Appalachian fir-clubmoss), *Rubus idaeus* ssp. *strigosus*, *Sibbaldiopsis tridentata*, and *Solidago randii*. In addition, the watchlist species *Gymnocarpium appalachianum* (Appalachian oak fern) is present within the summit forest.

The *Abies balsamea* within this rock outcrop site is part of a much larger occurrence over a wide area on Hawksbill Mountain. Within this site, 84 trees 2 m (7 ft) or taller, 12 trees smaller than 2 m (7 ft), and one seedling were counted in 2005. There were 13 dead or dying standing trees. Most trees were scattered within the forest canopy south of the cliff top, but occasional trees were found behind outcrops or in patches along the cliff top between rock outcrops.

Clematis occidentalis var. *occidentalis* was observed at this site not only in the area where it was first found in 1999, but in a new location. In the previously known location, 120 m (394 ft) west-southwest of the summit, two patches were located between the cliff edge and the Salamander Trail. The two patches were 8 m (26 ft) apart, and each occupied about 10 m^2 (108 ft^2). The vines were twining over *Hamamelis virginiana* (witch-hazel), *Quercus rubra* (northern red oak), and other shrubs and scrubby trees. The new location was found about 90 m southwest of the summit on north side of the fire road leading to Byrds Nest No. 2. This colony occupied a 1 x 2 m (3 x 7 ft) area, and the cluster of fruiting vines was found twining over a young *Betula alleghaniensis* (yellow birch) within a disturbed, scrubby area.

Huperzia appalachiana was found here on the outcrop containing the smaller patch of High-Elevation Greenstone Barren on the eastern end of the site. At least a dozen clumps were located on relatively exposed, north-facing, turfy ledges at the top of this outcrop with *Deschampsia flexuosa* and *Maianthemum canadense* (Canada mayflower). Another 32 clumps, with 14 fertile, were found at the base on the north side of this outcrop. Another small colony of *Huperzia appalachiana*, consisting of 15-20 small clumps, was observed at the site in 1990, but could not be relocated in 2005. It was found southwest of the summit in gravelly/mossy soil in a sheltered cleft on the exposed northwest-facing cliff face.

Approximately 450 canes of *Rubus idaeus* ssp. *strigosus* were observed in scattered patches throughout most of this site. Plants were seen in openings along trails, at the back edges of open rock outcrops, in wooded areas below the cliffs, and within the summit forest. Plants were found in either open or lightly shaded areas. The 2005 visit to this site was made late in the season after fruiting had occurred. The population area extends outside of the site boundary, and that portion of the population area within the site was expanded from the area previoulsy mapped by DCR-DNH.

Hundreds of stems of *Sibbaldiopsis tridentata* were found in five patches located from 10-110 m (33-361 ft) southwest of the Hawksbill summit. The population area is at most 3 m (10 ft) wide. Plants were found on less accessible cliff-top crevices, vertical crevices, and rock surfaces on edges of precipices where hikers are less likely to trample.

At least 600 clumps of *Solidago randii* were documented in three areas at this site: open cliff tops and ledges along the escarpment southwest of the summit, outcrops in the immediate area of the summit, and ledges on small outcrops north of the summit. The population area extends from 420 m (1378 ft) southwest to 85 m (279 ft) north of the summit platform. Plants are typically in areas protected from trampling such as crevices, inaccessible ledges, and the back edge of the open cliff top where woody vegetation affords some protection.

RARE ANIMALS: No new animal element occurrences were found in 2006; however, the *Falco peregrinus* (peregrine falcon), *Troglodytes troglodytes* (winter wren), and a millipede, *Semionellus placidus*, are all known from the area. *Falco peregrinus* has been reintroduced to SHEN as part of the recovery plan for this species. From 1989 to 1993, a total of 37 falcons were successfully fledged. From 2000 to 2006, 52 falcons were successfully fledged (R. Gubler, Biologist, SHEN, pers. comm.).

In June 1991, four singing male *Troglodytes troglodytes* were heard in the Hawksbill Summit site (DCR-DNH Biotics data). It is not known if this represents a breeding population that persists today. Surveys in 2006 included looking and listening for this species, but it was not relocated. Contractual constraints did not permit the intensity of surveys needed to adequately confirm the current presence or absence of Winter Wren at this site.

Little is known about the life history of *Semionellus placidus*. DCR-DNH biologists collected it at this site in 1990 while surveying for *Plethodon shenandoah*. It is presumed to be from similar forested talus areas.

Four watchlist moth species were captured in UV-traps in 8 August 2006: *Apamea lignicolor* (wood-colored Apamea moth), *Homochlodes disconventa* (dark Homochlodes moth), *Rheumaptera hastata* (spear-marked black moth), *Sphinx kalmiae* (laurel sphinx).

Plate 59. View looking north from metabasalt outcrops at the summit of Hawksbill. The brilliant yellow lichen on the rocks is *Rhizocarpon geographicum*, a boreal disjunct.

THREATS: This site is a popular destination for hikers and receives heavy annual visitation. Decades of trampling on the cliff-top ledges and rock scrambling elsewhere has led to the denuding of fragile soil mats supporting herbaceous vegetation, as well as the removal of some soil mats and lichens on rock surfaces. The condition of the rare High-Elevation Greenstone Barren community on accessible summit ledges is very poor, although cliff faces and a few less accessible ledges are still in excellent condition. In addition, the clearing and human activities associated with Byrd's Nest No. 2 shelter have encouraged the spread of several invasive exotic plants, including *Poa compressa* (flat-stemmed bluegrass), *Rumex acetosella* (sheep sorrel), *Festuca pratensis* (meadow fescue), and *Centaurea biebersteinii* (spotted knapweed), into critical outcrop habitats of the site. The presence of these exotics is a symptom of trampling disturbance that degrades the compositional integrity of the rare High-Elevation Greenstone Barren. In addition, the tough-rooted perennials *Poa compressa* and *Rumex acetosella* are well adapted to and established in outcrop habitats that support rare natives such as *Sibbaldiopsis tridentata* and *Solidago randii.* Other exotics or aggressive native species noted at this site include *Phleum pratense* (meadow timothy), *Carduus acanthoides* (spiny plumeless thistle), *Plantago major* (common plantain), *Polygonum caespitosum* var. *longisetum* (long bristled smartweed), and *Achillea millefolium* (common yarrow).

The main threat to all *Falco peregrinus* populations range-wide was once pesticide contamination leading to reproductive failure (USFWS, 1991). This threat appears to be diminishing (USFWS, 1991). Current threats include direct human disturbance, which can cause individual nesting pairs to abandon their nest site. In addition, predation, habitat destruction, and occasional poaching have been identified as threats (USFWS, 1991).

Habitat destruction and forest fragmentation are the primary threats to *Troglodytes troglodytes*. In addition, human disturbance may interrupt nesting attempts. The use of insecticides may adversely impact winter wren populations at the local level by decreasing their food supply.

There are no documented threats to *Semionellus placidus*. It is likely, however, that habitat alterations that lead to changes in either the soil structure or moisture levels would adversely impact this species.

MANAGEMENT RECOMMENDATIONS: Along with the other ROMP sites on Hawksbill, this site constitutes one of the most biologically significant areas in the Central Appalachians and merits more vigorous protection than it currently receives. The High-Elevation Greenstone Barren, in particular, is a priority for protection given its restriction to less than 30 outcrops and 10 acres, all in just a few areas of SHEN. While the Hawksbill summit is a popular and inspiring destination for hikers, recreational use of this site must be balanced with the need to protect rare and fragile biological resources before they reach a non-recoverable condition.

Permanently close southwestern summit outcrops to protect *Falco peregrinus* habitat and to allow recovery of native vegetation. Currently, SHEN closes these outcrops during the Peregrine nesting season. Extending the closure for protection and recovery of both animal and plant resources is a small step that will result in large conservation benefits. Park visitors will still be able to enjoy views from Byrd's Nest Shelter and the summit platform.

Close the numerous social trails to the cliffs that branch off the trail between Byrd's Nest Shelter and the summit viewing platform. Visitor trampling has destroyed vegetation between the trail and cliff top ledge and led to the presence of trail weeds that benefit from disturbance. The use of fencing may be necessary. Post signs to inform visitors of natural resource protection values.

Implement an education program and install signs to inform visitors of natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN, how

they interact, and why their conservation is important.

Monitor recovery of the rare plants and the health of the rare natural communities. Conduct surveys on a 3-5 year interval to assess rare plant populations and the health of natural community types. At the same time, conduct a survey and assessment of invasive plants.

Manage invasive plants, particularly *Centaurea biebersteinii*, *Poa compressa* and *Rumex acetosella*, where they are well-established. The use of herbicide is recommended for controlling these species because hand-pulling will create more soil disturbance and is labor-intensive. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Annually monitor the effectiveness of the invasive plant control effort. Continue monitoring *Centaurea, Poa*, and *Rumex* for several years following treatment and assess the need for further action. Once invasive have been controlled, include an invasive plant survey in 3-5 year interval site surveys.

Continue adherence to the recovery plan protocols (USFWS, 1991) for *Falco peregrinus*, including monitoring and additional survey work. Nesting areas should be protected from human disturbances.

Further inventory of the *Troglodytes troglodytes* should be conducted to determine its status in the park. Nests located near trails and other high visitor use areas should be monitored to determine if they are impacted by frequent disturbance.

No specific management recommendations are offered for *Semionellus placidus*. With little known about its life history, there are no specific management recommendations for the ground beetle. Relocating this species at this site and determining its range would be positive first steps to managing for it.

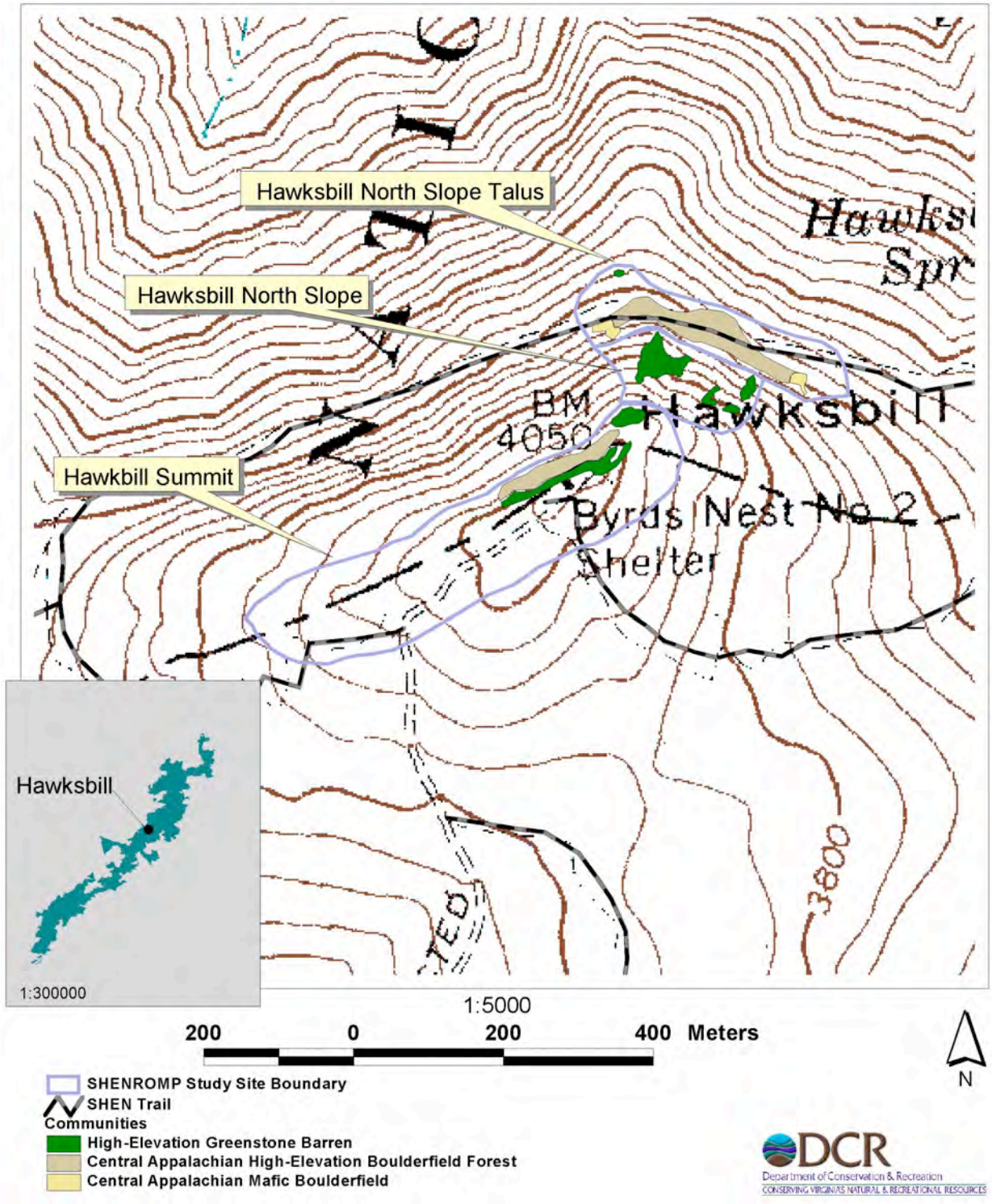


Fig. 120. Location of significant natural communities at Hawksbill Summit.

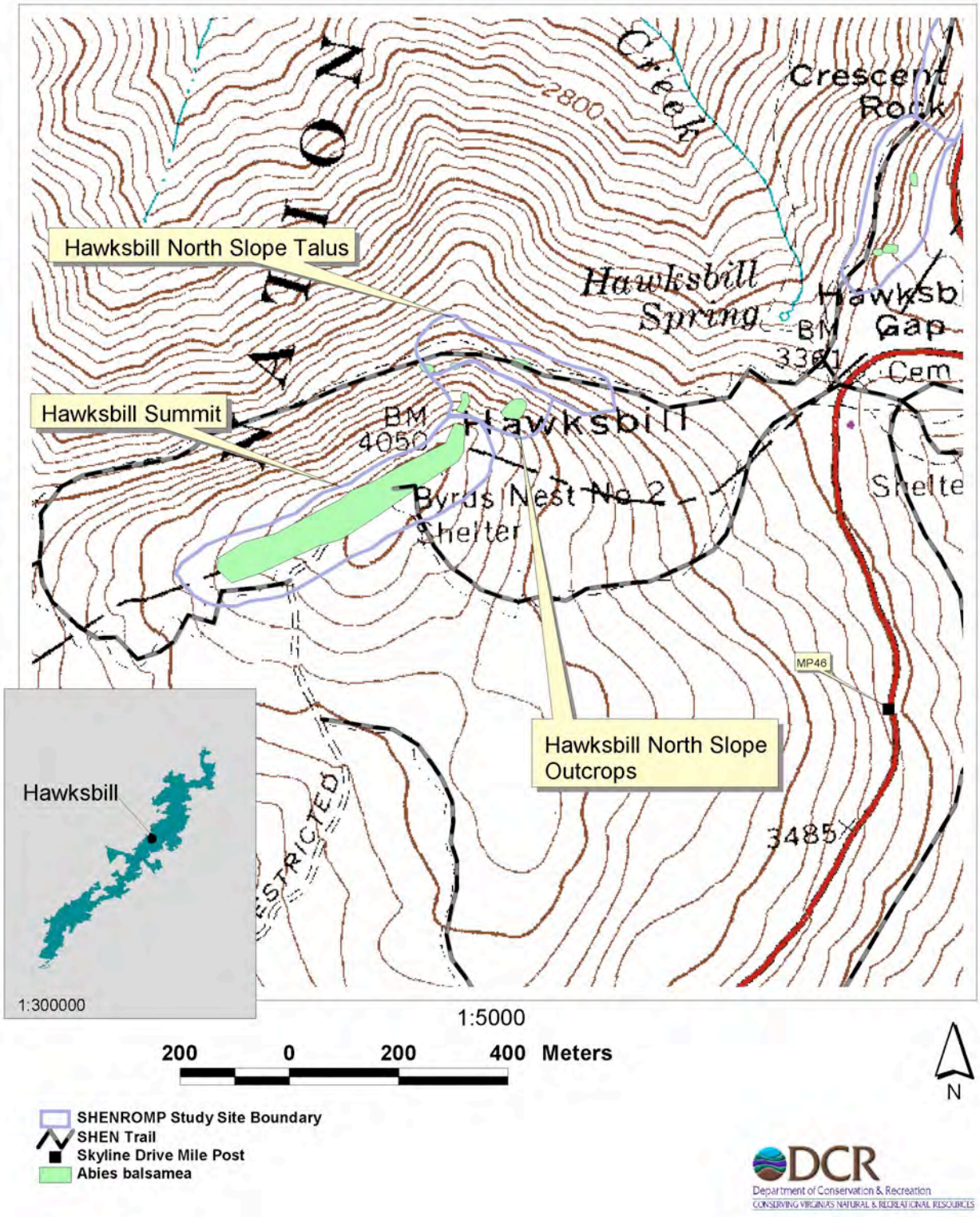


Fig. 121. Location *of Abies balsamea* at Hawksbill Summit.

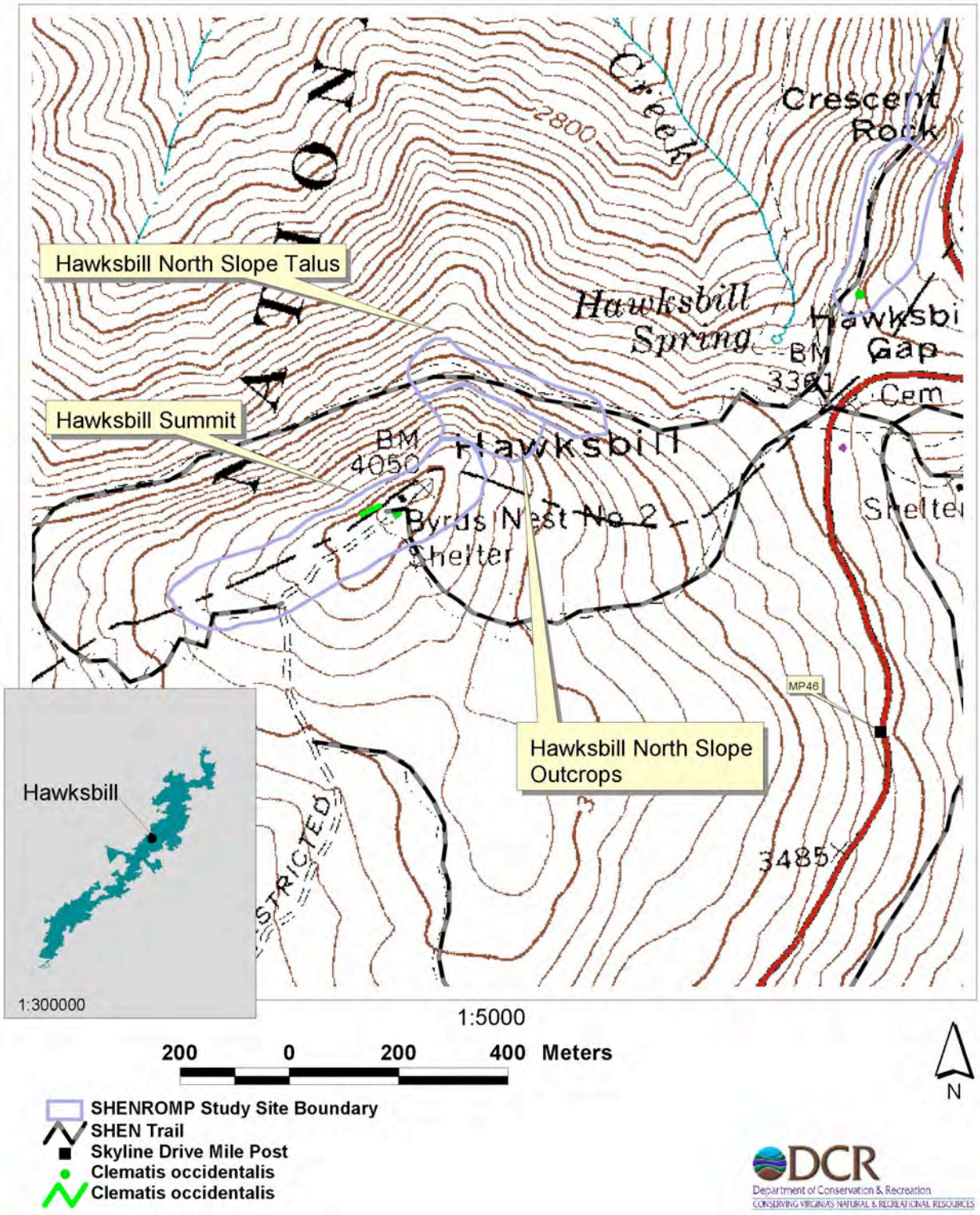


Fig. 122. Location of *Clematis occidentalis* var. *occidentalis* at Hawksbill Summit.

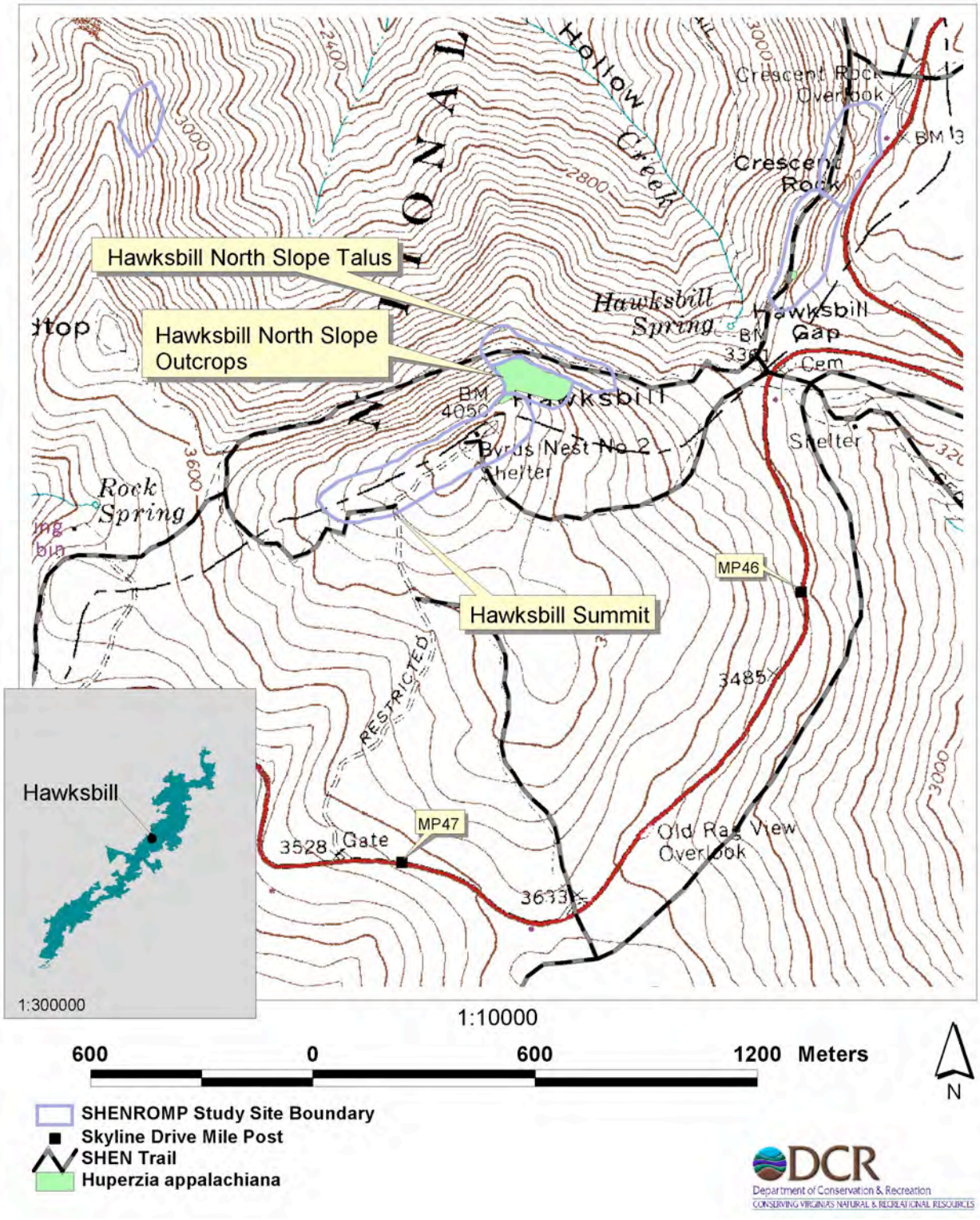


Fig 123. Location of *Huperzia appalachiana* at Hawksbill Summit.

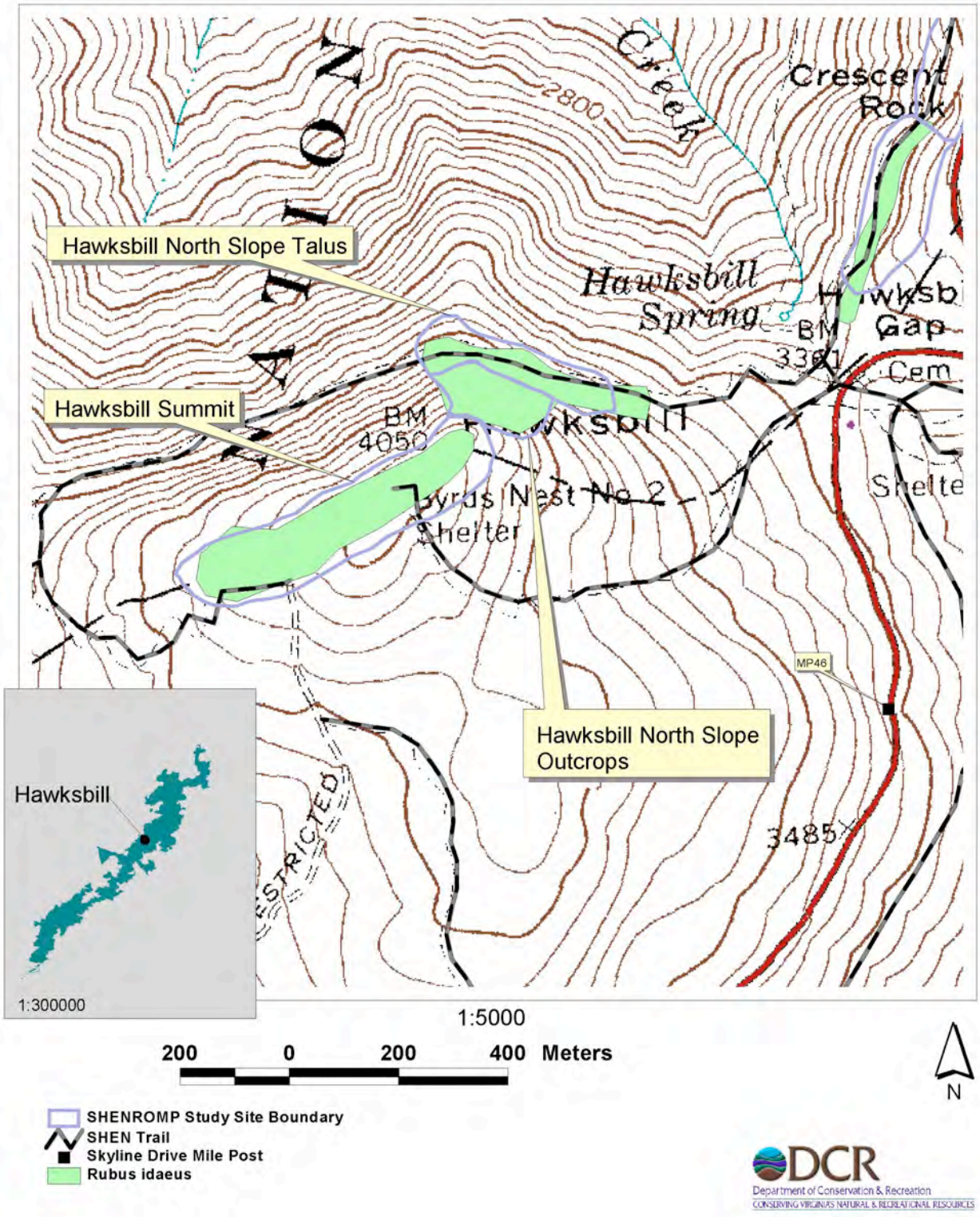


Fig. 124. Location of *Rubus idaeus* var. *strigosus* at Hawksbill Summit.

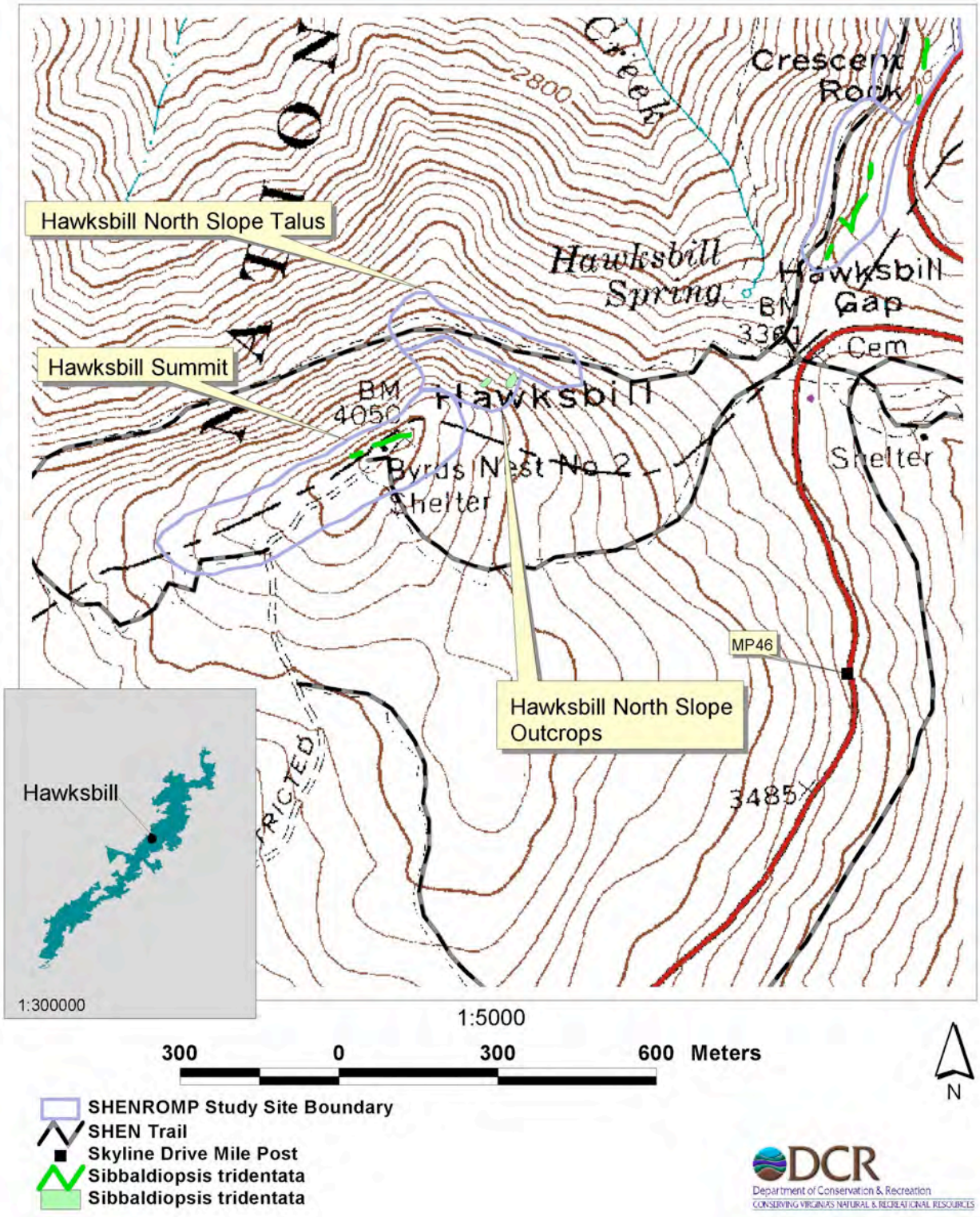


Fig. 125. Location of *Sibbaldiopsis tridentata* from Hawksbill Summit.

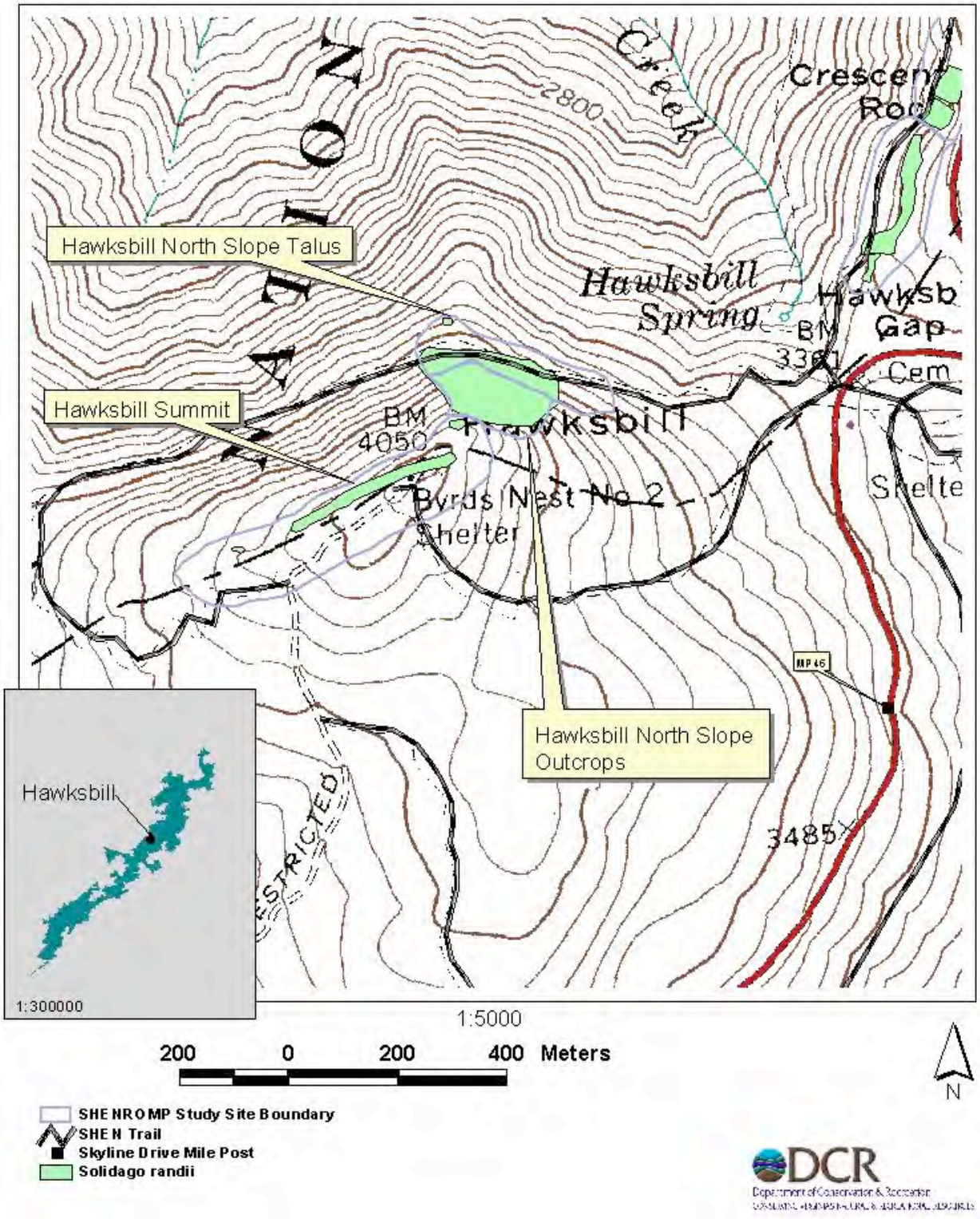


Fig. 126. Location of *Solidago randii* at Hawksbill Summit.

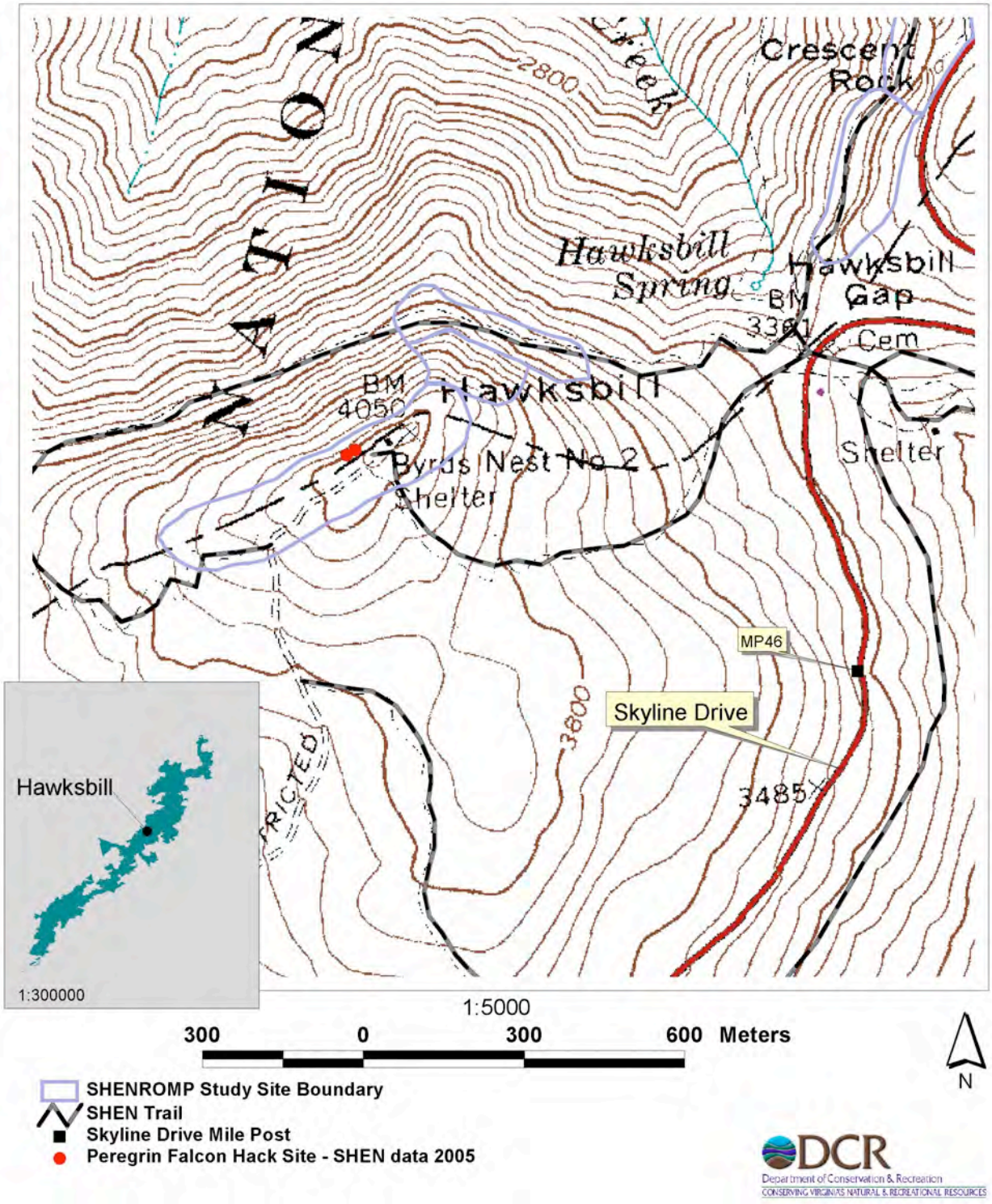


Fig. 127. Location of *Falco peregrinus* at Hawksbill Summit.

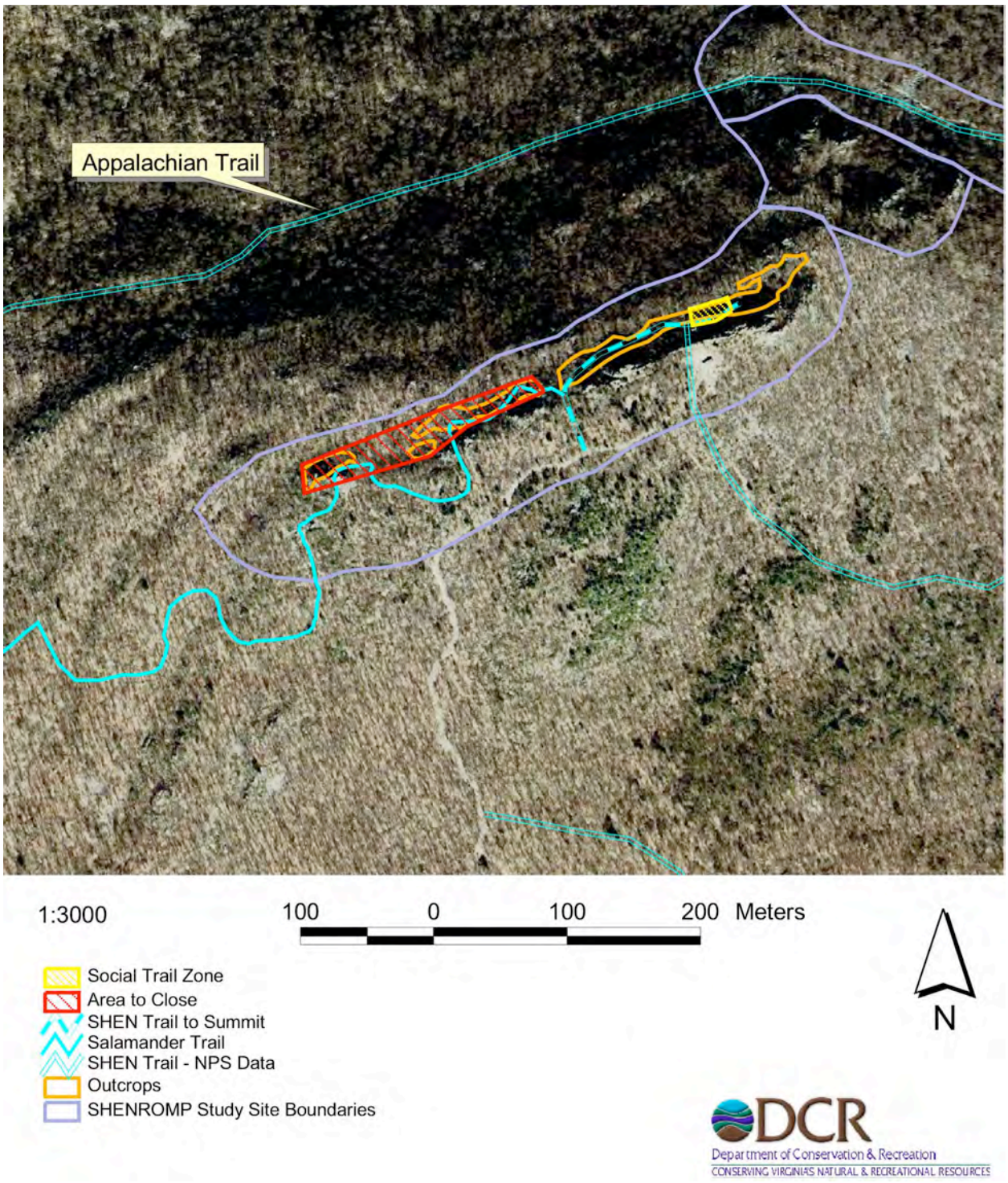


Fig. 128. Site details for Hawksbill Summit, including location of social trails and area recommended for closure.

NAKEDTOP UPPER EAST SLOPE (C34)

CONSERVATION SITE: Hawksbill Mountain-Crescent Rock (B1) **THREAT RANK:** 0

LOCALITY: Page **QUADRANGLE(S):** Big Meadows

LOCATION: This site is located in the Central District on the west side of Skyline Drive. It extends from 0.50-0.70 km (0.30-0.42 mi) north northeast of the summit of Nakedtop.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana* / *Physocarpus opulifolius* / *Carex pensylvanica* - *Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2	S2	None	None	A
Plants: None						
Animals: *Myotis leibii*	Eastern small-footed myotis	G3	S1	None	None	CD

SITE DESCRIPTION: This site encompasses a single large open rock exposure on the steep eastern flank of a narrow ridge extending north from the summit of Nakedtop. The exposure here is a granitic face nearly flush with the surrounding slope. The opening is about 0.25 ha (0.63 ac) in size and lies at elevations between 975 m (3,200 ft) and 1,012 m (3,320 ft). The composition of the granite here is variable, but always with high proportions of quartz and feldspar. While much this outcrop is sparsely vegetated, in many areas shallow depressions, ledges, and crevices have allowed a build-up of organic debris sufficient to supports mats of herbs and scattered woody species.

This site is located in a remote area of the park and receives little visitation.

NATURAL COMMUNITIES: Slopes above and adjacent to the outcrop are vegetated with Northern Red Oak Forest (Pennsylvania Sedge – Wavy Hairgrass Type). The steep, 0.25 ha (0.6 ac) granitic face contains two natural community types. The north end of the outcrop is xeric and supports a lithophytic variant of the Central Appalachian Pine – Oak / Heath Woodland characterized by scattered *Pinus pungens* (table-mountain pine) and *Quercus prinus* (chestnut oak). Colonies of *Kalmia latifolia* (mountain-laurel) and *Gaylussacia baccata* (black huckleberry) occur under the trees and exposed rock surfaces are abundantly covered with the xerophytic lichens *Lasallia papulosa*, *Lasallia pensylvanica*, and *Dimelaena oreina*.

Most of the outcrop is less xeric and supports a pristine occurrence of the Central Appalachian Mafic Barren community type. Frequent seepage down the outcrop face supports swathes of the moss *Grimmia laevigata* that follow the water courses. Other areas have well developed ledges with organic deposition, as well as bryophyte / lichen mats of *Polytrichum* spp., *Hedwigia ciliata*, *Bryum* sp., *Cladonia*

rangiferain, *Cladonia crispata*, etc., that support patches of non-ericaceous shrubs and graminoid-dominated herbaceous vegetation. The most abundant herbs are the graminoids *Schizachyrium scoparium* (little bluestem), *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), and *Danthonia spicata* (poverty oat-grass). Associated low-cover herbs include *Solidago roanensis* (Roan Mountain goldenrod), *Hypericum punctatum* (common St. John's-wort), *Viola sagittata* (arrow-leaved violet), *Dichanthelium acuminatum* (woolly panic grass), *Helianthus divaricatus* (woodland sunflower), *Hylotelephium telephioides* (Allegheny stonecrop), *Parthenium integrifolium* var. *integrifolium* (wild quinine), *Symphyotrichum undulatum* (wavy-leaved aster), *Carex pensylvanica* (Pennsylvania sedge), and *Houstonia longifolia* (longleaf bluets). Scattered shrubs and trees include *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Crataegus intricata* (a hawthorn), *Rosa carolina* var. *carolina* (pasture rose), *Vaccinium pallidum* (early lowbush blueberry), *Fraxinus americana* (white ash), and *Amelanchier sanguinea* var. *sanguinea* (roundleaf serviceberry). Drier outcrop surfaces lacking vascular plants are dominated by the lichen *Xanthoparmelia conspersa*. Quantitative plot data were collected from this stand during the ROMP project (plot SHNP143).

RARE PLANTS: Small populations of three watchlist plants were found at this site: *Solidago hispida* var. *hispida* (hairy goldenrod), *Crataegus pruinosa* (a hawthorn), and *Amelanchier sanguinea* var. *sanguinea* (roundleaf serviceberry).

RARE ANIMALS: Three adult male individuals of *Myotis leibii* (eastern small-footed myotis) were observed under small rock plates, which were about 30cm in diamter and 5-10cm thick with small concavities under them allowing for the bats to rest there. Two of the three moved to other cover objects after release. This roosting habitat has been reported in the literature previously for this species (Erdle and Hobson, 2001).

Plate 60. Central Appalachian Mafic Barren dominated by *Schizachyrium scoparium* (little bluestem) and *Deschampsia flexuosa* (wavy hairgrass) occupies the Nakedtop granitic outcrop.

THREATS: Exotic plants were not found at this site and no threats to the significant natural community were noted.

In general terms, threats to *Myotis leibii* are primarily human caused, such as habitat destruction at roost or hibernation sites, killing of the animal, or the introduction of toxins into the environment that negatively impact food supply (Erdle and Hobson, 2001). Specific threats at this site are limited because human disturbance is highly unlikely. The primary threat to this species may be the use of pesticides for gypsy moth control.

MANAGEMENT RECOMMENDATIONS:

Conduct a survey on a 5-10 year interval to assess the status of the Central Appalachian Mafic Barren, invasive plants, and changes in visitor use.

Conduct further surveys in SHEN for *Myotis leibii.* There is ample available habitat in talus slopes, rock outcrops and crevices, and even man-made structures or rock piles. Additionally, there are verbal reports of unidentified bats in the talus slopes of Hawksbill (W. Cass, pers. comm., 2006) and in a rip-rap pile near Dean Mountain (unknown SHEN employee, pers. comm., 2006).

Close access to the outcrop if human visitation becomes a concern at this site. Likewise, if additional populations are found at other, more highly disturbed sites, limiting access should be considered for those areas.

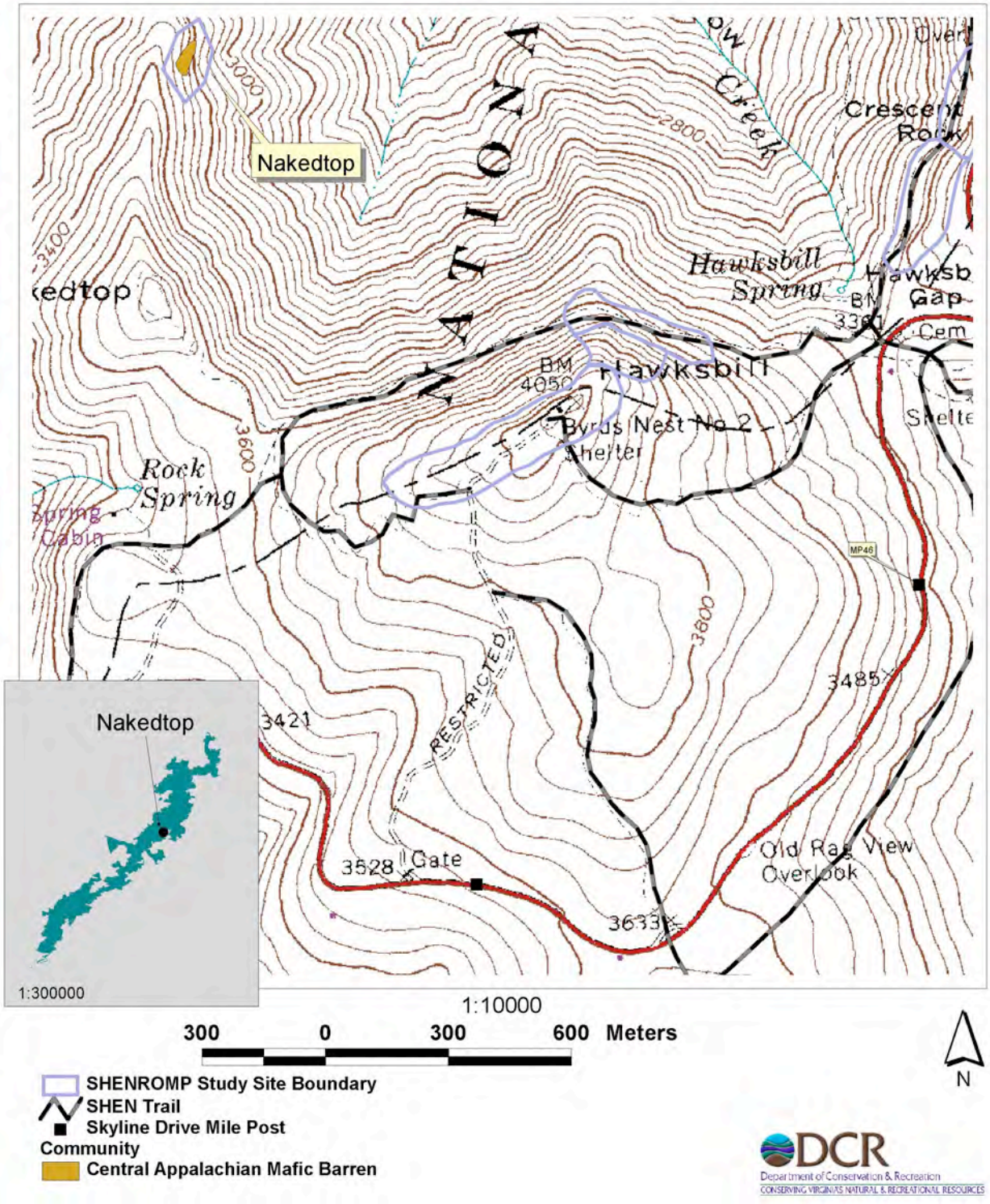


Fig. 129. Location of significant natural community at Nakedtop Upper East Slope.

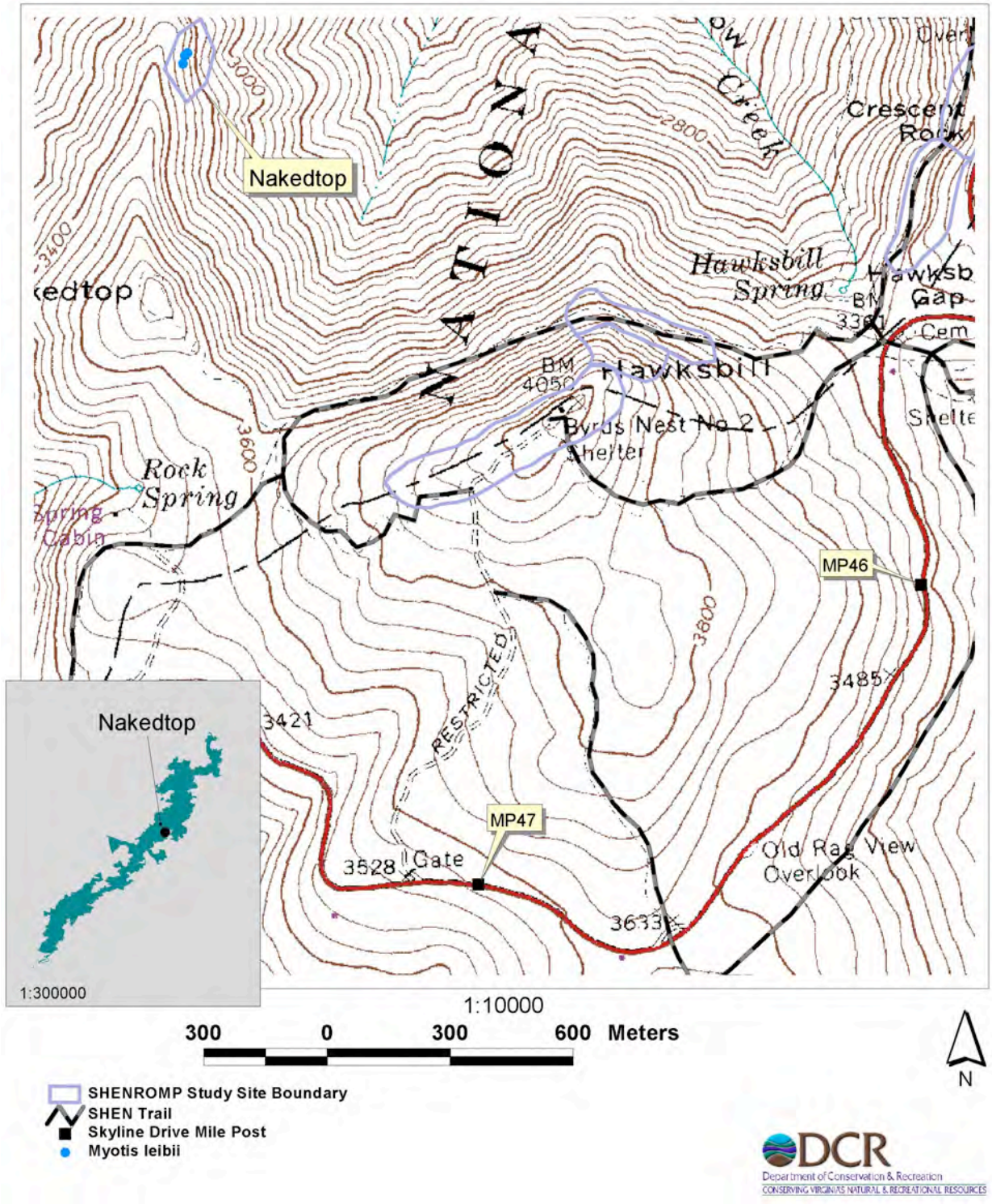


Fig. 130. Location of *Myotis leibii* at Nakedtop Upper East Slope.

FRANKLIN CLIFFS NORTH (C15)

CONSERVATION SITE: Franklin Cliffs (B2) **THREAT RANK:** 1

LOCALITY: Page County **QUADRANGLE(S):** Big Meadows

LOCATION: This site is located in the Central District on the west side of Skyline Drive. It extends from 0.32-0.82 km (0.20-0.51 mi) north northeast of Franklin Cliffs Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii* Herbaceous Vegetation[1]	High-Elevation Greenstone Barren	G1	S1	None	None	AB
Plants:						
Muhlenbergia glomerata	Marsh muhly	G5	S2	None	None	C
Solidago randii[1]	Rand's goldenrod	G5T4	S2S3	None	None	BC
Animals: None						

[1]Parts of this element occurrence lie within the Franklin Cliffs Overlook and Franklin Cliffs South ROMP sites.

SITE DESCRIPTION: This site encompasses a northwest-facing cliff of Catoctin Formation metabasalt. The cliff is about 320 m (1,050 ft) long and up to about 24 m (80 ft) high. While the southern two-thirds of the cliff are continuous, the northern third is intermittent.

The cliff is oriented on a slight bias to the topographic contour. The top of the cliff has an elevation of about 981 m (3220 ft) at its northeastern end, but drops in a series of stair steps to about 945 m (3,100 ft) at its southwestern end. These stair steps face the southwest, providing ample sunny habitat for a diversity of herbaceous plants. The face of the cliff has numerous ledges and crevices, but much of this habitat was too steep to safely explore except with binoculars.

This site is more difficult to access than the other two Franklin Cliff sites as there is no trail leading to the cliff top. While the Appalachian Trail is located a short distance below the cliff, it is a long, steep climb to the top from that trail.

NATURAL COMMUNITIES: The cliffs at this site occur within a matrix of deciduous forest. At the north end of the site, a relatively small stand of early-successional *Robinia pseudoacacia* (black locust) forest covers the level ridge crest. To the south, the rocky but relatively gentle slopes above the outcrops support an extensive stand of Central Appalachian Montane Oak-Hickory Forest (Basic Type). Steep, bouldery slopes between the cliffs and the Appalachian Trail support a large stand of Central Appalachian Basic Boulderfield Forest (Montane Basswood - White Ash Type).

Exposed outcrops support a large occurrence of the globally rare High-Elevation Greenstone Barren community, which is endemic to several high-elevation sites in SHEN. This vegetation type is

characterized by patchy thickets of low shrubs and tree saplings interspersed with large open rock surfaces with herbaceous species rooted in crevices and on mats of thin, organic-rich soil. The occurrence here covers approximately 0.6 ha (1.4 ac) in a single patch, about equally divided between cliff-top ledges and vertical cliff faces. The stair-stepped ledges at this site have well-developed turfs of grasses and xerophytic forbs, but woody scrub is more prevalent than at many other sites. Characteristic woody plants include *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Smilax tamnoides* (bristly greenbrier), *Betula alleghaniensis* (yellow birch), *Kalmia latifolia* (mountain-laurel), *Rosa virginiana* (Virginia rose), and *Rhus typhina* (staghorn sumac). Characteristic herbaceous species include *Deschampsia flexuosa* (wavy hairgrass), *Solidago randii* (Rand's goldenrod), *Phlox subulata* (moss phlox), *Houstonia longifolia* (longleaf bluets), *Campanula divaricata* (southern hairbell), *Polygonum tenue* (slender knotweed), *Allium cernuum* (nodding onion), *Hylotelephium telephioides* (Allegheny stonecrop), *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oat grass), *Arabis lyrata* (lyre-leaf rockcress), *Bulbostylis capillaris* (common hairsedge), and *Agrostis perennans* (autumn bentgrass). Quantitative plot data were collected from this stand in 1999 (plot SHNP015).

RARE PLANTS: Two rare plants were found at this site. A previously known colony of *Solidago randii* was relocated at this site, and a new population of *Muhlenbergia glomerata* (marsh muhly) was found.

Solidago randii is found throughout most of the cliff top and face. The estimated colony size is 400 clumps. About 60 culms of *Muhlenbergia glomerata* were found on a gentle, southwest-facing shelf at the woodland edge just behind (southeast of) the cliff top. The plants occupy a 2 x 3 m (6 x 10 ft) area within dry, partially open habitat. Two other common grass species in the genus, *Muhlenbergia schreberi* (nimble-will) and *Muhlenbergia frondosa* (wirestem muhly) were also found in the area. A few individuals of the watchlist plant *Crataegus pruinosa* (a hawthorn) were also found near the *Muhlenbergia glomerata* population.

RARE ANIMALS: No animal element occurrences or watchlist species were found by DCR-DNH during surveys in 2005.

Plate 61. High-Elevation Greenstone Barren on ledge at the top of Franklin Cliffs North.
THREATS: This site receives little visitation and shows few signs of trampling impacts. A *Robinia pseudoacacia* (black locust) early successional forest is located behind (east of) a portion of the cliff.

This area was apparently either a homestead site or some other type of clearing prior to the SHEN's establishment. The disturbance here has created the opportunity for the establishment of weedy native and exotic plants, including *Polygonum caespitosum* (long bristled smartweed), *Verbascum thapsus* (great mullein), *Rumex acetosella* (sheep sorrel), *Poa compressa* (flat-stemmed bluegrass), *Achillea millefolia* (common yarrow), *Ambrosia artemisiifolia* (common ragweed), *Lepidium virginicum* (poor man's pepper-grass), and *Muhlenbergia frondosa* (wirestem muhly). These species linger on, degrading the northern end of the significant community to some extent. Otherwise, the community is in excellent to pristine condition.

MANAGEMENT RECOMMENDATIONS: As one of the few sites for high-elevation metabasalt outcrops and the globally rare High-Elevation Greenstone Barren, Franklin Cliffs is a priority for vigorous protection, especially since the community occurrence here is large and undisturbed. Current abundance levels of invasive plants do not warrant control actions.

Monitor this site on a 5-10 year interval to assess the rare plants and rare natural community, conduct a survey and assessment of invasive plants, and check for signs of visitor use.

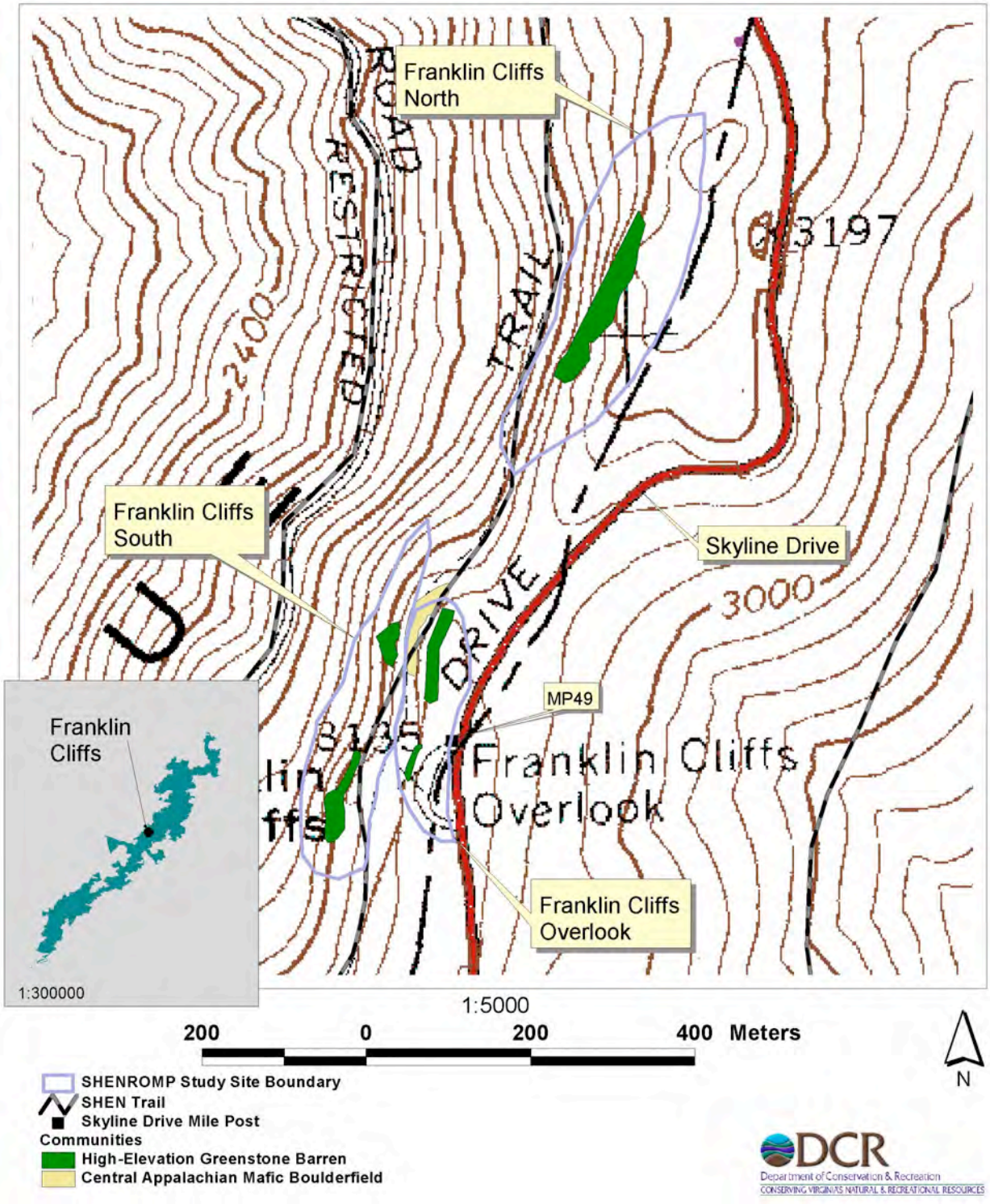


Fig. 131. Location of significant natural community at Franklin Cliffs North.

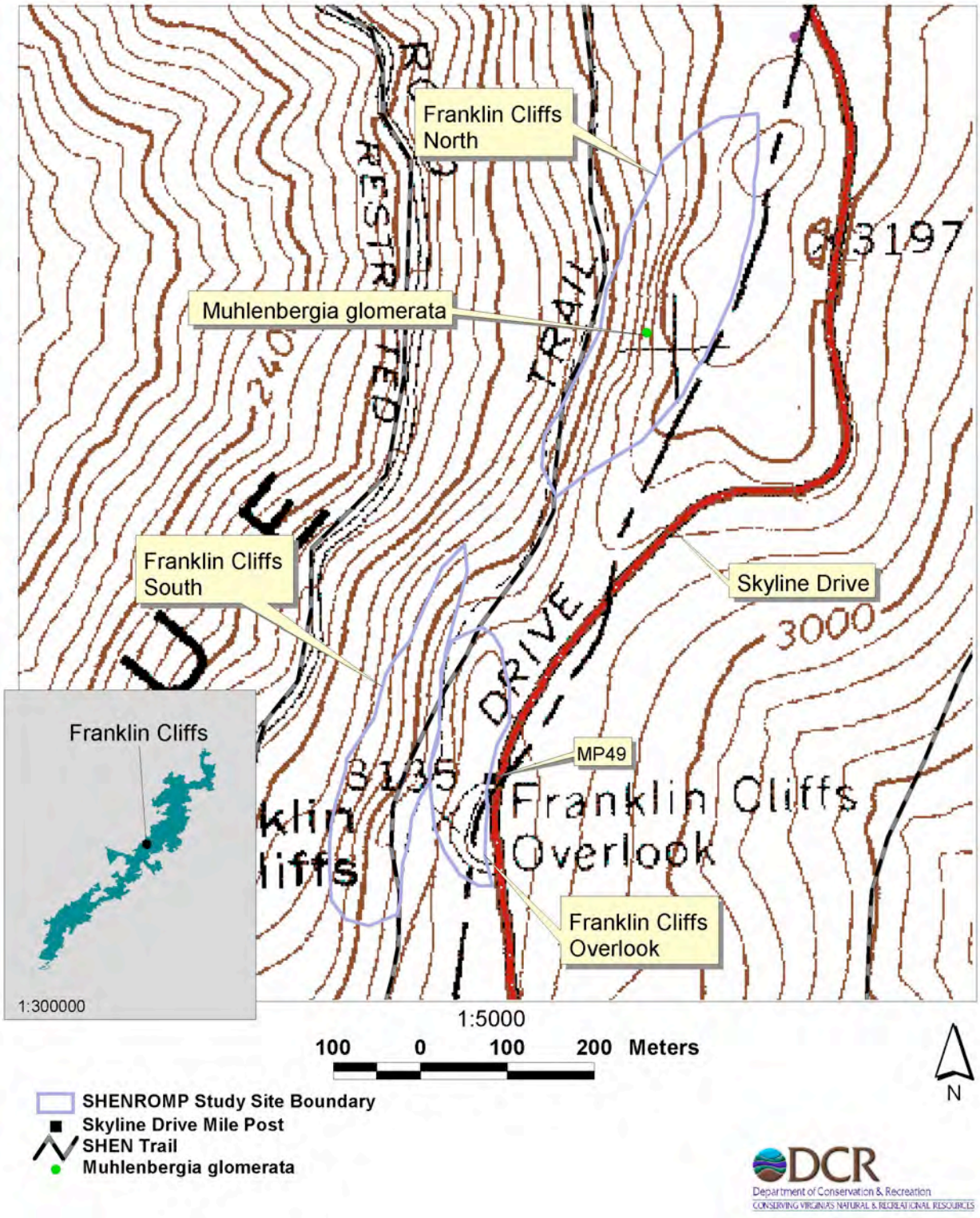


Fig. 132. Location of *Muhlenbergia glomerata* at Franklin Cliffs North.

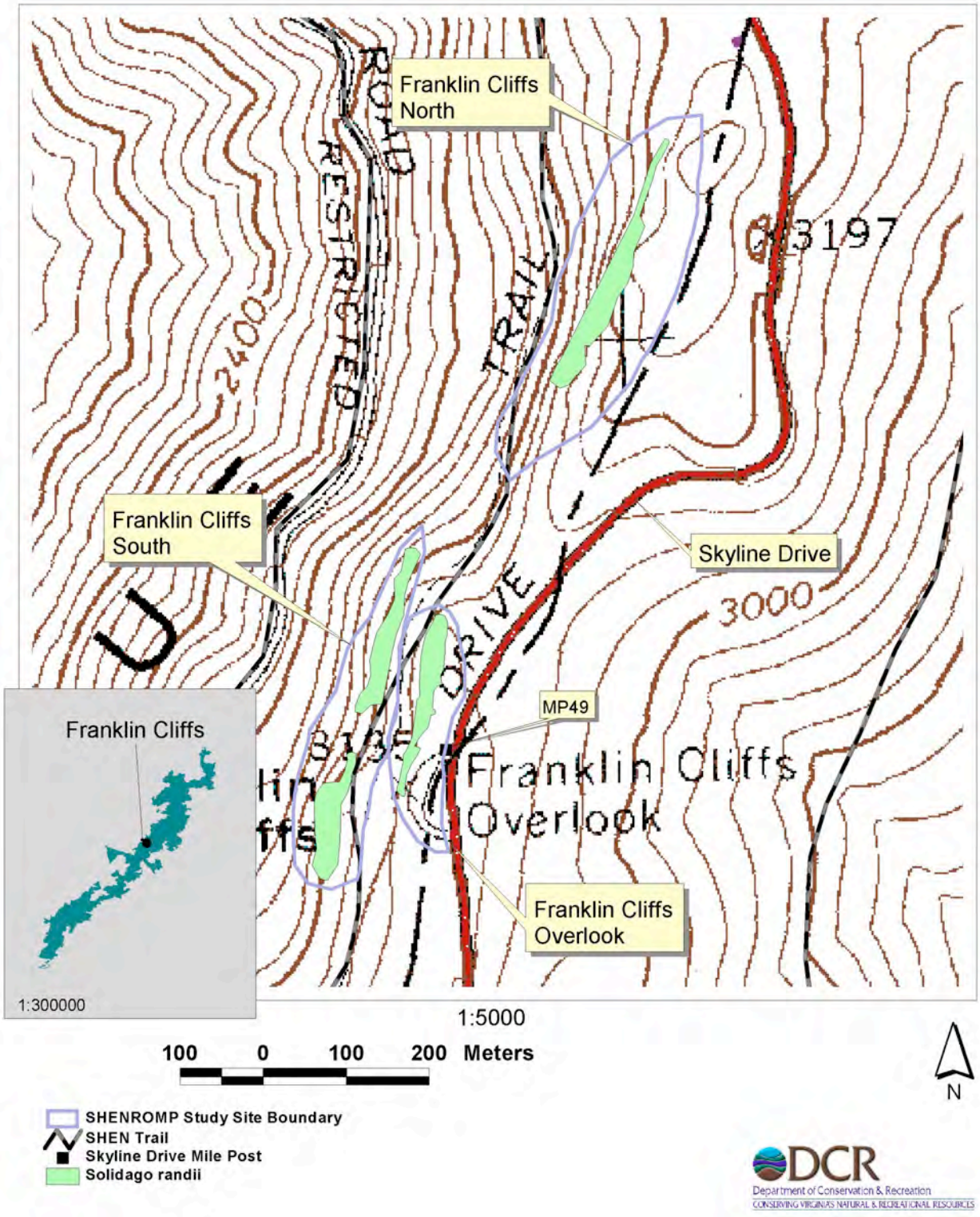


Fig. 133. Location of *Solidago randii* at Franklin Cliffs North.

FRANKLIN CLIFFS OVERLOOK (C16)

CONSERVATION SITE: Franklin Cliffs (B2) **THREAT RANK:** 4

LOCALITY: Page and Madison Counties **QUADRANGLE(S):** Big Meadows

LOCATION: This site is located in the Central District on the west side of Skyline Drive. It extends from the Franklin Cliffs Overlook north for 0.16 km (0.11 mi) and is immediately upslope from the Franklin Cliffs South site.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii Herbaceous Vegetation[1]	High-Elevation Greenstone Barren	G1	S1	None	None	C
Lasallia papulosa - Stereocaulon glaucescens – Chrysothryx chlorina Nonvascular Vegetation	Central Appalachian Mafic Boulderfield	G2?	S2?	None	None	AB
Plants:						
Populus tremuloides	Quaking aspen	G5	S2	None	None	D
Solidago randii[1]	Rand's goldenrod	G5T4	S2S3	None	None	BC
Animals: None						

[1]Parts of this element occurrence lie within the Franklin Cliffs North and Franklin Cliffs South ROMP sites.

SITE DESCRIPTION: This site contains a west to northwest-facing Catoctin Formation metabasalt cliff. The cliff extends for about 215 m (705 feet) with a short gap just north of the Franklin Cliffs Overlook. From a broad, level top at an elevation of 646 m (2,120 ft), the cliff drops steeply for up to about 10 m (33 ft). In many areas the cliff face is fairly sheer with relatively few ledges. Extensive areas of metabasalt talus are found at the cliff's base.

The southern end of the cliff abuts the Franklin Cliffs Overlook parking area and receives heavy visitation. An unsigned but well-used short trail leads from the northern end of the parking area to that portion of the cliff top located to the north. The Appalachian Trail is located a short distance below the cliff, offering unmarked access to the cliff to those willing to make a short, steep climb up the talus slope.

NATURAL COMMUNITIES: Except in the vicinity of the Overlook, the bedrock outcrops at this site are surrounded by deciduous forest. To the east, between the cliffs and Skyline Drive, the forest is primarily Central Appalachian Montane Oak-Hickory Forest (Basic Type), with a few patches of Northern Red Oak Forest (Pennsylvania Sedge - Wavy Hairgrass Type) on convex topography immediately behind the cliffs. The bouldery slopes below the cliff are forested with Central Appalachian Basic Boulderfield Forest (Montane Basswood - White Ash Type). The forested boulderfields are broken

by a 0.2 ha (0.5 ac) patch of open, lichen-dominated talus representing the Central Appalachian Mafic Boulderfield community. Dominant lichen species on the deeply piled metabasalt boulders include *Stereocaulon glaucescens*, *Lasallia papulosa*, *Umbilicaria muehlenbergii*, and numerous crustose species. The condition of this community is essentially pristine. Fully open, nonvascular metabasalt (and similar mafic) boulderfields are extremely rare in the mid-Atlantic region, and this community type is endemic to five sites in SHEN.

The exposed cliff supports a fairly large (0.2 ha [0.5 ac]) occurrence of the globally rare High-Elevation Greenstone Barren community, which is endemic to several high-elevation sites in SHEN. At the north end of the cliff and on cliff faces, composition of this community is quite typical with patches of woody scrub interspersed with herbaceous mats. Shrubs and tree saplings occurring at this site include *Amelanchier sanguinea* vara. *sanguinea* (roundleaf serviceberry), *Betula alleghaniensis* (yellow birch), *Physocarpus opulifolius* var. *opulifolius* (ninebark), *Diervilla lonicera* (northern bush honeysuckle), *Rosa carolina* var. *carolina* (pasture rose), *Populus tremuloides* (quaking aspen), and *Kalmia latifolia* (mountain-laurel). Characteristic herbs include *Solidago randii* (Rand's goldenrod), *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Carex pensylvanica* (Pennsylvania sedge), *Houstonia longifolia* (longleaf bluets), *Phlox subulata* (moss phlox), *Hylotelephium telephioides* (Allegheny stonecrop), *Allium cernuum* (nodding onion), *Agrostis perennans* (autumn bent grass), *Viola sagittata* (arrow-leaved violet), *Polygonum scandens* var. *cristatum* (crested false buckwheat), and *Bulbostylis capillaris* (common hairsedge). A diverse assortment of lichens also occurs on the exposed rock faces.

At the south end of the cliff top, the composition of the community is somewhat transitional to that of lower-elevation barrens with the appearance of species such as *Fraxinus americana* (white ash), *Vaccinium stamineum* (deerberry), *Parthenium integrifolium* (wild quinine), *Schizachyrium scoparium* (little bluestem), *Symphyotrichum laeve* var. *concinnum* (smooth blue aster), *Helianthus divaricatus* (woodland sunflower), *Aristida dichotoma* (fork-tip three-awn grass), and *Calamagrostis porteri* (Porter's reedgrass).

RARE PLANTS: Two rare plants were located at this site: *Populus tremuloides* and *Solidago randii*. Both of these species were previously known from the site.

Solidago randii is found on both the cliff face and top, but the stronghold for this species is the woodland edge just behind (east of) that portion of the cliff top north of the overlook. The colony size is estimated at 250 clumps. *Populus tremuloides* is located in a 6 x 20 m (20 x 66 ft) area at the highest, most exposed spot along the cliff top. Due to the propensity of this species to produce shoots from an extensive root system, it was not possible to determine the number of individuals present. Twenty-four trunks were counted, however, ranging from small seedlings about 0.3 m (1.0 ft) tall to trees with a height of 3 m (10 ft). Ten dead trunks were also counted, and it was noted that some branches had browned leaves by the August 11 survey date. The dieback of trunks should probably be expected here due to the stresses of winter exposure and summer droughts.

The watchlist plant *Crataegus pruinosa* (a hawthorn) was found at this site. This species was found in the woodland edge just behind (east of) that portion of the cliff top north of the overlook and also in the vegetated island between the Franklin Cliffs Overlook parking lot and Skyline Drive. Two other watchlist plants were found here: *Amelanchier sanguiea* var. *sanguinea* (roundleaf serviceberry) and *Liatris turgida* (= *Liatris helleri*, shale-barren blazing-star).

RARE ANIMALS: No animal element occurrences or watchlist species were found by DCR-DNH during surveys at this site in 2005.

Plate 62. Metabasalt outcrops at Franklin Cliffs Overlook in autumn.

THREATS: The condition of the significant barrens community is very poor at the overlook and steadily becomes better with increasing distance from the overlook. The more disturbed areas have suffered serious soil compaction and removal of fragile moss and soil mats from decades of continuous trampling. In these areas, indigenous herbs of the community have been greatly reduced and drought-tolerant exotics and weedy natives such as *Poa compressa* (flat-stemmed bluegrass), *Symphyotrichum pilosum* (frost aster), and *Juncus tenuis* (slender rush) have become established.

Trampling is very severe on that portion of the cliff by the overlook. The few remaining clumps of *Solidago randii* are estimated to represent only 3-5 percent of the number of clumps that would be present if this portion of the cliff were pristine. That portion of the cliff top north of the overlook also receives heavy trampling. This diminishes somewhat at the northern end of the cliff where the trail peters out. The *Populus tremuloides* population area is somewhat protected from trampling by the configuration of the rock and by a clump of *Kalmia latifolia* (mountain-laurel). If this clump of *Kalmia latifolia* is trampled or otherwise damaged, there will be little to protect the *Populus tremuloides* area from increased visitor impacts.

Invasive or aggressive native species found on this cliff include *Poa compressa*, *Rumex acetosella* (sheep sorrel) and *Juncus tenuis*. Some *Microstegium vimineum* (Japanese stiltgrass) was noted in the gap in the cliff north of the overlook.

MANAGEMENT RECOMMENDATIONS: This site is a strong candidate for changes in management, leading to restoration and recovery of a globally rare community endemic to higher

elevations of Shenandoah National Park. The continuing impacts of constant visitor trampling on the outcrops must be ameliorated to begin this process.

Close the trail from parking lot to the northern outcrop. Contain visitation to the overlook parking and adjacent outcrop. Use fencing if necessary to enforce trail closure.

Implement an education program and install signs to inform visitors of the natural resource protection values of the outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Manage invasive plants *Poa compressa* and *Rumex acetosella*. The use of herbicide is recommended for controlling these species because hand-pulling will create more soil disturbance and is labor-intensive. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Monitor recovery of the rare plants and the health of the rare natural community. Following management actions, conduct a survey on a 3-5 year interval to assess rare plant populations and the health of the significant natural communities.

Annually monitor the effectiveness of the invasive plant control effort. Continue monitoring *Poa* and *Rumex* for several years following treatment and assess need for further action. Once invasive have been controlled, include an invasive plant survey in 3-5 year interval site surveys.

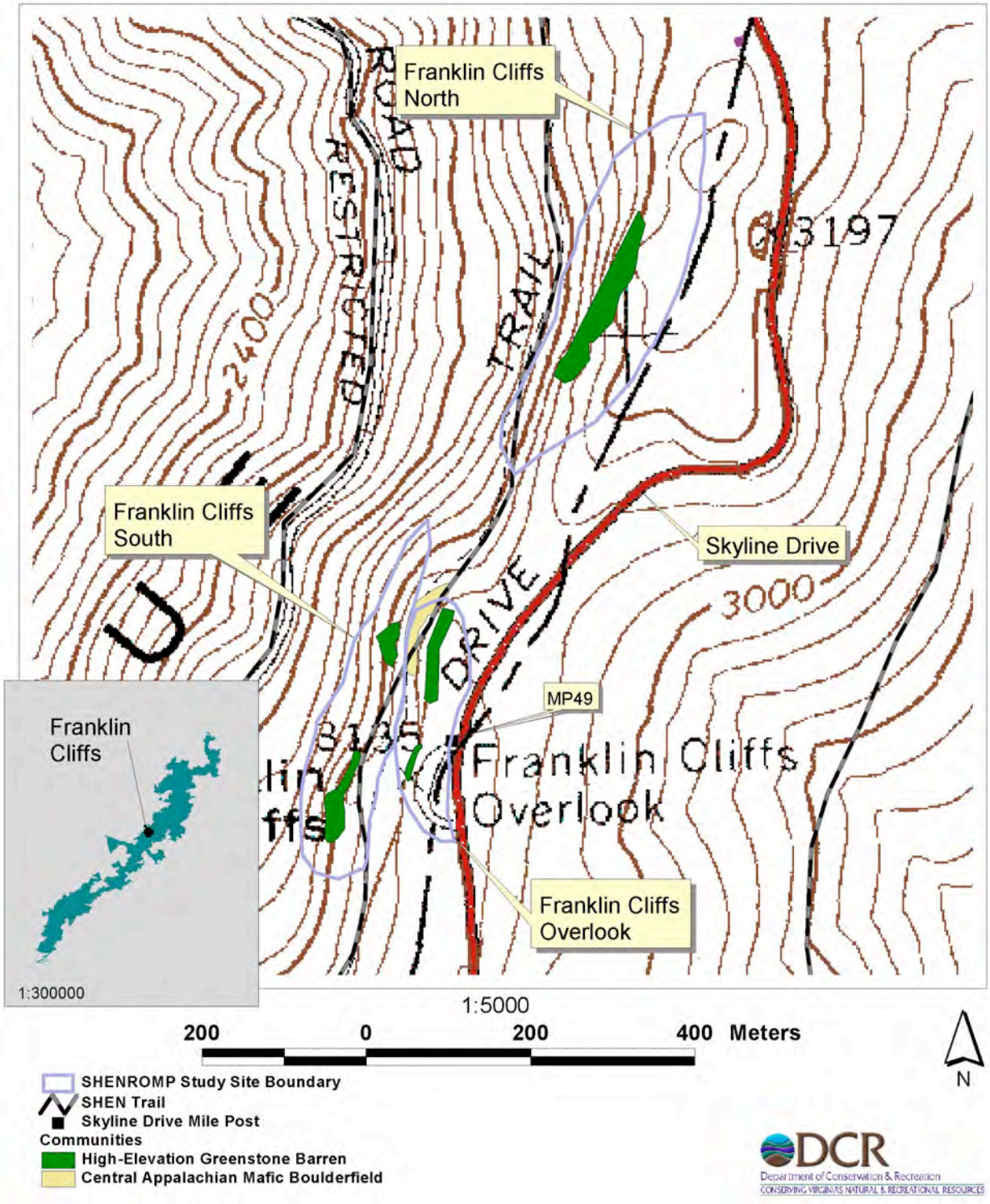


Fig. 134. Location of significant natural communites at Franklin Cliffs Overlook.

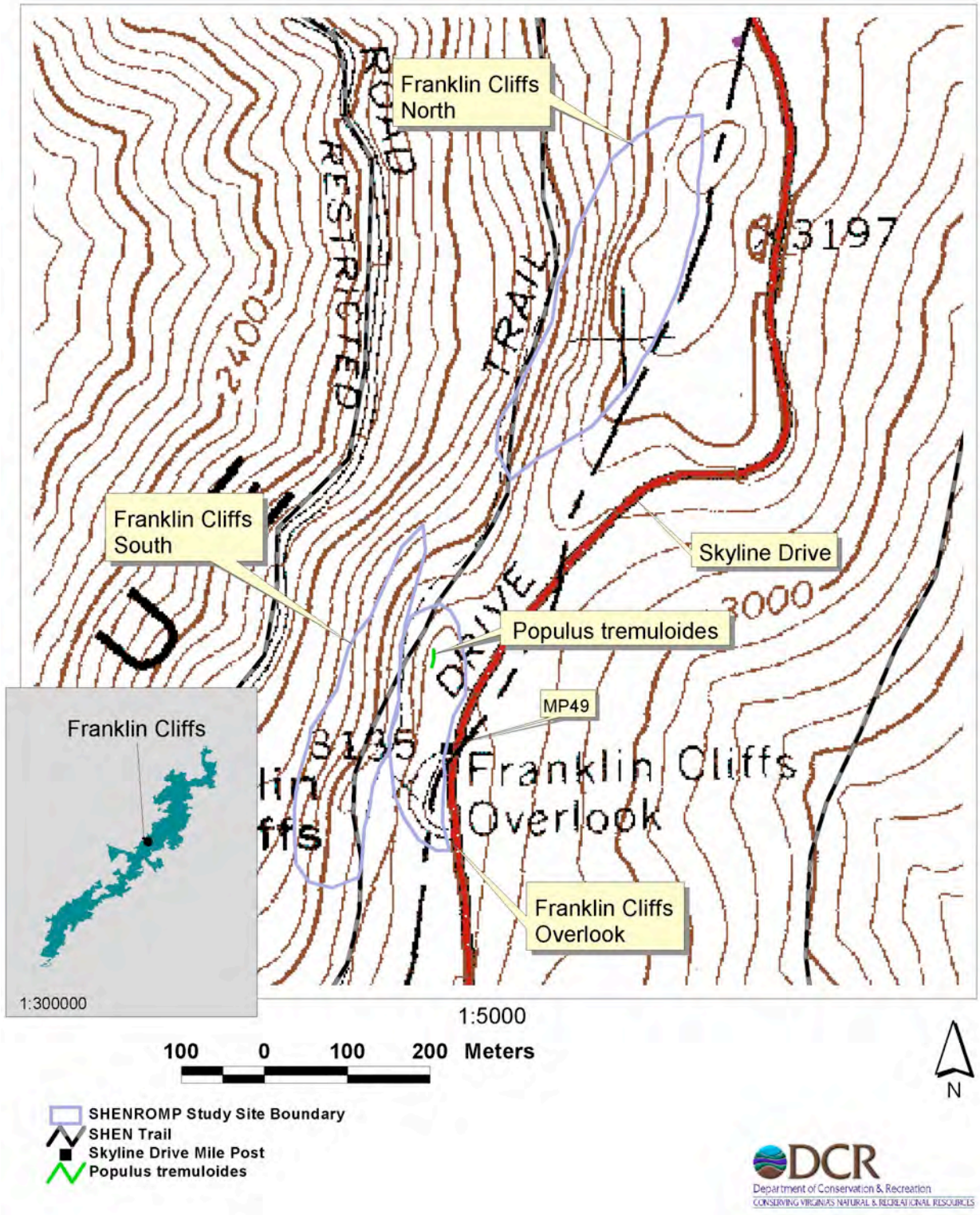


Fig. 135. Location of *Populus tremuloides* at Franklin Cliffs Overlook.

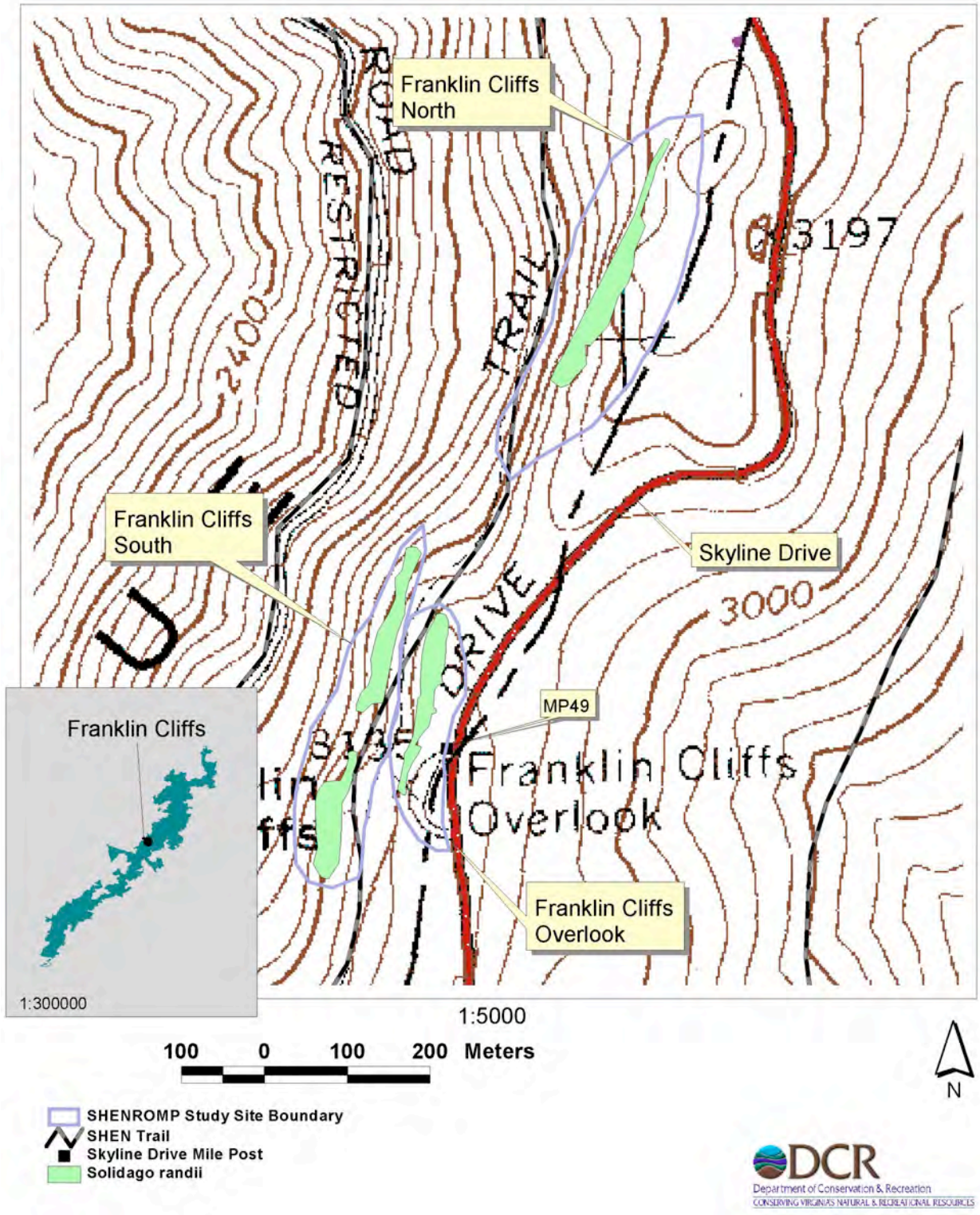


Fig. 136. Location of *Solidago randii* at Franklin Cliffs Overlook.

FRANKLIN CLIFFS SOUTH (C17)

CONSERVATION SITE: Franklin Cliffs (B2) **THREAT RANK:** 4

LOCALITY: Page County **QUADRANGLE(S):** Big Meadows

LOCATION: This Central District site lies on the west side of Skyline Drive. It extends from 0.30 km (0.18 mi) north northwest to 0.18 km (0.11 mi) southwest of Franklin Cliffs Overlook. It abuts the Franklin Cliffs Overlook site, which is immediately upslope.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Diervilla lonicera - Solidago randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii* Herbaceous Vegetation[1]	High-Elevation Greenstone Barren	G1	S1	None	None	C
Plants: *Solidago randii*[1]	Rand's goldenrod	G5T4	S2S3	None	None	BC
Animals: None						

[1]Parts of this element occurrence lie within the Franklin Cliffs North and Franklin Cliffs Overlook ROMP sites.

SITE DESCRIPTION: The outcrops at this site consist of a single, discontinuous line of metabasalt cliffs with west to northwest aspects. This line of exposures extends for about 420 m (1,378 ft), but is broken in several places by intervening steep, rocky, forested slopes. A particularly large gap is found near the center of the site. The level tops of these cliffs are mostly located at elevations between 920-930 m (3,020-3,050 ft). Cliff faces are often sheer, particularly towards the base, but there are also many less steeply inclined areas with numerous ledges.

The Appalachian Trail runs along a topographic bench at the top of the Franklin Cliffs South outcrops, providing easy access to several cliff top overlooks and ledges via short social trails. Many of the exposures at this site, however, are too steep to readily access.

NATURAL COMMUNITIES: The discontinuous outcrops at this site are embedded in a matrix of deciduous forest, principally the Central Appalachian Dry-Mesic Chestnut Oak - Northern Red Oak Forest. The vegetation of the outcrops is more difficult to classify, as much of it consists of a heterogeneous mixture of scrubby trees, including both higher-elevation species such as *Betula alleghaniensis* (yellow birch), and lower-elevation species such as *Quercus prinus* (chestnut oak), *Pinus rigida* (pitch pine), and *Pinus virginiana* (Virginia pine).

Several discrete ledges near the top of the outcrops support vegetation that has been classified as the globally rare High-Elevation Greenstone Barren community, which is endemic to several high-elevation sites in SHEN. At least one patch at the north end of the outcrop complex has a fairly typical composition, with scrubby *Betula alleghaniensis*, *Sorbus americana* (American mountain-ash), and *Diervilla lonicera* (northern bush honeysuckle) interspersed with herbaceous patches of *Solidago randii*

(Rand's goldenrod), *Deschampsia flexuosa* (wavy hairgrass), *Carex pensylvanica* (Pennsyvlania sedge), *Hylotelephium telephioides* (Allegheny stonecrop), *Houstonia longifolia* (longleaf bluets), and *Dennstaedtia punctilobula* (hay-scented fern). To the south, patches become increasingly transitional to lower-elevation metabasalt barrens with species such as *Fraxinus americana* (white ash), *Parthenium integrifolium* (wild quinine), *Symphyotrichum laeve* var. *concinnum* (smooth blue aster), *Helianthus divaricatus* (woodland sunflower), and *Penstemon canescens* (gray beardtongue) mixing with species more typical of the high-elevation barrens. Another small patch of vegetation occupying a 150 m^2 (492 ft^2), mid-cliff shelf at the south end of the outcrop complex is dominated by *Photinia melanocarpa* (black chokeberry) and resembles the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) but otherwise has a composition consistent with the High-Elevation Greenstone Barren community. Despite the transitional nature of some patches of vegetation on these outcrops, analysis of plot data indicate that all patches are best assigned to the latter type. Quantitative plot data were collected from this occurrence in 1999 (plot SHNP019) and again during the ROMP project (plot SHNP138).

RARE PLANTS: A previously known colony of *Solidago randii* (Rand's goldenrod) was relocated at this site. At least 500 clumps of this rare composite were seen here on September 13, 2006. Most of the plants were growing on cliff tops or on ledges just below the tops. Smaller numbers were seen on cliff faces, lower ledges, and the forest edge behind open cliff tops. Most plants were in full flower on the survey date. Many plants had galls.

A few individuals of the watchist plant *Crataegus pruinosa* (a hawthorn) were observed on cliff tops at this site.

RARE ANIMALS: No animal element occurrences were found by DCR-DNH at this site in 2005. One watchlist moth, *Cyclophora myrtaria* (a geometrid moth, n = 1), was captured at a UV-trap on 4 September 2005.

Plate 63. Narrow cliff top at Franklin Cliffs South. Small, scrubby patches of the High-Elevation Greenstone Barren community occur on these ledges.

THREATS: Most trampling impacts are on cliff tops and upper ledges which are easily accessed via short social trails from the Appalachian Trail. Impacts at several of these overlooks are severe, with soil heavily compacted and denuded of fragile herbaceous vegetation and bryophytes. *Solidago randii* has been nearly eliminated at one of these areas and severely reduced at several others.

Many areas not accessed by social trails or on the lower shelves of the outcrops are entirely undisturbed. However, the vegetation patches most representative of the globally rare barrens community are at the top, adjacent to trails.

A 0.5 x 2.0 m (1.6 x 6.6 ft) patch of the highly invasive grass *Microstegium vimineum* (Japanese stiltgrass) was found on a cliff top near the northern end of this site.

MANAGEMENT RECOMMENDATIONS:

Close most social trails from the Appalachian Trail to the outcrops. Contain visitation to only the most degraded outcrop. Use signs to inform visitors of the sensitive resources and their conservation value. Use barriers if necessary.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor the recovery of the rare plant and the health of the significant natural community. Conduct a survey on a 3-5 year interval to assess the rare plant population and the health of High-Elevation Greenstone Barren. At the same time, conduct a survey and assessment of invasive plants.

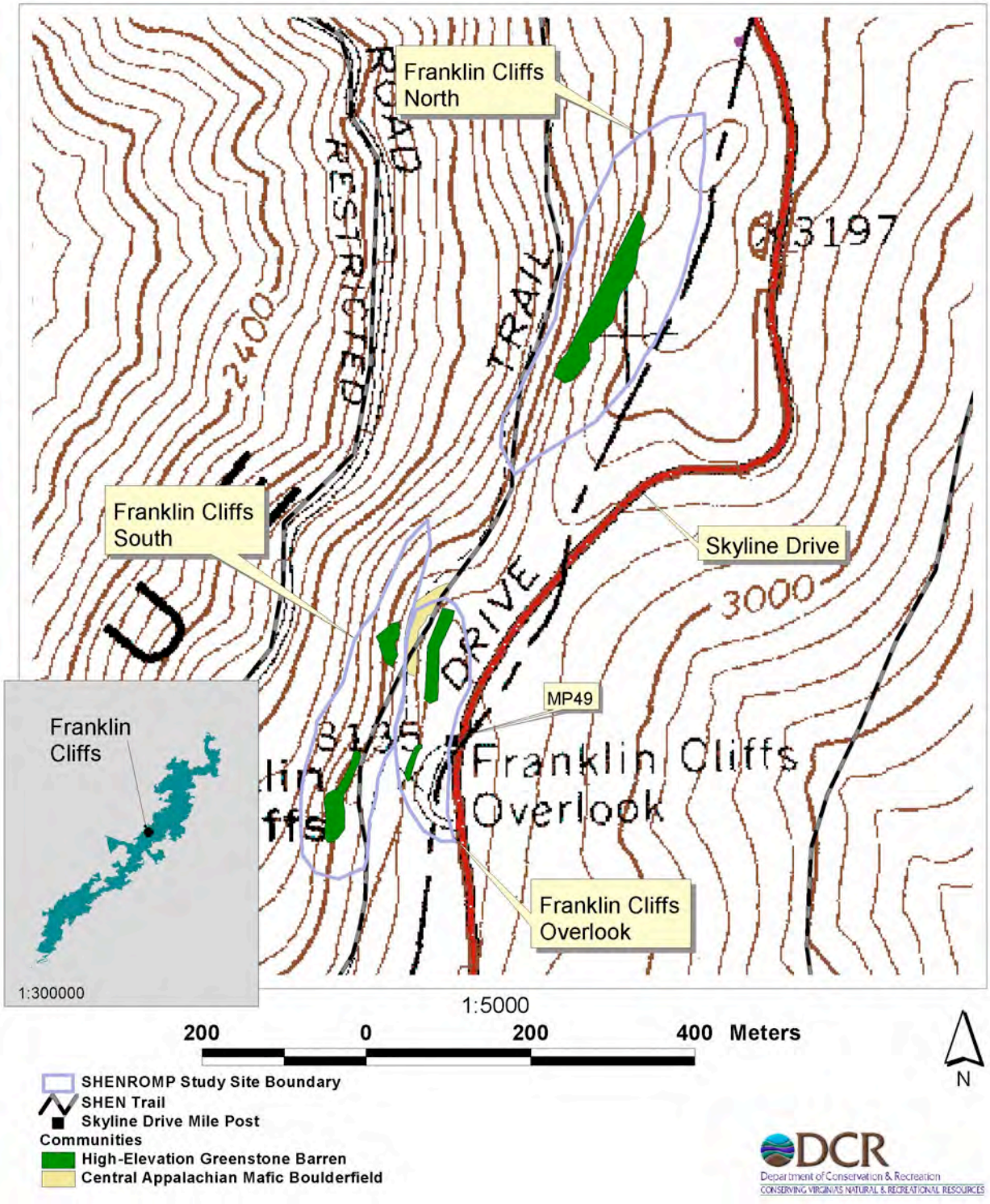


Fig. 137. Location of significant community at Franklin Cliffs South.

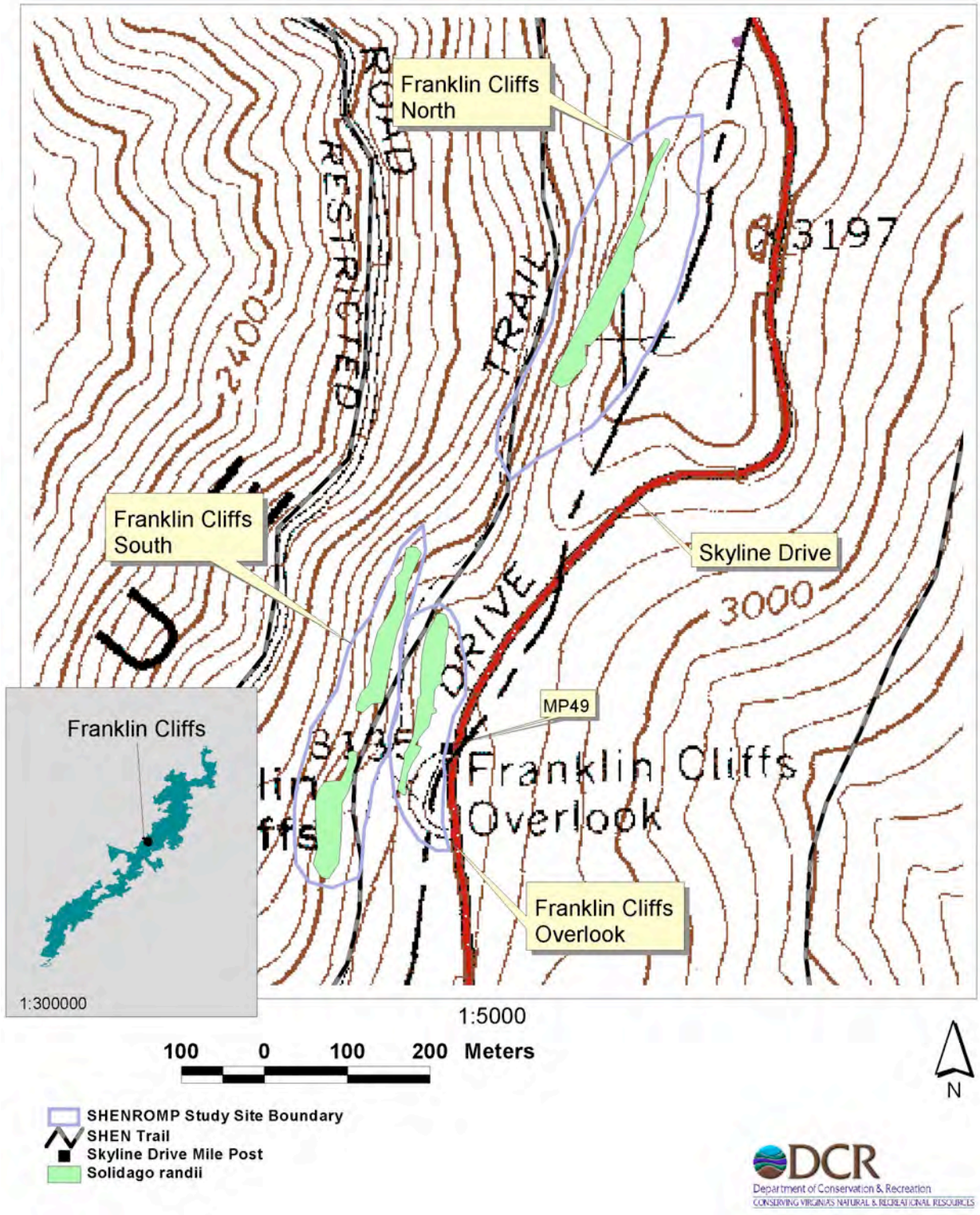


Fig. 138. Location of *Solidago randii* at Franklin Cliffs South.

ROSE RIVER CLIFFS (C68)

CONSERVATION SITE: Rose River Cliffs (B2) **THREAT RANK:** 2

LOCALITY: Madison County **QUADRANGLE(S):** Big Meadows

LOCATION: This site is located in the Central District east of Skyline Drive. It extends from 3.06-3.60 km (1.90-2.22 mi) southeast of Fishers Gap.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana - Carya glabra* / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	A
Juniperus virginiana - Fraxinus americana / *Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation	Central Appalachian Circumneutral Barren	G2	S2	None	None	A
Plants: None						
Animals: None						

SITE DESCRIPTION: This large, complex site is located on steep, southwest-facing slopes above the Rose River at elevations extending from 518 m (1,700 ft) to almost 744 m (2,400 ft). The bedrock here is Catoctin Formation metabasalt.

The site's principal feature is an open, linear exposure that extends for about 140 m (459) ft at elevations of 634-671 m (2,080-2,200 ft). A massive cliff forms the base of this exposure, which grades upward into a variety of ledges, faces, and outcrops. A large, smooth face is found at the southeastern end of this exposure, an unusual feature for metabasalt. Smaller faces are found at the exposure's northeastern end.

A smaller but similar exposure is found upslope at elevations of about 701-735 m (2,300-2,410 ft). This exposure has more ledges and fewer areas of smooth rock faces. In the southern portion of the site, a series of ledges and small cliffs are separated by relatively level terraces. There are only a few small canopy openings in this area, however.

This site is located away from roads and trail and receives little visitation.

NATURAL COMMUNITIES: The matrix forest vegetation of this site is a complex of Central Appalachian Basic Oak – Hickory Forest (Submontane / Foothills Type), Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest, and Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. Areas of cliffs, outcrops, and shallow rocky soils at three topographic levels support complexes of two globally rare communities: the Central Appalachian Circumneutral Barren on the most

exposed cliffs and outcrops, and the Central Appalachian Basic Woodland on areas with somewhat greater soil development.

Two patches of Central Appalachian Circumneutral Barren were documented. The larger of these, covering 0.25 ha (0.65 ac), is situated on several massive, steeply dipping outcrops and cliffs in the middle of the site. Stunted and gnarled *Juniperus virginiana* var. *virginiana* (eastern redcedar) is the dominant woody plant of this community, forming a very sparse to open canopy. Stunted *Fraxinus americana* (white ash), *Carya ovalis* (red hickory), and *Pinus virginiana* (Virginia pine) are scattered in the stands. *Rosa carolina* var. *carolina* (pasture rose) is an abundant low shrub while *Rhus typhina* (staghorn sumac) is locally important. Herbs are quite patchy, rooting in crevices and mats of moss, organic matter, gravel, or thin colluvial soil. Herbaceous patch-dominants include *Schizachyrium scoparium* (little bluestem; on dry rocks), *Selaginella rupestris* (ledge spikemoss; on dry rocks), and *Talinum teretifolium* (roundleaf fameflower; on mossy, seasonally wet rocks). Other characteristic herbs are *Allium cernuum* (nodding onion), *Ambrosia artemisiifolia* (common ragweed), *Cyperus lupulinus* ssp. *lupulinus* (a flatsedge), *Hylotelephium telephioides* (Allegheny stonecrop), *Houstonia longifolia* (longleaf bluets), *Corydalis sempervirens* (pink corydalis), *Bulbostylis capillaris* (common hairsedge), *Dichanthelium acuminatum* var. *acuminatum* (woolly panic grass), *Dichanthelium linearifolium* (narrow-leaf panic grass), *Juncus secundus* (secund rush), *Carex pensylvanica* (Pennsylvania sedge), *Helianthus divaricatus* (woodland sunflower), *Penstemon canescens* (gray beardtongue), *Danthonia spicata* (poverty oat-grass), *Agrostis perennans* (autumn bentgrass), *Silene caroliniana* ssp. *pensylvanica* (wild pink), *Arabis laevigata* var. *laevigata* (smooth rockcress), *Heuchera americana* (American alumroot), and *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod). Characteristic non-vascular species on the open outcrops supporting this community include the moss *Grimmia laevigata* and the lichen *Dermatocarpon luridum* in periodically moist or wet microhabitats and the lichens *Xanthoparmelia conspersa*, *Lasallia papulosa*, *Rhizoplaca subdiscrepens*, *Diploschistes scruposus*, *Physcia* sp., *Flavoparmelia baltimorensis*, and numerous crusts in drier microhabitats. Quantitative plot data were collected from this occurrence during the ROMP project (plots SHNP154 and SHNP155).

The Central Appalachian Basic Woodland forms three patches covering 3.3 ha (8.1 ac) in aggregate. *Fraxinus americana*, *Carya ovalis*, *Carya glabra* (pignut hickory), and *Quercus prinus* (chestnut oak) are variably abundant co-dominants. *Ulmus rubra* (slippery elm), *Cercis canadensis* var. *canadensis* (eastern redbud), *Viburnum rafinesquianum* (downy arrow-wood), *Ostrya virginiana* (eastern hop-hornbeam), and *Rubus occidentalis* (black raspberry) are present in the understory. Abundant or characteristic herbaceous species include *Muhlenbergia sobolifera* (cliff muhly), *Solidago ulmifolia* var. *ulmifolia*, *Helianthus divaricatus*, *Brachyelytrum erectum* (common shorthusk), *Pycnanthemum incanum* (hoary mountain-mint), *Danthonia spicata* (poverty oat-grass), *Woodsia obtusa* ssp. *obtusa* (blunt-lobed woodsia), *Lespedeza intermedia* (wand bushclover), *Antennaria plantaginifolia* (plantain-leaf pussytoes), *Solidago arguta* (cut-leaved goldenrod), *Polygonatum biflorum* var. *biflorum* (Solomon's-seal), *Potentilla canadensis* (Canada cinquefoil), *Polygonum scandens* var. *cristatum* (crested false buckwheat), and *Symphyotrichum undulatum* (wavy-leaved aster).

The metabasalt barrens and woodlands at this site are among the largest of their types in the park, and their condition is pristine except for the presence of two exotic plants at low abundance (see Threats below).

RARE PLANTS: No rare or watchlist plants were found at this site.

RARE ANIMALS: No animal element occurrences were found by DCR-DNH in 2006. One watchlist moth species, *Lithacodia concinnimacula* (red-spotted Lithacodia), was captured on 16 May 2006 in a UV trap.

Plate 64. Open, periodically wet metabasalt face at Rose River Cliffs. This microhabitat supports mats of the bryophyte *Grimmia laevigata* and colonies of *Talinum teretifolium* (roundleaf fameflower).

THREATS: Despite the remote and undisturbed nature of this site, the exotic weeds *Commelina communis* (Asiatic dayflower) and *Rumex acetosella* (sheep-sorrell) are present in the significant natural communities. While *Rumex acetosella* does not currently represent a serious problem, *Commelina communis* is locally numerous in soil-filled crevices and on ledges within both the barrens and woodland communities.

MANAGEMENT RECOMMENDATIONS:

Manage the invasive plant *Commelina communis*. Herbicide is recommended for controlling this species. Hand-pulling *Commelina* will create more soil disturbance and is labor-intensive. Sponge or glove herbicide application methods are recommended to minimize non-target impacts that may accompany spray application.

Annually monitor the effectiveness of the invasive plant control effort. Continue monitoring *Commelina* for several years following treatment and assess need for further action. Once invasive have been controlled, include an invasive plant survey in 3-5 year site surveys.

Monitor the health of the rare natural communities. Following successful invasive plant control, conduct visits on a 3-5 year interval to assess the health of the significant natural communities. At the same time, conduct a survey and assessment of invasive plants.

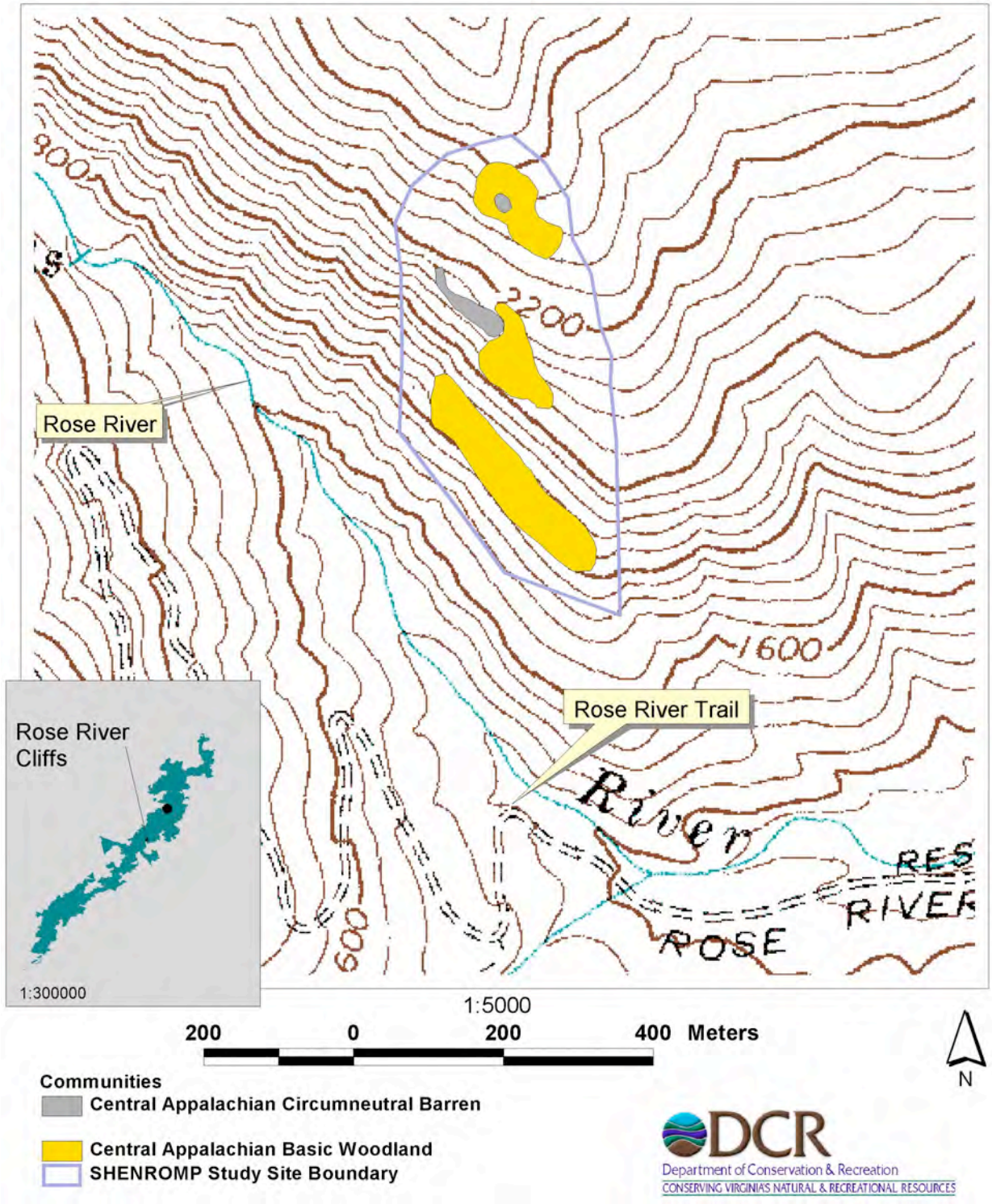


Fig. 139. Location of significant natural communities at Rose River Cliffs.

BLACKROCK CENTRAL DISTRICT (C04)

CONSERVATION SITE: Blackrock-Lewis Spring Falls (B2) **THREAT RANK:** 2

LOCALITY: Page County **QUADRANGLE(S):** Big Meadows

LOCATION: This site is located in the Central District and extends from 0.20-0.45 km (0.12-0.28 mi) southwest of the Big Meadows Lodge.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula alleghaniensis / *Sorbus americana* - *Acer spicatum* / *Polypodium appalachianum* Forest	Central Appalachian High-Elevation Boulderfield Forest	G2	S2	None	None	AB
Photinia melanocarpa - *Gaylussacia baccata* / *Carex pensylvanica* Shrubland	High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type	G1	S1	None	None	B
Plants:						
Rubus idaeus ssp. *strigosus*	Red raspberry	G5T5	S2	None	None	BC
Sibbaldiopsis tridentata	Three-toothed cinquefoil	G5	S2	None	None	D
Solidago randii	Rand's goldenrod	G4T4	S3S3	None	None	D
Animals:						
Itame ribearia	A geometrid moth	G4	S1S3	None	None	E

SITE DESCRIPTION: This site encompasses two northwest-facing cliffs of Catoctin Formation metabasalt. The upper cliff is about 75 m (246 ft) long and up to about 12 m (40 ft) high. The lower cliff is not as high, and it is intermittent, petering out to the south in a series of small outcrops. To the northwest of each cliff are extensive areas of large block metabasalt talus.

The two cliffs are oriented on a bias to the topographic contour. Therefore, the top of the upper cliff has an elevation of about 1,134 m (3,720 ft) at its northeastern end, but drops rather steeply to about 1,109 m (3,640 ft) at its southwestern end. The top of this upper cliff is broad and drops in a series of sunny terraces that provide ample habitat for rare plants. The face of this cliff is often sheer and well shaded due to its northerly orientation. The top of the lower cliff has a highly irregular surface with few places for plants to establish a foothold.

The two cliffs are separated from one another by the Appalachian Trail, which provides easy access to the lower cliff where hikers have established a couple of unofficial overlooks. The northeastern corner of the top of the upper cliff is easily accessed by a short, signed trail from the Big Meadows Lodge parking area. This area receives frequent visitation and some visitors continue further down the cliff top. Most apparently turn back when a steeper section of the cliff top is reached.

NATURAL COMMUNITIES: The gentle upper slopes of this site are forested with Northern Red Oak Forest (Pennsylvania Sedge – Wavy Hairgrass Type). Downslope, two globally rare communities occupy the metabasalt cliffs and talus.

The terraced top of the upper cliff is open and supports a 0.04 ha (0.1 ac) occurrence of the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community that has been somewhat degraded by hiker trampling. This shrubland is co-dominated by low colonies of *Photinia melanocarpa* (black chokeberry) and *Gaylussacia baccata* (black huckleberry). Additional woody species occurring here are stunted saplings of *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak), *Sorbus americana* (American mountain-ash), and *Prunus pensylvanica* (pin cherry); *Hamamelis virginiana* (witch-hazel), *Kalmia latifolia* (mountain-laurel), *Diervilla lonicera* (northern bush-honeysuckle), *Vaccinium pallidum* (early lowbush blueberry), *Rhododendron prinophyllum* (early azalea), *Ribes rotundifolia* (Appalachian gooseberry), and *Menziesia pilosa* (minniebush). Crevices and depressions filled with gravel or organic matter support small herbaceous patches of *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Sibbaldiopsis tridentata* (three-toothed cinquefoil), *Danthonia spicata* (poverty oat-grass), *Agrostis perennans* (autumn bentgrass), *Carex pensylvanica* (Pennsylvania sedge), *Heuchera pubescens* (marbled alumroot), *Hylotelephium telephioides* (Allegheny stonecrop), and *Lysimachia quadrifolia* (whorled loosestrife). Colonies of *Maianthemum canadense* (Canada mayflower) occur in moist moss under the shrubs. Quantitative plot data were collected from this stand during the ROMP project (plot SHNP137).

A long, narrow, 0.5 ha (1.2 ac) patch of Central Appalachian High-Elevation Boulderfield Forest occupies the large-block talus below the cliffs. Other than the slight fragmentation caused by the Appalachian Trail, this community is an outstanding occurrence containing all the representative variation in the type. The northern part of the stand has a more or less closed canopy of old, gnarled *Betula alleghaniensis*, with an understory of shrubby *Sorbus americana* and *Acer spicatum* (mountain maple). Except immediately below the cliff, the southern part of the stand is shrubbier and dominated by *Sorbus americana*. Additional woody associates include *Ilex montana* (mountain holly), *Sambucus racemosa* var. *pubens* (red elderberry), *Prunus pensylvanica*, *Rubus idaeus* ssp. *strigosus* (red raspberry), and *Menziesia pilosa*. Herbs are sparse but include *Polypodium appalachianum* (Appalachian rock polypody), *Carex aestivalis* (summer sedge), *Carex brunnescens* ssp. *sphaerostachya* (brownish sedge), *Dryopteris marginalis* (marginal wood-fern), *Gymnocarpium appalachianum* (Appalachian oak fern), and *Heuchera pubescens*. Quantitative plot data were collected from this occurrence in 1999 (plot SHNP033).

Lichen assemblages on protected outcrops and boulders are typical of those found on high-elevation metabasalt in the park. Among the characteristic species here are *Lasallia papulosa*, *Umbilicaria muehlenbergii*, *Xanthoparmelia conspersa*, *Flavoparmelia baltimorensis*, *Dimelaena oreina*, *Stereocaulon glaucescens*, *Melanelia stygia*, *Rhizocarpon geographicum*, *Chrysothrix chlorina*, *Porpidia* spp., *Lepraria* spp., *Aspicilia cinerea*, and *Fuscidea recensa*.

RARE PLANTS: Three rare plant populations were located at this site. Previously known populations of *Solidago randii* and *Rubus idaeus* ssp. *strigosus* (red raspberry) were relocated, and a new population of *Sibbaldiopsis tridentata* was found.

One small patch of *Solidago randii* was found at the northeastern corner of the top of the upper cliff. About 25 clumps were found here in a 4 m^2 (43 ft^2) area. A single additional clump was found about 30 m (98 ft) west-southwest of this patch.

Two small patches of *Sibbaldiopsis tridentata* were found along the top of the upper cliff. At the easternmost location, mats of this species occupy about 12 percent of a 4 m^2 (43 ft^2) area. At the westernmost location, mats occupy about 15 percent of a 1 m^2 (11 ft^2) area.

Rubus idaeus ssp. *strigosus* was mostly found on northwest-facing talus slopes to the northwest of the cliffs. A few plants were seen, however, at the northeastern corner of the top of the upper cliff. The plant was seen in two areas totaling 0.19 ha (0.46 ac). The number of canes present was estimated at 1,300.

There is a record for *Cornus rugosa* (roundleaf dogwood) at this site from 1976. Attempts have been made over the years to relocate this population without success. The occurrence is now considered by DCR-DNH to be historical (DCR-DNH Biotics data).

RARE ANIMALS: A UV-trap was set at Blackrock Central on 13 July, 2005, ran overnight, and picked up on 14 July, 2005. The light was placed about 325 m southwest of the Big Meadows Lodge in a hardwood forest with an open understory and near a rock ledge. Included in the capture was one specimen of *Itame ribearia* (Currant spanworm moth) and three watchlist moth species (one specimen each): *Apamea lignicolor* (wood-colored Apamea moth) *Itame subcessaria* (barred Itame moth), and *Xanthorhoe labradorensis* (Labrador carpet). Another UV-trap was set from 6-7 June 2006 that caught two additional watchlist moth species: *Hydriomena bistrialis* (a geometrid moth) and *Lithacodia concinnimacula* (red-spotted Lithacodia moth).

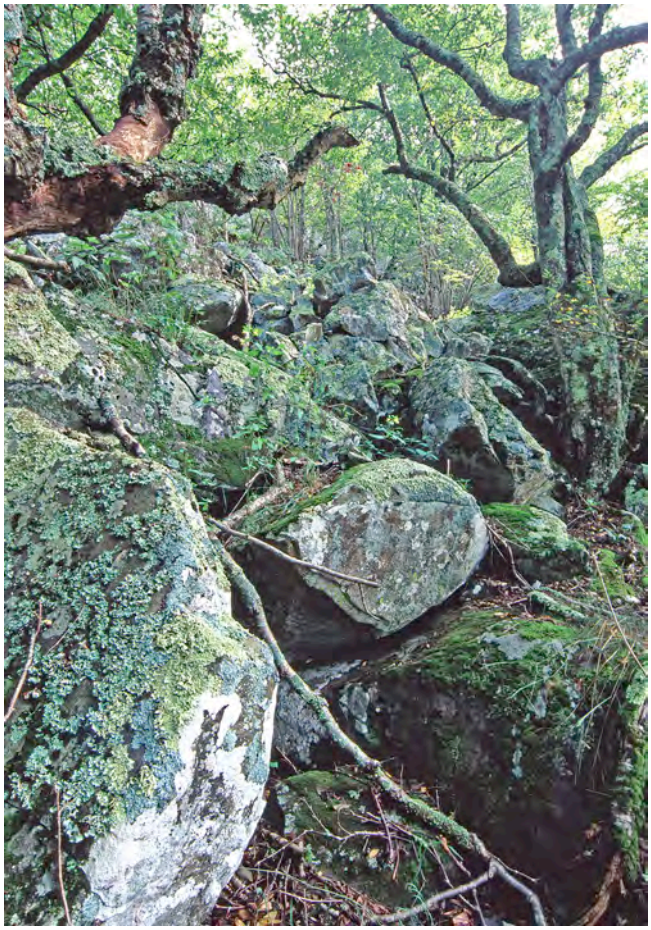


Plate 65. Central Appalachian High-Elevation Boulderfield Forest at Blackrock Central District. Deeply piled talus and gnarled, stunted *Betula alleghaniensis* (yellow birch) are characteristic of this community type.

THREATS: Trampling is severe at the northeastern corner of the upper cliff and at Appalachian Trail overlooks on the lower cliff. Trampling is moderate elsewhere on the upper cliff. *Solidago randii* and *Sibbaldiopsis tridentata* occupy only a small fraction of what appears to be suitable habitat for these

species and could easily be lost from the site without management action. The small size and low stature of the High-Elevation Outcrop Barren vegetation makes it very vulnerable to damage from trampling. The dominant shrubs of this community may have been eliminated from some shelves and crevices at this site by decades of heavy visitation.

Exotic and aggressive native species found on this outcrop include *Stellaria media* (common chickweed), *Plantago rugelii* (pale plantain), *Galinsoga parviflora* (small flowered quickweed), *Poa pratensis* (Kentucky bluegrass), *Poa annua* (flat-stemmed bluegrass), *Taraxacum officinale* (common dandelion), *Trifolium repens* (white clover), *Rumex acetosella* (sheep sorrel), *Bromus japonicus* (Japanese brome grass), *Rectum minus* (lesser burdock), *Phleum pratense* (meadow timothy), and *Achillea millefolium* (common yarrow). These species are indicators of trampling disturbance at the site and are a direct threat to the compositional integrity of the significant High-Elevation Outcrop Barren community.

Rock climbing or other visitor uses probably have little impact on any of the moth species. The primary threat to these animals is the use of pesticides for gypsy moth or other insect control.

MANAGEMENT RECOMMENDATIONS: This is one of only 11 known sites in the world for the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community. As such, it merits strong protection and remedial action to contain and reduce the ongoing destructive impacts by hikers.

Contain visitation to the uppermost outcrop overlook. If necessary, use barriers to deter access to the High Elevation Outcrop Barren on the lower outcrops.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor recovery of the rare plants and the health of the rare natural communities. Following implementation of management actions, conduct annual assessments of rare plant populations and the health of the significant natural communities. At the same time, conduct a survey and assessment of invasive plants.

There are no specific management recommendations for the rare moth species. Further sampling is recommended to determine the species' range within SHEN. In addition, only target specific pesticides should be used in the vicinity of the site.

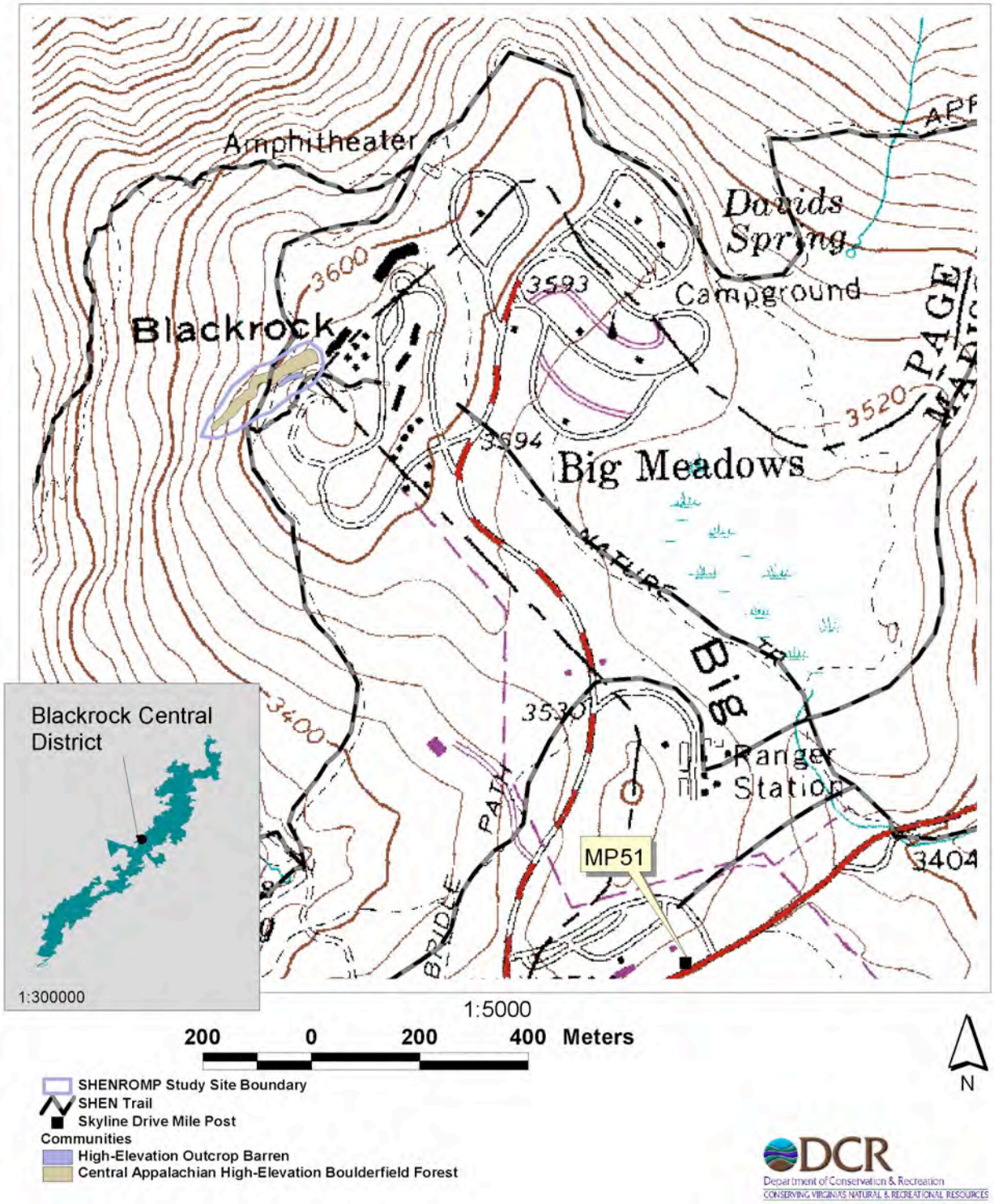


Fig. 140. Location of significant natural communities at Blackrock Central District.

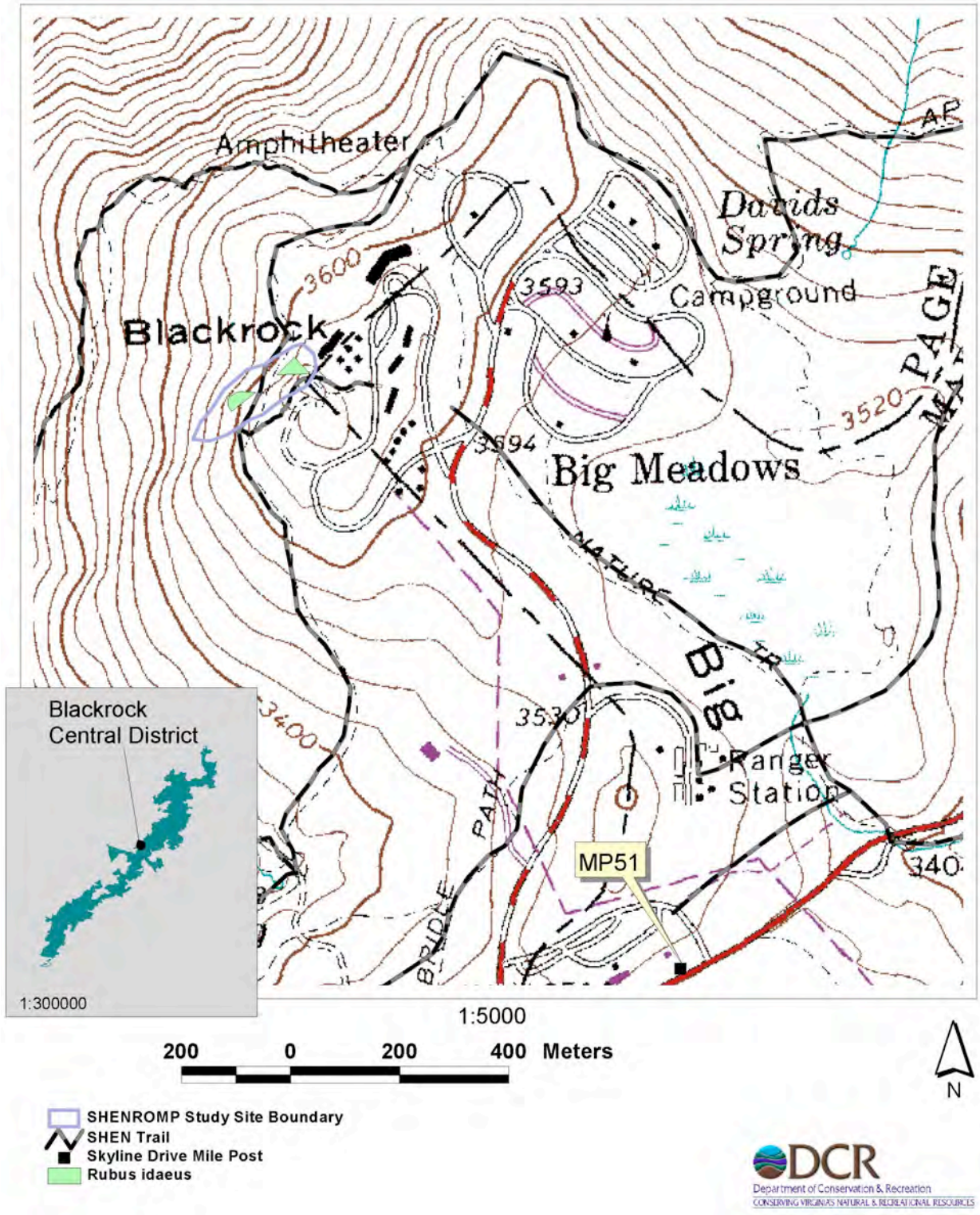


Fig. 141. Location of *Rubus idaeus* ssp. *strigosus* at Blackrock Centarl District.

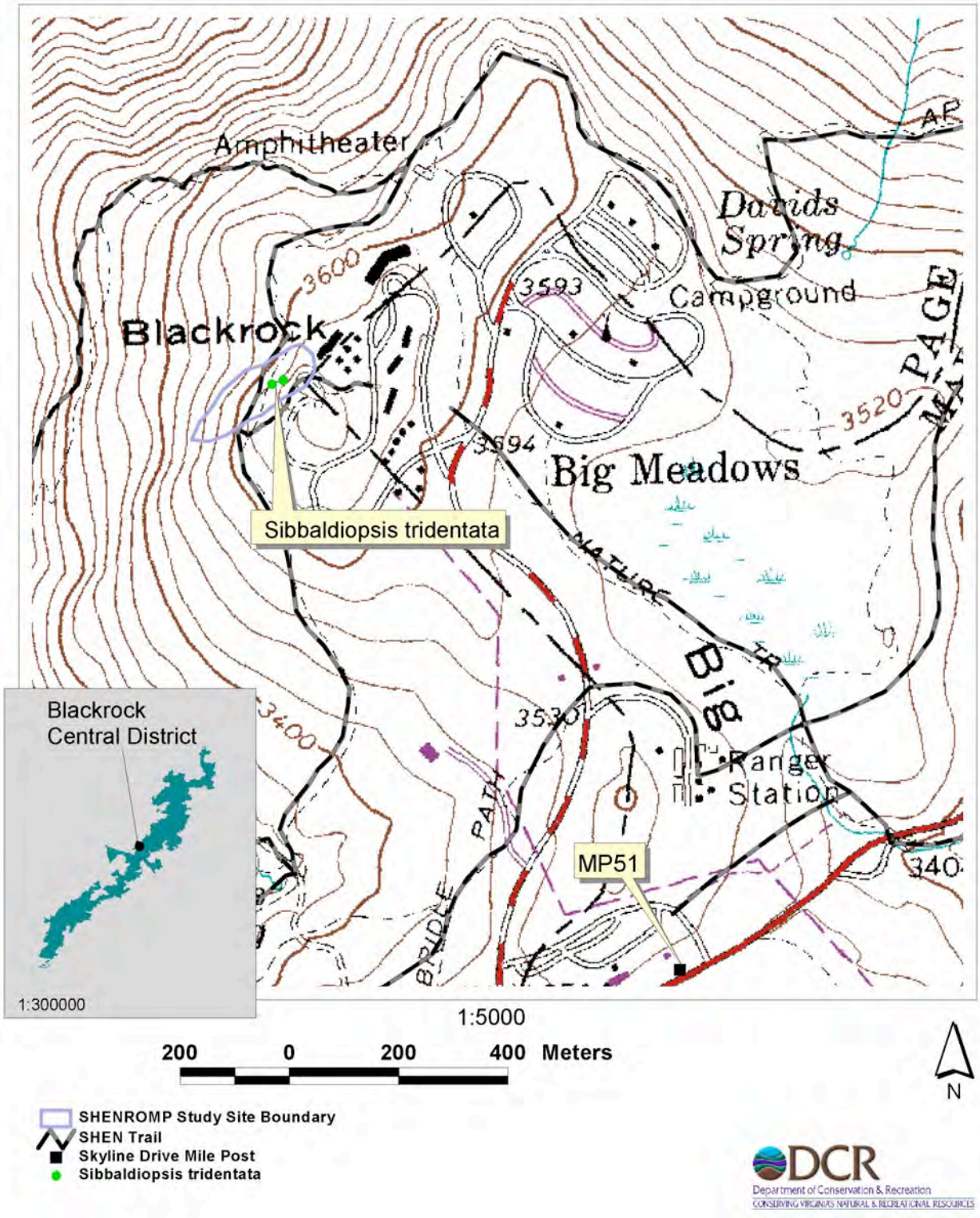


Fig. 142. Location of *Sibbaldiopsis tridentata* at Blackrock Central District.

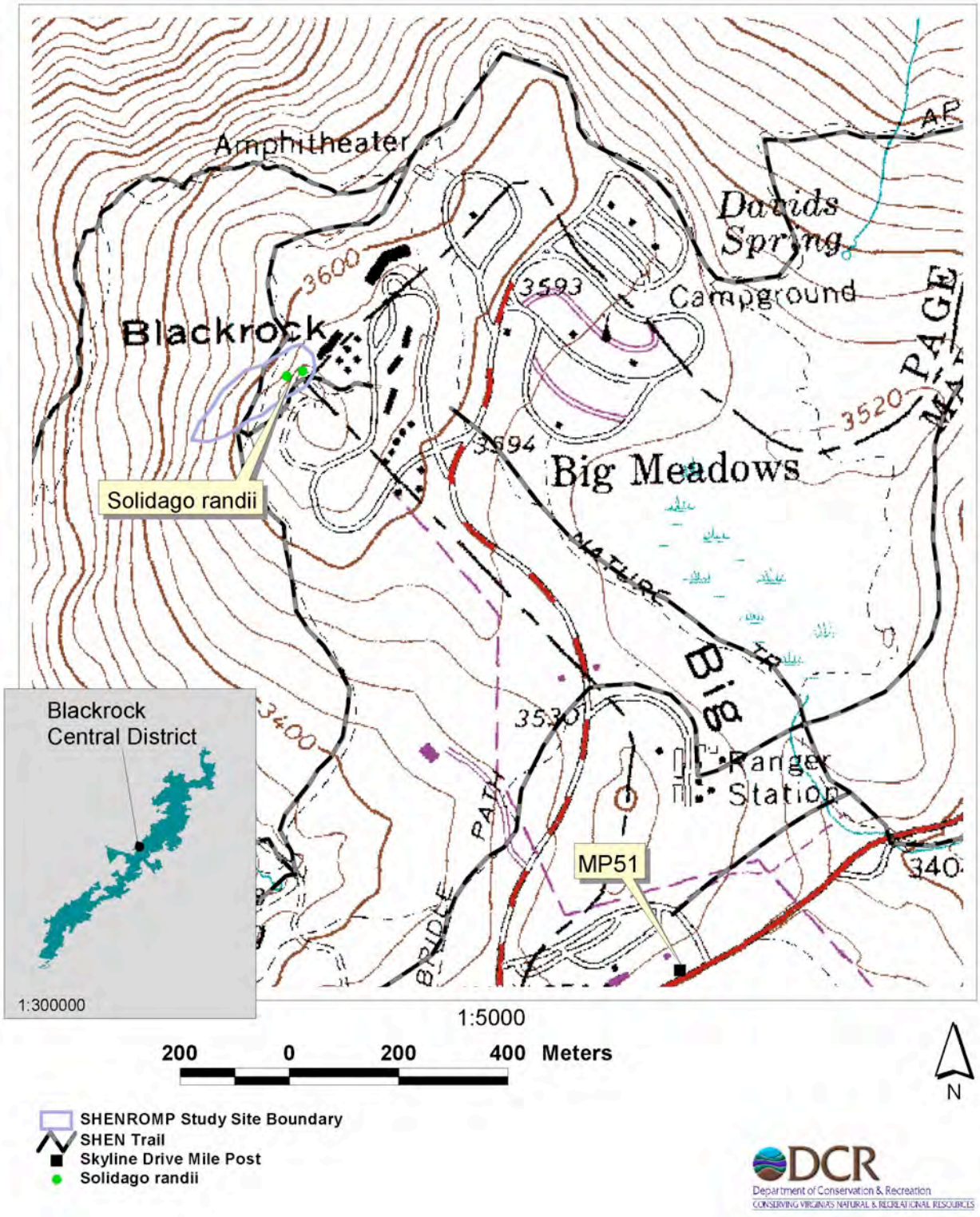


Fig. 143. Location of *Solidago randii* at Blackrock Central District.

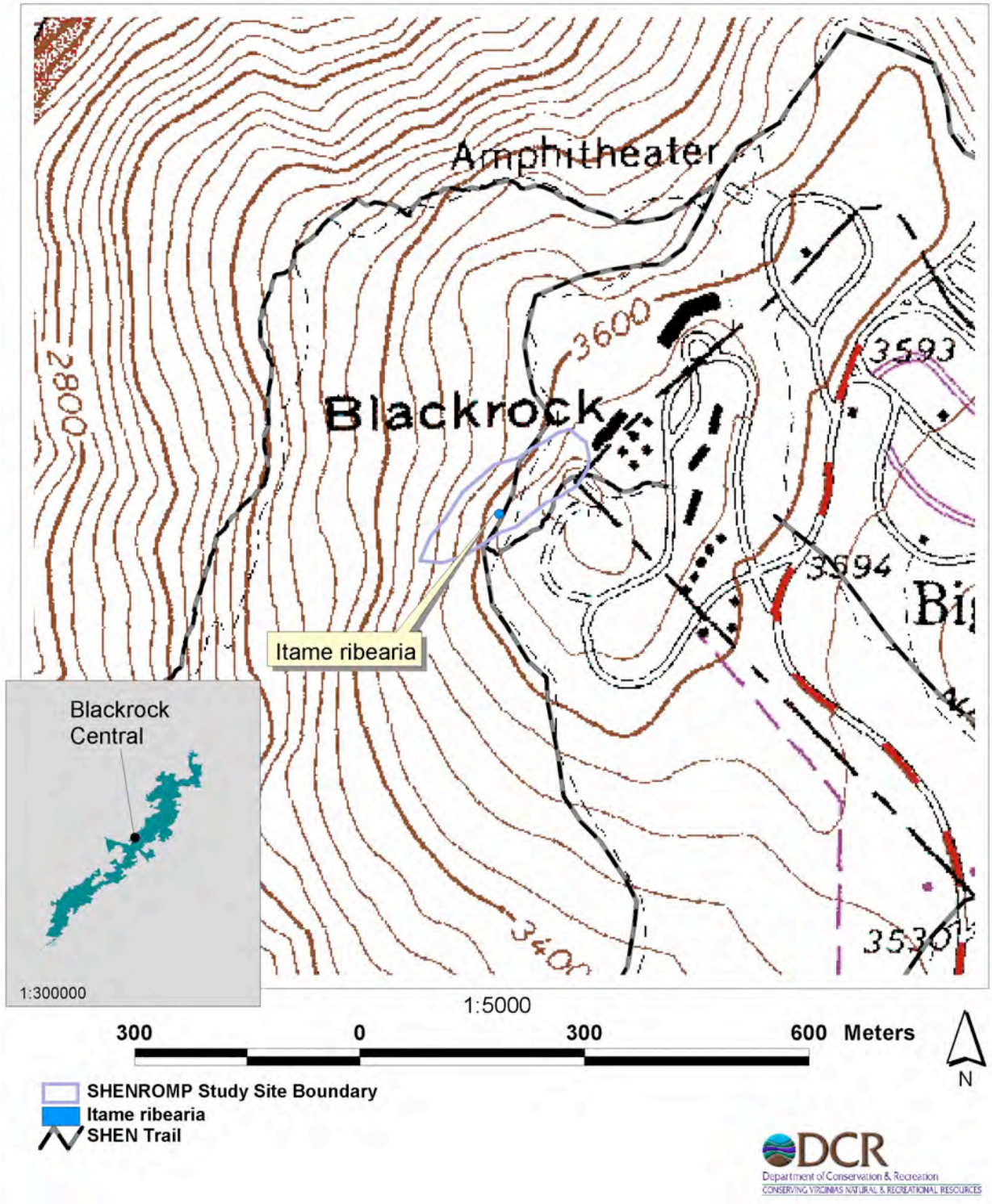


Fig. 144. Location of *Itame ribearia* at Blackrock Central District.

BEARFENCE MOUNTAIN (C67)

CONSERVATION SITE: Bearfence Mountain (B2) **THREAT RANK:** 5

LOCALITY: Page and Greene Counties **QUADRANGLE(S):** Fletcher

LOCATION: This Central District site is located a short distance east of Skyline Drive. It extends from the summit of Bearfence Mountain northward for 0.52 km (0.32 mi).

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Photinia melanocarpa - Gaylussacia baccata* / *Carex pensylvanica* Shrubland	High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type	G1	S1	None	None	C
Plants: *Solidago randii*	Rand's goldenrod	G5T4	S2S3	None	None	B
Animals: None						

SITE DESCRIPTION: This site encompasses a long spine of open Catoctin Formation metabasalt located on a narrow ridge that extends north from the summit of Bearfence Mountain. The open spine begins about 200 m (656 ft) north of the summit at an elevation of 1,061 m (3,480 ft). From there it extends due north for about 300 m (984 ft), dropping to an elevation of 1,039 m (3,410 ft). Dropoffs to the west are sharp, consisting of sheer cliffs up to about 15 m (49 ft) high or steeply pitched ledgy exposures. To the east, the dropoffs are somewhat gentler, but cliffs are present in places on that side of the spine as well. A small opening is also present about 70 m (230 ft) northwest of the Bearfence Mountain summit.

The Bearfence Rock Scramble trail traverses the top of the metabasalt spine, and the Appalachian Trail runs along the base of the spine to the west. The two trails converge both north and south of the site boundary, forming a loop. This loop is a popular day hike located just a short distance east of Skyline Drive.

NATURAL COMMUNITIES: Wooded slopes surrounding the outcrop at this site support several different forest communities. Central Appalachian Montane Oak – Hickory Forest (Basic Type) is prevalent on the eastern slopes, except for a small area of Northern Red Oak Forest (Pennsylvania Sedge – Wavy Hairgrass Type) near the crest. On the western flank of Bearfence, Central Appalachian Northern Hardwood Forest (Yellow Birch – Northern Red Oak Type) occupies a narrow zone on the rocky, upper slope, transitioning quickly to Central Appalachian Basic Boulderfield Forest (Montane Basswood – White Ash Type) at slightly lower elevations.

Open parts of the massive summit outcrop support small, degraded patches of the globally rare High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community. This is a patchy shrubland with *Photinia melanocarpa* (black chokeberry), *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (early lowbush blueberry), *Diervilla lonicera* (northern bush-honeysuckle), *Sassafras albidum* (sassafras), *Kalmia latifolia* (mountain-laurel), and *Smilax tamnoides* (bristly greenbrier)

prominent in variable combinations. Small herbaceous patches containing *Solidago randii* (Rand's goldenrod), *Hylotelephium telephioides* (Allegheny stonecrop), *Carex pensylvanica* (Pennsylvania sedge), *Carex aestivalis* (summer sedge), *Danthonia spicata* (poverty oat-grass), *Polypodium appalachianum* (Appalachian rock polypody), *Campanula divaricata* (southern hairbell), and *Agrostis perennans* (autumn bentgrass) are interspersed among the shrubs. Stunted *Betula alleghaniensis* (yellow birch), *Tsuga canadensis* (eastern hemlock), and *Quercus rubra* (northern red oak) occur along the edges, in an ecotone with the adjacent forests. Quantitative plot data were collected from this occurrence during the ROMP project (plot SHNP134).

Lichens have been extensively damaged and worn off main rock summits by trampling However, protected faces have dense and diverse lichen cover by *Lasallia papulosa*, *Umbilicaria muehlenbergii*, *Stereocaulon glaucescens*, *Porpidia* sp., *Aspicilia cinerea*, *Rhizoplaca subdiscrepens*, *Rhizocarpon geographicum*, and many other species.

RARE PLANTS: A previously known population of *Solidago randii* was relocated at this site in 2006. Plants were found in open areas along the entire length of the metabasalt spine; 900-1,000 clumps were seen here on the September 20 survey date. Many plants appeared to be of below average vigor on that date. In addition, the condition of this population appears to have declined since 1991 because of increased trampling impacts.

RARE ANIMALS: No animal element occurrences or watchlist species were found during DCR-DNH surveys in 2006.

Plate 66. *Photinia melanocarpa* (black chokeberry) growing in metabasalt crevices at Bearfence Mountain.

THREATS: A popular circuit trail traverses part of outcrop summit, most of natural community occurrence, and significant parts of the *Solidago randii* population. The habitat and vegetation have been severely damaged by decades of constant heavy trampling. Exotics observed on the outcrops included *Digitaria ischaemum* (smooth crabgrass) in two locations and a small amount of the highly invasive species *Poa compressa* (flat-stemmed bluegrass) in one location. The highly invasive species *Alliaria petiolata* (garlic mustard) and *Polygonum caespitosum* var. *longisetum* (long-bristled smartweed) were seen in more shaded trailside habitats off the outcrops.

MANAGEMENT RECOMMENDATIONS: This is one of only 11 known sites in the world for the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community. As such, it merits strong protection and remedial action to contain and reduce the ongoing destructive impacts by hikers before the vegetation reaches a non-recoverable condition.

Close the southern portion of the Bearfence Rock Scramble trail and make the existing trail dead-end at the outcrop summit viewpoint. Use barriers if necessary.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Reduce the abundance of the invasive plant *Digitaria sanguinalis* on the High-Elevation Outcrop Barren. The use of herbicide is recommended for controlling this species because hand-pulling will create more soil disturbance and is labor-intensive. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Monitor recovery of the rare plant and the health of the rare natural community. Conduct a survey on a 3-5 year interval to assess *Solidago randii* population and the health of the High-Elevation Outcrop Barren. At the same time, conduct a survey and assessment of invasive plants.

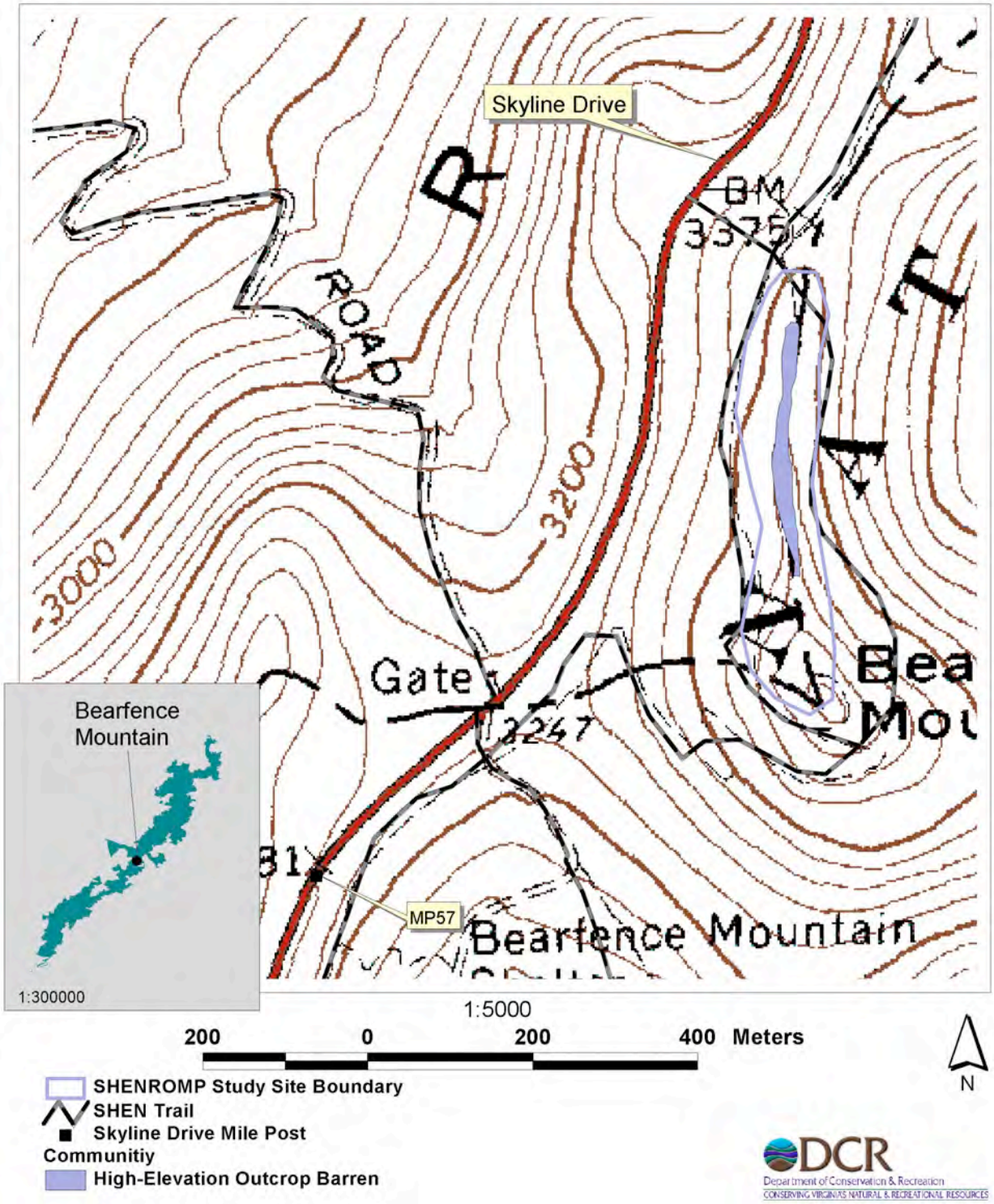


Fig. 145. Location of significant natural community at Bearfence Mountain.

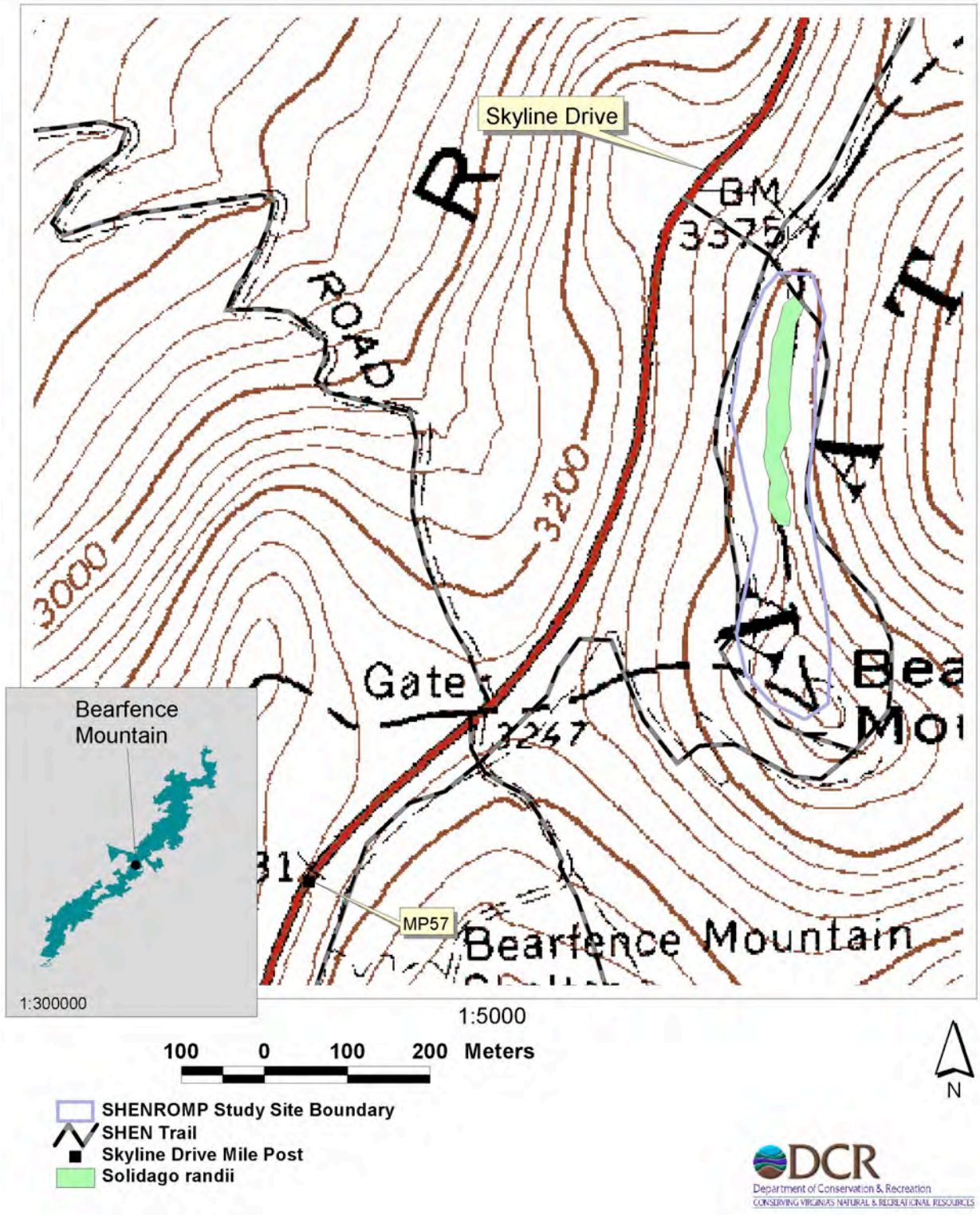


Fig. 146. Location of *Solidago randii* at Bearfence Mountain.

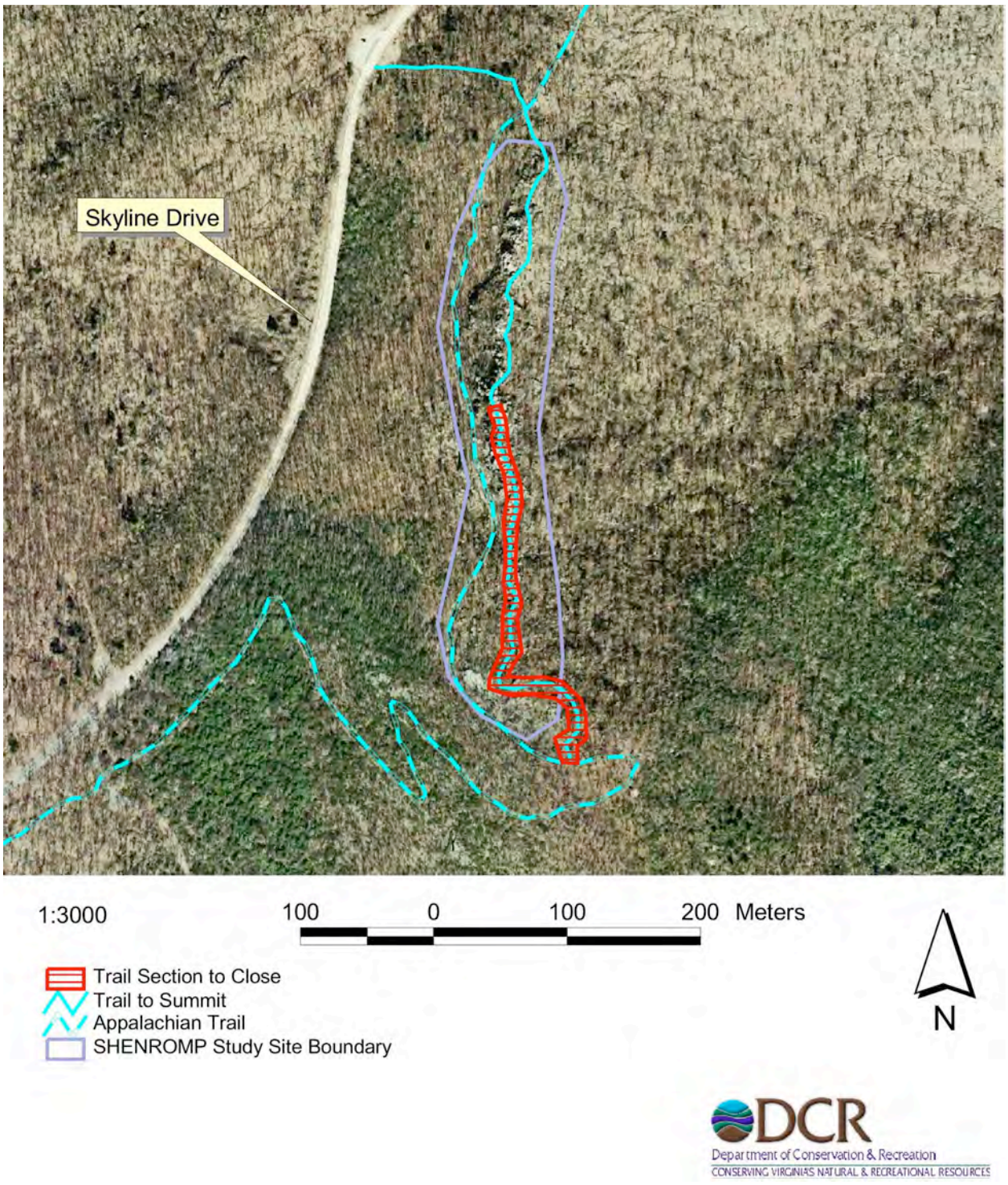


Fig. 147. Site details for Bearfence Mountain, showing section of trail recommended for closure.

UPPER DEVILS DITCH (C50)

CONSERVATION SITE: None **THREAT RANK:** 0

LOCALITY: Greene County **QUADRANGLE(S):** Fletcher

LOCATION: This Central District site is located east of Skyline Drive. It extends from 0.35 km (0.21 mi) southeast to 0.84 km (0.52 mi) south southeast of the Bearfence Mountain Hut.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: None						
Plants: None						
Animals: None						

SITE DESCRIPTION: This site encompasses three west-by-southwest-facing charnockite outcrops at elevations between 951 m (3,120 ft) and 975 m (3,200 ft). From north to south, the sizes of the outcrops are about 0.10 ha (0.26 ac), 0.01 ha (0.04 ac), and 0.11 ha (0.29 ac), respectively. The upper slopes of these outcrops are gently to moderately inclined, but lower slopes are quite steep, often exceeding 40 percent. Weathering by exfoliation is evident.

These outcrops are sparsely vegetated. A few shallow depressions, ledges, and crevices allow a build-up of organic debris sufficient to supports mats of herbs and scattered woody species. Most vegetation is on the more gently inclined upper slopes.

While these outcrops are a short distance from Skyline Drive and as close as 80 m (262 ft) from the Slaughter Trail, they appear to receive little or no visitation. The terrain here is steep, and the outcrops are surrounded by dense thickets of *Kalmia latifolia* (mountain-laurel).

NATURAL COMMUNITIES: No significant natural communities were found at this site. Most of the wooded slope within the site boundary is vegetated with a fine, old stand of Central Appalachian Low-Elevation Chestnut Oak Forest with a dense shrub layer of *Kalmia latifolia*. Local concavities with deeper talus support small stands of Sweet Birch – Chestnut Oak Talus Woodland. The slightly exfoliating granitic exposures are densely covered by lichens. Convex faces are generally dominated by *Dimelaena oreina* and *Xanthoparmelia conspersa*, while concave faces and seepage courses support a variety of more mesophytic lichens and large moss mats of *Grimmia laevigata*. A scrubby, lithophytic version of Central Appalachian Pine – Oak / Heath Woodland occupies the upper edges of the outcrops. This consists of scattered, stunted *Pinus rigida* (pitch pine), *Pinus pungens* (table-mountain pine), *Pinus strobus* (white pine), *Quercus prinus* (chestnut oak), and *Quercus rubra* (northern red oak), along with small patches of *Gaylussacia baccata* (black huckleberry), *Vaccinium pallidum* (early lowbush blueberry), and *Kalmia latifolia* (mountain-laurel). Herbs are scarce but scattered individuals of *Danthonia spicata* (poverty oat-grass), *Dichanthelium acuminatum* var. *acuminatum* (woolly panic grass), *Solidago puberula* var. *puberula* (downy goldenrod), and *Carex pensylvanica* (Pennsylvania sedge) were recorded.

In addition to the species mentioned above, the following lichens were recorded from the open outcrops: on drier rocks, *Lasallia pensylvanica*, *Lasallia papulosa*, *Umbilicaria muehlenbergii*, *Fuscidia recensa*,

Acaraspora fuscata, *Diploschistes scruposus*, and *Rhizoplaca subdiscrepens* were found; on periodically moist rocks, *Umbilicaria mammulata*, *Cladonia* spp., and *Stereocaulon glaucescens* were found.

RARE PLANTS: No rare or watchlist plants were located at this site.

RARE ANIMALS: No animal element occurrences were found by DCR-DNH in 2005. Two watchlist moths were captured in a UV-trap on 9 June 2005 (one specimen each): *Metarranthis mestusata* (a geometrid moth) and *Phlogopohora iris* (olive angle shades).

Plate 67. The southernmost of three exposed, charnockite outcrops at Upper Devils Ditch.

THREATS: No trampling impacts or invasive species were observed at this site

MANAGEMENT RECOMMENDATIONS:

No management required at this site.

FIELD HOLLOW CLIFF (C66)

CONSERVATION SITE: Field Hollow Cliff (B3) **THREAT RANK:** 0

LOCALITY: Rockingham County **QUADRANGLE(S):** Elkton East

LOCATION: This Central District site is located west of Skyline Drive. It extends from 0.83 km (0.51 mi) north to 1.28 km (0.79 mi) north northeast of Bald Face Mountain Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana* / *Physocarpus opulifolius* / *Carex pensylvanica* - *Allium cernuum* - (*Phacelia dubia*) Wooded Herbaceous Vegetation	Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type)	G2	S2	None	None	BC
Plants: None						
Animals: None						

SITE DESCRIPTION: This site encompasses two curved lines of mostly west to north-facing exposures of Catoctin Formation metabasalt. A lower line of cliffs and outcrops is found at elevations ranging from 829 m (2,720 ft) to 856 m (2,810 feet). An upper line of outcrops is at elevations between 890 m (2,920 ft) and 927 m (3,040 ft). Most of the outcrops at this site are small and well shaded by the surrounding forest canopy. The exception is a high open cliff located at the western end of the lower tier of exposures. This cliff, which faces west northwest, is 100 m (328 ft) long and up to about 20 (66 ft) m high.

While this site is only 0.33 km (0.21 mi) from Skyline Drive, it receives little or no visitation due to the rugged terrain and lack of trails.

NATURAL COMMUNITIES: The forests at this site are generally uneven-aged and mature, with some large trees scattered throughout the area. The gentler upper slopes support lush stands of the Central Appalachian Montane Oak-Hickory Forest (Basic Type), which has a rich herb layer with *Laportea candensis* (wood nettle), *Asarum canadense* (wild ginger), *Amphicarpaea bracteata* (hog-peanut), *Caulophyllum thalictroides* (blue cohosh), and other nutrient-demanding forbs. Just above the major open cliff and other exposures of the lower line of outcrops, these nutrient-demanding species drop out, substrates appear to become drier and more oligotrophic, and the forest cover abruptly changes to a mosaic of Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest and Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. It is not clear whether the apparent gradation in soil fertility at this site is related to bedrock chemistry or to shallower soil depth and increased leaching below the upper bedrock exposures. The forests below the lower line of cliffs were not examined in this study.

Ledges at the top of the lower-line cliff and another outcrop 250 m (820 ft) to the northeast support small patches of the globally rare Central Appalachian Mafic Barren (Ninebark / Pennsylvania Sedge Type). This community has patches of stunted trees, shrubs and herbaceous vegetation interspersed with exposed, lichen-dominated outcrop surfaces. At this site, the vegetation has a sparse overstory consisting primarily of *Fraxinus americana* (white ash), with some *Ostrya virginiana* (eastern hop-hornbeam) and *Betula lenta* (sweet birch) also present. *Physocarpus opulifolius* var. *opulifolius* (ninebark) and *Chionanthus virginicus* (fringetree) are dominant shrubs, with associates of *Rhus typhina* (staghorn sumac), *Amelanchier sanguinea* var. *sanguinea* (roundleaf serviceberry), *Crataegus intricata* (a hawthorn), *Ribes rotundifolium* (Appalachian gooseberry), *Photinia melanocarpa* (black chokeberry), *Rosa carolina* var. *carolina* (pasture rose), *Spiraea betulifolia* var. *corymbosa* (dwarf spiraea), *Rubus allegheniensis* (Alleghany blackberry), and *Rubus occidentalis* (black raspberry). The most abundant herbs are *Hylotelephium telephioides* (Allegheny stonecrop), *Danthonia spicata* (poverty oat-grass), *Solidago bicolor* (white goldenrod), *Helianthus divaricatus* (woodland sunflower), *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Allium cernuum* (nodding onion), *Phacelia dubia* var. *dubia* (Appalachian phacelia), and *Houstonia longifolia* (longleaf bluets). Other characteristic herbs include *Agrostis perennans* (autumn bentgrass), *Ambrosia artemisiifolia* (common ragweed), *Antennaria plantaginifolia* (plantain-leaf pussytoes), *Arabis laevigata* var. *laevigata* (smooth rockcress), *Bidens bipinnata* (spanish-needles), *Carex pensylvanica* (Pennsylvania sedge), *Carex virescens* (ribbed sedge), *Deschampsia flexuosa* var. *flexuosa* (wavy hairgrass), *Dichanthelium boscii* (Bosc's panic grass), *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Heuchera americana* (American alumroot), *Liatris turgida* (= *Liatris helleri*, shale-barren blazing-star), *Polygonum scandens* var. *cristatum* (crested false-buckwheat), *Polypodium appalachianum* (Appalachian rock polypody), *Symphyotrichum laeve* var. *laeve* (= *Aster laevis* var. *laevis*, smooth aster), and *Viola sagittata* (arrow-leaved violet). Quantitative plot data were collected from this occurrence during the ROMP project (plot SHNP160).

Prominent lichens of the exposed to semi-shaded cliff tops are *Lasallia pensylvanica*, *Lasallia papulosa*, *Xanthoparmelia conspersa*, *Flavoparmelia baltimorensis*, *Usnea cf. halei*, *Cladonia crispata*, *Acarospora fuscata*, *Physcia* sp., *Diploschistes scruposus*, *Aspicilia cinerea*, and *Fuscidea recensa*. The sheltered, vertical lower faces of the main cliff have extraordinarily large patches of the brilliant yellow lichen *Chrysothrix chlorina.*

RARE PLANTS: The watchlist plants *Amelanchier sanguinea* var. *sanguinea* and *Liatris turgida* occur in small numbers at this site.

RARE ANIMALS: No animal element occurrences were found by DCR-DNH in 2005 or 2006. One watchlist crustacean was collected at seeps in the area in 2005: *Stygobromus spinosus* (Blue Ridge Mountain amphipod).

Plate 68. View looking north from the top of the high, open metabasalt exposure at Field Hollow Cliff.

THREATS: Exotic species found within the site boundary include *Ailanthus altissima* (tree-of-heaven), *Alliaria petiolata* (garlic mustard), *Polygonum caespitosum* var. *caespitosum* (long bristled smartweed), *Poa compressa* (flat-stemmed bluegrass), and *Rumex acetosella* (sheep-sorrel).

Poa compressa, *Alliaria petiolata*, and *Rumex acetosella* have invaded the significant barrens community at the west end of the massive lower cliff. The *Poa* and *Alliaria* are both numerous and pose a significant threat to the long-term compositional integrity of this vegetation.

MANAGEMENT RECOMMENDATIONS:

Manage invasive plants *Poa compressa*, *Rumex acetosella*, and *Alliaria petiolata*. The use of herbicide is recommended for controlling these species. Hand-pulling will create more soil disturbance and is labor-intensive, and is not recommended. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Annually monitor site following treatment to determine whether further action is required to control invasive species.

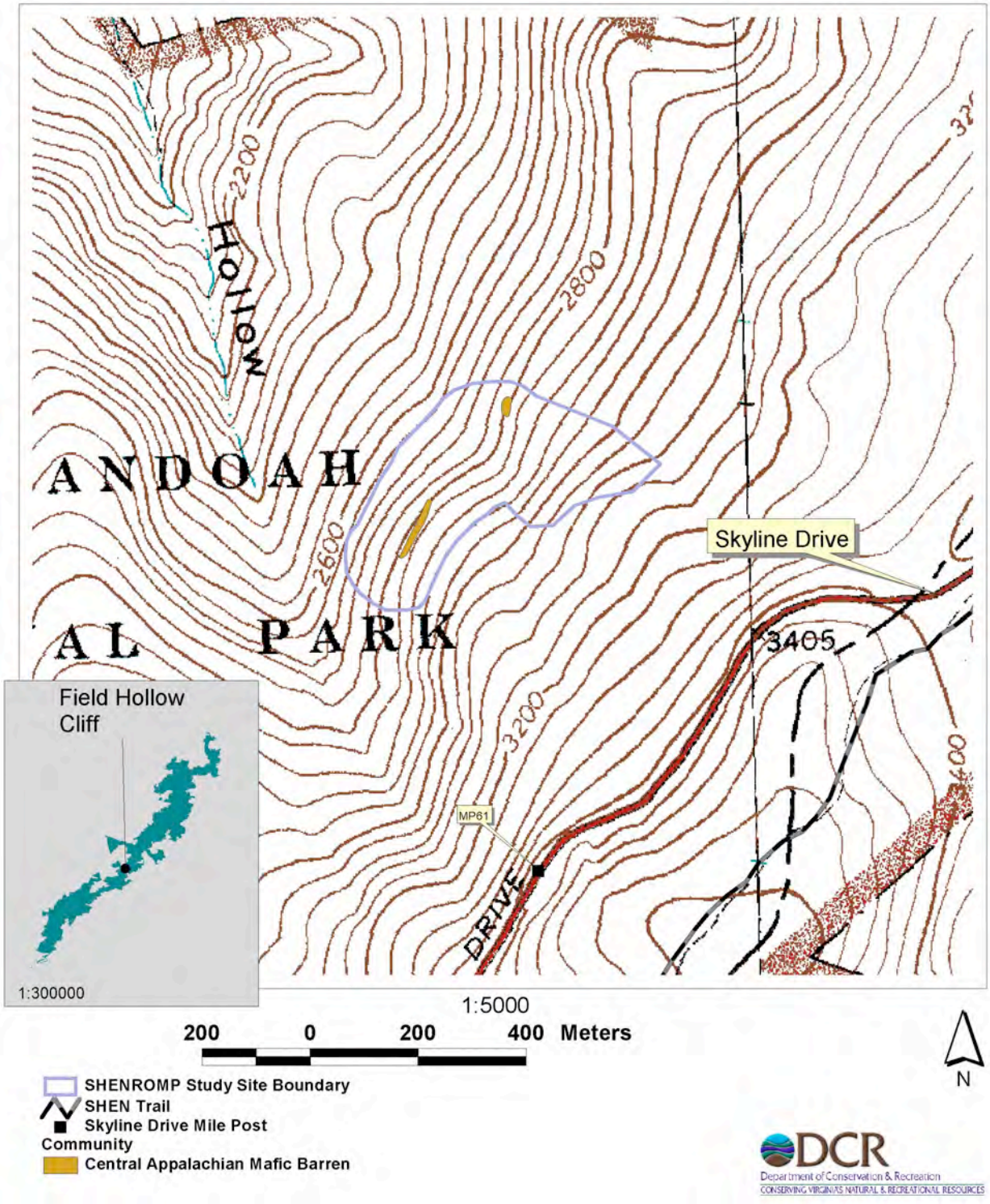


Fig. 148. Location of significant natural community at Field Hollow Cliff.

DEAN MOUNTAIN RIDGE (C12)

CONSERVATION SITE: Dean Mountain Ridge (B5) **THREAT RANK:** 0

LOCALITY: Rockingham County **QUADRANGLE(S):** Elkton East

LOCATION: This is the southernmost site in the Central District. It is located on the west side of Skyline Drive from 1.05-1.39 km (0.66-0.86 mi) north of South River Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: None						
Plants: *Solidago randii*	Rand's goldenrod	G5T4	S2S3	None	None	C
Animals: None						

SITE DESCRIPTION: The main feature of this site is a broken line of partially open small cliffs and outcrops extending for about 80 m (262 ft) near the site's southern end. These are southwest-facing metabasalt exposures that reach a height of about 15 m (50 ft). Their tops are located at an elevation of about 1,003 m (3,290 ft) at the southeastern end, but drop to about 988 m (3,240 ft) at the northwestern end. There are also several small outcrops in the northern half of this site, but they are well-shaded.

Although it is located not far from Skyline Drive, there are no trails in the vicinity of this site, and it receives little visitation.

NATURAL COMMUNITIES: No significant natural communities were found at this site. The gentle upper slopes support a lush stand of Central Appalachian Montane Oak-Hickory Forest (Basic Type) growing on relatively deep, fertile soils. This rich forest continues downslope in a slight concavity that runs more or less through the middle of the site. To both the north and south of the concavity, soils become shallower on convex slopes above large outcrops, and the forest cover transitions into a variant of Northern Red Oak Forest (Pennsylvania Sedge – Wavy Hairgrass Type) with patches of deciduous ericads in the shrub layer. Only the tops of the southern outcrops are open, supporting a depauperate "barren" with *Solidago randii* (Rand's goldenrod), *Hylotelephium telephioides* (Allegheny stonecrop), and a few other species. These open patches are not large enough to accommodate even a 100 m^2 plot, and are regarded as an ecotone of the Northern Red Oak Forest. Below both sets of outcrops are stands of Central Appalachian Basic Boulderfield Forest (Montane Basswood – White Ash Type).

RARE PLANTS: A previously known population of *Solidago randii* (Rand's goldenrod) was relocated at this site on September 20, 2006. About 60 clumps of the rare plant were found in a 10 x 80 m (33 x 262 ft) area along the top of the line of metabasalt exposures and on ledges along the upper one-half of the their faces where there was sufficient sunlight. Most plants were in flower on the survey date.

RARE ANIMALS: No animal element occurrences were found by DCR-DNH in 2005. Three watchlist moth species were captured in a UV-trap picked up on 8 June 2005 (one specimen each): *Apamea plutonia* (a noctuid moth), *Metarranthis mestusata* (a geometrid moth) and *Phlogophora iris* (olive angle shades).

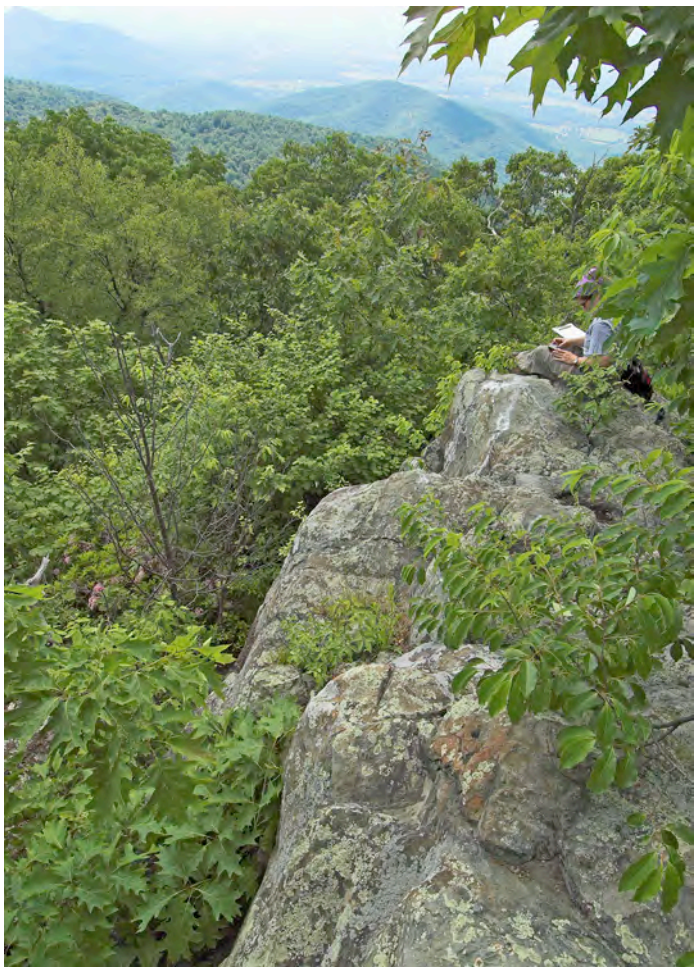


Plate 69. Metabasalt outcrops at Dean Mountain Ridge are small and only partly open.

THREATS: *Alliaria petiolata* (garlic mustard) and *Polygonum caespitosum* var. *longisetum* (long-bristled smartweed) are rife in the rich forest upslope from the open outcrops. It is possible that these non-native plants may invade the *Solidago randii* population area.

MANAGEMENT RECOMMENDATIONS:

On a 5-10 year interval, monitor *Solidago randii* population and survey for invasive species in the open outcrop areas.

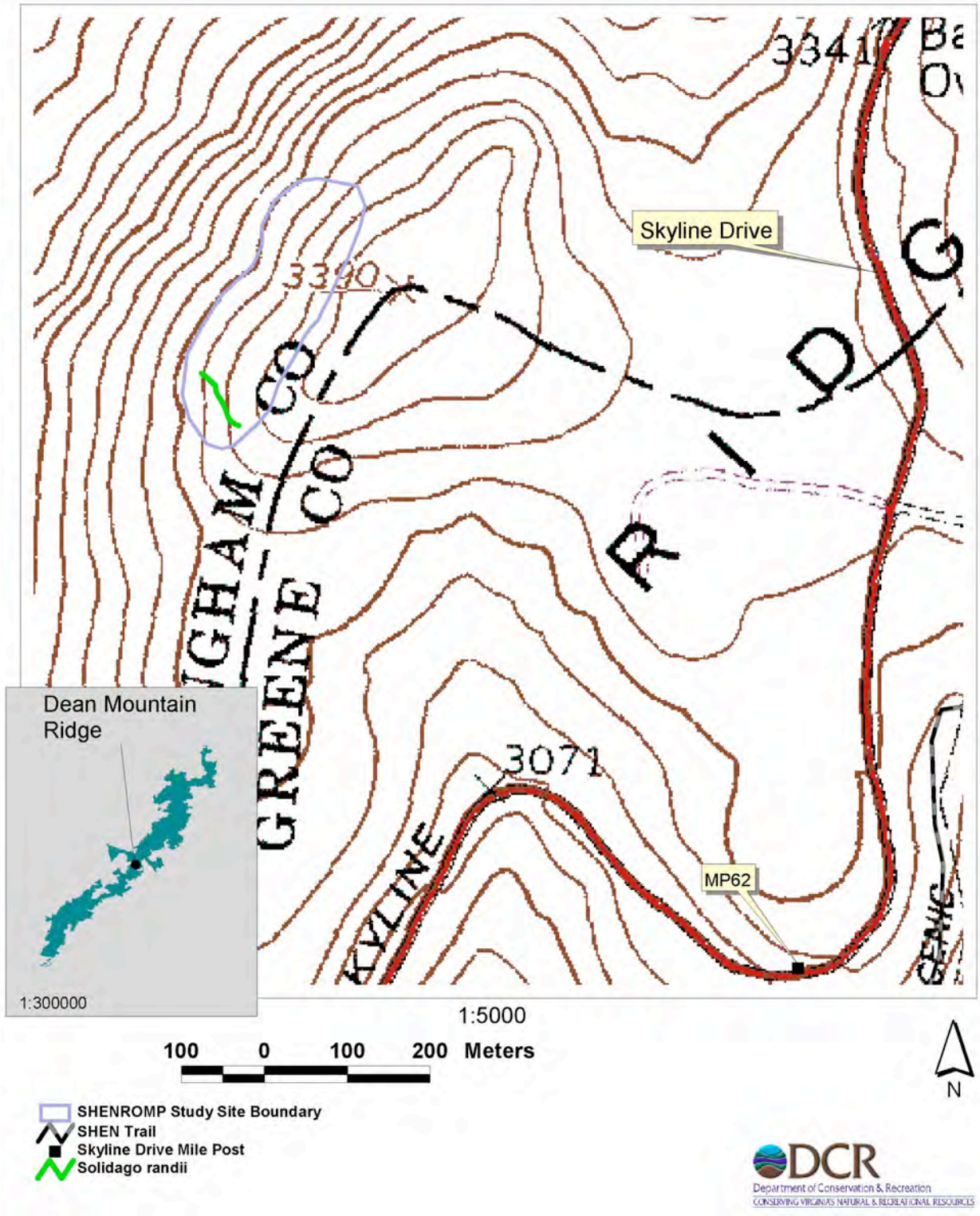


Fig. 149. Location of *Solidago randii* at Dean Mountain Ridge.

HIGHTOP (C23)

CONSERVATION SITE: Hightop Overlook (B2) **THREAT RANK:** 3

LOCALITY: Rockingham County **QUADRANGLE(S):** Swift Run Gap

LOCATION: This South District site is located east of Skyline Drive. It extends from 0.55-0.69 km (0.35-0.43 mi) southeast of Swift Run Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Photinia melanocarpa - Gaylussacia baccata* / *Carex pensylvanica* Shrubland	High-Elevation Outcrop Barren (Black Chokeberry Igneous / Metamorphic Type)	G1	S1	None	None	BC
Plants: *Solidago randii*	Rand's goldenrod	G5T4	S2S3	None	None	BC
Animals: *Troglodytes troglodytes*[1]	Winter Wren	G5	S2B/S4N	None	SC	B

[1] Based on previously documented record (DCR-DNH Biotics data). Part of this element occurrence lies outside of the ROMP site.

SITE DESCRIPTION: This site is located on the upper northwestern flank of Hightop and contains a line of several open, ledgy, northwest-facing rock outcrops at approximately 1,067-1,073 m (3,500-3,520 ft) elevation. Other outcrops are also present in this line, but they are well shaded by the forest canopy. Below these outcrops are talus slopes, only one of which is open. Further downslope, a line of high cliffs was located at or just outside the western boundary of the outcrop site. The tops of these cliffs are at an elevation of 1,036 m (3,400 ft) and are mostly densely vegetated and well shaded. Two open areas were observed, however. All the rock outcrops here are Catoctin Formation metabasalt.

NATURAL COMMUNITIES: Except for the open outcrops and cliff-top areas, this site is heavily forested. In the northern and eastern portions, Central Appalachian Montane Oak-Hickory Forest (Basic Type) is the prevailing cover. Small patches of Central Appalachian Northern Hardwood Forest and Central Appalachian High-Elevation Boulderfield Forest are present in the southwestern part of the site. The open outcrops and ledges support patches of the globally rare High-Elevation Outcrop Barren (Black Chokeberry Igneous / Metamorphic type) totalling about 500 m^2 (5,379 ft^2) in aggregate. On Hightop, this vegetation is a patchy shrubland dominated by thickets of *Photonia melanocarpa* (black chokeberry), *Gaylussacia bacata* (black huckleberry), and *Smilax tamnoides* (bristly greenbrier), interspersed with lichen-dominated outcrop surfaces and small mats of herbaceous plants. Associated scrub species include *Sorbus americana* (American mountain-ash), *Hamamelis virginiana* (witch-hazel), *Menziesia pilosa* (minniebush), stunted *Betula alleghaniensis* (yellow birch), and stunted *Quercus rubra* (northern red oak). *Hylotelephium telephioides* (Allegheny stonecrop), *Solidago randii* (Rand's goldenrod), and *Carex pensylvanica* (Pennsylvania sedge) are the most frequent herbs. Other herbaceous associates noted on these outcrops include *Angelica triquinata* (filmy angelica), *Danthonia spicata* (poverty oat grass), *Dennstaedtia punctilobula* (hay-scented fern), *Deschampsia flexuosa* (wavy hairgrass), *Liatris turgida* (= *Liatris helleri*, shale-barren blazing-star), and *Polypodium appalachianum* (Appalachian rock polypody). Quantitative plot data were collected from this occurrence in 1999 (plot SHNP039).

RARE PLANTS: Six subpopulations of *Solidago randii* (Rand's goldenrod) with a total of about 171 clumps were observed at this site in 2005. Four of the subpopulations were located on the open upper outcrops where the rare goldenrod was previously known. From northeast to southwest, these consist of two, 40, 60, and 20 clumps, respectively. Two new subpopulations were found in 2005, consisting of 36 and 13 clumps. These were located on the open cliff tops near the site's western boundary and downslope from the major outcrops. These lower cliff tops had not been previously surveyed for *Solidago randii*. Plants were either in young inflorescence or had not bolted by the July survey date.

The watchlist herb *Liatris turgida* (= *Liatris helleri*) is also known from this site.

RARE ANIMALS: No new rare animal species were located during surveys in 2006. There is an existing record for a *Troglodytes troglodytes* (Winter Wren) occurrence. Two males were observed singing on 26 July 1990 during field surveys for DCR-DNH. It is not known if this represents a breeding population that persists today. Surveys in 2006 included looking and listening for this species, but it was not relocated. Contractual constraints did not permit the intensity of surveys needed to adequately confirm the current presence or absence of Winter Wren at this site.

Two watchlist moth species were captured (1 specimen each) in a UV-trap on 4 August 2006: *Catocala relicta* (white underwing), and *Catocala serena* (serene underwing).

Plate 70. Exposed metabasalt outcrops at Hightop are small and extremely vulnerable to trampling due to their proximity to the Appalachian Trail.

THREATS: Social trails lead from the Appalachian Trail to two of the major open rock outcrops in the upper sections of the site, and these two are less vegetated**.** The patches of High-Elevation Outcrop Barren (Black Chokeberry Igneous / Metamorphic type) at these frequently accessed outcrops are in relatively poor condition, with the soil mats supporting herbaceous species severely trampled and reduced. The condition of this vegetation on the outcrops remote from the trail is pristine.

The invasive weed *Poa compressa* (flat-stemmed bluegrass) is present on the two upper outcrops accessed by social trails. The southernmost of these also has *Microstegium vimineum* (Japanese stilt grass), *Polygonum caespitosum* var. *longisetum* (long-bristled smartweed), and *Rumex acetosella* (sheep sorrel). These disturbance-dependent exotics are a symptom of the heavy visitation and trampling this site receives.

Habitat destruction and forest fragmentation are the primary threats to *Troglodytes troglodytes*. In addition, human disturbance may interrupt nesting attempts. The use of insecticides may adversely impact winter wren populations at a local level by decreasing their food supply.

MANAGEMENT RECOMMENDATIONS: This is one of only 11 known sites in the world for the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community. As such, it merits strong protection and remedial action to reduce and contain the ongoing destructive impacts by hikers.

Close the social trail leading to northernmost outcrop. The use of signs or a temporary barrier will likely be required due to the visibility of the outcrop from the trail.

Manage the invasive plant *Poa compressa*. The use of herbicide is recommended for controlling this species. Hand-pulling will create more soil disturbance and is labor-intensive; therefore, this method is not recommended. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Annually monitor the effectiveness of the invasive plant control effort. Continue monitoring *Poa compressa* for several years following treatment and assess the need for further action.

Monitor recovery of the rare plant and the health of the significant natural community. Conduct a survey on a 3-5 year interval to assess the *Solidago randii* population and the health of the High-Elevation Outcrop Barren. At the same time, conduct a survey and assessment of invasive plants.

Conduct further inventory of the *Troglodytes troglodytes* to determine its status in SHEN. Nests located near trails and other high visitor use areas should be monitored to determine if they are impacted by frequent disturbance.

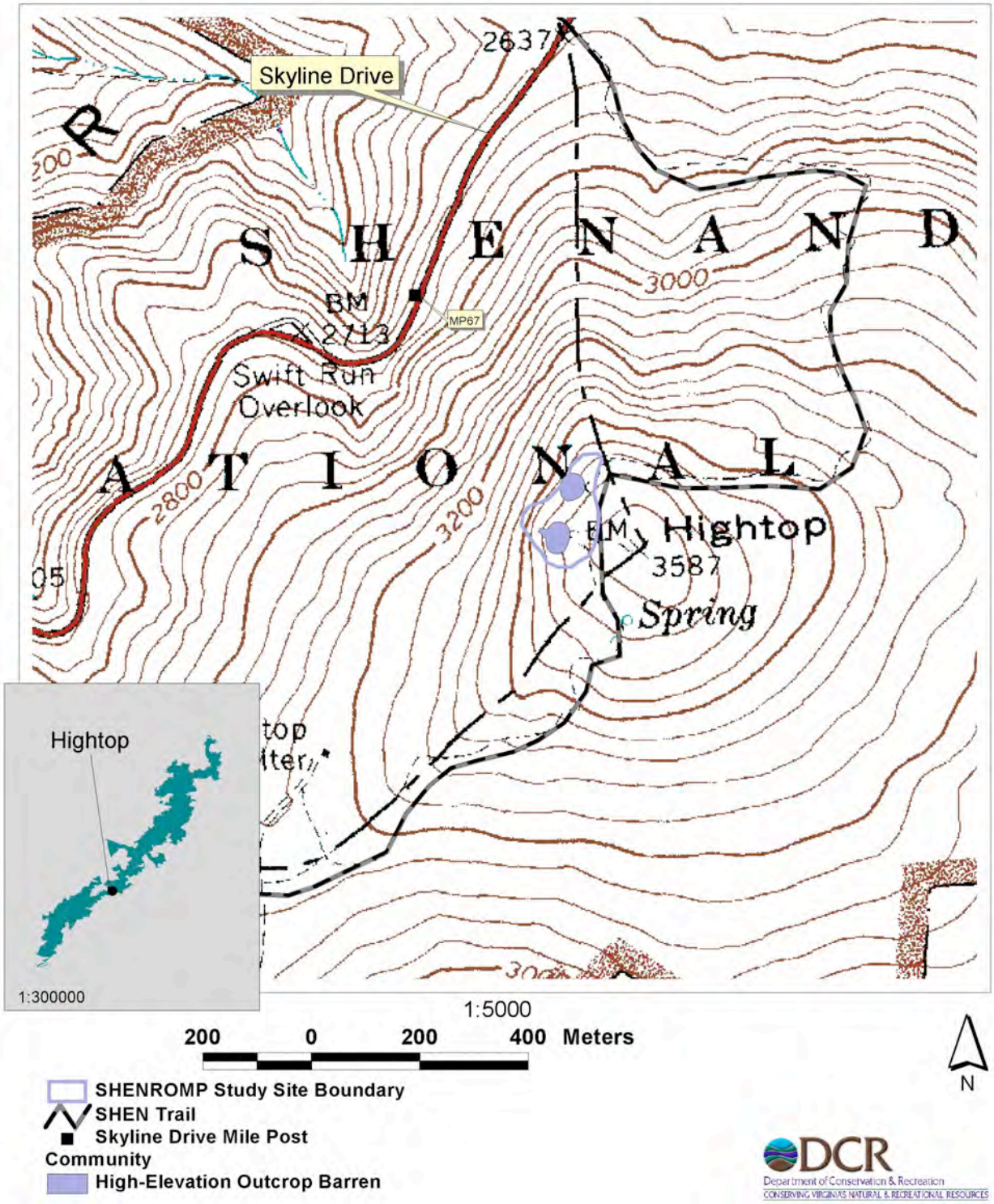


Fig. 150. Location of significant natural community at Hightop.

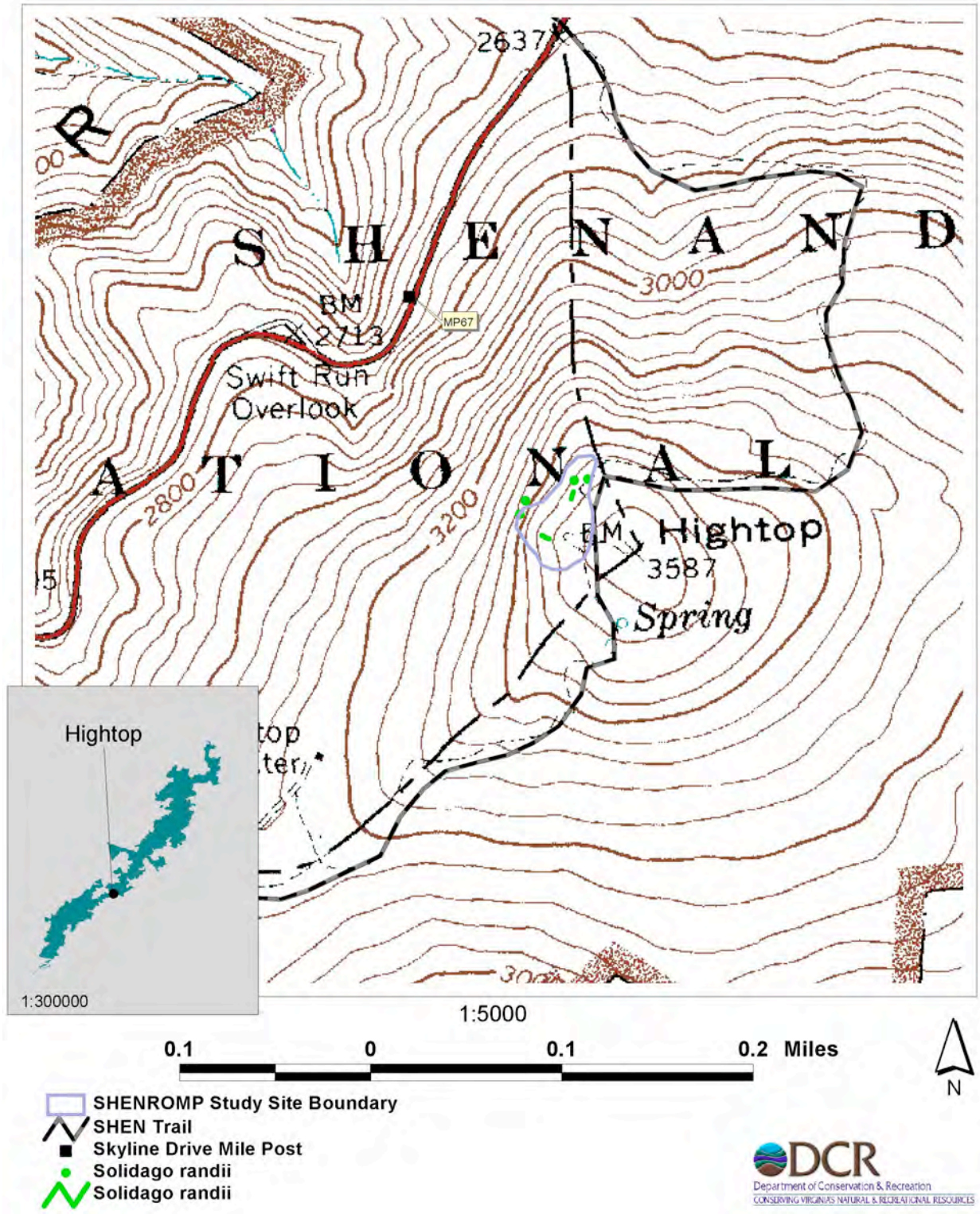


Fig. 151. Location of *Solidago randii* at Hightop

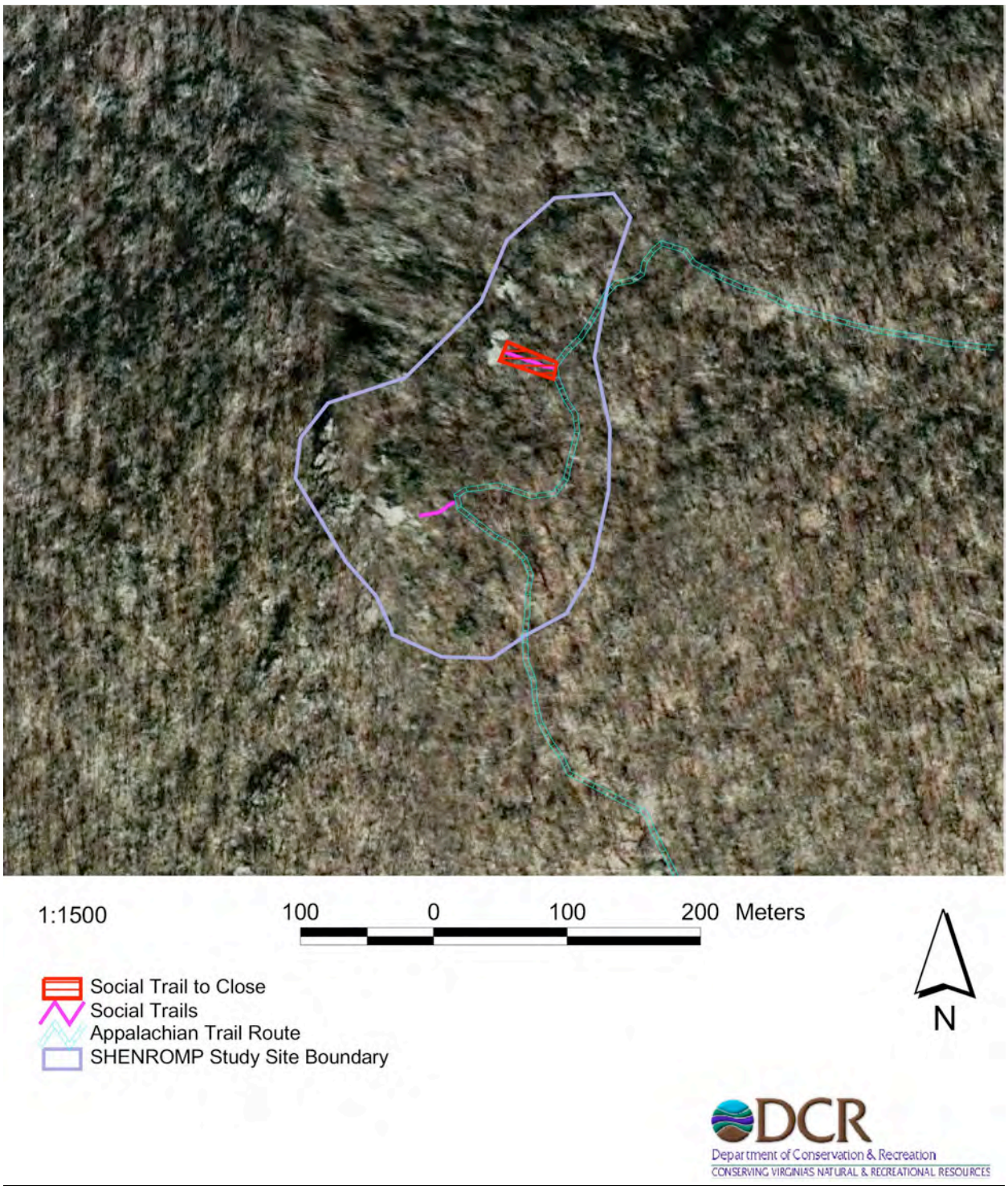


Fig. 152. Site details for Hightop, including social trail recommended for closure.

POWELL GAP CLIFF (C42)

CONSERVATION SITE: None **THREAT RANK:** 1

LOCALITY: Greene County **QUADRANGLE(S):** Swift Run Gap

LOCATION: This site in the South District is located south of Skyline Drive and downslope from the Appalachian Trail. It extends from 0.33-0.55 km (0.2 mi-0.35 mi) southwest of Powell Gap.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: None						
Plants: None						
Animals: None						

SITE DESCRIPTION: This site encompasses a line of small cliffs 5-10 m (16-33 ft) high located just below the Appalachian Trail in the northern section of the site. Further downslope, two large rock knobs are located in the middle and southern portions of the study area. The site also contains numerous smaller exposures. Rock exposures at this site face east-southeast to east-northeast.

This site was included in the ROMP study in order to include an example of the Swift Run Formation, which is composed of metasedimentary material, primarily phyllite and sandstone. This Formation is not present at any of the other study sites, and is rarely exposed in large outcrops in SHEN. The rock exposures here, however, are partly to fully-shaded, providing little potential habitat for the rare species and vegetation communities that are the focus of this study.

A social trail leads from the Appalachian Trail to a small overlook at the top of the cliffs in the northern portion of the site. This area is mostly bare rock due to trampling and clearing.

NATURAL COMMUNITIES: No significant natural communities were found at this site. The gentle crest at the western edge of the site supports a stand of Central Appalachian Montane Oak-Hickory Forest (Acidic Type), while Central Appalachian Low-Elevation Chestnut Oak Forest is the prevailing vegetation on the slopes below the crest. The east-facing exposure of Swift Run Formation rocks is partly open but is very small and is considered an ecotone of the adjacent forests rather than a discrete community. It does, however, support a few rock-loving species not found in the adjacent forests, including *Rhus typhina* (staghorn sumac), *Corydalis sempervirens* (pink corydalis), and *Hylotelephium telephioides* (Allegheny stonecrop).

RARE PLANTS: No rare or watchlist plants were found at this site.

RARE ANIMALS: No animal element occurrences were found during DCR-DNH surveys in 2005. One watchlist moth, *Xanthrorhoe labradorensis* (Labrador carpet), was captured at a UV-trap set near a forested rock outcrop.

Plate 71. Exposures of the Swift Run phyllitic sandstone at Powell Gap Cliff are small and partly shaded, providing little habitat for outcrop vegetation and rare plants.

THREATS: Not applicable.

MANAGEMENT RECOMMENDATIONS:

No management is required at this site.

ROCKY MOUNTAIN (C44)

CONSERVATION SITE: Rocky Mountain (B5) **THREAT RANK:** 1

LOCALITY: Rockingham County **QUADRANGLE(S):** McGaheysville

LOCATION: This South District site lies west of Skyline Drive. It extends from 1.87 km (1.18 mi) to 2.32 km (1.45 mi) west of Twomile Run Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: None						
Plants:						
Aralia hispida[1]	Bristly sarsaparilla	G5	S2	None	None	CD
Asplenium bradleyi	Bradley's spleenwort	G4	S2	None	None	D
Animals: None						

[1]Part of this element occurrence lies within the Brown Mountain ROMP site.

SITE DESCRIPTION: This site is centered on a knob at the northern end of the ridge that comprises Rocky Mountain. Elevations here range from 829 m (2,720 ft) up to about 860 m (2,820 ft).

Rock exposures at this site consist of a series of roughly parallel Erwin Formation quartzite outcrops separated by areas of talus. Theses outcrops run on a bias to ridge that forms Rocky Mountain. Thus, whereas the ridge is oriented from southwest to northeast, the exposures have a south southwest to north northeast orientation.

These outcrops are long narrow ribs of rock with steep faces dropping away on both sides. The two largest are at the western end of the site. The westernmost drops off to the west as a cliff up to about 6 m (20 ft) high; the drop to the east is shorter. A rock spire, about 15 m (49 ft) high, is located at the northern end of this rib. East of this is the longest and most dramatic outcrop at the site, with steep faces on both sides. Several smaller outcrops are located further east. Most of these outcrops extend outside of the site boundary to the south.

The Brown Mountain Trail crosses this site. It runs across and part way along the site's largest outcrop, providing ready access to the entirety of that outcrop and its dramatic views.

NATURAL COMMUNITIES: No significant natural communities targeted by this project were found. The principal vegetation types on the slopes and crests of this site are the Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest and the Central Appalachian Pine – Oak / Heath Woodland. These forests and woodlands have been severely damaged by outbreaks of gypsy moth and southern pine beetle during the past 15 years and many snags of trees which died following these outbreaks are present. The open canopy conditions that resulted from tree mortality have stimulated a dense growth of shrubs and tree saplings in many parts of the site.

Many of the quartzite outcrops are well shaded by trees. The open and semi-open outcrops at and below the ridge crest support a lithophytic variant of the Pine – Oak / Heath Woodland that has open cover of severely stunted trees (often < 6 m [20 ft] tall). Characteristic species of this variant are *Pinus rigida*

(pitch pine), *Pinus pungens* (table-mountain pine), *Quercus prinus* (chestnut oak), *Quercus ilicifolia* (bear oak), *Kalmia latifolia* (mountain-laurel), *Betula lenta* (sweet birch), *Sassafras albidum* (sassafras), *Gaylussacia baccata* (black huckleberry), *Vaccinium stamineum* (deerberry), and *Vaccinium pallidum* (early lowbush blueberry). Tangles of *Smilax glauca* (whiteleaf greenbrier) and *Smilax rotundifolia* (common greenbrier) are common and a few herbs – e.g., *Schizachyrium scoparium* (little bluestem), *Danthonia spicata* (poverty oat-grass), *Carex tonsa* (shaved sedge), *Aureolaria pedicularia* (fern-leaved yellow foxglove), and *Aralia hispida* (bristly sarsaparilla) – occur on open gravelly shelves where rhizomatous heaths are less abundant. Turkey-beard (*Xerophyllum asphodeloides*) is often abundant among heaths in the more open stands of this community. The lichen assemblages are typical of those found on siliciclastic rocks, with *Lasallia pensylvanica*, *Lasallia papaulosa*, and *Dimelaena oreina* all abundant on open outcrops and *Umbilicaria mammulata* and *Flavoparmelia baltimorensis* conspicuous on more sheltered outcrops.

The entire stand of Central Appalachian Pine – Oak / Heath Woodland that occurs in several patches on the ridges of Rocky Mountain and Brown Mountain is considered an outstanding occurrence of the type by DCR-DNH.

RARE PLANTS: Previously known populations of *Aralia hispida* and *Asplenium bradleyi* (Bradley's spleenwort) were relocated at this site in 2006. Thirty individuals of *Aralia hispida* were found within a 6 x 8 m (20 x 26 ft) area on the southeastern side of the longest rock rib at this site. Most plants were along the partially shaded base of this outcrop, with one individual growing from a crevice in the sheer face. Seventeen of these plants had young inflorescences on the June 1 survey date.

Four clumps of *Asplenium bradleyi* (Bradley's spleenwort) were found on a small, partially shaded, fractured outcrop situated between the two major rock ribs at this site. The plants occupied 30 cm (12 in) of crevice in a well-shaded recess facing south southwest. The plants were depauperate in size and appeared somewhat desiccated on the June 1 survey date. This represents a smaller population than was reported in 1993 (10-50 plants).

RARE ANIMALS: No animal element occurrences were found during DCR-DNH surveys in 2005. One watchlist species, *Liochlorophis vernalis* (smooth green snake), was observed just west of the Rocky Mountain cliffs on 28 June 2005.

Plate 72. Quartzite outcrops and pine – oak / heath woodland at the summit of Rocky Mountain.

THREATS: The *Aralia hispida* population at this site has declined from the several hundred individuals reported here along the trail and either side of the ridgecrest in 1991 and 1993. *Aralia hispida* is believed to be a fire dependent species that cannot compete with other species in the absence of periodic wildfire or prescribed burning. This area last burned in 1986. The remaining small population of plants found in 2006 downslope from the trail are in an inaccessible area that would seldom- to-never be affected by trampling. No exotic species were observed in the 2006 survey.

MANAGEMENT RECOMMENDATIONS:

Monitor the *Aralia hispida* population to determine population trends.

Determine feasibility of allowing prescribed wildfire at this site. The rare plant *Aralia hispida* would benefit from a more frequent fire return interval. The SHEN fire manager should be consulted during the development of the rock outcrop management plan to determine feasibility of allowing wildfire to burn this site.

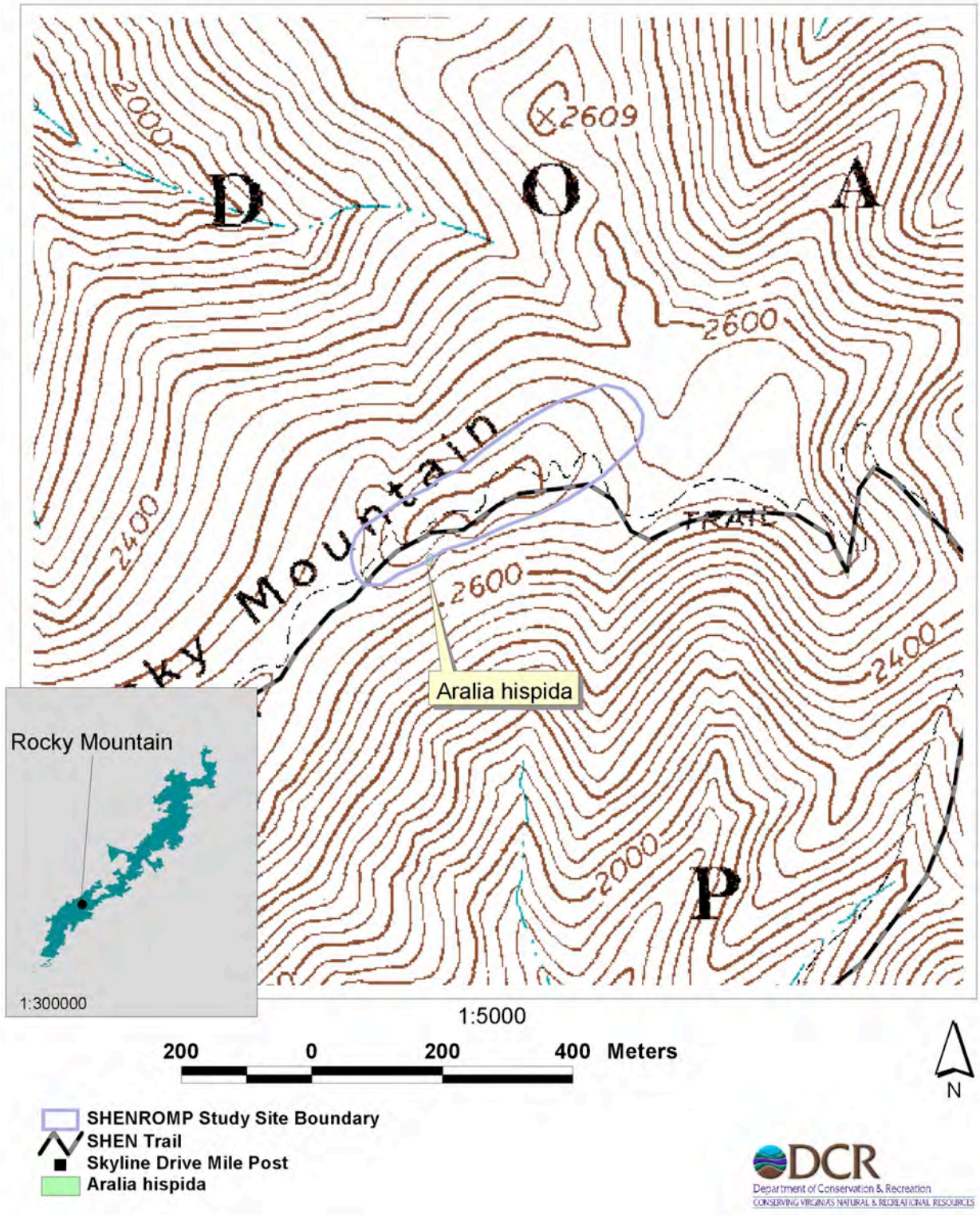


Fig. 153. Location of *Aralia hispida* at Rocky Mountain.

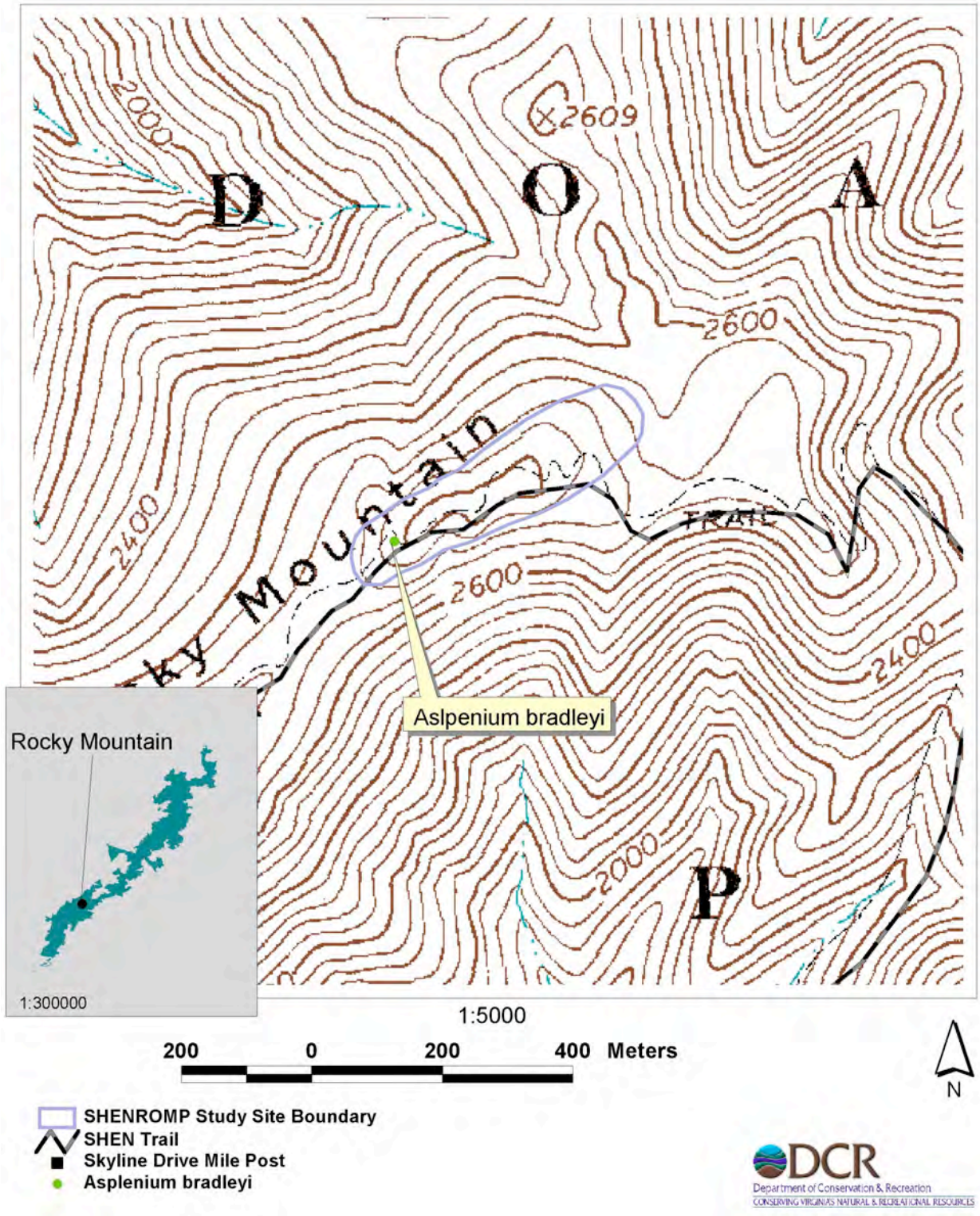


Fig. 154. Location of *Asplenium bradleyi* at Rocky Mountain.

BROWN MOUNTAIN (C64)

CONSERVATION SITE: Rocky Mountain (B5) **THREAT RANK:** 1

LOCALITY: Rockingham County **QUADRANGLE(S):** McGaheysville

LOCATION: Located west of Skyline Drive, this South District site extends from 2.29-3.29 km (1.43-2.05 mi) northwest of Rockytop Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: None						
Plants: *Aralia hispida*[1]	Bristly sarsaparilla	G5	S2	None	None	CD
Animals: None						

[1] Part of this element occurrence lies within the Rocky Mountain ROMP site.

SITE DESCRIPTION: This large, complex site contains a variety of Erwin Formation quartzite exposures associated with a long narrow ridge that connects the summit of Brown Mountain at the site's northwestern end with the westernmost summit of Rocky Mountain at the site's southeastern end. Exposures here are located at elevations between 752-817 m (2,400-2680 ft).

The narrow ridge is capped by a series of intermittent quartzite outcrops that face to the west or southwest. Extensive areas of talus are found along the ridgeline and on the ridge's southeastern flank. These are concentrated in northwestern half of the site. At the site's southeastern end, a high, open, L-shaped cliff faces south. An extensive talus field lies below this cliff. To the north and west of this cliff, in the vicinity of the westernmost summit of Rocky Mountain, are several areas of open flatrock.

The Brown Mountain Trail extends along the length of the ridge and crosses the summit of Brown Mountain. Several social trails lead from this trail to outcrop overlooks.

NATURAL COMMUNITIES: No significant natural communities targeted by this project were found. The forests and woodlands of this site have been severely damaged by outbreaks of gypsy moth and southern pine beetle during the past 15 years and many snags of trees which died following these outbreaks are present. On the gentler crest and upper slopes in the northern section of the site, Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest is the principal vegetation cover, with patches of Central Appalachian Pine – Oak / Heath Woodland becoming frequent in rocky terrain on the western side.
Extensive talus on the steeper western slopes supports patches of Sweet Birch – Chestnut Oak Talus Woodland interspersed with patches of the lichen-dominated Central Appalachian Acidic Boulderfield community. Characteristic species of the talus woodlands include *Betula lenta* (sweet birch), *Quercus prinus* (chestnut oak), *Pinus strobus* (white pine), *Pinus rigida* (pitch pine), *Kalmia latifolia* (mountain-laurel), *Menziesia pilosa* (minniebush), and *Parthenocissus quinquefolia* (Virginia creeper). The non-vascular boulderfields are generally dominated by *Lasallia pensylvanica*, *Lasallia papulosa*, *Dimelaena oreina*, *Xanthoparmelia* spp., and *Fuscidea recensa*. Neither of these communities is rare, and the occurrences here are fairly average in size and quality.

Pine – Oak / Heath Woodland is more prevalent in the southern half of the site and much of this vegetation is extremely dense and shrubby. The open canopy conditions that resulted from tree mortality have stimulated a vigorous growth of shrubs and tree saplings in many parts of the site. *Xerophyllum asphodeloides* (turkey-beard) and *Pteridium aquilinum* var. *latiusculum* (bracken fern) are among the very few herbs that are competitive and often abundant among heaths in the more open stands of this community. The entire stand of Central Appalachian Pine – Oak / Heath Woodland that occurs in several patches on the ridges of Rocky Mountain and Brown Mountain is considered an outstanding occurrence of the type by DCR-DNH.

Many of the quartzite outcrops are well shaded by trees, but several open flatrocks are present, along with a massive, arching cliff at the southern end of the site. Open and semi-open outcrops support a lithophytic variant of the Pine – Oak / Heath Woodland that has open cover of severely stunted trees (often < 6 m [20 ft] tall). Characteristic species of this variant are *Pinus rigida*, *Pinus pungens* (table-mountain pine), *Quercus prinus*, *Quercus ilicifolia* (bear oak), *Nyssa sylvatica* (black gum), *Kalmia latifolia*, *Betula lenta*, *Amelanchier arborea* (downy serviceberry), *Sassafras albidum* (sassafras), *Gaylussacia baccata* (black huckleberry), *Photinia melanocarpa* (black chokeberry), *Vaccinium stamineum* (deerberry), and *Vaccinium pallidum* (early lowbush blueberry). Tangles of *Smilax glauca* (whiteleaf greenbrier) and *Smilax rotundifolia* (common greenbrier) are common. Herbaceous plants are extremely sparse, but occasional lithophytes such as *Corydalis sempervirens* (pink corydalis) and *Aralia hispida* (bristly sarsaparilla) occur in crevices and pockets of organic matter.

RARE PLANTS: A small, previously unknown population of *Aralia hispida* was located at this site. Five immature plants and five with young inflorescences were located within a 0.5 m^2 (5 ft^2) area along the open top of a west southwest-facing outcrop located near the middle of the site. These plants were stunted in size, with none over 36 cm (14 in) high.

RARE ANIMALS: No animal element occurrences or watchlist species were found during DCR-DNH surveys of this site in 2005.

Plate 73. Quartzite outcrops and talus on the southeastern flank of Brown Mountain.

THREATS: *Aralia hispida* is believed to be a fire dependent species that cannot compete with other species in the absence of periodic wildfire or prescribed burning. A social trail leads into the outcrop with

the *Aralia hispida*, but the plants are on an outer, steeper portion of the cliff top where hikers are less apt to walk. No exotic plant species were observed

MANAGEMENT RECOMMENDATIONS:

Monitor the *Aralia hispida* population to determine population trends. Establish a population threshold to trigger management action.

Determine feasibility of allowing prescribed wildfire at this site. The rare plant *Aralia hispida* would benefit from a more frequent fire return interval. The SHEN fire manager should be consulted during the development of the rock outcrop management plan to determine feasibility of allowing wildfire to burn this site.

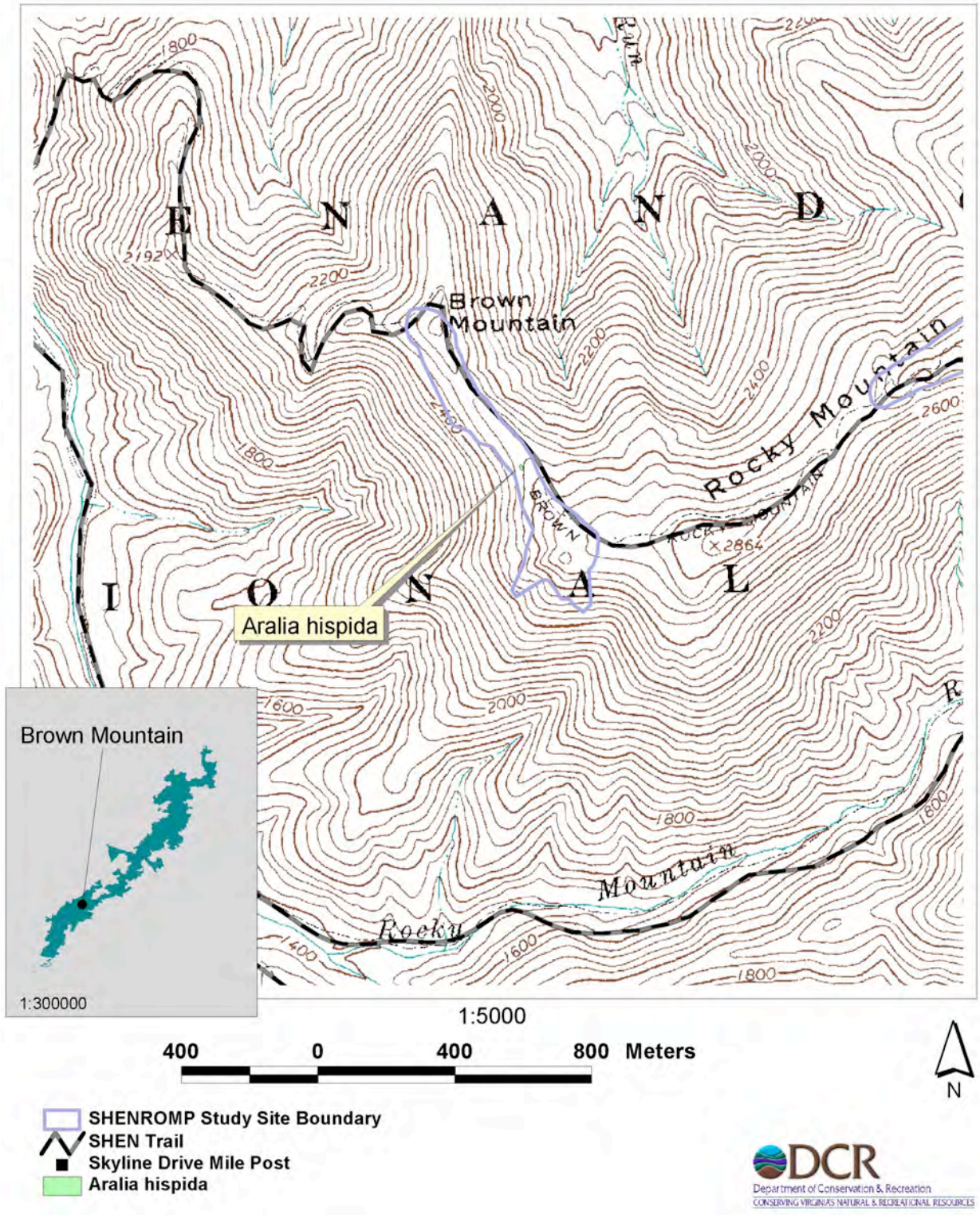


Fig. 155. Location of *Aralia hispida* at Brown Mountain.

LOFT MOUNTAIN SUMMIT (C29)

CONSERVATION SITE: Ivy Creek-Loft Mountain (B2) **THREAT RANK:** 3

LOCALITY: Rockingham and Albemarle Counties **QUADRANGLE(S):** McGaheysville

LOCATION: This South District site is located east of Skyline Drive and 0.33 km (0.20 mi) to 0.66 km (0.40 mi) southwest of the intersection of Skyline Drive and the turn off into the Loft Mountain Wayside.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Photinia melanocarpa - Gaylussacia baccata* / *Carex pensylvanica* Shrubland	High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type	G1	S1	None	None	B
Plants: *Solidago randii*	Rand's goldenrod	G5T4	S2S3	None	None	BC
Animals: None						

SITE DESCRIPTION: Significant outcrops of Catoctin Formation metabasalt occur at two levels within this site: just below and northwest of the summit at elevations between about 988 m (3,240 ft) and 1,000 m (3,280 ft) and at the northwestern end of the site at elevations between 927 m (3,040 ft) and 975 m (3,200 ft.)

The summit exposure consists of a northwest-facing cliff approximately 200 m (656 ft) long and 5-10 m (16- 33 ft) high. Much of the cliff is forested. A 0.13 ha (.33 ac) opening is situated at the east end of the cliff, while a 0.05 ha (0.1 ac) opening is located at the west end. A very small opening is positioned between the larger ones. The lower level of exposures consists of a line of west-northwest facing cliffs that also extends for about 200 m (656 ft). The cliffs comprising this lower level are mostly shaded by the forest canopy except at the southwestern end where there is an open area of approximately 0.6 ha (0.16 ac).

The Appalachian Trail and Frazier Discovery Trail traverse the southeastern part of the site. These two trails are contiguous over part of this area but divide just south of the larger, western opening on the upper cliff. A short side trails leads from the confluent trails to an overlook at the smaller opening at the east end of the cliff. After it leaves the Appalachian Trail, the Frazier Discovery Trail crosses the top of the larger, western opening. It also comes close to the lower line of cliffs, but these cliffs are not visible from the trail and apparently receive little visitation.

NATURAL COMMUNITIES: The upper slope and summit along the southern edge of the site are part of a weedy, regenerating young forest of *Robinia pseudoacacia* (black locust), *Prunus serotina* var. *serotina* (wild black cherry), *Fraxinus americana* (white ash), and *Crataegus* spp. (hawthorns) that occupies extensive old fields along the crest and upper slopes of Loft Mountain. In the ROMP site, this old-field vegetation is in a stage of transition to Central Appalachian Montane Oak – Hickory Forest (Basic Type). Rocky slopes in the remainder of the site support older forests, primarily Central Appalachian Northern Hardwood Forest (Yellow Birch – Northern Red Oak Type) below the cliffs and

Central Appalachian Basic Boulderfield Forest (Montane Basswood – White Ash Type) at east end of site.

The two upper-cliff outcrop openings and one lower-cliff opening support patches of the globally rare High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community. Because of extensive disturbances (see Threats below), patches on the upper cliffs are confined to the edges and protected ledges of the openings. The vegetation is an open to dense shrubland usually dominated by *Photinia melanocarpa* (black chokeberry), with associated *Sorbus americana* (American mountain-ash), *Gaylussacia baccata* (black huckleberry), *Diervilla lonicera* (northern bush honeysuckle), *Vaccinium pallidum* (early lowbush blueberry), *Menziesia pilosa* (minniebush), *Ilex montana* (mountain holly), *Spiraea betulifolia* var. *corymbosa* (dwarf spiraea), and *Kalmia latifolia* (mountain-laurel). Stunted *Betula alleghaniensis* (yellow birch), *Quercus rubra* (northern red oak), and *Tsuga canadensis* (eastern hemlock) are also scattered in the stands. Small herbaceous patches of *Saxifraga michauxii* (Michaux's saxifrage), *Solidago randii* (Rand's goldenrod), *Polypodium appalachianum* (Appalachian rock polypody), *Dennstaedtia punctilobula* (hayscented fern), *Danthonia spicata* (poverty oat-grass), *Hylotelephium telephioides* (Allegheny stonecrop), and *Carex pensylvanica* (Pennsylvania sedge) occur on exposed mats or organic material or gravel. *Maianthemum canadense* (Canada mayflower) and *Carex aestivalis* (summer sedge) may be numerous in moist moss under the shrubs. Quantitative plot data were collected from this occurrence during the ROMP project (plots SHNP135 and SHNP136).

On the upper cliff, lichens have been severely damaged or entirely removed by decades of hiker trampling. Protected vertical faces support lichen assemblages typical of high-elevation metabasalt: *Lasallia papulosa*, *Stereocaulon glaucescens*, *Umbilicaria muehlenbergii*, *Dimelaena oreina*, and many crusts. Open outcrops at the southwestern of the lower cliff are almost entirely covered by exceedingly dense colonies of *Lasallia papulosa*.

RARE PLANTS: Four subpopulations of *Solidago randii* (Rand's goldenrod), totaling 200-250 clumps, were found at this site: three along the summit cliff and one on the lower line of cliffs. At the northeastern end of the summit outcrop, about 40 clumps were found in a 10 x 40 m (33 x 131 ft) area along the cliff top. Further southwest along this top, 57 clumps were counted in a 7 x 28 m (23 x 92 ft) area. Some of these plants appeared chlorotic. About 70 clumps were seen at the southwestern end of the summit cliff within a 55 m^2 (592 m^2) area. About 30 of these clumps were along the cliff top and the remainder on cliff-face ledges.

The *Solidago randii* colony on the lower line of cliffs is found in the open area at the southwestern end of the site and was newly discovered in 2005. About 120 clumps were found here in a 6 x 45 m (20 x 148) ft) area. Many of these plants were sterile rosettes found in shadier areas back from the cliff top.

RARE ANIMALS: No animal element occurrences were found during DCR-DNH surveys in 2005. Four watchlist moths were collected in a UV-trap on 30 June 2005: *Hypena sordidula* (sordid Hypena moth), *Itame exauspicata* (a geometrid moth), *Metarranthis mestusata* (a geometrid moth), and *Sphinx kalmia* (laurel sphinx).

Plate 74. Metabasalt outcrops supporting the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) near the summit of Loft Mountain.

THREATS: Trampling is a major threat to the significant community and rare plant on the summit cliff openings. The large flatrock at the northeastern end of this cliff is almost totally denuded of vegetation except for back edges and crevices protected by woody species. The lower level cliffs may receive some light human visitation based on a possible faint trail detected through the brown foliose lichen on the rocks here. The exotic weed *Rumex acetosella* (sheep sorrel) occurs on two of the summit exposures: the large northeastern summit flatrock and an exposure in the central portion of the cliff. A more vegetated back section of this central exposure also supports the exotics *Polygonum caespitosum* var. *longisetum* (long-bristled smartweed) and *Poa compressa* (flat-stemmed bluegrass). These disturbance-dependent exotics are symptomatic of the heavy visitation and trampling this site receives. *Poa compressa* and *Rumex acetosella*, in particular, are tough-rooted perennials capable of outcompeting many native, crevice-inhabiting herbs, and represent serious threats to the potential rehabilitation of this habitat.

Many standing dead *Tsuga canadensis* (eastern hemlock), which succumbed to infestations of hemlock woolly adelgid, were present in areas adjacent to and below the lower cliffs.

MANAGEMENT RECOMMENDATIONS: This is one of only 11 known sites in the world for the High-Elevation Outcrop Barren (Chokeberry Igneous / Metamorphic Type) community. As such, it merits strong protection and remedial action to contain and reduce the ongoing destructive impacts by hikers. The highest management priority is to protect the patches of this vegetation that are still intact due to their location on less accessible ledges and peripheries of the outcrops.

Re-route Discovery Trail away from northernmost summit outcrop. The trail from the parking area can connect with the Appalachian Trail well away from the northern outcrop and, instead, direct visitors to the large southern outcrop. Keep visitors off other outcrops with a wall or other barrier. See Figure 158.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

Monitor lower outcrop complex for visitor use. These outcrops will become visible from parking on Skyline Drive as the *Tsuga canadensis* dies from wooly adelgid infestation. If outcrop begin to show signs of use, take steps to deter visitation through education on resource protection values of outcrops and directing visitors to the summit outcrop.

Reduce the abundance of invasive plants *Poa compressa*, *Rumex acetosella*, and *Polygonum caespitosum* var. *longisetum* where they are well-established. The use of herbicide is recommended for controlling these species. Hand-pulling will create more soil disturbance and is labor-intensive; therefore, it is not recommended. Sponge- or glove-application methods are recommended to minimize non-target impacts that may accompany spray application.

Monitor the recovery of the rare plant and the health of the significant natural community. Conduct a survey on a 3-5 year interval to assess the *Solidago randii* population and the health of the High-Elevation Outcrop Barren. At the same time, conduct a survey and assessment of invasive plants.

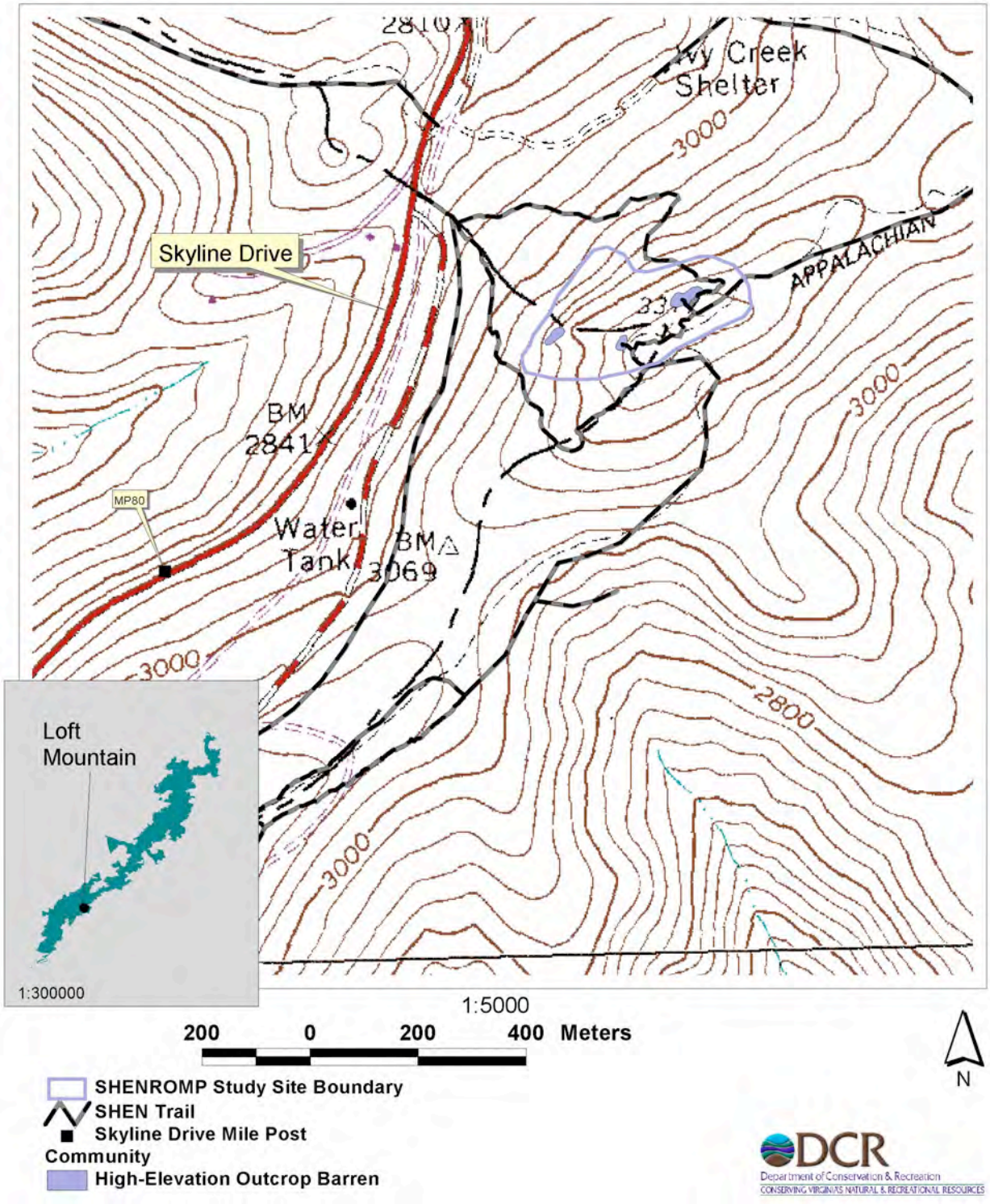


Fig. 156. Location of significant natural community at Loft Mountain Summit.

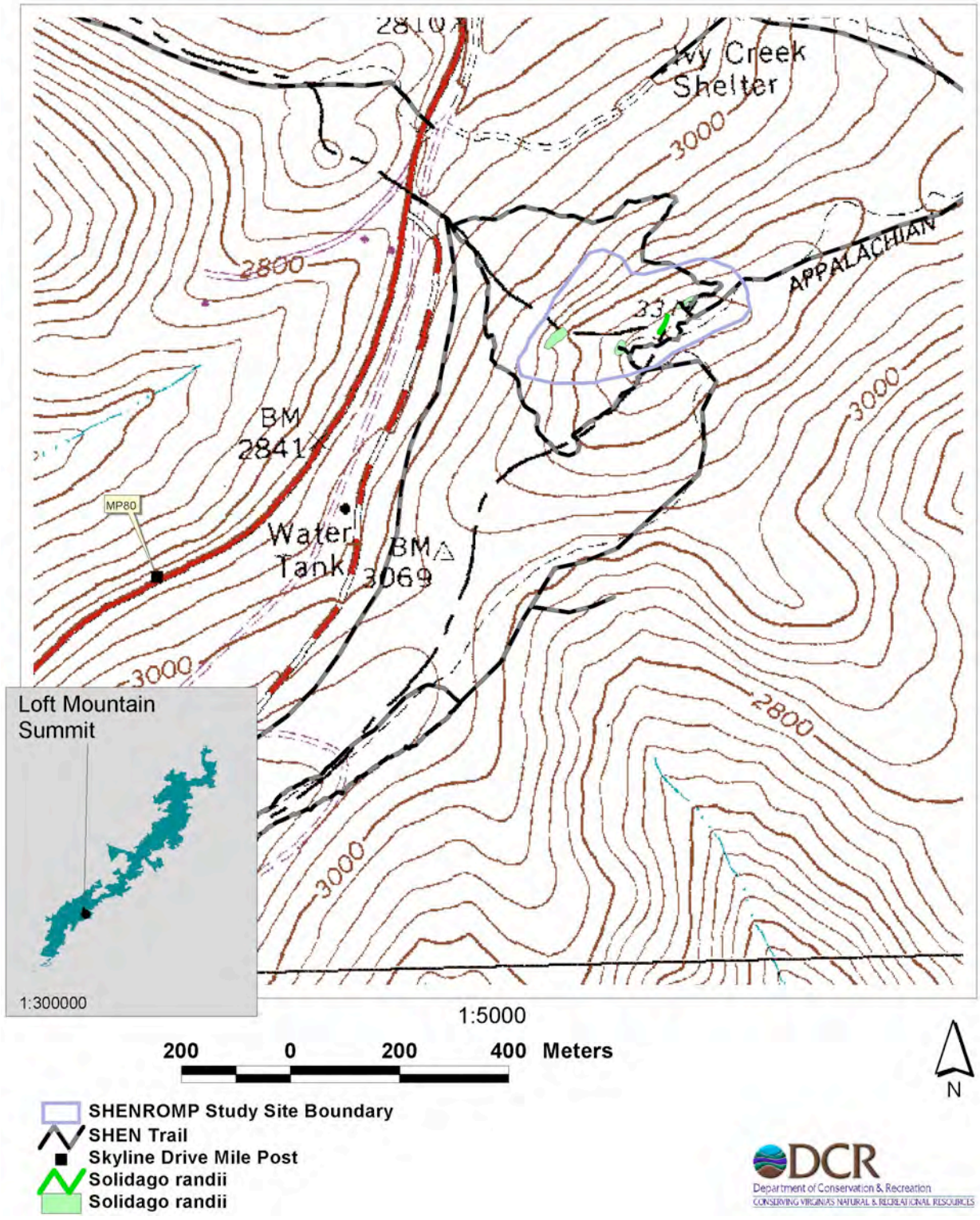


Fig. 157. Location of *Solidago randii* at Loft Mountain Summit.

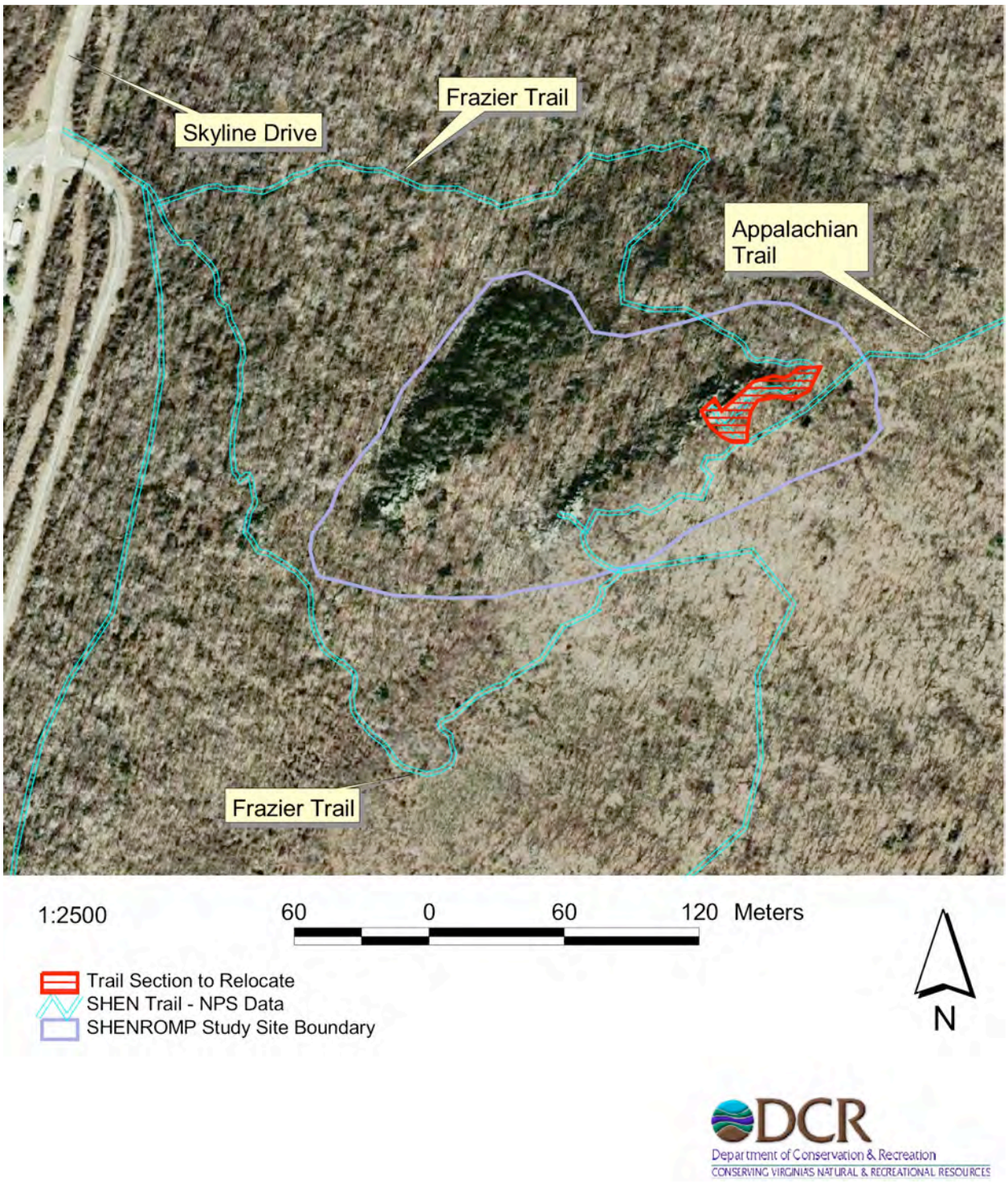


Fig. 158. Site details and recommended trail relocation for Loft Mountain Summit.

BLACKROCK SOUTH DISTRICT (C05)

CONSERVATION SITE: Trayfoot Mountain-Hall Mountain (B3) **THREAT RANK:** 1

LOCALITY: Rockingham and Albemarle Counties **QUADRANGLE(S):** Browns Cove

LOCATION: This South District site is located west of Skyline Drive and extends from 0.58-0.85 km (0.36-0.53 mi) southwest of the Blackrock parking area.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula lenta - *Quercus prinus* / *Parthenocissus quinquefolia* Woodland[1]	Sweet Birch - Chestnut Oak Talus Woodland	G3G4	S3S4	None	None	A
Lasallia (*papulosa*, *pensylvanica*) - *Dimelaena oreina* - (*Melanelia culbersonii*) Nonvascular Vegetation[1]	Central Appalachian Acidic Boulderfield	G4?	S4?	None	None	A
Plants: None						
Lichens:						
Arctoparmelia centrifuga	Concentric-ring lichen	G3G5	S1?	None	None	E
Buellia stellulata	a lichen	GNR	S1	None	None	E
Cladonia coccifera	a lichen	G5	S1?	None	None	E
Animals:						
Catocala herodias gerhardi	Herodias underwing	G3T3	S2S3	None	None	E

[1] Part of this element occurrence (eo) lies within the Trayfoot Saddle Boulderfields East and West ROMP sites.

SITE DESCRIPTION: This site encompasses a large, approximately 2.0 ha (5.0 ac) open boulderfield that caps a ridge and extends down both sides. Near the ridge spine, a few small areas of bedrock remain in place but the greater portion of the site consists of a steep, extensive deposit of angular, large-block boulders weathered from Harpers Formation quartzite. This site lies within an elevation range of 853-945 m (2,800-3,100 ft), and aspect varies from east to northwest. This boulderfield and others in SHEN may be the products of periglacial processes active during the last (Wisconsin) glaciation, when extreme climatic conditions probably accelerated physical weathering of the rocks.

The size of boulders at this site decreases with increasing distance (both downslope and across slope) from the ridge spine. This pattern is inversely correlated with the ability of trees and other vascular vegetation to invade the boulderfield. Thus, woodlands of gnarled trees are generally encroaching on the smaller-block weathered boulder deposits on the edges of the open boulderfields. A few small woodland patches occur as inclusions as well.

This site is easily accessed by a gentle 0.8 km (0.5 mi) walk from the Blackrock Parking area on Skyline Drive. The Appalachian Trail traverses three sides of the upper boulderfield area, while the Blackrock Spur Trail traverses the ridge spine through the lower portion. Trayfoot Mountain Trail crosses the lower edge of the boulderfields on the western edge of the site.

NATURAL COMMUNITIES: Large and outstanding occurrences of two natural communities occupy this site, each covering approximately 2 ha (5 ac). Vascular vegetation is lacking from this site's open boulderfields, which are covered by a diverse assortment of lichens representing the Central Appalachian Acidic Boulderfield nonvascular community. Dominant and characteristic species include *Lasallia papulosa*, *Lasallia pensylvanica*, *Dimelaena oreina*, *Melanelia culbersonii*, *Hypogymnia physodes*, *Physcia dubia*, *Physcia subtilis*, *Umbilicaria muehlenbergii*, *Xanthoparmelia conspersa*, and *Xanthoparmelia plittii*. Crustose taxa at this site, often most abundant along partly shaded edges of the boulderfields, include *Aspicilia cinerea*, *Fuscidia rescensa*, *Lecanora caesioalba*, *Lepraria neglecta*, *Rhizocarpon reductum*, and *Sarcogyne clavus*. Flat surfaces and interstices that have thin deposits of organic matter often support a variety of fruticose lichens, including *Cladina rangiferina*, *Cladina uncialis*, *Cladonia crispata*, *Cladonia macilenta*, *Cladonia ochrochlora*, and *Cladonia squamosa*.

The Blackrock South District site is situated at the upper elevation range for this community, which is reflected by the presence of several more characteristically northern and boreal lichens such as *Melanelia stygia*, *Arctoparmelia centrifuga* and *Cladonia coccifera*. In addition, other significant lichen collections from this site included *Buellia stellulata* (not previously reported from the eastern U.S.) and a distinctive yellow crust that is apparently undescribed. Extensive collections of lichens were made at this site and sent to specialists at the New York Botanical Garden for identification. The results of this effort strongly indicate that Blackrock South supports notably diverse lichen assemblages, with a number of regionally uncommon or rare members.

The Sweet Birch - Chestnut Oak Talus Woodland community occupies more weathered edges of the boulderfields. At this site stunted, gnarled, *Betula lenta* (sweet birch) trees less than 10 m (33 ft) tall, and sometimes only shrub-sized, dominate the woodland. Scattered associate trees include *Acer rubrum* (red maple), *Pinus strobus* (white pine), *Prunus pensylvanica* (pin cherry), *Quercus prinus* (chestnut oak), and *Quercus rubra* (northern red oak). Patchy, moderately dense to sparse shrub layers of *Acer pensyvlanicum* (striped maple), *Ilex montana* (mountain holly), *Menziesia pilosa* (minniebush), and *Vaccinium angustifolium* (northern lowbush blueberry) occur in some places under the trees. Lichens are abundant (about 65% cover) and diverse, with common taxa including *Umbilicaria mammulata*, *Lasallia papulosa*, *Flavoparmelia baltimorensis*, *Cetrellia chicitae*, *Cladonia* spp., etc. True herbs are absent, or nearly so.

RARE PLANTS: No rare or watchlist plants were found at this site.

RARE LICHENS: The assemblage of lichens at this site contains three species currently considered rare in Virginia: *Arctoparmelia centriguga*, *Buellia stellulata*, and *Cladonia coccifera*. *Buellia stellulata*, which has not been previously reported from the eastern U.S. (R. Harris, The New York Botanical Garden, pers. comm. to SHEN), was also collected at the Crescent Rock South District ROMP site. Collections of *Arctoparmelia centrifuga* and *Cladonia coccifera*, both arctic-boreal disjuncts, may be the first from Virginia.

RARE ANIMALS: On 18 August 2005, one individual of *Catocala herodias gerhardi* (Herodias underwing), was captured in an UV-trap. This moth uses species of *Quercus* (oak), and in particular *Q. ilicifolia* (bear oak) or *Q. marilandica* (blackjack oak), as its caterpillar host plant (NatureServe, 2005). Bear oak was seen in the area, though not at the immediate trap location. It is difficult to determine population status based on this data.

In addition, one watchlist moth, *Caripeta angustiorata* (brown pine looper moth), was captured in a UV trap on 18 August 2005.

Plate 75. Lichen-dominated Central Appalachian Acidic Boulderfield community at Blackrock South District. Sweet Birch – Chestnut Oak Talus Woodland is encroaching the downslope portion of the boulderfield.

THREATS: Because it is spectacular and accessible via a very short hike from Skyline Drive, this is a popular destination for day hikers. The site is often crowded on weekends and local impacts from visitors leaving the trail and scrambling on the rocks appears to be increasing. The rock scrambling and consequent trampling of fragile lichens (especially the large, loosely attached *Lasallia* spp.) appears to be concentrated around the ridge spine on both the Appalachian Trial and the Blackrock Spur Trail, where large blocks of bedrock make scrambling easier.

There are potential negative effects to *Catocala herodias gerhardi* from certain types of pesticides used to control gypsy moths or other insects that may adversely affect non-target species.

MANAGEMENT RECOMMENDATIONS: The size, quality, and rare species of the lichen community at this site argue for strong protection and management. Although it has not yet reached severe levels, off-trail visitor trampling of lichens needs to be drastically reduced. Barriers such as mesh fences, though aesthetically displeasing, may be necessary to accomplish this, at least on a short-term basis. In addition, interpretive signs explaining the ecological significance of the site, its lichen community, and its rare lichens might increase visitor's awareness of their potential impacts. The proximity of the site to Skyline Drive and the Appalachian Trail makes active management of this site

feasible.

Reduce off-trail rock scrambling in the high-quality rare lichen community. Use interpretative signs placed at key areas where trampling occurs or barriers if necessary.

Implement an education program and install signs to inform visitors of the natural resource protection values of outcrops. A vigorous education program would include on-site programs, print and electronic literature, and signs that discuss the unique geological and rare biological components of SHEN outcrops, why their conservation is important, and how visitors can participate in conservation actions.

No specific management recommendations are offered for *Catocala herodias gerhardi*. This species is unlikely to be impacted by management decisions specifically targeting cliffs and rock outcrops; however, caution should be used if gypsy moth or other insect suppression is contemplated in the area, as certain pesticides have broad effects on non-targeted invertebrate species. Further sampling to determine the full range of the moth within SHEN is recommended, as well as the use of target specific pesticides for gypsy moth control.

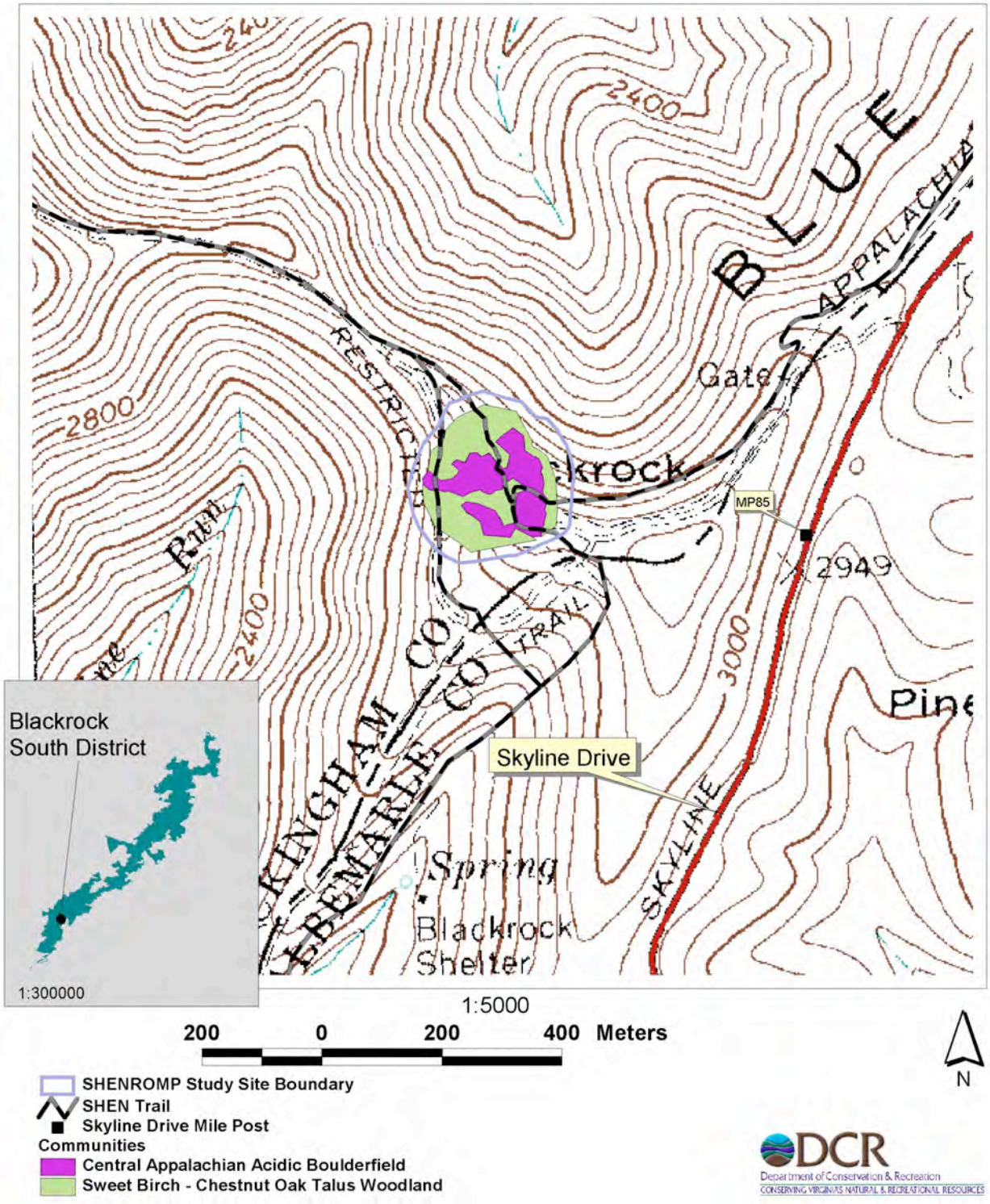


Fig. 159. Location of significant natural communities at Blackrock South District.

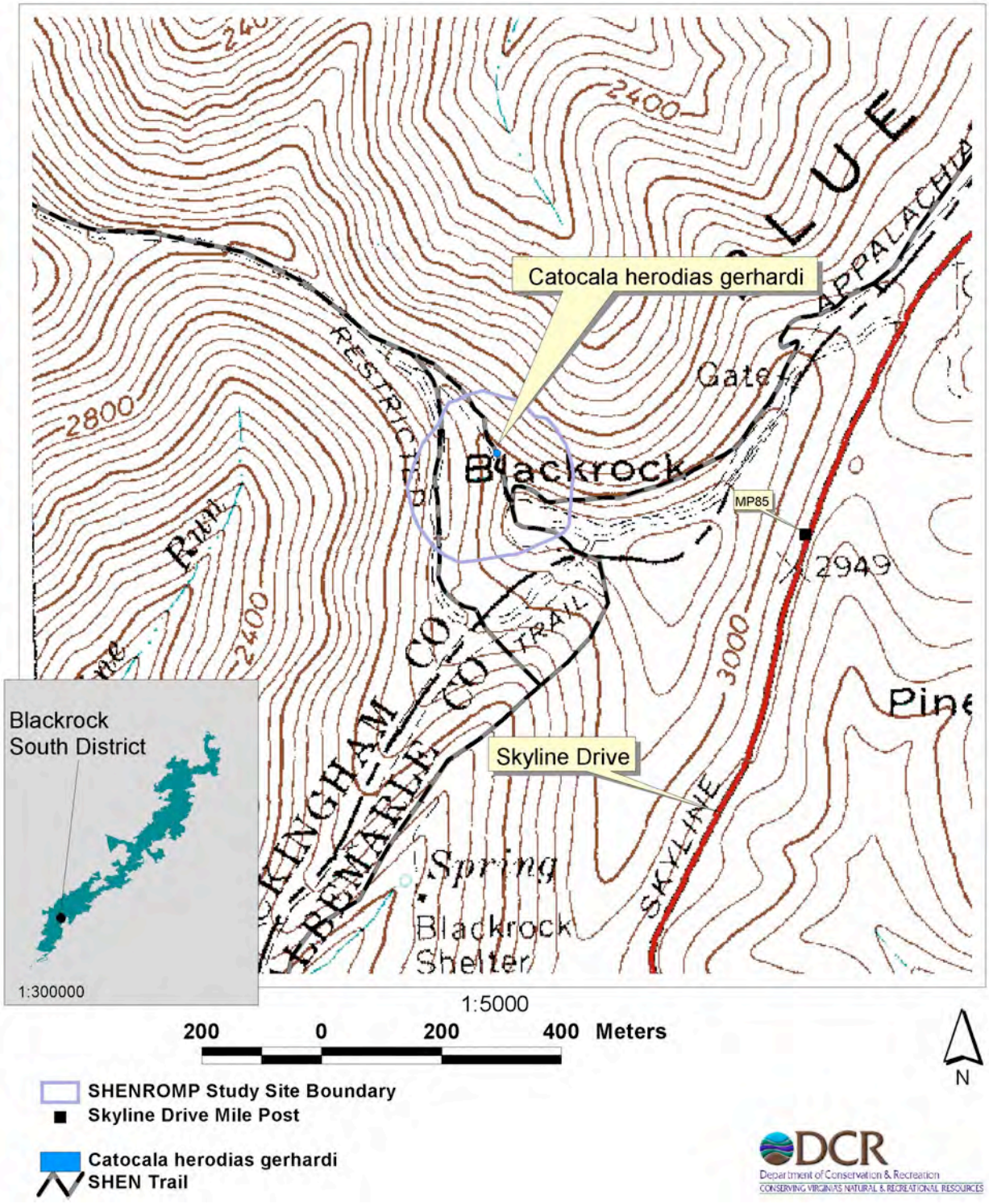


Fig. 160. Location of *Catocala herodias gerhardi* at Blackrock South District.

TRAYFOOT SADDLE BOULDERFIELDS EAST (C49)

CONSERVATION SITE: Trayfoot Mountain-Hall Mountain (B3) **THREAT RANK:** 0

LOCALITY: Rockingham County **QUADRANGLE(S):** Crimora

LOCATION: This South District site is located east of the saddle that lies north of Trayfoot Mountain and 1.6 km-1.8 km (1 mi-1.1 mi) northwest of the Blackrock parking area along Skyline Drive.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula lenta - *Quercus prinus* / *Parthenocissus quinquefolia* Woodland[1]	Sweet Birch - Chestnut Oak Talus Woodland	G3G4	S3S4	None	None	A
Lasallia (*papulosa*, *pensylvanica*) - *Dimelaena oreina* - (*Melanelia culbersonii*) Nonvascular Vegetation[1]	Central Appalachian Acidic Boulderfield	G4?	S4?	None	None	A
Plants:						
Betula cordifolia[2]	Mountain paper birch	G5T5	S2	None	None	C
Animals: None						

[1] Part of this element occurrence lies within the Trayfoot Saddle Boulderfield East and Blackrock South District ROMP sites.
[2] Part of this element occurrence lies within the Trayfoot Saddle Boulderfield West ROMP site and part extends beyond any ROMP site.

SITE DESCRIPTION: This site is located between 863 m (2,840 ft) and 948 m (3,120 ft) elevation on the east side of a ridge that extends north from the summit of Trayfoot Mountain. It encompasses two large, open boulderfields on steep, xeric east to northeast-facing slopes. These boulderfields are composed of small to moderate sized Hampton Formation quartzite boulders that support a variety of lichens but no vascular plants. They are surrounded by a matrix of acidic woodland and forest. The larger of the two boulderfields is an irregularly shaped opening of 0.5 ha (1.2 ac) located in the middle of the site. It begins near the ridgeline and extends for 93 m (305 ft) downslope and 96 m (315 ft) across the slope. A smaller opening of 0.13 ha (0.3 ac) occupies the northern end of the site, extending downslope for 58 m (190 ft) and across slope for 38 m (125 ft).

The Furnace Mountain Trail is located on the ridge crest that forms the western boundary of this site. This is an infrequently used trail, and the site receives little visitation.

NATURAL COMMUNITIES: An abundance of scattered charcoal and scars on larger oaks indicates a history of fires at this site. The more heavily forested parts of the site – mostly upslope of the boulder-fields – represent the Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. Two steep, open boulderfields lacking vascular plants and covering 0.63 ha (1.5 ac) in aggregate occupy

the east-facing slope within a matrix of Sweet Birch – Chestnut Oak Talus Woodland that covers at least 1.2 ha (3 ac). Dominant lichens of the open boulderfields are *Umbilicaria muehlenbergii*, *Lasallia pensylvanica*, *Lasallia papulosa*, *Dimelaena oreina*, and an unidentified dark gray crust. Also present are *Melanelia culbersonii*, *Cladonia rangiferina*, *Cladonia* spp., *Flavoparmelia baltimorensis*, and *Xanthoparmelia plittii*. The adjacent woodlands are co-dominated by *Betula lenta* (sweet birch), *Quercus prinus* (chestnut oak), and *Quercus rubra* (northern red oak) in variable combinations. *Betula cordifolia* (mountain paper birch), *Pinus rigida* (pitch pine), *Kalmia latifolia* (mountain-laurel), *Menziesia pilosa* (minniebush), *Ilex montana* (mountain holly), *Vaccinium angustifolium* (northern lowbush blueberry), and *Parthenocissus quinquefolia* (Virginia creeper) are associated trees and shrubs. Herbaceous species are very sparse to absent. Both communities are of outstanding size and quality.

RARE PLANTS: A previously known population of *Betula cordifolia* (mountain paper birch) was relocated at this site in acidic woodlands along the downslope edges of the two boulderfields. About eight clumps consisting of 12 mature trunks were located along the edge of the northern boulderfield. Three colonies were located along the edge of the larger boulderfield in the center of the site. From north to south, these had nine clumps with 19 mature stems, three clumps with 10 suckers, and one large clump with nine mature stems, respectively. Reproduction in these subpopulations appears to be primarily by suckers rather than by seed although some samaras were present. Standing broken trunks and fallen branch and trunk debris were common. This damage may be the result of stress to the trees from past gypsy moth defoliation in combination with ice and wind damage. In addition, the seed germination, recruitment, and suckering of this species is responsive to fire. The current colonies may represent an even-age stand dating to a major fire event in the first half of the 20th century.

RARE ANIMALS: No animal element occurrences or watchlist species were found during DCR-DNH surveys in 2005.

Plate 76. A large occurrence of the lichen-dominated Central Appalachian Acidic Boulderfield occupies much of the Trayfoot Saddle Boulderfields East site.

THREATS: Despite trail access to the site, there are no trampling impacts due to the steep, rocky terrain that makes it an uninviting place to walk. Gypsy moth damage and the virtual exclusion of fire as an ecological process are the biggest threats to *Betula cordifolia*.

MANAGEMENT RECOMMENDATIONS:

Determine feasibility of allowing prescribed wildfire at this site. The rare plant *Betula cordifolia* would benefit from a more frequent fire return interval. The SHEN fire manager should be consulted during the development of the rock outcrop management plan to determine feasibility of allowing wildfire to burn this site.

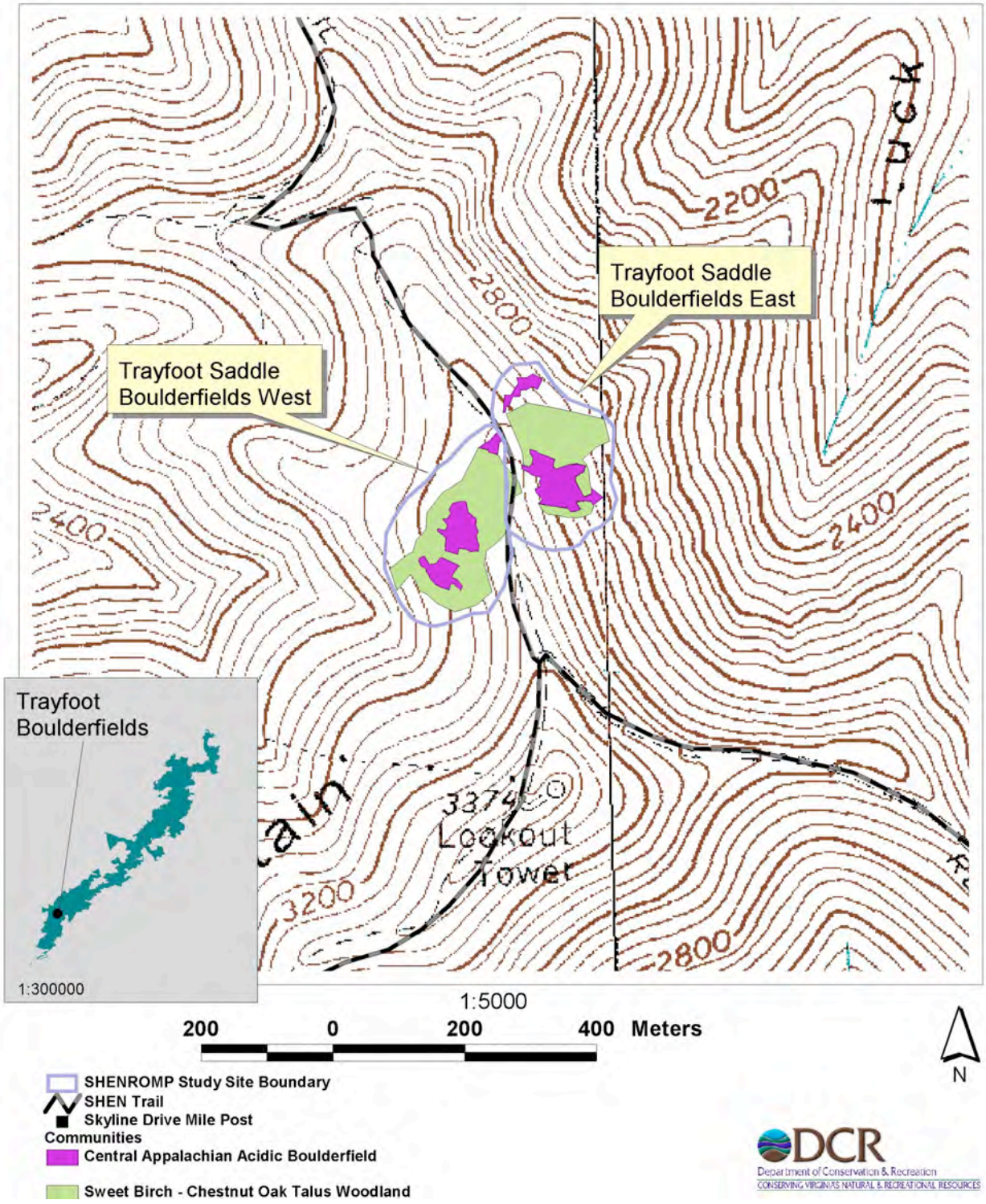


Fig. 161. Location of significant natural communities at Trayfoot Saddle Boulderfields East.

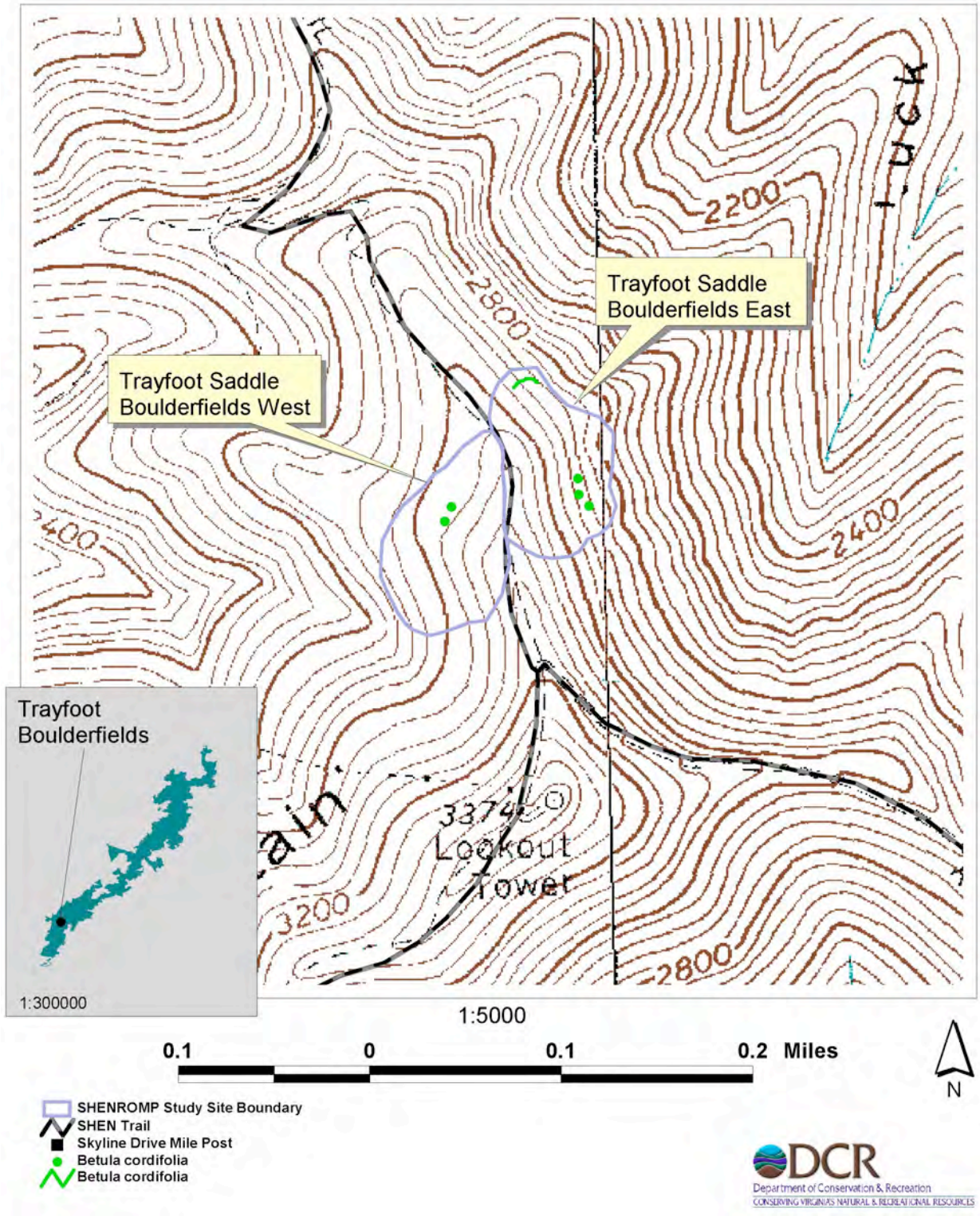


Fig. 162. Location of *Betula cordifolia* at Trayfoot Saddle Boulderfields East.

TRAYFOOT SADDLE BOULDERFIELDS WEST (C65)

CONSERVATION SITE: Trayfoot Mountain-Hall Mountain (B3) **THREAT RANK:** 0

LOCALITY: Rockingham County **QUADRANGLE(S):** Crimora

LOCATION: This South District site is located west of the saddle that lies north of Trayfoot Mountain and 1.7-1.9 km (1.03-1.16 mi) northwest of the Blackrock parking area along Skyline Drive.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities:						
Betula lenta - *Quercus prinus* / *Parthenocissus quinquefolia* Woodland[1]	Sweet Birch - Chestnut Oak Talus Woodland	G3G4	S3S4	None	None	A
Lasallia (*papulosa*, *pensylvanica*) - *Dimelaena oreina* - (*Melanelia culbersonii*) Nonvascular Vegetation[1]	Central Appalachian Acidic Boulderfield	G4?	S4?	None	None	A
Plants:						
Betula cordifolia[2]	Mountain paper birch	G5T5	S2	None	None	C
Animals: None						

[1] Part of this element occurrence lies within the Trayfoot Saddle Boulderfield East and Blackrock South District ROMP sites.
[2] Part of this element occurrence lies within the Trayfoot Saddle Boulderfield East ROMP site and part extends beyond any ROMP site.

SITE DESCRIPTION: This site is located between 875 m (2,880 ft) and 948 m (3,120 ft) elevation on the west side of a ridge that extends north from the summit of Trayfoot Mountain. It encompasses three large, open boulderfields on steep, xeric west to southwest-facing slopes. These boulderfields are composed of small to moderate sized Hampton Formation quartzite boulders that support a variety of lichens but no vascular plants. They are surrounded by a matrix of acidic woodland and forest. The largest of the boulderfields is a roughly rectangular shaped opening of 0.3 ha (0.8 ac) situated near the middle of the site. It extends for about 49 m (161 ft) downslope and 78 m (256 ft) across the slope. To the south is an irregularly shaped 0.18 ha (0.45 ac) opening that extends downslope for 77 m (253 ft) and across slope for 39 m (128 ft). Both of these boulderfields are in midslope positions. A small boulderfield is located just below the ridge crest at the north end of the site.

The Furnace Mountain Trail is located on the ridge crest that forms the western boundary of this site. This is an infrequently used trail, and the site receives little visitation.

NATURAL COMMUNITIES: An abundance of scattered charcoal and scars on larger oaks indicates a history of fires at this site. The more heavily forested parts of the site – mostly upslope of the boulderfields – represent the Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest. Three open boulderfields lacking vascular plants and covering 0.6 ha (1.4 ac) in aggregate occupy the east-facing slope within a matrix of Sweet Birch – Chestnut Oak Talus Woodland. Dominant lichens

of the open boulderfields are *Lasallia pensylvanica*, *Lasallia papulosa*, *Dimelaena oreina*, and an unidentified dark gray crust. Also present are *Melanelia culbersonii*, *Cladonia rangiferina*, *Cladonia uncialis*, *Cladonia crispata*, *Umbilicaria muehlenbergii*, and *Xanthoparmelia plittii*. The adjacent woodland, which covers at least 2.5 ha (6 ac) is co-dominated by *Betula lenta* (sweet birch), *Quercus prinus* (chestnut oak), and *Quercus rubra* (northern red oak) in variable combinations. Associated trees and shrubs include *Betula cordifolia* (mountain paper birch), *Pinus rigida* (pitch pine), *Ilex montana* (mountain holly), *Prunus pensylvanica* (pin cherry), *Menziesia pilosa* (minniebush), *Vaccinium angustifolium* (northern lowbush blueberry), *Acer pensylvanicum* (striped maple), *Ribes rotundifolium* (Appalachian gooseberry), *Kalmia latifolia*, and *Parthenocissus quinquefolia*. Herbaceous species are very sparse to absent. Quantitative plot data were collected from this part of the occurrence in 1999 (plot SHNP046).

RARE PLANTS: A previously known population of *Betula cordifolia* (mountain paper birch) was relocated at this site in acidic woodlands along the downslope edges of the larger (northern) boulderfield.

Two colonies were found here: the northernmost with13 mature trunks in several poorly differentiated clumps and the southernmost with 16 mature trunks in six clumps. Reproduction in these colonies appears to be primarily by suckers rather than by seed; no samaras were present. Standing broken trunks and fallen branch and trunk debris were common. This damage may be the result of stress to the trees from past gypsy moth defoliation in combination with ice and wind damage. In addition, the plants appeared to be drought stressed on the September 2005 survey date. The seed germination, recruitment, and suckering of this species is responsive to fire. The current colonies may represent an even-age stand dating to a major fire event in the first half of the 20th century.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2005.

Plate 77. An outstanding occurrence of Sweet Birch – Chestnut Oak Talus Woodland occupies deposits of relatively small rocks at the Trayfoot Saddle Boulderfields West site.

THREATS: Despite trail access to the site, there are no trampling impacts due to the steep, rocky terrain that makes it an uninviting place to walk. Gypsy moth damage and the virtual exclusion of fire as an ecological process are the biggest threats to *Betula cordifolia*.

MANAGEMENT RECOMMENDATIONS:

Determine the feasibility of prescribed fire at this site. The rare plant *Betula cordifolia* would benefit from more frequent fire return interval. The SHEN fire manager should be consulted during the development of the rock outcrop management plan to determine the feasibility of conducting prescribed fire at this site.

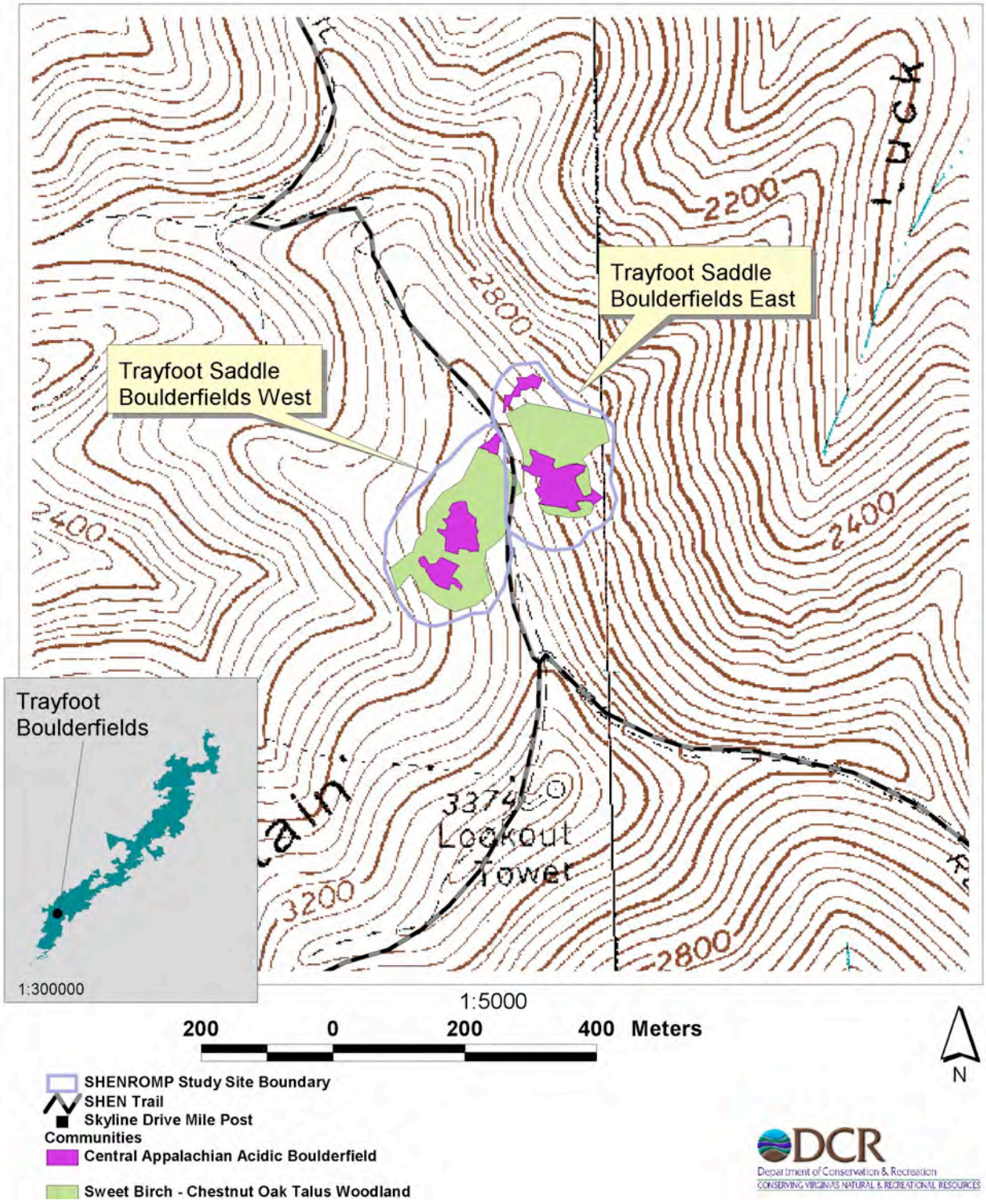


Fig. 163. Location of significant communities at Trayfoot Saddle Boulderfields West.

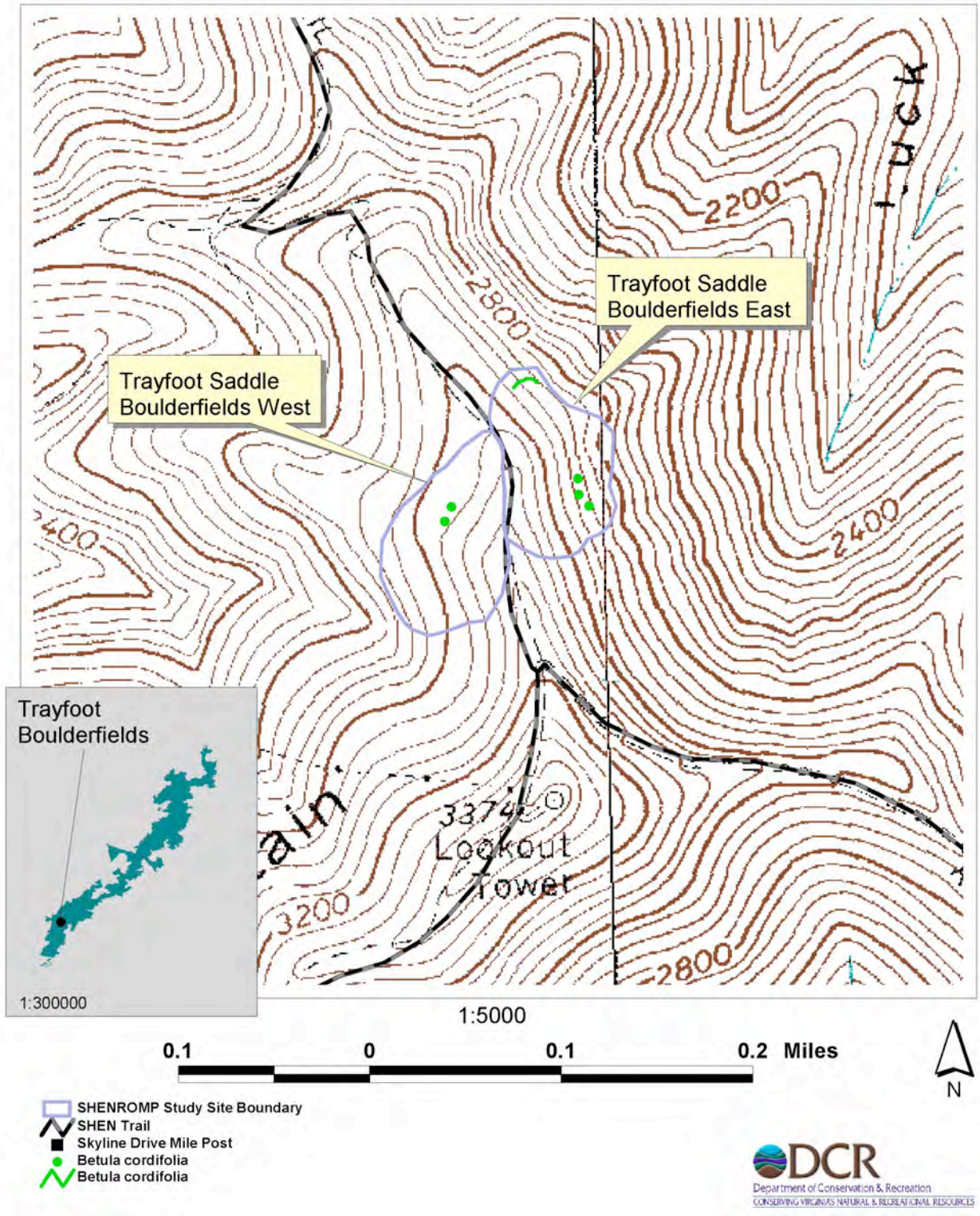


Fig. 164. Location of *Betula cordifolia* at Trayfoot Saddle Boulderfields West.

CALVARY ROCKS-CHIMNEY ROCK (C08)

CONSERVATION SITE: Calvary Rocks (B5) **THREAT RANK:** 1

LOCALITY: Augusta County **QUADRANGLE(S):** Crimora

LOCATION: This site is located in the South District west of Skyline Drive. It extends from 1.05-1.50 km (0.67-0.94 mi) northwest of the Riprap Trail parking area.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: None						
Plants:						
Aralia hispida	Bristly sarsaparilla	G5	S2	None	None	B
Animals: None						

SITE DESCRIPTION: This site contains two separate areas of open rock exposures composed of highly fractured Erwin Formation quartzite. Calvary Rocks consists of a rib of rock outcrops that caps a narrow ridge at the northeastern end of Rocks Mountain. Both the ridge and the outcrops are oriented from southwest to northeast. Outcrops here extend for about 600 m (1,968 ft) at elevations between 838-884 m (2,750-2,900 ft). Scattered areas of talus flank the outcrops.

Chimney Rock consists of a large cliff and freestanding rock pillar located near the top of a northwest-facing spur that lies perpendicular to the Calvary Rocks ridge. It is located about 0.30 km (0.18 mi) northwest of Calvary Rocks. An extensive boulderfield lies below the cliff. These features are located at elevations between 768-805 m (2,520-2,640 ft).

The Riprap Trail crosses this site, running along the northern portion of Calvary Rocks and just above the top of the Chimney Rock cliff.

NATURAL COMMUNITIES: No significant natural communities were found at this site. The principal vegetation types on the slopes and crests are the Central Appalachian / Northern Piedmont Low-Elevation Chestnut Oak Forest and the Central Appalachian Pine – Oak / Heath Woodland. The most characteristic species of these rather floristically depauperate vegetation types are *Quercus* spp. (oaks), *Pinus* spp. (pines), *Nyssa sylvatica* (black gum), and several ericaceous shrubs. The forest cover is broken by several small, lichen-dominated boulderfields, and small stands of Sweet Birch – Chestnut Oak Talus Woodland occupy more weathered talus below Calvary Rocks. *Betula lenta* (sweet birch), *Quercus prinus* (chestnut oak), *Sassafras albidum* (sassafras), and *Parthenocissus quinquefolia* (Virginia creeper) are typical species of these boulderfields. Forests and woodlands of this site have been severely damaged by outbreaks of gypsy moth and southern pine beetle during the past 15 years and many snags of trees which died following these outbreaks are present. The open canopy conditions that resulted from this widespread tree mortality, combined with the effects of a large fire in October 1998, have stimulated very vigorous and dense growth of shrubs and tree saplings in many parts of the site.

Quartzite outcrops of Calvary Rocks and Chimney Rocks support a more open, lithophytic variant of the Pine – Oak / Heath Woodland. Characteristic species on these outcrops are *Pinus rigida* (pitch pine), *Pinus pungens* (table-mountain pine), *Quercus prinus*, *Quercus coccinea* (scarlet oak), *Quercus ilicifolia*

(bear oak), *Betula lenta*, *Gaylussacia baccata* (black huckleberry), *Kalmia latifolia* (mountain-laurel), *Photinia melanocarpa* (black chokeberry), *Sassafras albidum*, and *Vaccinium pallidum* (early lowbush blueberry). Herbs are sparse, but *Polypodium appalachianum* (Appalachian rock polypody), *Danthonia spicata* (poverty oat-grass), and the state-rare *Aralia hispida* (bristly sarsaparilla) are locally common.

Lasallia pensylvanica, Dimelaena oreina, and *Xanthoparmelia conspersa* are prevalent lichens on the open to thinly shaded rocks throughout, while *Flavoparmelia baltimorensis*, *Umbilicaria mammulata*, and many crusts are typical of more shaded and sheltered rocks. The narrow Appalachian endemic *Melanelia culbersonii* is present at both Calvary and Chimney Rocks.

RARE PLANTS: A large, previously known population of *Aralia hispida* was relocated at this site in 2006. About 400 plants were found here in three areas along the rib of rock comprising Calvary Rocks. From northeast to southwest, the approximate number of plants found in each area and the area's size are as follows: 275 plants in a 15 x 90 m (49 x 295 ft) area, 30 plants in a 200 m^2 (2,152 ft^2) area, and 80-100 plants in a 10 x 50 m (33 x 164 ft) area. About half of the plants had immature inflorescences on the May 30 survey date.

RARE ANIMALS: No animal element occurrences where found during DCR-DNH surveys in 2006. Two watchlist moth species were captured in a UV-trap on 17 May 2006: *Euchlaena marginaria* (a geometrid moth) and *Heliomata infulata* (rare spring moth).

Plate 78. Outcrops of the white Erwin quartzite at the summit of Calvary Rocks.

THREATS: The northeasternmost *Aralia hispida* population area abuts the Riprap Trail. In addition, a poorly defined social trail leads to the southwesternmost area. At present, however, trampling of the rare plant appears to only be a minor problem.

Aralia hispida is believed to be a fire dependent species that cannot compete with other species in the absence of periodic wildfire or prescribed burning. The species was first reported from this site in 1970, but could not be relocated in 1990 (DCR-DNH Biotics data). The current abundance of *Aralia hispida* at this site probably reflects a response of this species to the large fire of October 1998, which burned most of the area.

MANAGEMENT RECOMMENDATIONS:

Determine feasibility of allowing prescribed wildfire at this site. The rare plant *Aralia hispida* would benefit from a more frequent fire return interval. The SHEN fire manager should be consulted during the development of the rock outcrop management plan to determine feasibility of allowing wildfire to burn this site.

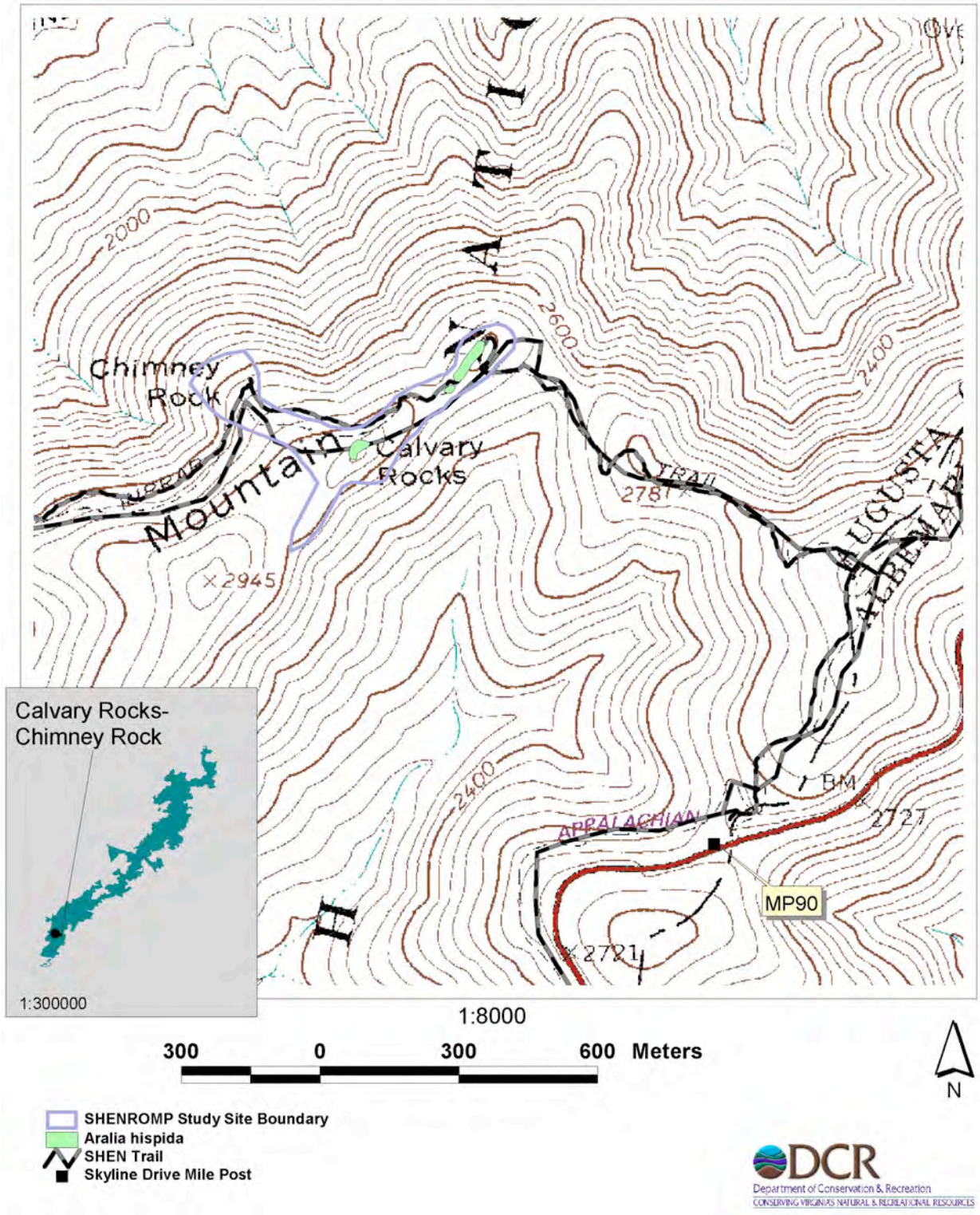


Fig. 165. Location of *Aralia hispida* at Calvary Rocks-Chimney Rock.

SAWLOG RIDGE (C45)

CONSERVATION SITE: South Fork Moorman's River (B2) **THREAT RANK:** 1

LOCALITY: Albemarle County **QUADRANGLE(S):** Crimora

LOCATION: This South District site is located west of the Charlottesville Reservoir. It extends from 2.0 km (1.2 mi) to 2.2 km (1.4 mi) southeast of Moormans River Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana - Carya glabra* / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	A
Plants: None						
Animals: None						

SITE DESCRIPTION: This site contains two openings with bedrock exposures on a southeast-facing slope at elevations between 534 m (1,720 ft) and 567 m (1,860 ft). An upper opening is about 0.81 ha (2.00 ac) in size; the lower opening is about 0.35 ha (0.87 ac). The slope here is steep, with inclinations mostly in the 30-35 percent range.

The bedrock at this site is Catoctin Formation metabasalt. The two steep bedrock openings have very different physical characteristics. The upper opening is long and horizontal, consisting of a mosaic of small rock outcrops nearly flush with the surrounding landform. The lower, narrower opening is situated in a topographic concavity that receives considerable seepage during wet periods. This area supports a mixture of low outcrops and boulders. Both openings have many areas of sufficient soil development to support dense herb layers and scattered trees and shrubs.

This site is in a remote area of SHEN and well away from trails. It receives little or no visitation.

NATURAL COMMUNITIES: Vegetation of the wooded slopes of this site represents the Central Appalachian Basic Oak-Hickory Forest (Submontane / Foothills Type). Areas on and adjacent to the two bedrock exposures support a 1.8 ha (4.5 ac) stand of Central Appalachian Basic Woodland. Tree height and cover in this woodland varies with surficial outcrop cover. Portions of the stand located on the two large bedrock exposures have very open overstories of highly stunted trees scarcely 6 m [20 ft] tall, suggesting one of the more herbaceous "barrens" communities. Areas more peripheral to the large outcrops have an open to semi-closed canopy of moderately stunted trees > 10 m [33 ft] tall. In addition, although graminoids are prevalent in the herb layer throughout, entirely different species dominate on the upper and lower outcrops. Despite these pronounced variations, quantitative analysis of plot data demonstrates that total floristic composition is fairly uniform throughout the stand and is consistent with other plots of Central Appalachian Basic Woodland.

Overstory dominants of the woodland are *Fraxinus americana* (white ash), *Carya ovata* (shagbark hickory), and *Carya glabra* (pignut hickory), with scattered *Juniperus virginiana* var. *virginiana* (eastern redcedar) and *Quercus prinus* (chestnut oak) also present. Common small trees and shrubs include *Ptelea trifoliata* (hop-tree), *Cercis canadensis* var. *canadensis* (eastern redbud), and *Ostrya virginiana* (eastern hop-hornbeam). The dominant herb in the more mesic, lower (downslope) opening is *Chasmanthium latifolium* (river-oats), which is absent from other parts of the stand. Throughout most of the stand, *Carex pensylvanica* (Pennsylvania sedge), *Solidago ulmifolia* var. *ulmifolia* (elm-leaf godenrod), *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Dichanthelium boscii* (Bosc's panic grass), *Dichanthelium linearifolium* (narrow-leaf panic grass), *Phacelia dubia* var. *dubia* (Appalachian phacelia), *Helianthus divaricatus* (woodland sunflower), *Commelina erecta* var. *erecta* (slender dayflower), *Schizachyrium scoparium* (little bluestem), *Pycnanthemum incanum* (hoary mountain-mint), *Muhlenbergia sobolifera* (cliff muhly), *Lespedeza intermedia* (wand bushclover), *Ambrosia artemisiifolia* (common ragweed), and *Cheilanthes lanosa* (hairy lipfern) are common to abundant herbs. Many additional species occur at low cover. Quantitative plot data were collected from this occurrence in 1999 (plots SHNP055 and SHNP056).

RARE PLANTS: No rare or watchlist plants were found at this site.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

Plate 79. Swards of *Chasmathium latifolium* (river oats) dominate the Central Appalachian Basic Woodland on the lower outcrop at Sawlog Ridge.

THREATS: The exotics *Alliaria petiolata* (garlic mustard) and *Verbascum thapsus* (great mullein) are present, but do not appear to be a threat to native species at present.

MANAGEMENT RECOMMENDATIONS:

On a 1-3 year interval, monitor *Alliaria petiolata* and *Verbascum thapsus* population trends. Establish a population threshold for *Alliaria* and *Verbascum* to trigger management action.

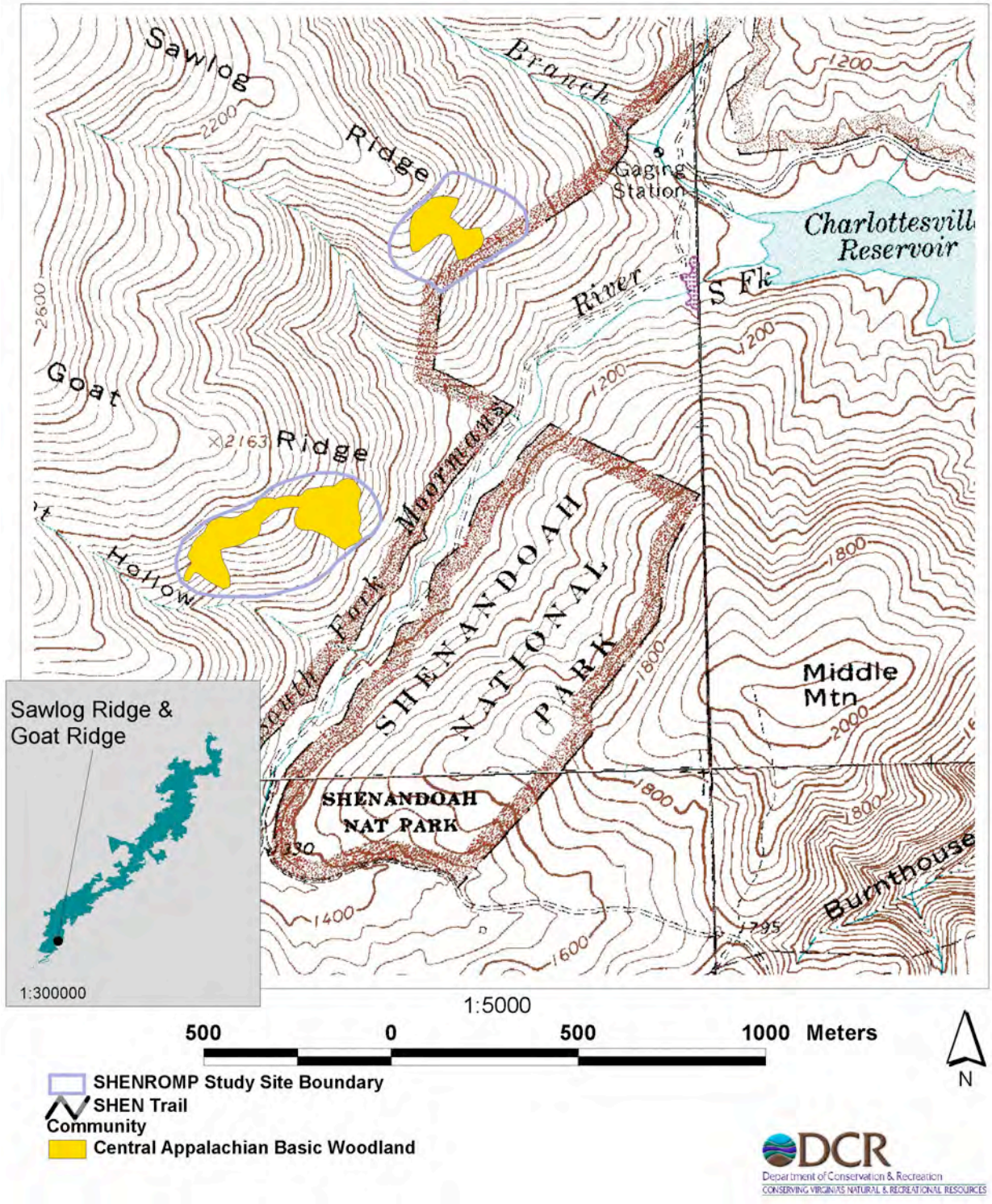


Fig 166. Location of significant natural community at Sawlog Ridge.

GOAT RIDGE (C18)

CONSERVATION SITE: South Fork Moorman's River (B2) **THREAT RANK:** 2

LOCALITY: Albemarle County **QUADRANGLE(S):** Crimora

LOCATION: This South District site is located at the eastern edge of Shenandoah National Park. It extends from 1.77 km (1.10 mi) to 2.27 km (1.42 mi) east of Turk Mountain Overlook.

NATURAL HERITAGE RESOURCES SUMMARY TABLE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RARITY RANK	STATE RARITY RANK	USFWS STATUS	VA LEGAL STATUS	ELEMENT OCCURRENCE RANK
Communities: *Fraxinus americana - Carya glabra* / *Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland	Central Appalachian Basic Woodland	G2	S2	None	None	A
Plants: None						
Animals: None						

SITE DESCRIPTION: This site contains a series of openings with bedrock exposures on steep south to southeast-facing slopes. The largest of these, located in the western half of the site, is long and horizontal, traversing south and southeast-facing slopes for about 125 m (410 ft) at elevations between 549-573 m (1,800-1880 ft). Several smaller openings are found in the eastern half of the site at elevations between 451-524 m (1,480-1,720 ft). These are located on southeast-facing slopes. Other small outcrops are found on southwest-facing slopes at the site's western end. These are mostly widely enough scattered so that there is little or no break in the woodland or forest canopy.

The bedrock at this site is Catoctin Formation metabasalt. Rock exposures here take the form of a mosaic of small outcrops interspersed with areas of sufficient soil development to support well-developed herb layers and scattered trees and shrubs. The outcrops are mostly low and often flush with the surrounding landform. An exception is an outcrop within the largest opening in the site which has a protruding, cliff-like base. Loose rock is also present in the openings.

This site is in a remote area of SHEN and well away from trails. It receives little or no visitation.

NATURAL COMMUNITIES: Vegetation of the wooded slopes of this site represents a mosaic of the Central Appalachian Basic Oak-Hickory Forest (Submontane / Foothills Type) and the Central Appalachian Dry-Mesic Chestnut Oak – Red Oak Forest. An irregular, elongated 5 ha (12 ac) area on the middle slope is characterized by shallow, rocky soils and rock outcrops that support a superb stand of Central Appalachian Basic Woodland. This woodland is exceptional in both its size and quality. Its physiognomy varies with surficial outcrop cover. Portions of the stand located on several bedrock exposures have very open overstories of highly stunted trees scarcely 6 m tall, suggesting one of the more herbaceous "barrens" communities. Other parts of the stand have an open to semi-closed canopy of moderately stunted trees > 10 m [33 ft] tall. However, quantitative analysis of plot data demonstrates that

total floristic composition is consistent throughout the stand and that the more open portions should be considered as physiognomic variants of the overall woodland.

The woodland overstory consists largely of *Fraxinus americana* (white ash), *Carya glabra* (pignut hickory), *Carya ovalis* (red hickory), and *Carya ovata* (shagbark hickory) in variable proportions. *Pinus virginiana* (Virginia pine) is present around some of the rock outcrops. An open understory of small trees and shrubs includes *Cercis canadensis* var. *canadensis* (eastern redbud), *Celtis tenuifolia* (Georgia hackberry), *Rosa carolina* var. *carolina* (pasture rose), *Viburnum prunifolium* (smooth black haw), and *Crataegus* sp. (a hawthorn). The herb layer varies from patchy to dense; patch-dominants include *Elymus hystrix* var. *hystrix* (bottlebrush grass), *Muhlenbergia sobolifera* (cliff muhly), *Helianthus divaricatus* (woodland sunflower), *Schizachyrium scoparium* (little bluestem), *Carex pensylvanica* (Pennsylvania sedge), *Phacelia dubia* var. *dubia* (Appalachian phacelia), *Pycnanthemum incanum* (hoary mountain-mint), and *Cheilanthes lanosa* (hairy lipfern, on and around rock outcrops). Other characteristic species include *Acalypha virginica* (Virginia copperleaf), *Allium cernuum* (nodding onion), *Ambrosia artemisiifolia* (common ragweed), *Asclepias verticillata* (whorled milkweed), *Bidens bipinnata* (Spanish-needles), *Bromus pubescens* (common eastern brome grass), *Clitoria mariana* (Maryland butterfly-pea), *Draba ramossisima* (rocktwist), *Eragrostis capillaris* (tiny lovegrass), *Geum virginianum* (cream avens), *Heuchera americana* (American alumroot), *Lespedeza violacea* (violet bushclover), *Packera anonyma* (=*Senecio anonymus*, Small's ragwort), *Panicum philadelphicum* (Philadelphia panic grass), *Solidago ulmifolia* var. *ulmifolia* (elm-leaf goldenrod), *Symphyotrichum laeve* var. *concinnum* (= *Aster laevis* var. *concinnus*, smooth aster), and *Woodsia obtusa* ssp. *obtusa* (blunt-lobed woodsia). Quantitative plot data were collected from this occurrence in 1999 (plot SHNP057) and again during the ROMP project (plot SHNP159).

RARE PLANTS: No rare or watchlist plants were found at this site.

RARE ANIMALS: No animal element occurrences or watchlist species where found during DCR-DNH surveys in 2006.

Plate 80. Steep, grassy opening in the Central Appalachian Basic Woodland at Goat Ridge.

THREATS: Invasive weeds are quite sparse at this site, but the shrub *Symphoricarpos orbiculatus* (coral-berry) forms small colonies in some of the more open outcrop habitats. *Alliaria petiolata* (garlic mustard) is also present within the site area.

MANAGEMENT RECOMMENDATIONS:

Manage the invasive plant *Symphoricarpus orbiculatus*. The use of herbicide is recommended for controlling this species. Growing in dense monotypic patches, *Symphoricarpus* can be treated by spray application using a backpack sprayer. Conduct post-treatment monitoring to determine any need for further action.

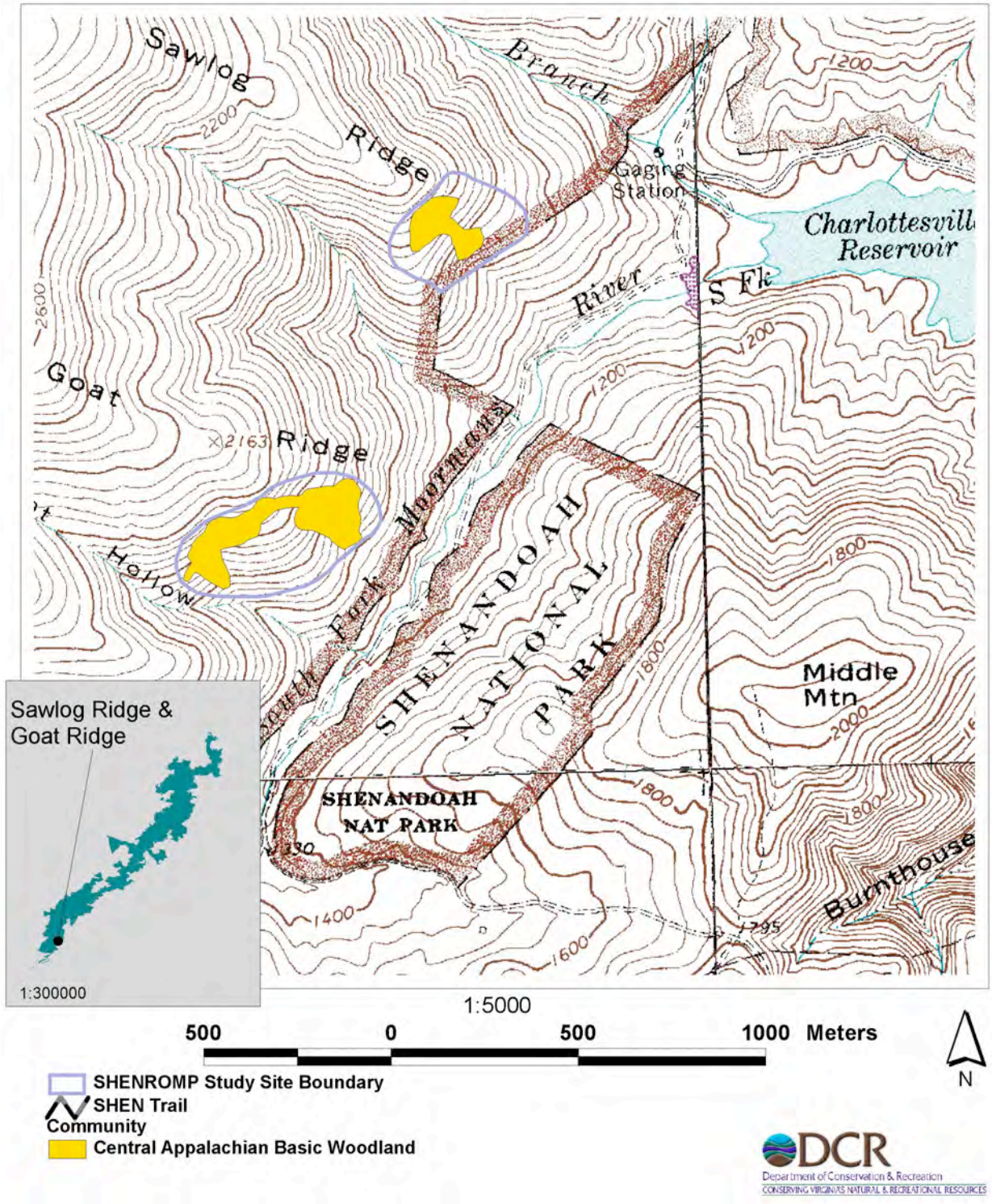


Fig. 167. Location of significant natural community at Goat Ridge.

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Appendix A

INTERNATIONAL ECOLOGICAL CLASSIFICATION STANDARD:

TERRESTRIAL ECOLOGICAL CLASSIFICATIONS

INTERNATIONAL ECOLOGICAL CLASSIFICATION STANDARD:

TERRESTRIAL ECOLOGICAL CLASSIFICATIONS

Subset from the National Vegetation Classification for the Shenandoah National Park Rock Outcrop Management Plan

21 March 2007

by

NatureServe

1101 Wilson Blvd., 15th floor
Arlington, VA 22209

6114 Fayetteville St, Suite 109
Durham, NC 27713

This subset of the International Ecological Classification Standard covers vegetation alliances and associations attributed to Shenandoah National Park. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, Durham, NC <mary_russo@natureserve.org> and Judy Teague, Regional Vegetation Ecologist, Durham, NC <judy_teague@natureserve.org>.

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Citations:

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[1] NatureServe is an international organization including NatureServe regional offices, a NatureServe central office, U.S. State Natural Heritage Programs, and Conservation Data Centres (CDC) in Canada and Latin America and the Caribbean. Ecologists from the following organizations have contributed the development of the ecological systems classification:

United States
Central NatureServe Office, Arlington, VA; Eastern Regional Office, Boston, MA; Midwestern Regional Office, Minneapolis, MN; Southeastern Regional Office, Durham, NC; Western Regional Office, Boulder, CO; Alabama Natural Heritage Program, Montgomery AL; Alaska Natural Heritage Program, Anchorage, AK; Arizona Heritage Data Management Center, Phoenix AZ; Arkansas Natural Heritage Commission Little Rock, AR; Blue Ridge Parkway, Asheville, NC; California Natural Heritage Program, Sacramento, CA; Colorado Natural Heritage Program, Fort Collins, CO; Connecticut Natural Diversity Database, Hartford, CT; Delaware Natural Heritage Program, Smyrna, DE; District of Columbia Natural Heritage Program/National Capital Region Conservation Data Center, Washington DC; Florida Natural Areas Inventory, Tallahassee, FL; Georgia Natural Heritage Program, Social Circle, GA; Great Smoky Mountains National Park, Gatlinburg, TN; Gulf Islands National Seashore, Gulf Breeze, FL; Hawaii Natural Heritage Program, Honolulu, Hawaii; Idaho Conservation Data Center, Boise, ID; Illinois Natural Heritage Division/Illinois Natural Heritage Database Program, Springfield, IL; Indiana Natural Heritage Data Center, Indianapolis, IN; Iowa Natural Areas Inventory, Des Moines, IA; Kansas Natural Heritage Inventory, Lawrence, KS; Kentucky Natural Heritage Program, Frankfort, KY; Louisiana Natural Heritage Program, Baton Rouge, LA; Maine Natural Areas Program, Augusta, ME; Mammoth Cave National Park, Mammoth Cave, KY; Maryland Wildlife & Heritage Division, Annapolis, MD; Massachusetts Natural Heritage & Endangered Species Program, Westborough, MA; Michigan Natural Features Inventory, Lansing, MI; Minnesota Natural Heritage & Nongame Research and Minnesota County Biological Survey, St. Paul, MN; Mississippi Natural Heritage Program, Jackson, MI; Missouri Natural Heritage Database, Jefferson City, MO; Montana Natural Heritage Program, Helena, MT; National Forest in North Carolina, Asheville, NC; National Forests in Florida, Tallahassee, FL; National Park Service, Southeastern Regional Office, Atlanta, GA; Navajo Natural Heritage Program, Window Rock, AZ; Nebraska Natural Heritage Program, Lincoln, NE; Nevada Natural Heritage Program, Carson City, NV; New Hampshire Natural Heritage Inventory, Concord, NH; New Jersey Natural Heritage Program, Trenton, NJ; New Mexico Natural Heritage Program, Albuquerque , NM; New York Natural Heritage Program, Latham, NY; North Carolina Natural Heritage Program, Raleigh, NC; North Dakota Natural Heritage Inventory, Bismarck, ND; Ohio Natural Heritage Database, Columbus, OH; Oklahoma Natural Heritage Inventory, Norman, OK; Oregon Natural Heritage Program, Portland, OR; Pennsylvania Natural Diversity Inventory, PA; Rhode Island Natural Heritage Program, Providence, RI; South Carolina Heritage Trust, Columbia, SC; South Dakota Natural Heritage Data Base, Pierre, SD; Tennessee Division of Natural Heritage, Nashville, TN; Tennessee Valley Authority Heritage Program, Norris, TN; Texas Conservation Data Center, San Antonio, TX; Utah Natural Heritage Program, Salt Lake City, UT; Vermont Nongame & Natural Heritage Program, Waterbury, VT; Virginia Division of Natural Heritage, Richmond, VA; Washington Natural Heritage Program, Olympia, WA; West Virginia Natural Heritage Program, Elkins, WV; Wisconsin Natural Heritage Program, Madison, WI; Wyoming Natural Diversity Database, Laramie, WY

Canada
Alberta Natural Heritage Information Centre, Edmonton, AB, Canada; Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada; British Columbia Conservation Data Centre, Victoria, BC, Canada; Manitoba Conservation Data Centre. Winnipeg, MB, Canada; Ontario Natural Heritage Information Centre, Peterborough, ON, Canada; Quebec Conservation Data Centre, Quebec, QC, Canada; Saskatchewan Conservation Data Centre, Regina, SK, Canada; Yukon Conservation Data Centre, Yukon, Canada

Latin American and Caribbean
Centro de Datos para la Conservacion de Bolivia, La Paz , Bolivia; Centro de Datos para la Conservacion de Colombia, Cali,Valle, Columbia; Centro de Datos para la Conservacion de Ecuador, Quito, Ecuador; Centro de Datos para la Conservacion de Guatemala, Ciudad de Guatemala , Guatemala; Centro de Datos para la Conservacion de Panama, Querry Heights , Panama; Centro de Datos para la Conservacion de Paraguay, San Lorenzo , Paraguay; Centro de Datos para la Conservacion de Peru, Lima, Peru; Centro de Datos para la Conservacion de Sonora, Hermosillo, Sonora , Mexico; Netherlands Antilles Natural Heritage Program, Curacao , Netherlands Antilles; Puerto Rico-Departmento De Recursos Naturales Y Ambientales, Puerto Rico; Virgin Islands Conservation Data Center, St. Thomas, Virgin Islands.

NatureServe also has partnered with many International and United States Federal and State organizations, which have also contributed significantly to the development of the International Classification. Partners include the following The Nature Conservancy; Provincial Forest Ecosystem Classification Groups in Canada; Canadian Forest Service; Parks Canada; United States Forest Service; National GAP Analysis Program; United States National Park Service; United States Fish and Wildlife Service; United States Geological Survey; United States Department of Defense; Ecological Society of America; Environmental Protection Agency; Natural Resource Conservation Services; United States Department of Energy; and the Tennessee Valley Authority. Many individual state organizations and people from academic institutions have also contributed to the development of this classification.

TABLE OF CONTENTS

I. Forest

I.B.2.N.a. Lowland or submontane cold-deciduous forest

Acer saccharum - Betula alleghaniensis - (Fagus grandifolia) *Forest Alliance (A.216)*

SUGAR MAPLE - YELLOW BIRCH - (AMERICAN BEECH) FOREST ALLIANCE

Alliance Summary: This alliance, found in the north-central and northeastern United States and adjacent southern Canada, is composed of rich mesic forests. Stands in this forest alliance typically have a closed canopy. Most of the trees are deciduous but conifers are often scattered throughout the stands. *Acer saccharum* is dominant in the overstory and sapling layer. *Betula alleghaniensis, Fagus grandifolia* (in the eastern two-thirds of this alliance's range), and *Tilia americana* may be codominants. Other common trees include *Abies balsamea, Acer rubrum, Fraxinus americana, Ostrya virginiana, Picea glauca, Pinus strobus, Quercus rubra*, and *Tsuga canadensis*. *Picea rubens* can be found in high elevation stands in the East. The dense overstory inhibits the growth of an abundant shrub layer. *Acer pensylvanicum* (in the east), *Corylus cornuta, Hamamelis virginiana, Lonicera canadensis, Taxus canadensis*, and *Viburnum acerifolium* are typical shrubs. Many of the common herbaceous species are typical of sub-boreal communities. These include *Aralia nudicaulis, Chimaphila maculata, Clintonia borealis,*

Lycopodium spp., *Maianthemum canadense, Osmorhiza claytonii, Oxalis montana, Pteridium aquilinum*, and *Streptopus lanceolatus var. longipes (= Streptopus roseus)*. Stands of this alliance are found on moderate to deep (60->150 cm) sandy loam, clay loam, or loamy sand soils. The soils are typically slightly acidic to circumneutral, mesic to wet-mesic and nutrient-rich. Most stands develop on flat to moderate slopes over glacial till. A relatively thick layer of fallen leaves covers the forest floor. Sites that support this alliance are on flat to moderately sloping terrain on glacial features such as till or moraines or on calcareous rocks, sandstone, or shale outside the glaciated region.

CENTRAL APPALACHIAN HIGH-ELEVATION BOULDERFIELD FOREST (CEGL008504)

Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum Forest
Yellow Birch / American Mountain-ash - Mountain Maple / Appalachian Rockcap Fern Forest

ELEMENT CONCEPT

Summary: This community type is known from high elevations of the northern Blue Ridge, Ridge and Valley, and Allegheny Mountains in Virginia and West Virginia. It occupies steep, boulder-strewn slopes at elevations from 1000 m (3300 feet) to over 1250 m (4100 feet). The type is most frequent and extensive on straight or concave, middle to upper slopes with northerly aspects, but is found occasionally on slopes with other aspects. Surface substrate is characterized by a surface cover of angular boulders weathered from granite, metabasalt (greenstone), quartzite, and sandstone. This vegetation type has a closed to open canopy overwhelmingly dominated by *Betula alleghaniensis*. The canopy trees are usually stunted and gnarled, exhibiting the effects of frequent ice and wind damage. Tree density is typically less than that of the surrounding forests. *Sorbus americana* and *Prunus pensylvanica* are minor canopy associates. Small tree and shrub densities are variable; *Sorbus americana* and *Acer spicatum* often have high cover in these layers. *Menziesia pilosa, Sambucus racemosa (= Sambucus pubens), Rubus idaeus ssp. strigosus*, and *Ribes cynosbati* are frequent shrubs. Herbaceous cover is often limited by the rocky substrate.

Environment: This community occupies steep (up to 38 degrees), boulder-strewn slopes at elevations from 1000 m (3300 feet) to over 1250 m (4100 feet). Mean elevation of plot-sampled Virginia sites is 1119 m (3672 feet). The type is most frequent and extensive on straight or concave, middle to upper slopes with northerly aspects, but is found occasionally on slopes with other aspects. Surface substrate is characterized by surface cover >75% of angular boulders weathered from granite, metabasalt (greenstone), quartzite, and sandstone. Surface cover of bryophytes and lichens on rocks is typically >60%. Mineral soil samples could not be extracted from any of the Virginia plot-sampling sites. Surficial groundwater seepage is very rare in these habitats, although perched, subsurface groundwater may be present in some localities. Extreme winter temperatures, high winds, and ice storms are frequent, and strongly influence the physiognomy of forests on the boulderfields.

Vegetation: This vegetation type has a closed to open canopy overwhelmingly dominated by *Betula alleghaniensis*. The canopy trees are usually stunted and gnarled, exhibiting the effects of frequent ice and wind damage. Tree density is typically less than that of the surrounding forests. *Sorbus americana* and *Prunus pensylvanica* are minor

canopy associates. Small tree and shrub densities are variable; *Sorbus americana* and *Acer spicatum* often have high cover in these layers. *Menziesia pilosa, Sambucus racemosa (= Sambucus pubens), Rubus idaeus ssp. strigosus*, and *Ribes cynosbati* are frequent shrubs. Herbaceous cover is often limited by the rocky substrate, but lithophytic species such as *Polypodium appalachianum* may abundantly cover mossy rock surfaces. Additional characteristic herbs include *Oclemena acuminata (= Aster acuminatus), Dryopteris marginalis, Hylotelephium telephioides (= Sedum telephioides), Carex brunnescens ssp. sphaerostachya, Carex aestivalis, Arisaema triphyllum, Dryopteris intermedia, Gymnocarpium appalachianum, Maianthemum canadense*, and *Polygonatum pubescens*. Mean species richness of plot-sampled stands is 17 taxa per 400 m2.

Similar Associations:

- *Betula alleghaniensis / Ribes glandulosum / Polypodium appalachianum* Forest (CEGL006124)--has a number of typical southern Appalachian species and occupies more mesic boulderfields.

Related Concepts:

- *Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest (Fleming and Coulling 2001) =

Classification Comments: On the landscape, *Betula alleghaniensis / Sorbus americana - Acer spicatum / Polypodium appalachianum* Forest (CEGL008504) grades into fully exposed, lichen-dominated boulderfields at one extreme, and into rocky northern hardwood, red oak, or cove forests at the other. It has not been formally documented from West Virginia but has been observed by Virginia DCR-DNH ecologists at several sites, including Reddish Knob and Panther Knob, Pendleton County, and Black Mountain, Pocahontas County. It is probably widely but locally distributed at high elevations throughout the extreme western Ridge and Valley and Allegheny Mountains of West Virginia.

CONSERVATION RANKING

GRank: G2 (2001-6-21) **Reasons:** This is a small-patch community type occupying very restricted habitats within a narrow geographic range. There are less than 20 known occurrences of the type in Virginia.

ELEMENT DISTRIBUTION

Range: This community type is known from high elevations of the northern Blue Ridge, Ridge and Valley, and Allegheny Mountains in Virginia and West Virginia.
Subnations: VA, WV
TNC Ecoregions: 59:C
USFS Ecoregions: M221Aa:CCC, M221Ba:CCC, M221Bd:CCC, M221Da:CCC
Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

ELEMENT SOURCES

References: Fleming and Coulling 2001, Fleming and Moorhead 1996, Fleming et al. 2001, Fleming et al. 2004

II. Woodland

II.B.2.N.a. Cold-deciduous woodland

Fraxinus americana - Carya glabra - (Juniperus virginiana) *Woodland Alliance (A.604)*

WHITE ASH - PIGNUT HICKORY - (EASTERN RED-CEDAR) WOODLAND ALLIANCE

Alliance Summary: Woodlands in this alliance have *Fraxinus americana* and *Carya glabra* as typical canopy dominants, although *Juniperus virginiana, Quercus prinus*, or

other *Carya* spp. may have significant coverage in some associations. Some associations have a nearly closed or locally closed canopy, and could in some cases as readily be considered as forests, while others have an edaphically maintained woodland physiognomy. Other minor canopy species vary with geography, but may include *Quercus rubra var. rubra, Pinus virginiana, Ulmus alata, Quercus stellata, Carya ovata*, and *Carya pallida*. Subcanopy and shrub species are variable between associations, but can include *Amelanchier sanguinea, Ceanothus americanus, Celtis tenuifolia, Cercis canadensis, Chionanthus virginicus, Crataegus* sp., *Hypericum prolificum, Juniperus virginiana var. virginiana, Lonicera flava, Ostrya virginiana, Philadelphus hirsutus, Physocarpus opulifolius, Ptelea trifoliata, Rhus aromatica var. aromatica, Rhus typhina, Rosa carolina, Spiraea betulifolia var. corymbosa, Symphoricarpos orbiculatus, Toxicodendron radicans, Vaccinium arboreum, Vaccinium pallidum, Vaccinium stamineum, Viburnum rafinesquianum (= var. rafinesquianum)*, and *Viburnum rufidulum*. Herbaceous species vary among associations, but species known from these woodlands include *Allium cuthbertii, Andropogon gerardii, Andropogon gyrans, Andropogon ternarius, Anemone berlandieri, Anemone virginiana, Antennaria virginica, Aquilegia canadensis, Arabis canadensis, Arabis hirsuta var. pycnocarpa (= Arabis hirsuta var. adpressipilis), Arabis laevigata, Aristida purpurascens, Aristolochia serpentaria, Asclepias quadrifolia, Asplenium platyneuron, Symphyotrichum oblongifolium (= Aster oblongifolius), Symphyotrichum patens var. patens (= Aster patens var. patens), Campanula divaricata, Cardamine parviflora var. arenicola, Carex pensylvanica, Cheilanthes lanosa, Claytonia virginica, Coreopsis major, Coreopsis pubescens, Cunila origanoides, Danthonia compressa, Danthonia sericea, Danthonia spicata, Desmodium rotundifolium, Dichanthelium boscii, Dichanthelium scoparium, Dodecatheon meadia, Draba ramosissima, Elymus hystrix, Erigeron pulchellus, Helianthus divaricatus, Helianthus microcephalus, Houstonia longifolia, Hypericum gentianoides, Hypericum punctatum, Melica mutica, Muhlenbergia tenuiflora, Phacelia dubia, Phlox nivalis ssp. hentzii, Piptochaetium avenaceum, Polygala paucifolia, Polygonum tenue, Pycnanthemum incanum, Pycnanthemum montanum, Saxifraga michauxii, Schizachyrium scoparium, Sedum glaucophyllum, Selaginella rupestris, Packera millefolia (= Senecio millefolium), Packera obovata (= Senecio obovatus), Solidago arguta var. harrisii (= Solidago harrisii), Solidago juncea, Solidago nemoralis, Sorghastrum nutans, Tradescantia ohiensis, Verbesina occidentalis, Woodsia ilvensis*, and *Woodsia obtusa*. These woodlands are often a physiognomic complex of woodland, grassland, and rock outcropping, often associated with granitic domes or rocky summits. Soils are circumneutral and derived from such base-rich rocks as greenstone, plagioclase-rich granite, hornblende gneiss, amphibole gneiss, limestones, or calcareous shales. Woodlands in this alliance are currently defined from 305 to 1160 m (1000-3800 feet) elevation in the southern and central Blue Ridge, the Ridge and Valley of Virginia, and the upper Piedmont of Georgia, North Carolina, and Virginia.

CENTRAL APPALACHIAN BASIC WOODLAND (CEGL003683)

Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia Woodland
White Ash - Pignut Hickory / Rock Muhly - Spreading Sunflower - Elmleaf Goldenrod Woodland

ELEMENT CONCEPT

Summary: This association is a woodland dominated by *Fraxinus americana* and *Carya glabra*, occurring in dry, rocky, fertile soils derived from metabasalt of the Catoctin Formation and, less frequently, phyllite or metasiltstone of the Harpers and Weaverton formations. Stands are found from 60 to 950 m (250-3000 feet) in elevation in the central Blue Ridge and upper Piedmont. Less constant and important canopy species include *Carya ovalis, Quercus prinus, Quercus rubra var. rubra, Juniperus virginiana*, and *Pinus virginiana*. Subcanopy species include *Celtis tenuifolia, Celtis occidentalis, Cercis canadensis var. canadensis, Ostrya virginiana*, and *Ulmus rubra*. The shrub stratum includes *Rhus aromatica var. aromatica, Ptelea trifoliata, Viburnum rafinesquianum (= var. rafinesquianum), Rhus typhina, Toxicodendron radicans*, and *Vaccinium pallidum*. Typical species of the herb stratum include *Muhlenbergia sobolifera, Helianthus divaricatus, Pycnanthemum incanum, Elymus hystrix, Carex pensylvanica, Polygonum tenue, Woodsia ilvensis, Woodsia obtusa, Phacelia dubia, Symphyotrichum oblongifolium (= Aster oblongifolius), Solidago arguta var. harrisii (= Solidago harrisii), Selaginella rupestris, Cheilanthes lanosa, Danthonia spicata, Cardamine parviflora var. arenicola, Draba ramosissima, Sedum glaucophyllum*, and others.

Environment: Stands occupy dry, rocky, thin-soiled slopes over Catoctin metabasalt (greenstone, a mafic metamorphic rock) and rarely other high-base bedrock, such as metasiltstone and phyllitic metasiltstone in the vicinity of Harper's Ferry, calcareous sandstone on Peters Mountain at The Narrows, Giles County, Virginia, hornblende-biotite granite on Point Lookout Mountain (Striped Rock), Grayson County, Virginia, or pyroxene-bearing granites of the northern Blue Ridge. Elevations of 22 plot samples and other observed stands range from 60 to 1012 m (240-3300 feet), with a mean of 562 m (1845 feet). Habitats are usually situated on steep (up to 37 degrees) middle slopes, often on or around large bedrock exposures. Mean surface cover of outcrops and loose rocks is about 40%. Aspect ranges from southeast to northwest, but the majority of sites have south to southwest aspects. Soils are mostly very stony, clay loams that are strongly acidic (mean pH = 5.0) but have relatively high calcium (ca. 1800 ppm) and magnesium (ca. 400 ppm) levels.

Vegetation: Stands of this woodlands are generally dominated by *Fraxinus americana* and *Carya glabra*. Less constant and important canopy species include *Carya ovalis, Quercus prinus, Quercus rubra var. rubra, Juniperus virginiana*, and *Pinus virginiana*. Subcanopy species include *Celtis tenuifolia, Celtis occidentalis, Cercis canadensis var. canadensis, Ostrya virginiana*, and *Ulmus rubra*. The shrub stratum includes *Rhus aromatica var. aromatica, Ptelea trifoliata, Viburnum rafinesquianum (= var. rafinesquianum), Rhus typhina, Toxicodendron radicans*, and *Vaccinium pallidum*. Typical species of the herb stratum include *Muhlenbergia sobolifera, Helianthus divaricatus, Pycnanthemum incanum, Elymus hystrix, Carex pensylvanica, Polygonum tenue, Woodsia ilvensis, Woodsia obtusa, Phacelia dubia, Symphyotrichum oblongifolium (= Aster oblongifolius), Solidago arguta var. harrisii (= Solidago harrisii), Selaginella rupestris, Cheilanthes lanosa, Danthonia spicata, Cardamine parviflora var. arenicola, Draba ramosissima, Sedum glaucophyllum*, and others.

In plot-sampled stands, vegetation consists of open to very open woodlands with stunted canopies of 6- to 15-m tall trees. *Fraxinus americana* is the characteristic, consistently

dominant or codominant canopy species, usually contributing at least 25% cover. *Carya glabra* and, less frequently, *Carya ovata* and *Carya ovalis* are common, sometimes dominant overstory associates. *Quercus prinus, Quercus rubra, Juniperus virginiana, Pinus virginiana*, and *Juglans nigra* are minor canopy trees. Understory and shrub layers vary in density, with *Ulmus rubra, Celtis occidentalis, Ostrya virginiana, Cercis canadensis*, and *Rosa carolina* the most typical species. The herb layer varies from moderately open to dense and contains a diversity of xerophytic grasses and forbs. Dominant herbs occurring in 73% of plots and attaining a mean cover of 5% are *Muhlenbergia sobolifera, Helianthus divaricatus, Solidago ulmifolia, Carex pensylvanica, Elymus hystrix*, and *Phacelia dubia*. Unusual stands that occur on concave slopes at two Virginia sites have herb layers dominated by *Chasmanthium latifolium*. Less abundant but relatively constant (50%) herbs include *Acalypha virginica, Ambrosia artemisiifolia, Antennaria plantaginifolia, Arabis laevigata, Danthonia spicata, Dichanthelium boscii, Dichanthelium linearifolium, Eupatorium sessilifolium, Geum virginianum, Heuchera americana, Lespedeza frutescens (= Lespedeza intermedia), Polygonum scandens var. cristatum, Pycnanthemum incanum, Saxifraga virginiensis*, and *Woodsia obtusa*. Less frequent but locally abundant or important herbaceous species include *Schizachyrium scoparium, Senna marilandica, Symphyotrichum laeve var. concinnum (= Aster laevis var. concinnum), Symphyotrichum oblongifolium*, and *Tradescantia ohiensis*; the last species is prominent at, but confined to, the southernmost sites for this community in Giles and Grayson counties. *Solidago juncea, Carex muehlenbergii var. enervis, Lespedeza virginica*, and *Dichanthelium depauperatum* are important species of a variant of this community type occurring on metasedimentary rocks in Maryland, near Harpers Ferry, West Virginia. Species richness of plot-sampled stands ranges from 46 to 103 taxa per 400 square meters (mean = 66).

Dynamics: This community is associated with outcrops and thin-soil areas over metabasalt and, less frequently, other bedrock with high base status. The exotic herb *Commelina communis* and the shrub *Symphoricarpos orbiculatus*, introduced from farther west, are problematic invasives at some sites. *Symphoricarpos orbiculatus* is particularly aggressive and is capable of covering large areas with dense colonies in a matter of years, once established.

Similar Associations:

- *Carya glabra - Fraxinus americana / Acer leucoderme / Piptochaetium avenaceum* Woodland (CEGL008489)
- *Fraxinus americana / Dryopteris marginalis - Sedum glaucophyllum - Carex communis* Woodland [Provisional] (CEGL008541)
- *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (CEGL008529)
- *Juniperus virginiana* var. *virginiana - Celtis tenuifolia - Cercis canadensis / Sporobolus clandestinus - Danthonia sericea* Woodland (CEGL008499)
- *Quercus alba - Carya glabra - Fraxinus americana / Cercis canadensis / Muhlenbergia sobolifera - Elymus hystrix* Forest (CEGL006216)

Related Concepts:

- *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (Fleming and Coulling 2001) =
- Central Appalachian Basic Ash - Hickory Woodland (Fleming et al. 2004) =
- Greenstone Glade (Fleming 1993) B
- White ash - Shagbark hickory woodlands (CAP pers. comm. 1998) ?

Classification Comments: As currently circumscribed, this community type does not include related (and often spatially associated) wooded herbaceous vegetation occurring on massive, exposed outcrops, e.g., *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (CEGL008529).

CONSERVATION RANKING

GRank: G2 (2004-3-30) **Reasons:** This community is naturally rare, geographically restricted, and confined to special edaphic habitats, primarily over metabasalt in the Blue Ridge and upper Piedmont of Virginia and Maryland. There are few threats to occurrences of this community. Where trails transect or approach these communities, they receive minor trampling damage and introduction of alien species.

ELEMENT DISTRIBUTION

Range: This community is mostly restricted to areas underlain by Catoctin metabasalt (greenstone) in the Blue Ridge and adjacent Piedmont foothills of northern Virginia and Maryland. However, scattered outliers have been documented on diabase of the northern Piedmont Triassic Basin; on calcareous sedimentary substrates (sandstone, shale, metasiltstone, and phyllite) of the Blue Ridge and Ridge and Valley provinces; and on granitic terrain of the Blue Ridge. This vegetation type is rare in the George Washington National Forest, where the only known examples are located at the northern end of the Pedlar Ranger District. Excellent Blue Ridge and Piedmont examples of the type are protected in Shenandoah National Park and The Nature Conservancy's Wildcat Mountain Natural Area, respectively.
Subnations: MD, VA
TNC Ecoregions: 51:C, 52:C, 59:C, 61:?
USFS Ecoregions: 231Ae:CCC, 231Ak:CCC, 231Al:CCC, 231Ap:CCP, M221Aa:CCC, M221Ab:CC?, M221Da:CCC, M221Db:CC?, M221Dc:CCC
Federal Lands: NPS (Blue Ridge Parkway, C&O Canal, Catoctin Mountain, Harpers Ferry, Shenandoah); USFS (George Washington)

ELEMENT SOURCES

References: CAP pers. comm. 1998, Fleming 1993, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Fleming pers. comm., Southeastern Ecology Working Group n.d.

Quercus rubra - Quercus prinus *Woodland Alliance (A.624)*

NORTHERN RED OAK - CHESTNUT OAK WOODLAND ALLIANCE

Alliance Summary: This alliance includes woodland communities occurring on acidic, talus slopes or rocky slopes of higher elevations (e.g., from 1000-2620 feet in New England and to 4500 feet in West Virginia). Soils are shallow and acidic. *Quercus rubra* is sometimes dominant but usually occurs in association with *Quercus alba, Acer rubrum, Betula lenta, Quercus prinus*, and others. Canopies are often stunted. The shrub layer may include, in the northern part of the range, *Acer spicatum, Sambucus racemosa var. racemosa (= Sambucus racemosa ssp. pubens), Rhus typhina, Kalmia latifolia, Hamamelis virginiana*, while in the southern part of the range, *Rhododendron catawbiense, Rhododendron arborescens, Rhododendron calendulaceum, Rhododendron maximum, Menziesia pilosa, Gaylussacia ursina, Leucothoe recurva, Vaccinium simulatum*, and *Viburnum nudum var. cassinoides* are more typical. Herbs include

Pteridium aquilinum var. latiusculum, Aralia nudicaulis, Maianthemum canadense, Oclemena acuminata (= Aster acuminatus), Corydalis sempervirens, Deschampsia flexuosa, Carex pensylvanica, and *Polypodium virginianum*. Communities of this alliance are known from the Appalachian Mountains, from New York and New England, south to the Blue Ridge of North Carolina.

SWEET BIRCH - CHESTNUT OAK TALUS WOODLAND (CEGL006565)

Betula lenta - Quercus prinus / Parthenocissus quinquefolia Woodland
Sweet Birch - Chestnut Oak / Virginia Creeper Woodland

ELEMENT CONCEPT

Summary: This talus or rocky slope woodland community occurs in the central Appalachian Mountains and extends west to the Western Allegheny Plateau in Pennsylvania. The substrate is generally quartzite or sandstone talus. Sites are usually steeply sloping, but the type also sometimes occurs on gentler benches and ridge crests. Soils, where present, are shallow, organic, acidic and infertile. The canopy is of variable cover but generally open with gnarled, widely spaced trees. Characteristic trees are birches, primarily *Betula lenta* but less frequently including *Betula papyrifera, Betula populifolia*, or *Betula alleghaniensis*, as well as *Nyssa sylvatica*. Other tree associates may include *Tsuga canadensis, Acer rubrum, Carya glabra, Quercus prinus, Quercus alba, Quercus rubra, Quercus velutina*, or *Quercus coccinea*. Typical shrubs include *Acer spicatum, Acer pensylvanicum, Amelanchier arborea, Castanea dentata, Kalmia latifolia, Hamamelis virginiana, Menziesia pilosa, Ribes rotundifolium, Vaccinium angustifolium, Vitis* spp., *Toxicodendron radicans, Smilax rotundifolia*, and *Parthenocissus quinquefolia*. Ferns characterize the herb layer and may include *Dryopteris marginalis, Polypodium virginianum, Woodsia obtusa*, or *Asplenium platyneuron*. The forbs *Aralia nudicaulis, Heuchera* spp., and *Scutellaria saxatilis* are also well-adapted to the bouldery habitats. Lichens, especially the rock-tripes *Lasallia papulosa* and *Umbilicaria mammulata* and the foliose species *Flavoparmelia baltimorensis*, characterize the nonvascular layer.

Environment: Sites include the edges of very large, unvegetated (except for lichens), scarcely weathered block fields, as well as a variety of more weathered boulderfields and slopes covered by coarse to fine, bouldery colluvium. Much of the bouldery rubble is weathered from resistant quartzite or sandstone caprock. The elevation range of plot-sampled stands in Virginia is 100 to 1025 m (300-3360 feet). Slope position and aspect are variable, while associated landforms include landslide scarps, slide masses, concave hollow heads, and incised hollow bottoms. Mean cover of exposed boulders at Virginia sampling sites is 72%. In this very rocky environment, soil is limited to local, interstitial, root-rich duff deposits, or to "pads" of moss and underlying, thin, organic / sandy material that have developed on wide, flat boulder surfaces. Interstitial air spaces between boulders may be prevalent for 1.0 m or more below the surface. Soils are largely organic and usually extremely acidic and infertile. There is often some heterogeneity of boulder depth and weathering, as well as of microclimate and soil moisture, within boulderfields. In general, sites are somewhat xeric and show little evidence of subsurface drainage. However, this regime is ameliorated by higher elevations and north aspects, which probably slow evaporation and increase the moisture-holding capacity of the bouldery substrate.

Vegetation: Physiognomy varies from nearly closed forest to open woodland with widely spaced trees. The canopy is dominated by more-or-less gnarled specimens of *Betula lenta* and *Quercus prinus* generally <20 m tall. *Betula lenta* is usually the sole dominant of less weathered, steeper, more unstable boulderfield habitats, while a greater variety of trees is often codominant with *Betula lenta* on more weathered and stable habitats. Other overstory associates that may be important on some sites are *Quercus rubra, Nyssa sylvatica, Betula populifolia, Betula papyrifera var. cordifolia, Carya glabra, Tsuga canadensis*, and *Betula alleghaniensis*. The presence of well-preserved, fallen boles indicates that *Castanea dentata* was important on some boulderfields prior to the arrival of chestnut blight (Fleming and Moorhead 2000). *Acer rubrum* and *Nyssa sylvatica* are scattered canopy associates and frequent understory species. The typically open shrub layer contains *Acer pensylvanicum, Acer spicatum, Amelanchier arborea, Castanea dentata* sprouts, *Hamamelis virginiana, Ilex montana, Kalmia latifolia, Menziesia pilosa* (at the southern end of the range), and *Ribes rotundifolium*. The ground layer consists almost entirely of low-statured shrubs, particularly *Menziesia pilosa* and *Vaccinium angustifolium*, and/or scattered to abundant vines of *Parthenocissus quinquefolia, Vitis* spp., *Toxicodendron radicans*, and *Smilax rotundifolia*. True herbs are very sparse and restricted to mossy pockets or flat boulders; typical species are *Dryopteris marginalis, Polypodium appalachianum, Deschampsia flexuosa*, and *Danthonia spicata*. In the southern portion of the range, *Heuchera* spp. and *Scutellaria saxatilis* are characteristic herbs. Bryophyte cover ranges up to 65% in some microhabitats. The rock-tripes *Lasallia papulosa* and *Umbilicaria mammulata*, and the foliose species *Flavoparmelia baltimorensis*, are generally the most conspicuous lichens. The combination of surficial boulder cover and nutrient-poor substrate results in a notably low mean species richness (n = 24 taxa per 400 square meters) in Virginia and Maryland plot samples of this type.

Dynamics: This boulderfield woodland represents a long-term sere in the geomorphic and vegetational progression from exposed, lichen-dominated block fields to fully forested mountain slopes with well-developed mineral soils. In addition to edaphic stresses, trees of these habitats are subject to frequent damage from wind and ice storms. This community often occurs in patch-mosaics with open, lichen-covered boulderfields that lack vascular plants. Boundaries between the boulderfield woodlands and adjacent forests are often obscure, with composition gradually changing along with substrate conditions and soil depth. This type frequently intergrades with several communities of the Mixed Oak / Heath Forests group, especially *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057) of somewhat sheltered, often very rocky slopes. In Virginia, this association reaches optimal development on sideslopes of linear sandstone and quartzite strike ridges in the Ridge and Valley, and on the western, metasedimentary flank of the northern Blue Ridge. Landsliding and debris avalanches, which generate and regenerate boulderfield environments, are dominant erosional processes in these landscapes (Hack and Goodlett 1960).

Similar Associations:

- *Betula alleghaniensis - Quercus rubra / Polypodium virginianum* Woodland (CEGL006320)--is known from ME, NH, VT, NY, PA and perhaps NJ, is similar but more northern in character; it lacks *Betula lenta, Nyssa sylvatica*, and *Kalmia latifolia*.
- *Quercus prinus - Quercus rubra / Hamamelis virginiana* Forest (CEGL006057)--of somewhat sheltered, often very rocky slopes.

Related Concepts:

- *Betula lenta / Parthenocissus quinquefolia* Association (Rawinski et al. 1996) F
- *Betula lenta / Ribes rotundifolium - Menziesia pilosa / Parthenocissus quinquefolia - Polypodium appalachianum* Woodland (Fleming and Coulling 2001) F
- *Quercus rubra - Quercus montana - Betula lenta / Ilex montana / Menziesia pilosa* Forest (Fleming and Moorhead 2000) F
- *Quercus rubra - Quercus montana - Betula lenta / Parthenocissus quinquefolia* Forest (Fleming and Moorhead 2000) F

Classification Comments: This vegetation type is broadly defined and exhibits considerable geographic and elevational variation. It is also poorly represented by plot data, and additional sampling is needed, particularly of lower elevation and south-slope stands. Even with limited data, potential variants of the type in Virginia were proposed by Fleming and Moorhead (2000). A variant of sheltered north slopes in which *Tsuga canadensis* is codominant with *Betula lenta* and/or *Quercus* spp. has been reported from Virginia by Hupp (1983) and from Pennsylvania by Fike (1999), but may be referable to bouldery variants of *Tsuga canadensis - Quercus prinus - Betula lenta* Forest (CEGL006923). Many Virginia populations of the state-rare, northern tree *Betula papyrifera var. cordifolia* are associated with this community type.

CONSERVATION RANKING

GRank: G3G4 (2004-8-9) **Reasons:** Although this community type occurs in small patches over a limited geographic range, there are probably >200 sites (if not many hundreds of sites) in Virginia and West Virginia alone. Moreover, stands occupy rugged habitats that are not prone to anthropogenic disturbances.

ELEMENT DISTRIBUTION

Range: This community occurs locally throughout the Blue Ridge and Ridge and Valley sections of Pennsylvania, Virginia, West Virginia, and Maryland, extending northeast to the Pennsylvania-New Jersey border.

Subnations: MD, NJ, PA, VA, WV

TNC Ecoregions: 49:C, 59:C, 60:P, 61:C

USFS Ecoregions: 212Fc:PPP, 221Bd:CCC, 221D:CC, 221Ea:CCC, M221Ac:CCC, M221Bf:CCC

Federal Lands: NPS (Blue Ridge Parkway, Catoctin Mountain, Delaware Water Gap, Harpers Ferry, Shenandoah, Valley Forge); USFS (George Washington, Jefferson)

ELEMENT SOURCES

References: Anderson et al. 1998, Eastern Ecology Working Group n.d., Fike 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Hack and Goodlett 1960, Harrison 2004, Hupp 1983, Lea 2003, Rawinski et al. 1996, Russell and Schuyler 1988, VDNH 2003

II.C.3.N.a. Mixed needle-leaved evergreen - cold-deciduous woodland

Pinus (rigida, pungens, virginiana) - Quercus prinus *Woodland Alliance (A.677)*

(PITCH PINE, TABLE MOUNTAIN PINE, VIRGINIA PINE) - CHESTNUT OAK WOODLAND ALLIANCE

Alliance Summary: This alliance includes woodland vegetation that is dominated by *Pinus virginiana* or codominated by *Pinus rigida, Pinus pungens*, and/or *Quercus prinus*. Associations in this alliance are possible from central Pennsylvania southwest to Virginia

and Tennessee but tend to occur under extreme conditions (such as steep, shaly slopes) that maintain the open structure of the vegetation.

CENTRAL APPALACHIAN XERIC CHESTNUT OAK - VIRGINIA PINE WOODLAND (CEGL008540)

Quercus prinus - Pinus virginiana - (Pinus pungens) / Schizachyrium scoparium - Dichanthelium depauperatum Woodland
Chestnut Oak - Virginia Pine - (Table Mountain Pine) / Little Bluestem - Starved Witchgrass Woodland

ELEMENT CONCEPT

Summary: Most habitats for this Appalachian-Piedmont community are characterized by moderate to steep (mean = 20 degrees) slopes with much exposed mineral soil. Sites are confined to the lowest elevations (<600 m [2500 feet]), are distinctly xeric, and usually have southeast to southwest aspects. Underlying bedrock includes quartzite, sandstone, acidic granite, metabasalt (acidic phases), schist, and gneissic rocks. Most habitats are characterized by moderate to steep slopes with much exposed mineral soil and high cover of exposed rocks. This community is a mixed oak-pine woodland with a canopy of stunted, often gnarled trees, varying from open to very open. Stands are typically dominated by *Quercus prinus* and *Pinus virginiana* in variable proportions. *Pinus pungens* is an important, even dominant, associate in a minority of stands. The shrub layer varies from moderately dense to sparse, with *Vaccinium pallidum* and *Vaccinium stamineum* the most constant and abundant species. Graminoid-rich openings dominated by *Schizachyrium scoparium, Dichanthelium depauperatum, Carex pensylvanica, Danthonia spicata*, and *Dichanthelium commutatum* are frequent.
Environment: Underlying bedrock at plot-sampling sites includes Antietam quartzite, ferruginous metasandstone of the Harper's Formation, acidic granites, acidic phases of Catoctin metabasalt, schistose metasedimentary rocks of the Mather Gorge Formation, and ancient alluvium composed of quartzitic cobbles. Most habitats are characterized by moderate to steep (mean = 20 degrees) slopes with much exposed mineral soil. Sites are confined to the lowest elevations (<600 m [2500 feet]), are distinctly xeric, and usually have southeast to southwest aspects. Surface cover of outcrops and loose stones is relatively high (mean = 38% in plots). Soils are extremely acidic (mean pH = 4.3) and very low in base status, except for high aluminum levels. One somewhat anomalous site is located on massive alluvial fans that overlie the floor of the Great Valley of Virginia along the foot of the Blue Ridge in Augusta County. Here, stands occupy barren, elevated cobble terraces bordering a stream and representing the floodplain level of an earlier erosional cycle.
Vegetation: The canopy cover of stunted, often gnarled trees varies from open to very open. *Quercus prinus* and *Pinus virginiana* are usually codominant in variable proportions. *Pinus pungens* is an important, even dominant, associate in a minority of stands. Minor but relatively constant tree associates include *Quercus rubra, Carya glabra, Sassafras albidum*, and *Amelanchier arborea*. Minor, inconstant tree associates include *Quercus coccinea, Quercus velutina, Quercus stellata, Quercus marilandica, Quercus alba, Pinus strobus*, and *Fraxinus americana*. The shrub layer varies from moderately dense to sparse, with *Vaccinium pallidum* and *Vaccinium stamineum* the most constant and abundant species. *Quercus ilicifolia, Kalmia latifolia, Rhus copallinum,*

Castanea pumila, and *Toxicodendron pubescens* are inconstant, but occasionally common, in the type. Herbaceous composition and density vary with shrub density. Graminoid-rich openings dominated by *Schizachyrium scoparium, Dichanthelium depauperatum, Carex pensylvanica, Danthonia spicata*, and *Dichanthelium commutatum* are frequent. Also present is a surprising variety of low-cover forbs, among the most characteristic of which are *Hieracium venosum, Solidago erecta, Potentilla canadensis, Campanula divaricata, Viola sagittata, Houstonia longifolia, Antennaria plantaginifolia, Aureolaria laevigata, Symphyotrichum undulatum (= Aster undulatus), Coreopsis verticillata, Tephrosia virginiana, Polygonatum biflorum var. biflorum*, and *Clitoria mariana*. Additional herbs occurring less frequently include *Lespedeza hirta, Solidago odora, Deschampsia flexuosa, Coreopsis major, Solidago puberula var. puberula, Hypericum hypericoides ssp. multicaule (= Hypericum stragulum), Lysimachia quadrifolia, Asclepias amplexicaulis, Sericocarpus asteroides, Dicentra eximia, Paronychia fastigiata, Sericocarpus linifolius*, and *Ionactis linariifolius*. Species richness of plot-sampled stands ranges from 17 to 55 taxa per 400 square meters (mean = 34).

Similar Associations:

- *Pinus virginiana / Vaccinium pallidum / Schizachyrium scoparium - Carex pensylvanica* Woodland (CEGL003624)--on dry shale slopes of the Southern Appalachians.
- *Quercus prinus - Juniperus virginiana - (Pinus virginiana) / Philadelphus hirsutus - Celtis occidentalis* Woodland (CEGL007720)--on steep, rocky, riverine bluffs in the Southern Blue Ridge with exposed and eroding shale.
- *Quercus prinus / Quercus ilicifolia / Danthonia spicata* Woodland [Provisional] (CEGL008526)--on dry shale slopes of the Central Appalachians.

Related Concepts:

- *Pinus pungens - Pinus rigida / Quercus ilicifolia / Gaylussacia baccata* Association: *Andropogon scoparius - Coreopsis verticillata - Dichanthelium depauperatum* Subassociation, *pro parte* (Rawinski et al. 1996) ?
- *Quercus prinus - Pinus virginiana - Quercus (marilandica, stellata) / Dichanthelium depauperatum* Woodland (Fleming and Coulling 2001) =

Classification Comments: The classification of this type is supported by analysis of 12 Virginia and 3 Maryland plot samples. Additional inventory and data collection are needed to clarify the geographic range, classification, and environmental context of this type. The known range of this community is limited to the northern Blue Ridge, Ridge and Valley, and Piedmont in Virginia and Maryland, but geologic substrates and site conditions similar to those supporting the known examples occur elsewhere in the Central Appalachians, and a broader geographic range seems likely.

CONSERVATION RANKING

GRank: G2? (2001-9-21) **Reasons:** Although this community is likely to have a broader distribution in the Central Appalachians than present documentation suggests, it is a small-patch vegetation type restricted to special habitat conditions.

ELEMENT DISTRIBUTION

Range: The known range of this community is limited to the northern Blue Ridge, Ridge and Valley, and Piedmont in Virginia and Maryland, but geologic substrates and site conditions similar to those supporting the known examples occur elsewhere in the Central Appalachians, and a broader geographic range seems likely.
Subnations: MD, VA, WV?

TNC Ecoregions: 50:C, 59:C, 61:C
USFS Ecoregions: M221Aa:CCP, M221Ab:CCC, M221Da:CCC
Federal Lands: NPS (Blue Ridge Parkway, C&O Canal, Catoctin Mountain, Harpers Ferry, Shenandoah); USFS (Jefferson)

ELEMENT SOURCES

References: Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Rawinski et al. 1996

III. Shrubland

III.C.2.N.a. Mixed evergreen - cold-deciduous shrubland
Kalmia latifolia - Gaylussacia baccata *Shrubland Alliance (A.1050)*
MOUNTAIN LAUREL - BLACK HUCKLEBERRY SHRUBLAND ALLIANCE
Alliance Summary: Examples of this alliance are mixed deciduous-evergreen shrublands of the central Appalachian Mountains, ranging south into the Cumberlands of Kentucky. Stands are dominated by various mixtures of ericaceous shrubs, especially *Kalmia latifolia, Gaylussacia baccata*, and *Vaccinium* spp. Patch-dominance of these ericads may occur in pronounced zonation or in extremely dense, stratified mixtures. Additional stunted trees occasionally found at low cover may include *Acer rubrum, Amelanchier* spp., *Betula lenta, Picea rubens* (West Virginia only), *Pinus rigida, Pinus pungens, Quercus rubra*, and *Tsuga canadensis*. Herbaceous plants are typically very sparse. Stands occur on nearly level to steeply sloping outcrops, pavements, and clifftops of acidic bedrock and are situated on upper slopes and summits.

HIGH-ELEVATION OUTCROP BARREN (BLACK CHOKEBERRY IGNEOUS / METAMORPHIC TYPE) (CEGL008508)

Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica Shrubland
Black Chokeberry - Black Huckleberry / Pennsylvania Sedge Shrubland

ELEMENT CONCEPT

Summary: This community type is known from scattered localities along nearly the full length of the Blue Ridge in Virginia and could potentially occur in North Carolina, West Virginia, Maryland, and Pennsylvania. This vegetation type is associated with medium- to high-elevation exposed outcrops of igneous and metamorphic rocks, including metabasalt (greenstone), porphyritic leucocharnockite, amphibolite, and rhyolite. Elevation ranges from about 1030-1400 m (3400-4600 feet), but occurrences as low as 730 m (2400 feet) have been observed in the northern Virginia Blue Ridge. Habitats are typically on strongly convex, upper slopes and rocky summits with west to northwest or flat aspects. The community is a patchwork of shrub thickets, small herbaceous mats, and exposed, lichen-covered rock surfaces. *Photinia melanocarpa (= Aronia melanocarpa)* is the dominant shrub, or is codominant with *Gaylussacia baccata, Hamamelis virginiana, Smilax tamnoides*, and/or *Kalmia latifolia*. Minor woody components include *Sorbus americana, Rhododendron catawbiense*, and *Menziesia pilosa*, as well as severely stunted *Betula alleghaniensis* and *Quercus rubra*.
Environment: This vegetation type is associated with medium- to high-elevation exposed outcrops of igneous and metamorphic rocks, including metabasalt (greenstone), porphyritic leucocharnockite, amphibolite, and rhyolite. The elevation range of plot-sampled stands is from about 884 to 1400 m (2900-4600 feet), but occurrences as low as 730 m (2400 feet) have been observed in the northern Virginia Blue Ridge. Habitats are

typically on strongly convex, upper slopes and rocky summits with west to northwest or flat aspects. Surface cover of bedrock and loose boulders in plot-sampled stands averages 80%, with mean lichen cover of 44% on these rocks. Soil development and moisture potential at these sites are minimal, and habitats may also be subject to severe winter temperatures, high winds, and ice.

Vegetation: The community is a patchwork of shrub thickets, small herbaceous mats, and exposed, lichen-covered rock surfaces. *Photinia melanocarpa (= Aronia melanocarpa)* is the dominant shrub, or is codominant with *Gaylussacia baccata, Hamamelis virginiana, Smilax tamnoides*, and/or *Kalmia latifolia*. Minor woody components include *Sorbus americana, Rhododendron catawbiense*, and *Menziesia pilosa*, as well as severely stunted *Betula alleghaniensis* and *Quercus rubra*. The most frequent herbaceous species are *Carex pensylvanica, Saxifraga michauxii, Dennstaedtia punctilobula, Polypodium appalachianum, Agrostis perennans, Paronychia argyrocoma, Solidago simplex var. randii, Hylotelephium telephioides (= Sedum telephioides), Heuchera villosa, Campanula divaricata*, and *Danthonia spicata*. Species richness of plot-sampled stands ranges from 12 to 37 taxa per 100 square meters (mean = 22).

Related Concepts:

- *Hamamelis virginiana - Rhododendron catawbiense - Physocarpus opulifolius* Association (Rawinski and Wieboldt 1993) ?
- *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland (Fleming and Coulling 2001) =
- *Saxifraga michauxii - Solidago randii - Sibbaldiopsis tridentata* Herbaceous Vegetation (Coulling and Rawinski 1999) ?

Classification Comments: Additional data collection from known stands that have not been plot-sampled would increase the robustness of this type's classification. Examples of this community should be sought outside the Virginia Blue Ridge.

CONSERVATION RANKING

GRank: G1? (2001-6-20) **Reasons:** This is a naturally rare, small-patch vegetation type limited by special habitat requirements. Currently, there are only 10 known stands of this vegetation, in aggregate covering less than 4 hectares (10 acres). Additional occurrences are likely but would not significantly increase the aggregate acreage of the type.

ELEMENT DISTRIBUTION

Range: This community type is known from scattered localities along nearly the full length of the Blue Ridge in Virginia. It is of potential occurrence in North Carolina, West Virginia, Maryland, and Pennsylvania.

Subnations: MD?, NC?, PA?, VA, WV?

TNC Ecoregions: 51:C, 59:C

USFS Ecoregions: M221Da:CCC, M221Db:CCC, M221Dc:CCC

Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

ELEMENT SOURCES

References: Coulling and Rawinski 1999, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, Rawinski and Wieboldt 1993

CENTRAL APPALACHIAN HEATH BARREN (CEGL003939)

Kalmia latifolia - Gaylussacia baccata - Vaccinium (angustifolium, pallidum) - Menziesia pilosa Shrubland

Mountain Laurel - Black Huckleberry - (Northern Lowbush Blueberry, Hillside Blueberry) - Minniebush Shrubland

ELEMENT CONCEPT

Summary: This shrubland community is restricted to high-elevation, acidic bedrock exposures in the Central Appalachians of eastern West Virginia and northwestern Virginia. It occurs on upper-slope and ridgetop outcrops, pavements, and clifftops of acidic bedrock (quartzite and granitic) at elevations from about 975 to 1460 m (3200-4800 feet). Surface cover of bedrock and loose boulders averages about 80% in plot samples, and soil development is minimal. These habitats have distinctly xeric moisture regimes and are subject to year-round microclimatic extremes, including high solar exposure and temperatures in summer, high winds, periodic ice, and low winter temperatures. *Kalmia latifolia, Gaylussacia baccata*, and *Vaccinium* spp. are codominant shrubs in variable proportions, with *Vaccinium angustifolium* the principal species of high-elevation sites (all >1200 m [4000 feet]) in West Virginia and *Vaccinium pallidum* the characteristic species of somewhat lower-elevation (976-1200 [3200-4000 feet]) sites in Virginia. Other woody plants occurring frequently in the type include *Menziesia pilosa, Sorbus americana, Photinia melanocarpa (= Aronia melanocarpa), Gaultheria procumbens, Hamamelis virginiana, Prunus pensylvanica, Ilex montana, Nemopanthus mucronatus* (West Virginia only), and extremely stunted (<3 m tall) *Betula alleghaniensis*. Herbaceous plants are typically very sparse, but occasional dense colonies of *Deschampsia flexuosa* occur on open ledges with thin mats of moss and organic matter. The vegetation is floristically quite depauperate and plot-sampled stands have a mean species richness of only 15 vascular taxa.

Environment: Stands occur on nearly level to steeply sloping (>30 degrees) outcrops, pavements, and clifftops of acidic bedrock, including Tuscarora quartzite, charnockite, leucocharnockite, Old Rag granite, and sandstones of the Allegheny Formation and Pottsville group. Habitats are situated on upper slopes and summits with south to northwest aspects, at elevations ranging from about 975 to 1460 m (3200-4800 feet). Surface cover of bedrock and loose boulders averages about 80% in plot samples, and lichen cover on exposed rock surfaces is generally >75%. Soil development is minimal, consisting of localized crevices and mats of disintegrated rock and organic matter. These habitats have distinctly xeric moisture regimes and are subject to year-round microclimatic extremes, including high solar exposure and temperatures in summer, high winds, periodic ice, and low winter temperatures.

Vegetation: Total vegetation cover varies from <25% to >75% and consists of dense shrub thickets and small herbaceous mats among the exposed rocks. *Kalmia latifolia, Gaylussacia baccata*, and *Vaccinium* spp. are codominant shrubs in variable proportions, with *Vaccinium angustifolium* the principal species of high-elevation sites (all >1200 m [4000 feet]) in West Virginia and *Vaccinium pallidum* the characteristic species of somewhat lower-elevation (796-1200 m [3200-4000 feet]) sites in Virginia. Patch-dominance of these ericads may occur in pronounced zonation or in extremely dense, stratified mixtures. Other woody plants occurring frequently in the type include *Menziesia pilosa, Sorbus americana, Photinia melanocarpa (= Aronia melanocarpa), Photinia pyrifolia* (West Virginia only), *Gaultheria procumbens, Hamamelis virginiana, Prunus pensylvanica, Rubus hispidus* (West Virginia only), *Ilex montana, Nemopanthus mucronatus* (West Virginia only), and extremely stunted (<3 m tall) *Betula*

alleghaniensis. Additional stunted trees occasionally found in this type at low cover include *Acer rubrum, Amelanchier laevis, Amelanchier sanguinea, Betula lenta, Picea rubens* (West Virginia only), *Pinus rigida, Pinus pungens, Rhododendron prinophyllum, Quercus rubra*, and *Tsuga canadensis*. Herbaceous plants are typically very sparse, but occasional dense colonies of *Deschampsia flexuosa* occur on open ledges with thin mats of moss and organic matter. Other herbs that are sometimes important in this type are *Aralia nudicaulis, Lysimachia quadrifolia, Maianthemum canadense, Polypodium appalachianum, Pteridium aquilinum var. latiusculum, Carex pensylvanica, Dennstaedtia punctilobula, Melampyrum lineare, Lycopodium annotinum, Lycopodium dendroideum* (West Virginia only), *Polygonum cilinode, Oryzopsis asperifolia, Carex polymorpha, Aralia hispida*, and *Paronychia argyrocoma*. Species richness of 13 Virginia and West Virginia plot samples ranges from 5 to 22 taxa per 100 square meters (mean = 15).

Dynamics: There are few threats to this vegetation at remote sites. However, several Virginia occurrences on public lands (e.g., Old Rag Mountain and Mary's Rock in Shenandoah National Park) have been significantly impacted by heavy trampling at high-elevation overlooks near trails. In addition, susceptible lichen species may have been eliminated from these sites due to air pollution, but no baseline data are available to document this.

Similar Associations:

- *Kalmia latifolia - Gaylussacia (baccata, brachycera)* Cumberland Shrubland (CEGL008470)--of Kentucky and possibly Virginia and Tennessee.

Related Concepts:

- *Kalmia latifolia - Vaccinium pallidum* Shrubland [Provisional] (Fleming et al. 2004) =
- Central Appalachian Heath Bald (Fleming 1985) ?
- Mountain laurel-black huckleberry summit (CAP pers. comm. 1998) ?

Classification Comments: Classification of this type is based on analysis of 13 plot samples from Virginia and West Virginia. This community has some affinities to various southern Appalachian heath bald communities in floristics, structure, and general edaphic conditions, but lacks many of the characteristic southern Appalachian species such as *Rhododendron carolinianum, Rhododendron catawbiense, Rhododendron calendulaceum, Leucothoe recurva, Pieris floribunda*, and *Leiophyllum buxifolium*. Species of northern affinity not found in southern Appalachian heath balds (*Nemopanthus mucronatus, Vaccinium angustifolium, Lycopodium annotinum, Aralia hispida, Carex polymorpha, Oryzopsis asperifolia*) further differentiate this community, both from southern Appalachian heath bald communities and from Kentucky examples of *Kalmia latifolia - Gaylussacia baccata*-dominated vegetation.

CONSERVATION RANKING

GRank: G2 (2006-10-18) **Reasons:** This small-patch community is restricted to high-elevation, acidic bedrock exposures in the Central Appalachians of eastern West Virginia and northwestern Virginia. There are fewer than 10 known occurrences, and the potential range and habitat of this community are both extremely limited. In addition, at least three of the occurrences are on national park land and are located at popular destinations for hikers, which has lead to significant trampling impacts and soil mat removal.

ELEMENT DISTRIBUTION

Range: The type is known from scattered sites in the northern Blue Ridge, Ridge and Valley, and Allegheny Mountains of eastern West Virginia and northwestern Virginia.
Subnations: VA?, WV
TNC Ecoregions: 59:C
USFS Ecoregions: M221Aa:CCC, M221Ba:CCC, M221Bc:CCC, M221Bd:CCP, M221Da:CCC
Federal Lands: NPS (Shenandoah); USFS (George Washington, Monongahela)

ELEMENT SOURCES

References: CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Fleming 1985, Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004

V. Herbaceous Vegetation

V.A.6.N.q. Bedrock temperate or subpolar grassland with a sparse tree layer

(Fraxinus americana, Juniperus virginiana) / Carex pensylvanica - Schizachyrium scoparium *Wooded Herbaceous Alliance (A.3014)*

(WHITE ASH, EASTERN RED-CEDAR) / PENNSYLVANIA SEDGE - LITTLE BLUESTEM WOODED HERBACEOUS ALLIANCE

CENTRAL APPALACHIAN CIRCUMNEUTRAL BARREN (CEGL006037)

Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa Wooded Herbaceous Vegetation

Eastern Red-cedar - White Ash / Pennsylvania Sedge - Hairy Lipfern Wooded Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This barrens community occurs on steep slopes underlain by calcareous sedimentary, metasedimentary, and metamorphic rocks of the Central Appalachians. Soils are derived from calcareous shales of the Jennings and Hampshire Shale formations in the Ridge and Valley province, and from metabasalt of the Catoctin Formation on the northern Blue Ridge. Similar vegetation has also been reported from steep, rocky slopes underlain by Harpers Formation metasiltstone and phyllite on the Blue Ridge. Habitats are on steep, southeast - to southwest-facing slopes at elevations from 170 to 580 m (550-1900 feet). On sites underlain by shale, soils are thin but generally better developed than other shale-barren associations. Metabasalt sites typically have high cover (about 50%) of exposed bedrock outcrops with some areas of shallow soil development. Soils from both substrates have high calcium levels; those weathered from metabasalt also have high magnesium and manganese levels. A patchy overstory of stunted trees may ameliorate to some degree the otherwise xeric conditions imposed by exposure and slope. Canopy closure is usually less than 30%, occasionally higher, and tends to be patchy, with herbaceous openings. Shrubs are sparse at most known locations. The herbaceous layer forms 25-90% ground cover. The canopy is codominated by *Juniperus virginiana* and *Fraxinus americana*, with other associates including *Carya glabra, Quercus prinus, Celtis tenuifolia, Amelanchier arborea, Quercus rubra*, and *Pinus virginiana*. *Rhus aromatica* is a characteristic shrub. The herbaceous layer is very diverse. *Carex pensylvanica* is constant and dominant. *Danthonia spicata* is frequent but sparse. Other characteristic species include *Cheilanthes lanosa, Woodsia obtusa, Phacelia dubia, Deschampsia flexuosa, Solidago arguta var. harrisii (= Solidago harrisii),*

Schizachyrium scoparium, Phlox subulata, Silene antirrhina, Elymus hystrix (= Hystrix patula), Tradescantia virginiana, Helianthus divaricatus, Polygonum scandens var. cristatum, Polygonatum biflorum, Triodanis perfoliata, Pycnanthemum incanum, Allium cernuum, and *Arenaria serpyllifolia*. This association is distinguished from other shale-barren types by its open physiognomy, occurrence on circumneutral to calcareous rock at low to moderate elevations, and the frequency of several characteristic herbs including *Cheilanthes lanosa, Phacelia dubia, Tradescantia virginiana*, and *Triodanis perfoliata*. In addition, *Fraxinus americana* and *Celtis tenuifolia* occur at a higher frequency in this association than in other shale-barren types.

Environment: This barrens community occurs on steep slopes underlain by calcareous sedimentary, metasedimentary, and metamorphic rocks of the Central Appalachians. Soils are derived from calcareous shales of the Jennings and Hampshire Shale formations in the Ridge and Valley province, and from metabasalt of the Catoctin Formation on the northern Blue Ridge. Similar vegetation has also been reported from steep, rocky slopes underlain by Harpers Formation metasiltstone and phyllite on the Blue Ridge. Habitats are on steep, southeast - to southwest-facing slopes at elevations from 170 to 580 m (550-1900 feet). On sites underlain by shale, soils are thin but generally better developed than other shale barren associations. Metabasalt sites typically have high cover (about 50%) of exposed bedrock outcrops with some areas of shallow soil development. Soils from both substrates have high calcium levels; those weathered from metabasalt also have high magnesium and manganese levels.

Vegetation: This community type is characterized by a mixed physiognomy of scattered, stunted trees and herbaceous openings. The patchy canopy may ameliorate to some degree the otherwise xeric conditions imposed by exposure and slope. Canopy closure is usually less than 30%, occasionally higher. Shrubs are sparse at most known locations. The herbaceous layer forms 25-90% ground cover, except where broken by rock outcrops. The canopy is codominated by *Juniperus virginiana* and *Fraxinus americana*, with other associates including *Carya glabra, Quercus prinus, Celtis tenuifolia, Amelanchier arborea, Quercus rubra*, and *Pinus virginiana*. *Rhus aromatica* is a characteristic shrub. The herbaceous layer is very diverse. *Carex pensylvanica* is constant and dominant. *Danthonia spicata* is frequent but sparse. Other characteristic species include *Cheilanthes lanosa, Woodsia obtusa, Phacelia dubia, Deschampsia flexuosa, Solidago arguta var. harrisii (= Solidago harrisii), Schizachyrium scoparium, Phlox subulata, Silene antirrhina, Elymus hystrix (= Hystrix patula), Tradescantia virginiana, Helianthus divaricatus, Polygonum scandens var. cristatum, Polygonatum biflorum, Triodanis perfoliata, Pycnanthemum incanum, Allium cernuum*, and *Arenaria serpyllifolia*.

Although they are very similar, expressions of this community type on shale and metabasalt exhibit some compositional differences. Shale occurrences contain a greater number of low-cover forbs and exclusively contain several shale endemics and other species common on shale barrens, including *Blephilia ciliata, Deschampsia flexuosa, Draba ramosissima, Melica nitens, Minuartia michauxii, Oenothera argillicola, Packera antennariifolia*, and *Trifolium virginicum*. Metabasalt occurrences tend to have stratified graminoid dominance, with *Schizachyrium scoparium* forming a taller layer over *Carex pensylvanica*. Species documented only on metabasalt, including *Cyperus lupulinus,*

Isanthus brachiatus, Muhlenbergia capillaris var. capillaris, Polygonum tenue, Oligoneuron rigidum var. rigidum (= Solidago rigida ssp. rigida), Sporobolus clandestinus, and *Talinum teretifolium*, are probably associated with high-magnesium soils weathered from this substrate. However, despite these differences, stands on both substrates share almost all of the type's characteristic species as well as a remarkable number of other specialized xerophytic species, including *Asclepias verticillata, Symphyotrichum oblongifolium (= Aster oblongifolius), Bouteloua curtipendula, Lithospermum canescens, Paronychia montana, Selaginella rupestris, Taenidia montana*, and *Triosteum perfoliatum*.

Similar Associations:

- *(Pinus virginiana, Juniperus virginiana) / Schizachyrium scoparium - Eriogonum allenii* Wooded Herbaceous Vegetation (CEGL008530)
- *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (CEGL008529)
- *Pinus virginiana - Juniperus virginiana - Quercus rubra / Solidago arguta* var. *harrisii - Opuntia humifusa* Woodland (CEGL006288)
- *Pinus virginiana - Quercus prinus / Packera antennariifolia - Phlox subulata* Woodland (CEGL006562)

Related Concepts:

- Eastern Redcedar: 46 (Eyre 1980) B
- Red cedar-white ash alkaline shale woodland (CAP pers. comm. 1998) ?

CONSERVATION RANKING

GRank: G2 (1998-11-23) **Reasons:** This small-patch community likely totals less than 1000 acres rangewide in fewer than 60 occurrences. It is restricted to two subsections in the central Appalachians. Although the community is relatively isolated by its steep slope and unstable substrate, it is threatened by invasive exotics such as *Bromus sterilis, Bromus tectorum, Bromus japonicus, Centaurea biebersteinii, Lonicera japonica, Verbascum thapsus, Alliaria petiolata*, and *Ailanthus altissima*.

ELEMENT DISTRIBUTION

Range: This association is restricted to two subsections of four states in of the Central Appalachians.
Subnations: MD, PA, VA, WV?
TNC Ecoregions: 59:C
USFS Ecoregions: 221D:CP, M221Aa:CCC, M221B:C?, M221Da:CCC
Federal Lands: NPS (C&O Canal, Harpers Ferry?, Shenandoah)

ELEMENT SOURCES

References: CAP pers. comm. 1998, Eastern Ecology Working Group n.d., Eyre 1980, Fike 1999, Fleming et al. 2001, Harrison 2004, Lea 2003

CENTRAL APPALACHIAN MAFIC BARREN (NINEBARK / PENNSYLVANIA SEDGE TYPE) (CEGL008529)

Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia) Wooded Herbaceous Vegetation
White Ash / Eastern Ninebark / Pennsylvania Sedge - Nodding Onion - (Small-flower Scorpionweed) Wooded Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This community is known only from the northern Virginia Blue Ridge and possibly the higher adjacent foothills, in areas underlain by Catoctin metabasalt (greenstone) and Middle Proterozoic plutonic rocks. Sites are located on steep (up to 37 degrees), xeric, middle-elevation slopes where exposed outcrops effectively limit the establishment and normal development of trees. Underlying bedrock at most sites is metabasalt (greenstone). Two documented sites are underlain by charnockite, a pyroxene-bearing granitic rock, and it is likely that additional stands occur on this and related plutonic formations. Elevation of plot-sampled stands ranges from 543-1049 m (1782-3442 feet), with a mean of 835 m (2740 feet). Middle-slope topographic positions are typical, with slopes convex in at least one direction. Aspect varies from southeast to northwest, with westerly aspects prevalent. This vegetation type is dominated by herbaceous plants with scattered shrub patches and stunted trees. The herb layer usually ranges from 25-60% total cover (occasionally higher or lower), and from scattered to locally dense where soil and organic matter have accumulated. *Carex pensylvanica* and *Schizachyrium scoparium* are consistently dominant herbs. *Phacelia dubia* is an abundant spring ephemeral in about two-thirds of the plots, and this species may have been missed in late-season sampling of other plots.

Environment: Sites are located on steep (up to 37 degrees), xeric, middle-elevation slopes where exposed outcrops effectively limit the establishment and normal development of trees. Underlying bedrock at most sites is metabasalt (greenstone). Two documented sites are underlain by charnockite, a pyroxene-bearing granitic rock, and it is likely that additional stands occur on this and related plutonic formations. Elevation of plot-sampled stands ranges from 543-1049 m (1782-3442 feet), with a mean of 835 m (2740 feet). Middle-slope topographic positions are typical, with slopes convex in at least one direction. Aspect varies from southeast to northwest, with westerly aspects prevalent. Surface cover of exposed outcrops and loose rocks averages >50% and soil development is limited to depositional crevices and thin veneers on ledges. Soil samples collected from plots are very strongly acidic (mean pH = 4.5), with substantial organic matter content (mean = 26%), but have moderately high levels of calcium (mean = 1185 ppm) and magnesium (mean = 174 ppm).

Vegetation: This vegetation type is dominated by herbaceous plants with scattered shrub patches and stunted trees. The herb layer usually ranges from 25-60% total cover (occasionally higher or lower), and from scattered to locally dense where soil and organic matter have accumulated. *Carex pensylvanica* and *Schizachyrium scoparium* are consistently dominant herbs. *Phacelia dubia* is an abundant spring ephemeral in about two-thirds of the plots, and this species may have been missed in late-season sampling of other plots. Other relatively frequent (>50% constancy) herbs are *Agrostis perennans, Allium cernuum, Ambrosia artemisiifolia, Danthonia spicata, Dichanthelium acuminatum, Elymus hystrix, Helianthus divaricatus, Hylotelephium telephioides (= Sedum telephioides)*, and *Polygonatum biflorum*. *Deschampsia flexuosa, Festuca rubra*, and *Symphyotrichum laeve var. concinnum (= Aster laevis var. concinnus)* are each common locally. Herbaceous species that are characteristic of gravelly or mossy crevices and depressions with ephemeral spring seepage or periodic moisture accumulation include *Draba ramosissima, Muhlenbergia glomerata, Polygonum tenue, Saxifraga virginiensis, Talinum teretifolium*, and *Woodsia ilvensis*. Stunted trees (<10 m tall) of

Fraxinus americana are consistent features of the community type. *Physocarpus opulifolius* and *Rosa carolina* are the most frequent shrubs, but *Chionanthus virginicus, Rhus typhina, Juniperus virginiana, Amelanchier sanguinea, Ptelea trifoliata*, and *Spiraea alba var. latifolia* are each important in a subset of plots. Species richness of plot-sampled stands ranges from 28 to 43 taxa per 400 square meters (mean = 36).

Similar Associations:

- *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683)
- *Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation (CEGL006037)

Related Concepts:

- *Fraxinus americana / Physocarpus opulifolius / Carex pensylvanica - Allium cernuum - (Phacelia dubia)* Wooded Herbaceous Vegetation (Fleming and Coulling 2001) ?
- Greenstone glade (Fleming 1993) ?

Classification Comments: Although this community type has been referred to as a "greenstone glade" (Fleming 1993), this name is inappropriate given the occasional occurrence of the type on granitic rocks. Additional inventory and data collection are needed to determine the extent of this association on plutonic substrates.

This vegetation type often occurs adjacent to, or nested within, a larger patch of *Fraxinus americana - Carya glabra / Muhlenbergia sobolifera - Helianthus divaricatus - Solidago ulmifolia* Woodland (CEGL003683). Conceptual overlap between both of these communities and *Juniperus virginiana - Fraxinus americana / Carex pensylvanica - Cheilanthes lanosa* Wooded Herbaceous Vegetation (CEGL006037) needs resolution. The latter community is reported to be endemic to steep slopes underlain by calcareous shales of the Jennings and Hampshire formations in the Ridge and Valley region of Maryland. Based on descriptive material in the USNVC, it appears that this dry open woodland has characteristics of both basic woodlands and barrens, as well as of the more diverse shale barrens.

CONSERVATION RANKING

GRank: G2 (2001-10-11) **Reasons:** This vegetation is naturally rare, being restricted to special edaphic habitats on metavolcanic and plutonic rocks of limited geographic extent. There are probably at least 30 occurrences in Virginia and globally. Patches are small (generally <0.5 ha), but there are few threats to this community since most occurrences are on steep, remote sites in federally protected areas.

ELEMENT DISTRIBUTION

Range: This community is known only from the northern Virginia Blue Ridge and possibly the higher adjacent foothills, in areas underlain by Catoctin metabasalt (greenstone) and Middle Proterozoic plutonic rocks.

Subnations: VA

TNC Ecoregions: 59:C

USFS Ecoregions: M221Da:CCC

Federal Lands: NPS (Blue Ridge Parkway, Shenandoah); USFS (George Washington)

ELEMENT SOURCES

References: Fleming 1993, Fleming and Coulling 2001, Fleming et al. 2001, Southeastern Ecology Working Group n.d., VDNH 2003

V.B.2.N.b. Low temperate or subpolar perennial forb vegetation
Saxifraga michauxii *Herbaceous Alliance (A.1621)*
CLIFF SAXIFRAGE HERBACEOUS ALLIANCE
Alliance Summary: This alliance consists of moderate- to high-elevation rocky summit communities of the southern and central Blue Ridge (metamorphic rock portions of the southern and central Appalachians), on various rock types, including amphibolite, metabasalt (greenstone), gneiss, and others. There are several globally rare communities contained in this alliance. More common vegetation in this alliance will have *Saxifraga michauxii* as a characteristic component; other species are variable, but may include *Saxifraga virginiensis, Saxifraga micranthidifolia, Carex* spp., *Schizachyrium scoparium*, and others. Examples at high elevation exhibit a sparse vegetative cover of grasses, forbs and shrubs rooted in rock fissures and occur in a matrix of *Picea rubens - Abies fraseri* Forest. On rock outcrops of highly fractured felsic to mafic bedrock (over 1980 m), typical species include *Carex misera, Abies fraseri, Menziesia pilosa, Heuchera villosa, Rhododendron catawbiense, Saxifraga michauxii, Sorbus americana, Oclemena acuminata (= Aster acuminatus), Solidago glomerata*. Other characteristic species are *Minuartia groenlandica* and *Polypodium appalachianum*. On rock outcrops of felsic Anakeesta slate in the Great Smoky Mountains (from 1646-1987 m), typical species include *Saxifraga michauxii, Carex misera, Calamagrostis cainii, Rhododendron carolinianum, Solidago glomerata, Oclemena acuminata, Abies fraseri*, and *Leiophyllum buxifolium*. Other characteristic species are *Gentiana linearis* and *Calamagrostis cainii*. At low to middle elevations (1256-1713 m) in the southern Appalachians on outcrops of mafic rock, or on felsic rock where perennial seepage exists, the sparse vegetation consists of graminoids, forbs, and shrubs. It is surrounded by deciduous forests dominated by *Quercus rubra, Acer rubrum var. rubrum*, and occasionally *Tsuga caroliniana*. Typical species here include *Saxifraga michauxii, Coreopsis major, Schizachyrium scoparium, Kalmia latifolia, Dichanthelium acuminatum, Danthonia spicata*, and *Paronychia argyrocoma*. Other characteristic species include *Campanula divaricata, Solidago bicolor*, and *Allium cernuum (= Allium allegheniense)*. On amphibolite, metabasalt, metagabbro, or metagraywacke bedrock from 1350-1870 m elevation within a matrix of *Quercus rubra* Forest or high elevation grasslands and shrublands, the vegetation includes *Saxifraga michauxii, Danthonia spicata, Krigia montana, Carex misera, Angelica triquinata, Athyrium filix-femina ssp. asplenioides, Rhododendron catawbiense*, and *Heuchera villosa*. Other characteristic species are *Sanguisorba canadensis, Sibbaldiopsis tridentata, Hylotelephium telephioides (= Sedum telephioides), Houstonia purpurea var. montana, Geum radiatum, Solidago spithamaea*, and *Huperzia appalachiana*. In the central Blue Ridge mountains of Virginia, at elevations of 850-1200 m, this alliance occurs on greenstone (metabasalt, a mafic metamorphic rock). Characteristic herbaceous species include *Hylotelephium telephioides, Solidago simplex var. randii, Heuchera pubescens, Deschampsia flexuosa, Houstonia longifolia (= Houstonia longifolia var. compacta), Dennstaedtia punctilobula, Campanula divaricata, Agrostis perennans, Carex pensylvanica, Saxifraga michauxii, Arabis lyrata, Allium allegheniense*?, *Phlox subulata ssp. brittonii, Sibbaldiopsis tridentata, Liatris turgida, Huperzia appalachiana, Polypodium appalachianum, Gymnocarpium appalachianum*, and *Oclemena acuminata*. Shrubs include *Physocarpus opulifolius, Sorbus americana, Betula alleghaniensis, Quercus rubra, Ribes*

rotundifolium, Diervilla lonicera, Hamamelis virginiana, Ilex montana, Kalmia latifolia, Menziesia pilosa, and *Abies balsamea*. Rare alpine disjunct species are sometimes present, including *Juncus trifidus* and *Trisetum spicatum*.

HIGH-ELEVATION GREENSTONE BARREN (CEGL008536)

Diervilla lonicera - Solidago simplex var. *randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii* Herbaceous Vegetation
Bush-honeysuckle - Rand's Goldenrod - Wavy Hairgrass - Appalachian Live-forever - Cliff Saxifrage Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This association is known only from a few high-elevation mafic rock outcrops in the northern Virginia Blue Ridge. All known sites are located in Shenandoah National Park. This community type is associated with exposed rocky summits and upper slope outcrops of Catoctin Formation metabasalt (greenstone) at elevations from 900-1200 m (3000-4000 feet). Slope shape is typically convex in at least one direction, and aspect varies from west to north. The vegetation is characterized by a patchwork of shrub thickets (typically <25% cover), herbaceous mats (typically <40% cover), and crustose lichen colonies on exposed rock surfaces. The most frequent woody species include extremely stunted, wind-blasted specimens of the trees *Betula alleghaniensis* and *Sorbus americana*; characteristic shrubs and woody vines are *Diervilla lonicera, Physocarpus opulifolius, Prunus pensylvanica, Prunus virginiana, Kalmia latifolia*, and *Smilax tamnoides*. *Deschampsia flexuosa* and *Solidago simplex var. randii* are usually the dominant herbaceous species.

Environment: This community type is associated with exposed rocky summits and upper slope outcrops of Catoctin Formation metabasalt (greenstone) at elevations from 900-1200 m (3000-4000 feet). Mean elevation of nine plot-sampled stands is 1068 m (3506 feet); an exceptional occurrence on the north slope of Mount Marshall is situated at an unusually low elevation of 870 m (2860 feet). Slope shape is typically convex in at least one direction, and aspect varies from west to north. Mean surface cover of bedrock and loose rocks at sample sites is 69%, while mean lichen / moss cover on these rocks is 42%. The moisture regime of these sites is xeric, and soil development is limited to shallow accumulations of disintegrated rock and humus on shelves and in crevices. However, an ephemeral spring seep with seasonally wet moss mats is present at one site (Stony Man Mountain). These habitats are periodically exposed to extreme winter temperatures, high winds, and ice. Soil samples extracted from plot locations are extremely acidic (mean pH = 4.0) but often have moderately high levels of calcium, magnesium, and manganese and high levels of aluminum (mean = 1577 ppm).

Vegetation: The vegetation is characterized by a patchwork of shrub thickets (typically <25% cover), herbaceous mats (typically <40% cover), and crustose lichen colonies on exposed rock surfaces. The most frequent woody species include extremely stunted, wind-blasted specimens of the trees *Betula alleghaniensis* and *Sorbus americana*; characteristic shrubs and woody vines are *Diervilla lonicera, Physocarpus opulifolius, Prunus pensylvanica, Prunus virginiana, Kalmia latifolia*, and *Smilax tamnoides*. *Deschampsia flexuosa* and *Solidago simplex var. randii* are usually the dominant herbaceous species, with mean cover in plot samples of 10-25% and 5-10%, respectively. *Sibbaldiopsis tridentata* is abundant (up to 25% cover) in a subset of sites but is absent

from the majority of sites. Other relatively constant and characteristic herbaceous species are *Campanula divaricata, Carex pensylvanica, Heuchera pubescens, Hylotelephium telephioides (= Sedum telephioides), Phlox subulata, Poa compressa, Polypodium appalachianum*, and *Saxifraga michauxii*. Inconstant but locally prominent herbaceous species include *Allium cernuum, Angelica triquinata, Arabis lyrata, Houstonia longifolia, Danthonia spicata, Liatris turgida*, and *Saxifraga virginiensis*. The grass *Calamagrostis canadensis* is abundant in the local seepage area on Stony Man Mountain, Virginia. Mean species richness of plot-sampled stands is 29 taxa per 100 square meters.

Similar Associations:

- *Minuartia groenlandica - Paronychia argyrocoma - Saxifraga michauxii* Herbaceous Vegetation (CEGL008509)

Related Concepts:

- *Diervilla lonicera - Solidago simplex var. randii - Deschampsia flexuosa - Hylotelephium telephioides - Saxifraga michauxii* Herbaceous Vegetation (Fleming and Coulling 2001) ?

Classification Comments: This type (CEGL008536) was formerly represented, in part, by the now-obsolete *Saxifraga michauxii - Solidago simplex var. randii - Sibbaldiopsis tridentata* Herbaceous Vegetation (CEGL004941). Recent multivariate analyses of a 956-plot dataset by the Virginia Dept. of Conservation / Division of Natural Heritage strongly supports the segregation of this type from vegetation documented south of Shenandoah National Park on the granitic summit of Spy Rock (Nelson County) and the amphibolite summit of Buffalo Mountain (Floyd County). The barrens of these two sites have been classified as *Minuartia groenlandica - Paronychia argyrocoma - Saxifraga michauxii* Herbaceous Vegetation (CEGL008509). Several additional high-elevation greenstone outcrops in the park (e.g., Pass Mountain, Mount Marshall, Hightop) and elsewhere (e.g., Humpback Rocks, Nelson County) support *Photinia melanocarpa - Gaylussacia baccata / Carex pensylvanica* Shrubland (CEGL008508). Vegetation of CEGL008508 is characterized by rhizomatous colonies of the low shrubs *Photinia melanocarpa* and *Gaylussacia baccata* and has a lower herb diversity and overall species richness than CEGL008536. Vegetation of the Stony Man seepage area was formerly recognized as a distinct type, *Physocarpus opulifolius / Calamagrostis canadensis* Shrub Herbaceous Vegetation (CEGL004253) but is now regarded as a variant of CEGL008536.

Among the ten state-rare plant species associated with these barrens are several long-range boreal disjuncts that are likely Pleistocene relicts. The only known Virginia populations of *Juncus trifidus* and *Conioselinum chinense* occur on the Stony Man barrens, while the sole population of *Trisetum spicatum* occupies steep, turfy barrens on the Hawksbill north slope.

Because this association is endemic to Shenandoah National Park, stewardship of the existing occurrences is critical to ensure long-term viability. Although some habitats are remote and rarely visited, others (e.g., Crescent Rocks, Franklin Cliffs, and the Hawksbill, Stony Man, and Little Stony Man summits) are popular overlooks along trails and the Skyline Drive. In the latter localities, years of heavy visitation have essentially destroyed the fragile mats of herbaceous vegetation. More recently, rock climbing at Little Stony Man has added a new threat to those plants occupying the more protected, vertical crevices and cliff-face shelves. *Poa compressa* and *Rumex acetosella* are the only

frequent exotic plants found on high-elevation greenstone barrens, and both may occasionally exhibit invasive tendencies, especially in heavily trampled areas.

CONSERVATION RANKING

GRank: G1 (2001-10-3) **Reasons:** This is a naturally rare, small-patch community type limited by special habitat requirements. Currently, habitats supporting this unit are known from less than 15 discrete outcrops which together form five complexes or occurrences (Franklin Cliffs, Hawksbill, Crescent Rocks, Stony Man Mountain, Mount Marshall). Total coverage of all known occurrences is probably <12 hectares (30 acres). It is unlikely that any additional occurrences will be found, and these would not significantly increase the aggregate acreage of the type.

ELEMENT DISTRIBUTION

Range: This association is known only from a few high-elevation mafic rock outcrops in the northern Virginia Blue Ridge. All known sites are located in Shenandoah National Park. Most occurrences are in the higher, central section of the park, from the Big Meadows Area on the south to Stony Man Mountain on the north. A somewhat disjunct stand occurs on Mount Marshall in the northern section of the park.
Subnations: TN?, VA
TNC Ecoregions: 59:C
USFS Ecoregions: M221Da:CCC
Federal Lands: NPS (Shenandoah)

ELEMENT SOURCES

References: Fleming and Coulling 2001, Fleming et al. 2001, Fleming et al. 2004, TDNH unpubl. data

VI. Nonvascular Vegetation

VI.B.1.N.b. Alpine to submontane temperate or subpolar lichen vegetation
Lasallia (papulosa, pensylvanica) *Nonvascular Alliance (A.1824)*
(TOADSKIN LICHEN, PENNSYLVANIA TOADSKIN LICHEN) NONVASCULAR ALLIANCE
Alliance Summary: This alliance consists of large, lichen-dominated rock outcrops and boulderfields with little or no vascular vegetation. It occurs on a variety of sedimentary, metasedimentary and metamorphic substrates, including quartzite, sandstone and metabasalt. *Lasallia papulosa* and *Lasallia pensylvanica*, either singly or together, are two of the most abundant and conspicuous lichens. The Alliance occurs throughout the upper Piedmont from Maryland to North Carolina, and throughout the adjacent Blue Ridge and Ridge and Valley provinces of the central Appalachians, north into the High Allegheny Plateau. It is replaced at higher elevations of the southern Appalachians by the *Lasallia papulosa - Umbilicaria caroliniana* Nonvascular Alliance (A.1826). At higher elevations of the central Appalachians, it is replaced by the *Umbilicaria muehlenbergii* Nonvascular Alliance (A.1825).

CENTRAL APPALACHIAN ACIDIC BOULDERFIELD (CEGL004142)

Lasallia (papulosa, pensylvanica) - Dimelaena oreina - (Melanelia culbersonii) Nonvascular Vegetation
(Toadskin Lichen, Pennsylvania Toadskin Lichen) - Golden Moonglow Lichen - Culberson's Black-parmelia Nonvascular Vegetation

ELEMENT CONCEPT

Summary: This association is widely but locally distributed from the western Piedmont foothills in Maryland and Virginia through the Blue Ridge and Ridge and Valley portions of the central Appalachians, north at least to the Delaware Water Gap in Pennsylvania and New Jersey. It occurs primarily on fully exposed, minimally weathered quartzite and sandstone boulderfields at elevations from about 300 to 1000 m (1000-3300 feet). On the largest occurrences, vascular plants are generally absent and lichens dominate these habitats. *Lasallia papulosa* and *Lasallia pensylvanica*, either singly or in combination, are generally abundant and conspicuous. *Dimelaena oreina* abundantly covers many dry, exposed rock surfaces that are not covered with *Lasallia* spp. and larger foliose lichens. Although of scattered occurrence, *Melanelia culbersonii* has been found across the full elevation range of the type and is a good diagnostic species, as it appears to be restricted mostly to siliciclastic rocks (and occasionally coarse-grained, quartz-rich granites that are nearly devoid of dark minerals) in this region. A variety of other foliose, crustose and fruticose lichen species are associated. Smaller, more marginal occurrences have sparse vascular plant cover, primarily stunted trees of *Betula lenta, Sassafras albidum*, and *Quercus prinus*, ericaceous shrubs, and scrambling vines of *Parthenocissus quinquefolia*.

Environment: This association occurs primarily on fully exposed, minimally weathered quartzite and sandstone boulderfields at low and middle elevations of the northern Blue Ridge, Ridge and Valley, and adjacent foothills of the upper Piedmont. A few occurrences have also been noted on boulderfields composed of acidic granitic rocks (e.g., on Old Rag Mountain in Shenandoah National Park). The known elevation range is from about 300 to 1000 m (1000-3300 feet). Aspect is variable among sites, but slopes are typically steep to very steep (often >30 degrees). Block size is highly variable, from relatively small and loose stones (<1 m in diameter) to large, stable boulders (>1 m in diameter). Although this association is most extensive on boulder deposits, it may also occur on outcrops associated with the boulderfields, or on very large, exposed cliffs. There is little or no available soil except for occasional small deposits of organic matter in crevices.

Vegetation: On the largest occurrences, vascular plants are generally absent and lichens dominate. Maximum patch size is about ten acres, but most patches are considerably smaller. *Lasallia papulosa* and *Lasallia pensylvanica*, either singly or in combination, are generally abundant and conspicuous. *Dimelaena oreina* abundantly covers many dry, exposed rock surfaces that are not covered with *Lasallia* spp. and larger foliose lichens. Although of scattered occurrence, *Melanelia culbersonii* has been found across the full elevation range of the type and is a good diagnostic species, as it appears to be restricted mostly to siliciclastic rocks (and occasionally coarse-grained, quartz-rich granites that are nearly devoid of dark minerals) in this region. Other minor umbilicate and foliose species include *Hypogymnia physodes, Physcia subtilis, Umbilicaria muehlenbergii, Xanthoparmelia conspersa*, and *Xanthoparmelia plittii*. Many crustose species occur, including *Aspicilia cinerea, Fuscidea recensa, Lecanora* spp., *Lepraria* spp., *Rhizocarpon obscuratum (= Rhizocarpon reductum)*, and *Sarcogyne clavus*. Flat surfaces and interstices that have thin deposits of organic matter often support a variety of fruticose lichens, including *Cladina rangiferina, Cladina uncialis, Cladonia crispata, Cladonia macilenta, Cladonia ochrochlora*, and *Cladonia squamosa*. In the upper elevation range, boreal lichens such as *Melanelia stygia* and *Arctoparmelia centrifuga* are

present, but they are not abundant. Along the edges of the boulderfields, scattered individuals of *Parthenocissus quinquefolia, Vaccinium* spp., and other vascular plants may occur in transition zones with forests or woodlands. Smaller, more marginal occurrences frequently have sparse vascular plant cover, primarily stunted trees of *Betula lenta, Sassafras albidum, Quercus prinus, Quercus coccinea, Quercus velutina, Carya glabra*, and *Carya ovalis*. Widely scattered shrubs may include *Kalmia latifolia* and other ericads. Herbs are usually absent, but *Dicentra eximia* is known from some occurrences.

Dynamics: The exposed rock surfaces supporting this community are subject to fluctuating, daily extremes of temperature, humidity, and moisture saturation during the growing season, as well as to low temperatures, high winds, and frequent ice during the winter. Boulderfield habitats have resulted from periglacial phenomena and the collapse of resistant strata from weathering and erosion of weaker underlying rocks. Most central Appalachian boulderfields are well-weathered and now support woodland or forest vegetation. Relatively few remain fully exposed and support wholly nonvascular communities.

Similar Associations:

- *Lasallia papulosa - Lasallia pensylvanica* Nonvascular Vegetation (CEGL004385)--of quartzite cliffs in the western North Carolina Piedmont.
- *Lasallia papulosa - Stereocaulon glaucescens - Chrysothrix chlorina* Nonvascular Vegetation (CEGL004143)--occurs on mafic (metabasaltic) boulderfields of the northern Blue Ridge.
- *Umbilicaria muehlenbergii - Lasallia papulosa - (Melanelia stygia)* Nonvascular Vegetation (CEGL004389)--occurs at higher elevations in the same region and has different dominant species.

Classification Comments: Classification of this association is based on geographically limited lichen inventories in Shenandoah National Park, but it is believed to be widely applicable to similar boulderfields that are characteristic of central Appalachian siliciclastic ridges. In the park inventory, lichens were mass-collected from boulderfield and outcrop habitats on different geologic substrates, and specimens were identified by Richard Harris (New York Botanical Garden), Don Flenniken (author of Macrolichens of West Virginia), and James Lawry (George Mason University). Classification of lichen communities in eastern North America is currently difficult and tentative because inventory and data are generally lacking. The classification of this type versus *Betula lenta - Quercus prinus / Parthenocissus quinquefolia* Woodland (CEGL006565) can be tricky where there is a continuous gradation of vegetation cover (as at Delaware Water Gap), but generally this is applied where there is less than 25% vascular vegetation and nonvascular species are dominant.

Other Comments: This association is readily identifiable in the field by its occurrence on dry, acidic quartzite and sandstone talus, and the general abundance of large, brown foliose clumps of *Lasallia* spp. and flat-lying, yellow patches of *Dimelaena oreina*.

CONSERVATION RANKING

GRank: G4? (2006-11-28) **Reasons:** Although aggregate acreage is not large, there are probably several hundred occurrences of this association in Virginia alone, with many more known from or likely in adjacent states. Habitats are typically remote, extremely steep and difficult to traverse, minimizing potential human threats.

ELEMENT DISTRIBUTION

Range: This association is widely but locally distributed from the western Piedmont foothills in Maryland (e.g., Sugarloaf Mountain) and Virginia (e.g., Bull Run Mountain)

through the Blue Ridge and Ridge and Valley portions of the central Appalachians, north at least to the Delaware Water Gap in Pennsylvania and New Jersey. The type is fairly common on the siliciclastic western flank of the northern Blue Ridge and throughout the Ridge and Valley in west-central and northwestern Virginia. It is also frequent in the Ridge and Valley region of Pennsylvania (T. Smith pers. comm.) but may be restricted to the northeastern tier of counties in West Virginia. The potential range of this association covers a much larger geographic area.
Subnations: MD, NJ, PA, VA, WV
TNC Ecoregions: 52:C, 59:C, 60:C, 61:C
USFS Ecoregions: 212Fc:CCC, 221Da:CCC, 231Al:CCC, M221Aa:CCC, M221Ab:CCC, M221Ac:CCC, M221Da:CCC
Federal Lands: NPS (Catoctin Mountain, Delaware Water Gap, Shenandoah); USFS (George Washington, Jefferson, Monongahela?)

ELEMENT SOURCES

References: Eastern Ecology Working Group n.d., Fleming et al. 2006, Flenniken 1999

CENTRAL APPALACHIAN MAFIC BOULDERFIELD (CEGL004143)

Lasallia papulosa - Stereocaulon glaucescens - Chrysothrix chlorina Nonvascular Vegetation
Toadskin Lichen - Snow Lichen - Sulphur Dust Lichen Nonvascular Vegetation

ELEMENT CONCEPT

Summary: This association is known only from four counties on the northern Virginia Blue Ridge, where it occurs on fully exposed, minimally weathered metabasalt boulderfields at elevations from about 670 to 1160 m (2200-3800 feet). Vascular plants are generally absent and lichens dominate these habitats. *Lasallia papulosa* and *Stereocaulon glaucescens* are generally abundant and conspicuous in variable combinations. Although not abundant, *Chrysothrix chlorina* is scattered on sheltered boulder faces and in grottoes and is a good diagnostic species as it appears to be absent from siliciclastic boulderfields in this region. A variety of other foliose, crustose and fruticose lichen species are associated, including several characteristic arctic-boreal species at higher elevations.
Environment: This association occurs on fully exposed, minimally weathered metabasalt boulderfields at middle and high elevations of the northern Blue Ridge. The known elevation range is from about 670 to 1160 m (2200-3800 feet), with the majority of acreage located above 915 m (3000 feet). Aspect is variable among sites, but slopes are typically steep to very steep (often >30 degrees). Block size is typically <1 m, with the surficial boulders in the field somewhat loose. Although this association is most extensive on boulder deposits, it may also occur on fully exposed outcrops associated with the boulderfields.
Vegetation: Vascular plants are generally absent and lichens dominate. Maximum patch size is about one acre, and many patches are much smaller. *Lasallia papulosa* and *Stereocaulon glaucescens* are generally abundant and conspicuous in variable combinations. Although not abundant, *Chrysothrix chlorina* is a good diagnostic species as it appears to be absent from siliciclastic and granitic boulderfields in this region; it is scattered on sheltered boulder faces and in grottoes, often with *Psilolechia lucida, Usnea halei*, and *Ramalina intermedia*. Other minor umbilicate and foliose species include

Flavoparmelia baltimorensis, Parmelia sulcata, and *Umbilicaria muehlenbergii*. Many crustose species occur, including *Aspicilia cinerea, Diploschistes scruposus, Fuscidea recensa, Lepraria* spp., *Porpidia* spp., *Rhizocarpon rubescens*, and *Trapeliopsis granulosa*. Flat surfaces and interstices that have thin deposits of organic matter often support a variety of fruticose lichens, including *Cladina rangiferina, Cladina stellaris, Cladonia crispata, Cladonia furcata, Cladonia pleurota*, and *Cladonia squamosa*. At higher elevations, a number of characteristic arctic-boreal lichens occur, including *Cladonia coccifera, Melanelia stygia, Microcalicium arenarium, Parmelia omphalodes, Porpidia tuberculosa, Rhizocarpon geographicum*, and *Umbilicaria caroliniana*. Along the edges of the boulderfields, scattered individuals or patches of *Polypodium appalachianum, Hylotelephium telephioides*, and other vascular plants may occur in transition zones with forests or woodlands.

Dynamics: The exposed rock surfaces supporting this community are subject to fluctuating, daily extremes of temperature, humidity, and moisture saturation during the growing season, as well as to low temperatures, high winds, and frequent ice during the winter. Boulderfield habitats have resulted from periglacial phenomena and the collapse of resistant strata from weathering and erosion of weaker underlying rocks. Most Central Appalachian boulderfields are well-weathered and now support woodland or forest vegetation. In this region, metabasalt underlies much less acreage than quartzite and sandstone and is less resistant to weathering. Consequently, exposed metabasalt boulderfields are quite rare.

Similar Associations:

- *Lasallia (papulosa, pensylvanica) - Dimelaena oreina - (Melanelia culbersonii)* Nonvascular Vegetation (CEGL004142)--occurs on low- to middle-elevation siliciclastic boulderfields of the same region, has a different species composition, and has different relative abundances of shared species.
- *Umbilicaria muehlenbergii - Lasallia papulosa - (Melanelia stygia)* Nonvascular Vegetation (CEGL004389)--occurs on high-elevation siliciclastic rocks of the Ridge and Valley and Allegheny Mountains.

Classification Comments: Classification of this association is based on geographically limited lichen inventories in Shenandoah National Park. In the park inventory, lichens were mass-collected from boulderfield and outcrop habitats on different geologic substrates and specimens were identified by Richard Harris (New York Botanical Garden), Don Flenniken (author of Macrolichens of West Virginia), and James Lawry (George Mason University). Classification of lichen communities in eastern North America is currently difficult and tentative because inventory and data are generally lacking. Because *Stereocaulon glaucescens* and many other species in this association have northern or arctic-boreal ranges, related boulderfield communities are most likely to be found north of Virginia.

CONSERVATION RANKING

GRank: G1? (2006-12-7) **Reasons:** As currently defined, this association has an extremely narrow geographic range, with fewer than 20 known discrete patches covering an aggregate area of less than 10 acres. Although well-weathered, forested talus of metabasalt and similar mafic rocks are locally common in the Central Appalachians, fully exposed, minimally weathered boulderfields of these substrates are extremely rare in the region.

ELEMENT DISTRIBUTION

Range: This association is known only from metabasalt districts in four counties on the northern Virginia Blue Ridge. The potential range is larger, but suitable habitat (i.e., mafic substrates at higher elevations) are not known to occur elsewhere in the Central Appalachians.
Subnations: VA
TNC Ecoregions: 59:C
USFS Ecoregions: M221Da:CCC
Federal Lands: NPS (Shenandoah)

ELEMENT SOURCES

References: Fleming et al. 2006, Flenniken 1999, Southeastern Ecology Working Group n.d.

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Appendix B

Invertebrates Collected in Shenandoah National Park

Rare animal surveys were conducted on 50 selected rock outcrop areas in Shenandoah National Park (SHEN, Table B-1) in 2005 and 2006 to provide information on rare, threatened, and endangered species. As part of this effort, ultraviolet (UV) light traps were set in numerous localities to sample the invertebrate fauna of the 50 rock outcrop sites

As a by-product of collecting for rare species, numerous common invertebrate species were collected. This appendix documents the moth and beetle species captured and identified during these surveys (Tables B-2 and B-3).

All moths and many beetles were captured with a UV-light traps. Between 7 June 2005 and 28 September 2006, 58 UV-light traps were set successfully at 43 of the 50 rock outcrops sites in SHEN (Table B-1). Six sites were trapped on multiple dates. UV-light traps failed to work at four locations (Failed) either due to faulty equipment or poor weather conditions. A standard light trap (Martin, 1978) with a 15-watt standard UV-light (i.e. black light) fluorescent tube was used. Traps were typically set in the late afternoon. A photoelectric switch was used to turn the UV-light on at dusk and off at dawn. Commercially obtained No Pest Strips were used as the killing agent in the traps. The active agent in these strips is Dichlorvos. Additional beetle captures were made by hand, sweepnet, and beating sheets in all 50 ROMP sites.

It should be noted that while many types of rock outcrops were surveyed (i.e. metabasalt, granite etc; Table B-1), there are numerous other types of habitats within SHEN that were not surveyed and which may be a source of future additions to the park's moth and beetle faunas. Also, there were many specimens that could not be identified to species either due to the worn condition of the specimen or to our inexperience with the species.

In summary, 3,841 moth specimens were identified to species, totaling 449 species (Table B-2). Twenty-three families are represented. Figure B-1 shows a species accumulation curve, which indicates the cumulative numbers of unique species after each trapping effort. The curve tends to flatten out during late-summer periods in both 2005 and 2006, but, nonetheless, continues to rise. This indicates that additional species can be added to the list with further trapping efforts. Better identification skills would also add to the list (e.g., the microlepidotera are under-represented here, as we have little expertise in identifying these).

In addition, 1,501 beetle specimens were identified to species, totaling 204 species (Table B-3). Forty-seven families are represented. Figure B-2 shows a species accumulation curve for the beetles. This curve also flattens out toward the end of each season. Contractual time constraints prevented the identification of all of the specimens collected.

Finally, Table B-4 lists the remaining invertebrates identified to species, representing species from three classes (Chelicerata, Insecta, and Malacostraca), 12 orders, 47 families and 106 species. The remaining material was returned to SHEN. The complete database was also given to SHEN.

Table B-1: Locations and dates that ultraviolet (UV) light traps were set in SHEN during 2005 and 2006 surveys. Estimated elevations (measured near the location of the UV trap) are categorized as: Low = ca. <2600 ft, Middle = ca. 2600-3400 ft, and High > 3400 ft. Bedrock types are taken from Butler (2006), and descriptions can be found there.

Rock Outcrop Site	UV-trap survey dates (Number of traps set if >1)	Estimated Elevation	Bedrock
Dickey Ridge	19 July 2006	Low	Metabasalt
Dickey Hill	19 July 2006	Low	Metabasalt
Gooney Manor Overlook	19 July 2006	Low	Metabasalt
Browntown Valley Overlook	31 August 2006	Mid	Metabasalt
North Marshall Summit	27 July 2005	Mid	Metabasalt
South Marshall Cliff	27 July 2005	Mid	Metabasalt
Big Devils Stairs	28 July 2005 (Failed)	Low	Metabasalt
Little Devils Stairs	28 September 2006	Low	Metabasalt
Hogback Mountain Spur	28 September 2006	High	Granitic gneiss
Overall Run Falls North	19 September 2006 (2)	Low	Metabasalt
Overall Run Falls South	None	Low	Metabasalt
Pass Mountain	29 June 2006	Mid	Metabasalt
Oventop	20 September 2006	Low	Old Rag granite
Marys Rock	29 June 2006	High	Granitic
Pinnacles	29 June 2006	High	Charnockite
Little Stony Man	3 August 2006 (2)	High	Metabasalt
Stony Man Summit	15 September 2005 (2)	High	Metabasalt
Millers Head	6 June 2006 3 August 2006	High	Granite

Table B-1 continued: Locations and dates that ultraviolet (UV) light traps were set in SHEN during 2005 and 2006 surveys. Estimated elevations (measured near the location of the UV trap) are categorized as: Low = ca. <2600 ft, Middle = ca. 2600-3400 ft, and High > 3400 ft. Bedrock types are taken from Butler (2006), and descriptions can be found there.

Rock Outcrop Site	UV-trap survey dates (Number of traps set if >1)	Estimated Elevation	Bedrock
Old Rag Summit East	10 August 2006	Mid	Old Rag granite
Old Rag Summit West	10 August 2006	Mid	Old Rag granite
Old Rag Southside	10 August 2006	Mid	Old Rag granite
Whiteoak Canyon	21 July 2006	Low	Metabasalt/ granitic
Bettys Rock	29 June 2005 14 September 2005 7 June 2006 20 September 2006	High	Metabasalt
Crescent Rock Overlook	14 July 2005 16 May 2006 7 June 2006 20 September 2006	High	Metabasalt
Crescent Rock South	15 September 2005	High	Metabasalt
Halfmile Cliff	21 July 2006	High	Metabasalt
Hawksbill North Slope Outcrops	8 August 2006	High	Metabasalt
Hawksbill North Slope Talus	8 August 2006	High	Metabasalt
Hawksbill Summit	8 August 2006 31 August 2006	High	Metabasalt
Nakedtop Upper East Slope	31 August 2006	Mid	Granitic
Franklin Cliffs North	15 September 2005	Mid	Metabasalt
Franklin Cliffs Overlook	None	Mid	Metabasalt
Franklin Cliffs South	14 September 2005	Mid	Metabasalt
Rose River Cliffs	16 May 2006	Low	Metabasalt

Table B-1 continued: Locations and dates that ultraviolet (UV) light traps were set in SHEN during 2005 and 2006 surveys. Estimated elevations (measured near the location of the UV trap) are categorized as: Low = ca. <2600 ft, Middle = ca. 2600-3400 ft, and High > 3400 ft. Bedrock types are taken from Butler (2006), and descriptions can be found there.

Rock Outcrop Site	UV-trap survey dates (Number of traps set if >1)	Estimated Elevation	Bedrock
Blackrock Central District	14 July 2005 15 September 2005 7 June 2006	High	Metabasalt
Bearfence Mountain	17 May 2006 4 August 2006	High	Metabasalt
Upper Devils Ditch	9 June 2005	Mid	Charnockite
Field Hollow Cliff	8 August 2006	Mid	Metabasalt
Dean Mountain Ridge	8 June 2005	Mid	Metabasalt
Hightop	4 August 2006	High	Metabasalt
Powell Gap Cliff	14 September 2005	Mid	Metasedimentary (Swift Run Formation)
Rocky Mountain	30 June 2005	Mid	Erwin Formation quartzite
Brown Mountain	29 June 2005 (Failed)	Mid	Erwin Formation quartzite
Loft Mountain Summit	30 June 2005	Mid	Metabasalt
Blackrock South District	18 August 2005	Mid	Harpers Formation quartzite
Trayfoot Saddle Boulderfields E	17 August 2005	Mid	Hampton Formation quartzite
Trayfoot Saddle Boulderfields W	None	Mid	Hampton Formation quartzite
Calvary Rocks - Chimney Rock	17 May 2006	Mid	Erwin Formation quartzite
Sawlog Ridge	6 June 2006 (Failed)	Low	Metabasalt
Goat Ridge	6 June 2006 (Failed)	Low	Metabasalt

Table B-2. Identified moth species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions), V = potentially new Virginia record that needs further surveys of literature and/or collections to confirm, ? = specimen that needs dissection to confirm identification]

Arctiidae (n = 24)

Apantesis phalerata
Apantesis vittata
Clemensia albata
Crambidia pallida
Crambidia uniformis
Ecpantheria scribonia
Euchaetes egle
Grammia parthenice intermedia
Grammia virgo
Halysidota tessellaris
Haploa clymene
Haploa lecontei
Holomelina aurantiaca
Holomelina laeta
Holomelina opella
Hyphantria cunea
Hypoprepia fucosa
Hypoprepia miniata
Lophocampa caryae
Lycomorpha pholus
Pyrrharctia isabella
Spilosoma congrua
Spilosoma latipennis
Spilosoma virginica

Bombycidae (n = 2)

Apatelodes torrefacta
Olceclostera angelica

Crambidae (n = 8)

Blepharomastix ranalis
Desmia funeralis
Desmia maculalis
Hymenia perspectalis
Nomophila nearctica
Palpita magniferalis
Pantographa limata
Vaxi auratella

Drepanidae (n = 2)

Drepana arcuata
Oreta rosea

Geometridae (n = 112)

Aethalura intertexta
Anagoga occiduaria
Antepione thisoaria
Besma endropiaria
Besma quercivoraria
Biston betularia cognataria
Cabera erythemaria
Campaea perlata
Caripeta angustiorata#
Caripeta divisata
Cepphis armataria
Chlorochlamys chloroleucaria
Cladara anguilineata
Cleora sublunaria
Costaconvexa centrostrigaria
Cyclophora myrtaria#
Cyclophora pendulinaria
Dyspteris abortivaria
Dysstroma hersiliata
Ecliptopera atricolorata
Ectropis crepuscularia
Ennomos marginaria
Ennomos subsignaria
Epimecis hortaria
Epirrhoe alternata
Eubaphe mendica
Euchlaena irraria
Euchlaena marginaria#
Euchlaena muzaria#
Euchlaena obtusaria
Euchlaena pectinaria
Euchlaena tigrinaria#

Table B-2 continued. Identified moth species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions), V = potentially new Virginia record that needs further surveys of literature and/or collections to confirm, ? = specimen that needs dissection to confirm identification]

(Geometridae cont'd)

Eufidonia notaria
Eugonobapta nivosaria
Eulithis diversilineata
Eulithis molliculata[#]
Euphyia unangulata
Eupithecia miserulata
Eusarca confusaria
Eutrapela clemataria
Glena cribrataria
Heliomata cycladata
Heliomata infulata[#]
Hesperumia sulphuraria
Heterophleps refusaria
Heterophleps triguttaria
Homochlodes disconventa[#]
Hydrelia inornata
Hydriomena bistriolata[#]
Hypagyrtis unipunctata
Idaea eremiata
Iridopsis larvaria
Itame abruptata[#]
Itame exauspicata[#V]
Itame pustularia
Itame ribearia[*]
Itame subcessaria[#]
Lambdina athasaria complex
Lambdina fiscellaria complex
Lambdina pellucidaria
Lomographa vestaliata
Lytrosis unitaria
Macaria aemulataria
Macaria bicolorata
Macaria bisignata
Macaria granitata
Macaria minorata
Macaria multilineata
Macaria ocellinata
Macaria pinistrobata
Macaria promiscuata
Macaria signaria dispuncta
Macaria transitaria
Macaria ulsterata
Melanolophia canadaria
Mesoleuca ruficillata[#]
Metarranthis amyrisaria
Metarranthis angularia complex
Metarranthis lateritiaria
Metarranthis mestusata[#]
Nacophora quernaria
Nemoria bistriaria bistriaria
Nemoria lixaria
Nemoria mimosaria[#]
Nemoria rubrifrontaria
Pero ancetaria
Pero morrisonaria
Plagodis alcoolaria
Plagodis fervidaria
Plagodis kuetzingi
Plagodis occiduaria
Plagodis phlogosaria
Plagodis serinaria
Pleuroprucha insulsaria
Probole alienaria
Probole amicaria
Probole nepiasaria
Prochoerodes transversata
Protitame virginalis
Protoboarmia porcelaria
Rheumaptera hastata[#]
Rheumaptera prunivorata
Scopula limboundata
Sicya macularia
Tetracis cachexiata
Tetracis crocallata
Trichodezia albovittata
Xanthorhoe ferrugata
Xanthorhoe labradorensis[#]
Xanthorhoe lacustrata
Xanthotype sospeta[?]
Xanthotype urticaria[?]

Table B-2 continued. Identified moth species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions), V = potentially new Virginia record that needs further surveys of literature and/or collections to confirm, ? = specimen that needs dissection to confirm identification]

Lasiocampidae (n = 2)

Malacosoma americanum
Malacosoma disstria

Limacodidae (n = 12)

Adoneta spinuloides
Apoda biguttata
Apoda y-inversum
Euclea delphinii
Isa textula
Lithacodes fasciola
Parasa chloris
Parasa indetermina
Phobetron pithecium
Prolimacodes badia
Tortricidia flexuosa
Tortricidia testacea

Lymantriidae (n = 2)

Dasychira tephra
Lymantria dispar

Megalopygidae (n = 1)

Megalopyge crispata

Mimallonidae (n = 1)

Lacosoma chiridota

Noctuidae (n = 198)

Abagrotis alternata
Achatodes zeae
Acronicta afflicta
Acronicta americana
Acronicta clarescens
Acronicta fragilis
Acronicta funeralis
Acronicta hamamelis
Acronicta hasta
Acronicta impleta
Acronicta inclara complex
Acronicta innotata
Acronicta interrupta
Acronicta laetifica
Acronicta lithospila
Acronicta lobelia
Acronicta longa
Acronicta modica
Acronicta morula
Acronicta ovata
Acronicta rubricoma
Acronicta superans
Acronicta vinnula
Agriopodes teratophora
Agrochola bicolorago
Agrotis ipsilon
Agrotis venerabilis
Allagrapha aerea
Allotria elonympha
Amphipyra pyramidoides
Amphipyra tragopoginis
Anagrapha falcifera
Anathix ralla
Anicla forbesi
Anicla infecta
Anorthodes tarda
Apamea helva
Apamea lignicolora[#]
Apamea plutonia[#]
Apamea vulgaris
Argyrostrotis anilis
Autographa ampla[#]
Balsa labecula

Table B-2 continued. Identified moth species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions), V = potentially new Virginia record that needs further surveys of literature and/or collections to confirm, ? = specimen that needs dissection to confirm identification]

(Noctuidae cont'd)
Bleptina caradrinalis
Caenurgina crassiuscula
Callopistria mollissima
Calyptra canadensis
Catocala amica
Catocala andromedae
Catocala cerogama
Catocala coccinata
Catocala connubialis
Catocala dejecta
Catocala epione
Catocala flebilis
Catocala grynea
Catocala habilis
Catocala herodias gerhardi[*]
Catocala ilia
Catocala lineella
Catocala micronympha
Catocala palaeogama
Catocala piatrix
Catocala praeclara
Catocala relicta[#]
Catocala residua
Catocala serena[#]
Catocala sordida
Catocala ultronia
Celiptera frustulum
Cerma cerintha
Charadra deridens
Chytolita morbidalis
Chytolita petrealis
Chytonix palliatricula
Colocasia propinquilinea
Condica vecors
Cosmia calami
Crocigrapha normani
Cucullia convexipennis
Cucullia florea[#]
Diarsia jucunda
Diarsia rubifera
Drasteria grandirena
Dypterygia rozmani
Elaphria alapallida[?]
Elaphria festivoides[?]
Elaphria grata
Elaphria versicolor
Eosphoropteryx thyatyroides
Eudryas grata
Euparthenos nubilis
Euplexia benesimilis
Euretagrotis sigmoides
Feltia jaculifera
Galgula partita
Hadena ectypa[*]
Helicoverpa zea
Homohadena infixa
Hormorthodes furfurata
Hormorthodes lindseyi
Hypena baltimoralis
Hypena deceptalis
Hypena edictalis
Hypena madefactalis
Hypena manalis
Hypena palparia
Hypena scabra
Hypena sordidula[#]
Hyperstrotia secta
Hypsoropha hormos
Idia aemula
Idia americalis
Idia diminuendis
Idia laurenti
Idia lubricalis
Idia rotundalis
Idia scobialis
Isogona tenuis
Lacinipolia anguina

Table B-2 continued. Identified moth species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions), V = potentially new Virginia record that needs further surveys of literature and/or collections to confirm, ? = specimen that needs dissection to confirm identification]

(Noctuidae cont'd)
Lacinipolia laudabilis
Lacinipolia olivacea
Lacinipolia renigera
Lacinipolia teligera
Leucania commoides[#]
Leucania linda
Leucania ursula
Lithacodia concinnimacula[#]
Lithacodia muscosula
Marathyssa basalis
Melanchra adjuncta
Metalectra discalis
Mocis latipes
Mocis texana
Morrisonia latex
Mythimna unipuncta
Nedra ramosula
Nephelodes minians
Noctua pronuba
Ochropleura implecta
Oligia illocata
Oligia mactata
Oligia modica
Orthodes cynica
Orthodes detracta
Orthodes goodelli
Orthodes majuscula
Orthosia garmani
Orthosia hibisci
Paectes oculatrix
Palthis angulalis
Palthis asopialis
Pangrapta decoralis
Panopoda carneicosta
Panopoda rufimargo
Parallelia bistriaris
Peridroma saucia
Phalaenophana pyramusalis
Phlogophora iris[#]
Phlogophora periculosa
Phosphila miselioides
Phosphila turbulenta
Platyperigia multifera
Polia imbrifera
Polia nimbosa
Polygrammate hebraeicum
Properigea costa[*]
Protolampra brunneicollis
Pseudeustrotia carneola
Pseudohermonassa bicarnea
Pseudorthodes vecors
Renia discoloralis
Renia factiosalis
Renia flavipunctalis
Renia nemoralis
Scolecocampa liburna
Spaelotis clandestina
Spirameter lutra
Spodoptera ornithogalli
Spragueia leo
Tarachidia erastrioides
Thioptera nigrofimbria
Tricholita signata
Ulolonche culea
Ulolonche modesta
Xestia dolosa
Xestia elimata
Xestia normaniana
Xestia smithii
Zale aeruginosa
Zale helata
Zale minerea
Zale undularis
Zanclognatha jacchusalis
Zanclognatha laevigata
Zanclognatha lituralis
Zanclognatha obscuripennis
Zanclognatha ochreipennis

Table B-2 continued. Identified moth species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions), V = potentially new Virginia record that needs further surveys of literature and/or collections to confirm, ? = specimen that needs dissection to confirm identification]

Nolidae (n = 5)

Baileya australis
Baileya levitans
Baileya ophthalmica
Meganola phylla
Meganola spodia

Notodontidae (n= 25)

Clostera albosigma
Dasylophia anguina
Datana angusii
Datana drexelii
Datana integerrima
Datana ministra
Ellida caniplaga
Furcula borealis
Heterocampa biundata
Heterocampa guttivitta
Heterocampa obliqua
Heterocampa umbrata
Hyperaeschra georgica
Lochmaeus bilineata
Lochmaeus manteo
Macrurocampa marthesia
Nadata gibbosa
Nerice bidentata
Oligocentria lignicolor
Oligocentria semirufescens
Peridea angulosa
Peridea ferruginea
Schizura ipomoeae
Schizura leptinoides
Schizura unicornis
Symmerista albifrons complex[?]

Oecophoridae (n = 3)

Antaeotricha leucillana
Antaeotricha schlageri
Machimia tentoriferella

Pyralidae (n = 7)

Dolichomia binodulalis
Dolichomia olinalis
Galasa nigrinodis
Hypsopygia costalis
Oneida lunualis
Pococera asperatella
Tosale oviplagalis

Saturniidae (n = 8)

Actias luna
Anisota stigma
Antheraea polyphemus
Automeris io
Callosamia angulifera
Citheronia regalis
Dryocampa rubicunda
Eacles imperialis

Sesiidae (n = 1)

Synanthedon acerni

Sphingidae (n = 15)

Ceratomia amyntor
Ceratomia undulosa
Darapsa myron
Darapsa pholus
Darapsa versicolor[#]
Deidamia inscripta

Table B-2 continued. Identified moth species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions), V = potentially new Virginia record that needs further surveys of literature and/or collections to confirm, ? = specimen that needs dissection to confirm identification]

(Sphingidae cont'd)
Eumorpha pandorus
Hyles lineata
Laothoe juglandis
Lapara bombycoides
Manduca jasminearum
Paonias excaecatus
Paonias myops
Sphinx gordius
Sphinx kalmiae[#]

Thyatiridae (n = 2)

Habrosyne gloriosa
Pseudothyatira cymatophoroides

Tortricidae (n = 11)

Amorbia humerosana
Archips fervidana
Argyrotaenia alisellana
Argyrotaenia fasciola
Argyrotaenia mariana
Choristoneura parallela
Clepsis persicana
Ecdytolopha insiticiana
Eulia ministrana[V]
Proteotera moffatiana
Sparaganothis reticulatana

Uraniidae (n = 1)

Calledapteryx dryopterata

Yponomeutidae (n = 1)

Atteva punctella

Zygaenidae (n = 2)

Harrisina americana
Pyromorpha dimidiata

Table B-3. Identified beetle species of Shenandoah National Park collected in 2005 and 2006. V = new Virginia record based on known published records.
List compiled by Arthur V. Evans.

Artematopodidae (n = 1)

Eurypogon niger

Attelabidae (n = 1)

Attelabus bipustulatus

Biphyllidae (n = 1)

Diplocoelus brunneus

Brentidae (n = 1)

Arrenodes minutus

Buprestidae (n = 1)

Chrysobothris femorata

Cantharidae (n = 9)

Cantharis rotundicollis
Ditemnus bidentatus
Podabrus limbellus[V]
Podabrus protensus[V]
Podabrus rugulosus[V]
Rhagonycha angulata[V]
Rhagonycha fraxini
Rhagonycha lineola
Rhagonycha sylvatica[V]

Carabidae (incl. Cicindelidae) (n = 23)

Carabus goryi
Cicindela punctulata
Clivina bipustulata
Colliuris pensylvanicus
Cymindis limbatus
Dromius piceus
Gastrellarius honestus
Harpalus pensylvanicus
Lebia grandis
Lebia ornata
Lebia viridis
Myas cyanescens
Notiobia sayi
Platynus cincticollis
Scaphinotus ridingsii ridingsii
Selenophorus opalinus
Sphaeroderus canadensis canadensis
Stenolophus comma
Stenolophus conjunctus
Stenolophus ochropezus
Stenolophus rotundicollis[V]
Trichotichnus dichrous
Trichotichnus vulpecula

Cerambycidae (n = 31)

Analeptura lineola
Anelaphus parallelus
Astylopsis collaris
Brachyleptura circumdata
Centrodera decolorata[V]
Eburia quadrigeminata
Enaphalodes rufulus[V]
Euderces picipes
Gaurotes cyanipennis
Hesperophanes pubescens
Leptorhabdium pictum
Leptostylus transversus
Lepturges symmetricus[V]
Liopinus alpha
Liopinus punctatus
Megacyllene robiniae
Metacmaeops vittata[V]
Monochamus notatus
Oplosia nubila[V]
Orthosoma brunneum
Pidonia ruficollis
Prionus laticollis

Table B-3 continued. Identified beetle species of Shenandoah National Park collected in 2005 and 2006. [V = new Virginia record based on known published records]

(Cerambycidae cont'd)
Psyrassa unicolor
Saperda candida
Saperda vestita
Sternidius variegatus
Strangalepta abbreviata
Typocerus velutinus velutinus
Urgleptes signatus
Urographis fasciatus
Xylotrechus colonus

Ceratocanthidae (n = 1)

Germarostes aphodioides

Chrysomelidae (n = 14)

Altica kalmiae
Calligrapha lunata
Charidotella pupurata
Chrysochus auratus
Cryptocephalus quadruplex
Diabrotica undecimpunctata howardi
Diabrotica virgifera[V]
Disonycha glabrata
Epitrix fuscula
Monocesta coryli
Odontota dorsalis
Ophraella communa
Tricholochmaea cavicollis
Tymnes tricolor

Cleridae (n = 6)

Chariessa pilosa[V]
Cymatodera inornata[V]
Cymatodera undulate[V]
Cymatoderella collaris[V]
Neorthopleura damicornis[V]
Priocera castanea[V]

Coccinellidae (n = 7)

Anatis labiculata
Brachiacantha decempustulata
Coccinella septempunctata
Coelomegilla maculata
Harmonia axyridis
Hippodamia parenthesis
Psyllobora vigintimaculata

Cupedidae (n = 1)

Cupes captitata

Curculionidae (n = 1)

Cyrtepistomus castaneus

Dryopidae (n = 1)

Helichus lithospilus

Elateridae (n = 6)

Alaus oculatus
Ampedus nigricollis
Athous rugifrons
Denticollis denticornis[V]
Hemicrepidus memnonius
Orthostethus infuscatus

Erotylidae (incl. Languridae) (n = 1)

Acropteroxys gracilis

Eucnemidae (n = 1)

Fornax bicolor

Heteroceridae (n = 1)

Tropicus pusillus

Table B-3 continued. Identified beetle species of Shenandoah National Park collected in 2005 and 2006. [V = new state record based on known published records]

Hydrophilidae (n = 1)

Tropisternus lateralis nimbatus

Kateretidae (n = 1)

Brachypterus urticae

Lampyridae (n = 1)

Ellychnia lacustris

Lampyridae (n = 1)

Photuris pensylvanicus

Lucanidae (n = 1)

Ceruchus piceus[V]

Lycidae (n = 4)

Caenia dimiata
Calopteron reticulatum
Leptoceletes basalis[V]
Lyconotus lateralis

Lymexylidae (n = 1)

Melittoma sericeum

Melandryidae (n = 2)

Dircaea liturata
Serropalpus substriatus[V]

Melyridae (n = 1)

Collops quadrimaculatus

Mordellidae (n = 2)

Mordellistena fuscipennis
Mordellistena trifasciata

Mycetophagidae (n = 1)

Mycetophagus punctatus

Nitidulidae (n = 5)

Cryptarcha ampla[V]
Glisrochilus fasciatus[V]
Glisrochilus obtusus[V]
Glisrochilus sanguinolentus[V]
Prometopia sexmaculata[V]

Orsodacnidae (n = 1)

Orsodacne atra

Passandridae (n = 1)

Catogenus rufus[V]

Phengodidae (n = 1)

Phengodes laticollis laticollis

Ptilodactylidae (n = 1)

Ptilodactyla serricollis

Pyrochroidae (n = 3)

Dendroides canadensis
Dendroides concolor
Neopyrochroa flabellate

Table B-3 continued. Identified beetle species of Shenandoah National Park collected in 2005 and 2006. [V = new state record based on known published records]

Scarabaeidae (n = 30)

Aphodius fossor[V]
Aphodius pseudolividus
Callistethus marginatus
Cotinis nitida
Cyclocephala borealis
Cyclocephala lurida
Dialytes truncates[V]
Dialytes ulkei[V]
Dichelonyx diluta
Dichelonyx elongatula
Dichelonyx subvittata[V]
Diplotaxis atlantis
Diplotaxis harperi
Euphoria sepulcralis[V]
Maladera castanea
Nipponoserica peregrina
Osmoderma scabra
Phyllophaga hirticula
Phyllophaga balia
Phyllophaga drakii
Phyllophaga fusca
Phyllophaga longispina[V]
Phyllophaga marginalis
Phyllophaga quercus
Popillia japonica
Serica atracapilla
Serica georgiana
Serica sericea
Serica vespertina
Trichiotinus affinis

Scirtidae (n = 2)

Sacodes pulchella[V]
Sacodes thoracica[V]

Scraptiidae (n = 1)

Anaspis rufa[V]

Silphidae (n = 5)

Necrodes surinamensis
Nicrophorus orbicollis
Nicrophorus pustulatus
Nicrophorus sayi
Nicrophorus tomentosus

Staphylinidae (n = 2)

Pinophilus latipes
Platydracus maculosus

Stenotrachelidae (n = 2)

Cephaloon lepturides
Cephaloon ungulare

Synchroidae (n = 1)

Synchroa punctata

Tenebrionidae (n = 18)

Alobates morio[V]
Alobates pennsylvanica
Androchirus erythropus[V]
Arthromacra aenea aenea
Capnochroa fulignosus
Diaperis maculata
Hymenochara rufipes[V]
Hymenorus niger[V]
Hymenorus pilosus
Isomira iowensis[V]
Isomira oblongula[V]
Isomira pulla
Isomira quadristriata
Isomira sericea
Mycetochara fraterna
Pseudocistela marginata[V]
Strongylium tenuicollis
Uloma mentalis[V]

Table B-3 continued. Identified beetle species of Shenandoah National Park collected in 2005 and 2006. [V = new state record based on known published records]

Tetratomidae (n = 1)

Penthe pimelia

Trogidae (n = 5)

Trox aequalis
Trox foveicollis
Trox scaber
Trox spiculatus simi
Trox unistriatus

Trogossitidae (n = 1)

Thymalus margincollis

Table B-4. Identified invertebrate (non-lepidoptera and non-coleoptera) species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions)]

ORDER (#families/#genera/#species)
Family (#genera/#species)

SUBPHYLUM HEXAPODA
- CLASS INSECTA

ORDER BLATTODEA (1/1/1)

Polyphagidae (1/1)
Parcoblatta uhleriana (Saussure)

ORDER PHASMIDA (1/1/1)

Heteronemiidae (1/1)
Diapheromera femorata (Say)

ORDER ORTHOPTERA (3/4/7)

Gryllidae (1/3)
Oecanthus fultoni Walker
Oecanthus niveus (DeGeer)
Oecanthus quadripunctatus Beutenmuller

Tetrigidae (1/1)
Tettigodea lateralis (Say)

Tettigoniidae (2/3)
Amblycorypha rotundifolia Scudder
Scudderia furcata Brunner
Scudderia septentrionalis # (Audinet-Serville)

ORDER HEMIPTERA (12/25/28)

Acanaloniidae (1/1)
Acanalonia bivittata (Say)

Berytidae (1/1)
Neides muticus (Say)

Cercopidae (2/2)
Lepyronia quadrangularis (Say)
Philaenus spumaria (Linnaeus)

Cicadellidae (3/3)
Cuerna costalis (Fabricius)
Paraulacizes irrorata (Fabricius)
Penthimea americana Fitch

Coreidae (1/1)
Acanthocephala terminalis (Dallas)

Flatidae (1/1)
Metcalfia pruinosa (Say)

Membracidae (2/2)
Campylenchia latipes (Say)
Ophiderma definita Woodruff

Miridae (2/2)
Lygus lineolaris (Palisot de Beauvois)
Stenodema vicinum (Provancher)

Pachygronthidae (1/1)
Phlegyas abbreviatus (Uhler)

Pentatomidae (7/10)
Acrosternum hilare (Say)
Banasa calva (Say)
Banasa dimiata (Say)
Banasa euchlora Stal
Coenus delius (Say)
Elasmucha lateralis (Say)
Euschistus servus euschistoides (Vollenhoven)
Euschistus tristigmus tristigmus (Say)
Mormidea lugens (Fabricius)
Podisus maculiventris (Say)

Reduviidae (3/3)
Acholla multispinosus (DeGeer)
Narvesus carolinensis (Stal)
Rhiginia cruciata (Say)

Table B-4 (continued). Identified invertebrate (non-lepidoptera and non-coleoptera) species of Shenandoah National Park collected in 2005 and 2006. [* = rare species, # = watchlist species (Roble 2006, with revisions)]

Rhopalidae (1/1)
Harmostes reflexulus (Say)

ORDER MEGALOPTERA (1/1/1)

Corydalidae (1/1)
Corydalus cornutus (Linnaeus)

ORDER NEUROPTERA (4/6/6)

Chrysopidae (2/2)
Chrysopodes placita Banks
Eremochrysa canadensis (Banks)

Hemerobiidae (2/2)
Hemerobius stigmaterus (Fitch)
Wesmaelius nervosus (Fabricius)

Mantispidae (1/1)
Zeugomantispa minuta (Fabricius)

Myrmeleontidae (1/1)
Dendroleon obsoletus (Say)

ORDER DIPTERA (6/11/16)

Asilidae (4/9)
Holocephala fusca Bromley
Laphria canis complex
Laphria flavicollis Say
Laphria index McAtee
Laphria sacrator Say
Laphria thoracica (Fabricius)
Machimus notatus (Wiedeman)
Machimus novascotiae (Macquart)
Neoitamus orphne (Walker)

Bombyliidae (1/1)
Lepidophora lepidocera (Widemann)

Conopidae (1/1)
Physocephalus tibialis (Say)

Syrphidae (2/2)
Milesia virgniensis Drury
Pterallastes thoracicus Loew

Tabanidae (1/1)
Tabanus sulcifrons Macquart

Tachinidae (2/2)
Hystricia abrupta (Wiedemann)
Paradejeania rutiloides Jeannicke

ORDER TRICHOPTERA (11/17/32)

Dipsuedopsidae (1/1)
Phylocentropus lucidus (Hagen)

Glossosomatidae (1/1)
Glossosoma nigrior Banks

Hydropsychidae (3/15)
Cheumatopsyche ela Denning
Cheumatopsyche harwoodi Denning
Cheumatopsyche wrighti Ross
Diplectrona modesta Banks
Hydropsyche alhedra Ross
Hydropsyche betteni Ross
Hydropsyche bronta Ross
Hydropsyche cheilonia Ross
Hydropsyche hageni Banks
Hydropsyche leonardi Ross
Hydropsyche morosa Hagen
Hydropsyche phalerata Hagen
Hydropsyche scalaris Hagen
Hydropsyche slossonae Banks
Hydropsyche sparna Ross

Lepidostomtidae (2/2)
Lepidostoma sommermanae Ross
Triaenodes injusta Hagen

Leptoceridae (1/1)
Oecetis inconspicua (Walker)

Table B-4 (continued). Identified invertebrate (non-lepidoptera and non-coleoptera) species of Shenandoah National Park collected in 2005 and 2006. **[* = rare species, # = watchlist species (Roble 2006, with revisions)]**

Limnephilidae (2/2)
Pseudostenophylax sparsus Banks
Pycnopsyche gentilis (McLachan)

Molannidae (1/1)
Molanna blenda Sibley

Philopotamidae (2/3)
Dolophilodes distinctus (Walker)
Dolophilodes major (Banks)
Wormaldia thyria * Denning

Phryganeidae (2/2)
Argypnia vestita (Walker)
Phryganea sayi Milne

Polycentropidae (1/2)
Polycentropus cinereus (Hagen)
Polycentropus maculatus Banks

Rhyacophilidae (1/2)
Rhyacophila carolina Banks
Rhyacophila fuscula (Walker)

ORDER MECOPTERA (1/1/1)

Meropidae (1/1)
Merope tuber Newman

ORDER HYMENOPTERA (5/5/10)

Ichneumonidae (1/1)
Megarhyssa atrata (Fabricius)

Vespidae (3/5)
Dolichovespula adulterine (Buysson)
Vespa crabro (Linnaeus)
Vespula consobrina (Saussure)
Vespula maculifrons (Buysson)
Vespula vulgaris (Linnaeus)

Halictidae (2/2)
Augochlorella striata (Provancher)
Halictus ligatus Say

Apidae (1/1)
Bombus impatiens Cresson

Megachilidae (1/1)
Megachilus sculpturalis Smith

SUBPHYLUM CHELICERIFORMES - CLASS CHELICERATA

ORDER ARANEAE (1/1/2)

Aranaeidae (1/2)
Micrathena gracilis (Walckenaer)
Micrathena sagittata (Walckenaer)

SUBPHYLUM CRUSTACEA - CLASS MALACOSTRACA

ORDER ISOPODA (1/1/1)

Crangonyctidae (1/1)
Stygobromus spinosus # Hubricht and Machin

Figure B-1. Species accumulation curve representing the total number of moth species identified after each trapping date.

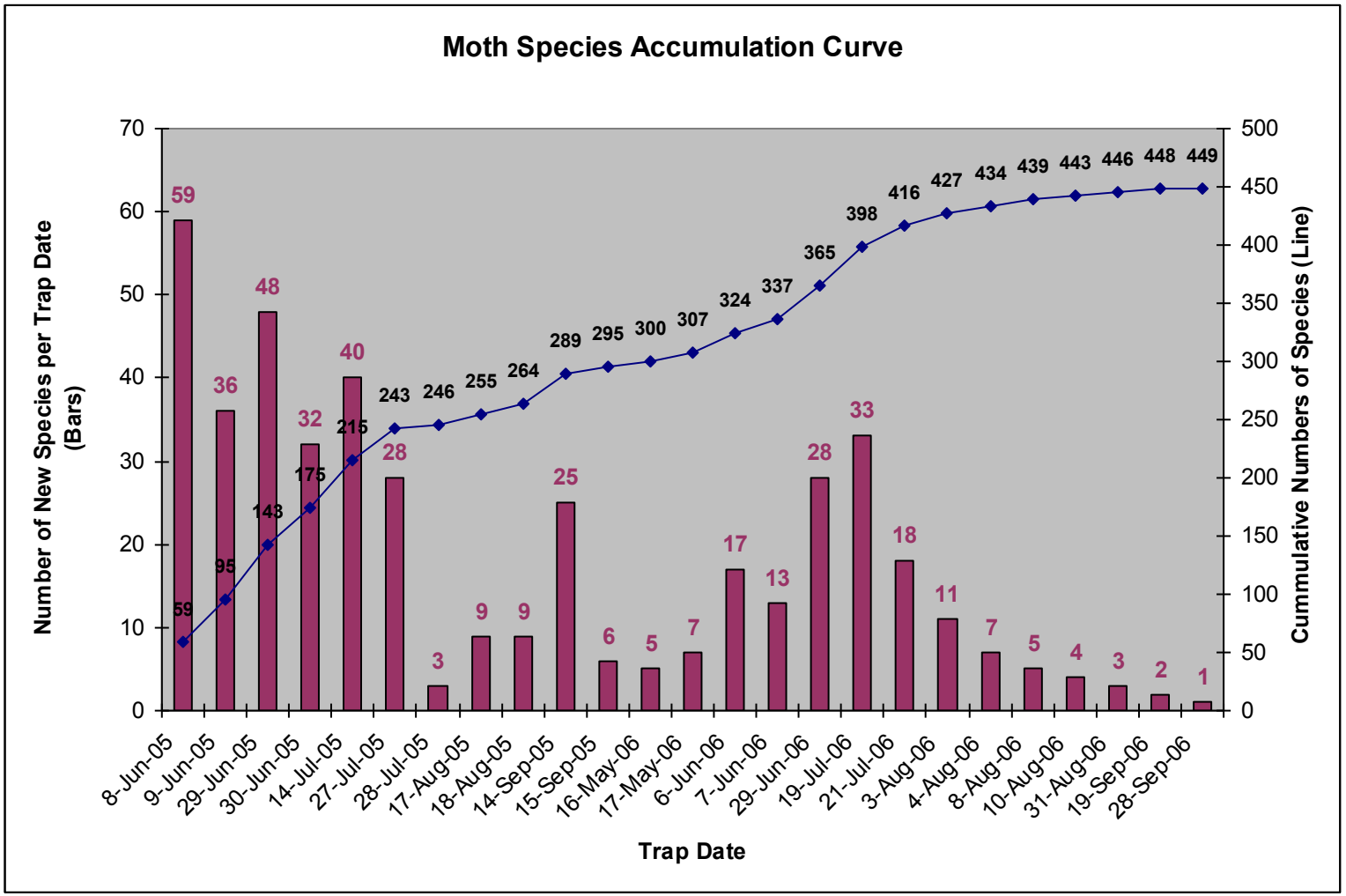

Figure B-2. Species accumulation curve representing the total number of beetle species identified after each trapping date.