CHAPTER III: CURRENT RESOURCE MANAGEMENT CAPABILITIES, ISSUES, THREATS, AND PROGRAM NEEDS

A. Introduction to the Appalachian Trail Resource Management Program

This section identifies current management capabilities and overall natural resource management program needs for (1) coordination of Trail-wide resource management programs (such as conducting systematic state-by-state inventories of natural resources along the entire Appalachian Trail); and (2) site-specific resource management needs and issues on lands administered by the Appalachian Trail Park Office only. As explained in greater detail below, this plan is intended to provide management direction for natural and cultural resources programs of the National Park Service Appalachian Trail Park Office and the Appalachian Trail Conservancy, within the larger context of cooperative management of the Appalachian National Scenic Trail.

Any discussion of management programs for the Appalachian National Scenic Trail needs to begin with a discussion of its extraordinarily complex land ownership pattern and management framework. As described under Land Ownership in Chapter I, the Appalachian Trail – in addition to crossing 82,700 acres of land administered by the Appalachian Trail Park Office – crosses an extensive land base administered by many other federal and state agencies. Each of these land-managing entities manages its section of the Appalachian National Scenic Trail:

- in partnership with the local Trail-maintaining club(s) and the Appalachian Trail Conservancy;
- in conformance with a memorandum of understanding or other instrument adhering to the management principles outlined in the *Appalachian Trail Comprehensive Plan*; and
- in accordance with its own administrative jurisdictional responsibilities.

Because of this complex, intermingled land ownership pattern, it is impractical and inefficient at best – and in some cases impossible – to conduct inventories solely on Trail lands administered by one agency. However, systematic inventories are critical for establishing priorities for resource management. Consequently, the Appalachian Trail Conservancy and the Appalachian Trail Park Office have encouraged and facilitated the development of resource inventories for all Appalachian Trail lands, regardless of ownership. Most frequently, these inventories have been conducted on a state-by-state basis. This approach provides all of the primary land managers along the Trail with a consistent set of data on which to base decisions that could affect Trail resources.

The next subsection of this plan is titled "**Sensitive Resource Areas**." The accompanying maps depict the general location of natural and cultural resource areas on all Trail lands, to the extent that this information is contained in these state-by-state inventories and assessments facilitated by the Appalachian Trail Conservancy and Appalachian Trail Park

Office or available from other sources. [Note: Site-specific locational data is not provided, to ensure that the location of sensitive natural or cultural resources remains confidential.]

The Appalachian Trail Conservancy and Appalachian Trail Park Office also have initiated and continue to support several Trail-wide volunteer-based monitoring programs, the oldest of which are :

- the A.T. corridor monitoring program, which consists of regular monitoring of Appalachian Trail corridor boundaries to discourage trespass and other illegal use of Appalachian Trail lands;
- the A.T. natural heritage site-monitoring program, which is focused on monitoring RTE species and threats to these species at specific natural heritage sites along the Trail.

These monitoring programs help land managers identify trends and potential problems that may require more intensive monitoring or further management actions to protect vulnerable resources. The RTE protection program also provides Trail maintainers with plant identification sheets to help them avoid harming RTE plants during routine Trail maintenance.

The Appalachian Trail Mega-Transect Program: The A.T. MEGA-Transect was officially launched in November 2006, although the concept began to emerge several years prior. For more information on the history and precursor projects to the A.T. MEGA-Transect, see the 2006 A.T. MEGA-Transect Symposium Proceedings posted on the ATC's website. The A.T. MEGA-Transect is the ATC and APPA umbrella program for environmental monitoring and natural resource management: the program includes aspects of environmental monitoring and natural resource management that are mandatory as per the National Park Service's delegation agreement to ATC, as well as projects that may not be mandatory but will serve the long-term goals of the NPS and the ATC, including education and outreach.

The programmatic mission is to establish the A.T. MEGA-Transect to monitor and understand changes in the environment to effectively manage natural resources, foster an appreciation for nature and conservation, and "tell the story" of the health of the Appalachian Trail and surrounding lands to visitors, neighbors, and the American public.

The goals of the A.T. MEGA-Transect are to:

- Monitor- collect new and existing data on key indicators of environmental health with citizen scientists, organizations, researchers, and agencies
- Understand- transform data into knowledge about the status a nd trends through analysis, synthesis, and modeling
- Inform and Engage- share this knowledge to engage, educate, and involve decision makers, stakeholders, and the American public in managing and

protecting the A.T. environment . Seek to attain the goals of existing natural resource and environmental legislation and make sound decisions for positive change.

Projects that meet mandatory resource stewardship requirements as per the delegation agreement include:

- The A.T. natural heritage site-monitoring program described above. This is one of the earliest monitoring efforts put in place by the ATC and the A.T. Park Office.
- Exotics monitoring and management, in particular to protect RTE species and sites: exotics management is mostly handled by the NPS Exotic Management Teams at the moment, and there is no comprehensive or strategic monitoring for exotic species separate from the natural heritage site-monitoring program. ATC has however recognized the importance of exotics monitoring and management and will strive to put a project in place based on sound protocols to track and manage exotics to a greater extent.

Additional projects that are being piloted by the ATC include:

- Wildlife monitoring using motion-triggered infrared cameras: this survey will enable the ATC, the NPS and the Smithsonian Institute, who is leading the project, to gain a greater understanding of the distribution of wildlife in different areas of the corridor, and thus of the quality of the wildlife habitat in different areas of the corridor and potentially the integrity of the corridor as a wildlife migration corridor. In addition to the scientific benefits of the study, the wildlife survey has enjoyed wide interest and support from club volunteers as well as new volunteers unaffiliated to clubs and the media.
- American Chestnut Data Gathering Project: This project is being run in cooperation with The American Chestnut Foundation, and is meant to contribute to TACF's current blight-resistant American chestnut breeding program as well as the future restoration of the American Chestnut on the Appalachian range.
- Water Quality Monitoring on the A.T. through World Water Monitoring Day

Other topics of interest for which projects may be developed in the future include:

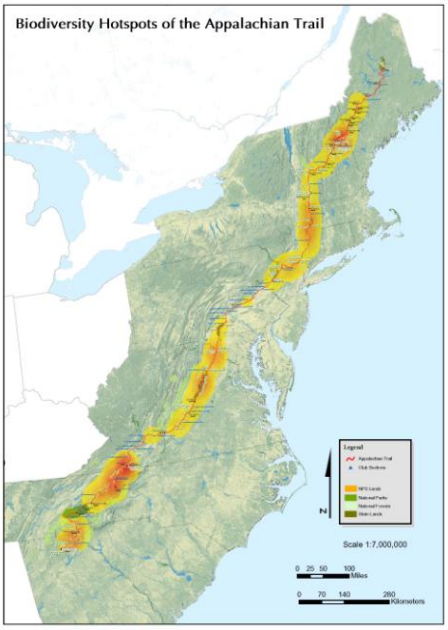
- Forest health monitoring
- Phenology
- Air quality
- Mountain birds
- Landscape dynamics
- Visitor Impacts

Beyond these initiatives, no further actions are considered in this plan that are common to all Trail lands and managers of those lands. **In other words, this plan does not dictate any specific management emphasis, identify any zones or management areas, or propose management actions for any lands other than lands administered by the Appalachian Trail Park Office**. As a result, Chapter III.C, which focuses on identification of park management areas, addresses resource management considerations and resource management zones on Appalachian Trail Park Office lands *only*.

Further, although Chapters III.E, III.F, III.G, III.H, and III.I include discussions of Trail-wide inventory needs and threats, the discussions on management needs that follow focus on resource management programs for the Appalachian Trail Park Office and Appalachian Trail Conservancy only.

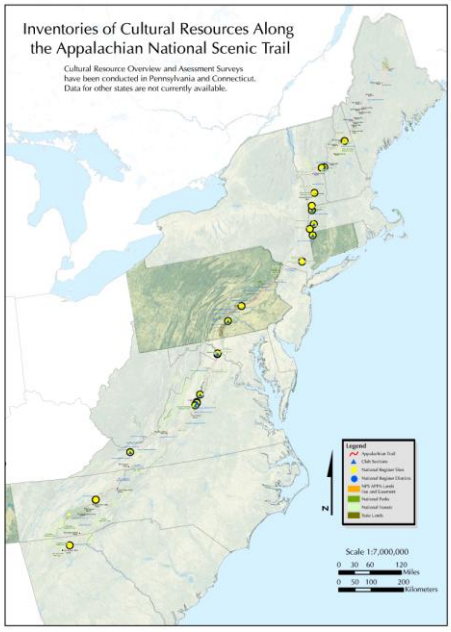
B. Sensitive Resource Areas

Sites containing sensitive natural and cultural resources on the Appalachian Trail have been delineated on *Maps II.B.1 and II.H.1*, based upon information that has been collected through a series of cooperative inventories of natural and cultural resources. The information available at this time is by no means comprehensive. In fact, a significant consideration in formulating the resource management program needs in this Resource Management Plan at this time is to identify information that has not yet been systematically collected.



Sensitive *natural* resource areas are based upon data obtained through a series of inventories conducted by state natural heritage programs and contractors in cooperation with the Appalachian Trail Conservancy, the Appalachian Trail Park Office, the USDA Forest Service, state agencies, and Trail-maintaining clubs between 1989 and 2002. [See *Map II.B.1, Biodiversity Hotspots along the Appalachian Trail*.] These inventories have been completed in all 14 states along the entire Trail; however, some additional work is needed to identify rare animal species in certain states.

Sensitive *cultural* resource areas reflected on the attached maps are based upon data obtained through inventories conducted by state universities and contractors in cooperation with the Appalachian Trail Conservancy, the Appalachian Trail Park Office, and Trail-maintaining clubs. As of 2008, these inventories are complete only in Pennsylvania and Connecticut. Additional inventories in other states are in the planning stages. [See *Map II.H.1, Inventories of Cultural Resources along the Appalachian Trail*.]



Because some of the information contained in the resource inventories is confidential, site-specific locational information about these sensitive cultural and natural resource sites is not depicted on either map (although information regarding the specific location of these sites is retained on file on the Appalachian Trail Park Office). Particularly sensitive sites are either not shown at all on the maps, or are

shown with a buffer area.

C. Management Areas for Lands Administered by the Appalachian Trail Park Office

When Congress passed the National Trail System Act, it required that the National Park Service develop a comprehensive plan for the Appalachian Trail instead of a General Management Plan. As a result, management zones on lands administered by the Appalachian Trail Park Office have not been formally identified.

The National Trails System Act further stated that national scenic trails are defined as "extended Trails so located as to provide for maximum outdoor recreation potential and *for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such Trails may pass*." The *Appalachian Trail Comprehensive Plan* also clearly defines the Appalachian Trail as a backcountry recreational resource that is managed "*for travel on foot, through the wild, scenic, wooded, pastoral, and culturally significant lands of the Appalachian Mountains*." The Appalachian Trail Park Office, the Appalachian Trail Conservancy, the Trail-maintaining clubs, and their agency partners all adhere to these guiding principles, which are further outlined and elaborated upon in numerous agreements and plans, including the *Appalachian Trail Comprehensive Plan*. This document, the *Appalachian Trail Resource Management Plan*, tiers directly to these guiding principles.

Delineation of Management Areas

The Appalachian Trail Park Office proposes to identify "Management Areas" on lands it administers, in lieu of identifying formal management zones for the Appalachian Trail. (Management zones will be formally identified at such time as the Appalachian Trail Park Office updates its *Comprehensive Plan* or prepares a general management plan for the Appalachian Trail.) These Management Areas do not have any legal force or effect, nor do they have any purpose other than highlighting areas where (1) specific uses or management emphases are predominant and (2) sensitive resources should be considered in making on-the-ground planning decisions.

Descriptions of Management Areas

For the purposes of identifying Management Areas (which apply *only* to lands administered by the Appalachian Trail Park Office), the Appalachian Trail Park Office proposes to consider all lands under its administration to be within a Backcountry Recreation Area, with two exceptions. The first exception pertains to lands immediately surrounding retained structures, roads, utilities, and other non-Trail-related development, which the Appalachian Trail Park Office considers to be within a Park Developed Area. The second exception pertains to lands that are maintained as pasture or farmland. The Appalachian Trail Park Office considers these lands as being within an Agricultural Area.

These three Management Areas – the Backcountry Recreation Area, the Park Developed Area, and the Agricultural Area, are described as follows:

Backcountry Recreation Area: This area includes all Appalachian Trail Park Office lands that contribute to providing a backcountry recreation experience. All Appalachian Trail Park Office lands that are not developed or used for agriculture fall into this category. The primary use of these lands is for providing a backcountry recreation experience *to the greatest extent possible*, even if certain lands are located within a relatively urban setting. Hiking and camping are the primary uses of these lands (even though certain other uses, such as maple sugaring, are permitted under reserved rights or special use authorizations). Trail shelters and overnight-use sites are included in and managed as part of the backcountry recreational area. Approximately 96% of Appalachian Trail Park Office lands fall into this category.

Park Developed Area: This area contains developed facilities, including retained structures and existing roads, parking areas, utility lines, and communication sites, and their immediate surroundings. Most of these facilities are not related to the Trail. Park developed areas that contain roads are identified with a 50' right-of-way (25' either side of centerline); even though the actual road width and right-of-way may be somewhat smaller or larger on the ground and in legal documents. Park developed areas that contain utility lines (which include electric powerlines, oil and natural gas pipelines, water lines, sewer lines, and linear communication facilities) are depicted with a 100' right-of-way (50' either side of centerline); again, the actual right-of-way width may be somewhat smaller or larger on the ground and in legal documents. Retained structures, parking lots, and communication sites will be depicted on the maps within a circular area 100' in diameter. Again, the actual footprint of these facilities on the ground, or the area described in legal documents if rights exist to permit these uses, may be somewhat smaller or larger. Approximately 2.4% of Appalachian Trail Park Office lands fall into this category.

Agricultural Area: This area includes all areas that are used for agricultural purposes, including pasture for livestock, haying, crop-raising, or retention as open areas. Data for this analysis will be derived from aerial photographs. Approximately 1.6% of Appalachian Trail Park Office lands fall into this category.

D. Current Resource Management Capabilities

Although a variety of state and federal agencies and non-governmental organizations have resource management programs that either directly or indirectly affect the Appalachian National Scenic Trail, the purpose of this plan is to evaluate and set priorities for resource management programs developed specifically for the Appalachian National Scenic Trail by the NPS Appalachian Trail Park Office (APPA) and the Appalachian Trail Conservancy (ATC). In keeping with this purpose, the following discussion is limited to the current resource management capabilities of the APPA (with some assistance from other NPS offices) and ATC. Detailed program descriptions are provided in the following sections of this plan (Sections III.E to III.I).

1. Resource Management Capabilities at the NPS Appalachian Trail Park Office

The Appalachian Trail Park Office's resource management programs are managed primarily through three positions: an Environmental Protection Specialist, a Natural Resource Specialist, and a Physical Science (GIS) Specialist. All of the natural and cultural resource management program duties described below are carried out in close cooperation and consultation with volunteers and staff at the Appalachian Trail Conservancy. Program duties and responsibilities for natural and cultural resources are currently assigned as follows:

Environmental Protection Specialist: The NPS Appalachian Trail Park Office Environmental Protection Specialist is responsible for:

1) Reviewing, analyzing, and commenting on proposed roads, pipelines, powerlines, cell towers, communication sites, and other developments that could potentially affect the Appalachian Trail
2) Preparing environmental analyses and compliance documents for proposed projects on Appalachian Trail Park Office lands
3) Management of Appalachian Trail Park Office cultural resource programs, including serving as the Section 106 coordinator for the Appalachian Trail and coordination of cultural resource inventories, cultural landscape inventories, and other cultural resource projects and programs
4) Coordination of Appalachian Trail Park Office participation in remediation and restoration of the Palmerton Zinc Superfund Site
5) Identification of lands that need to be acquired by the National Park Service to protect the Appalachian Trail, in cooperation with the Appalachian Trail Conservancy and affiliated Trail clubs
6) General coordination with the NPS Inventory and Monitoring Networks

Natural Resource Specialist: The NPS Appalachian Trail Park Office Natural Resource Specialist is responsible for:

1) Overall coordination and management of the A.T. volunteer natural heritage monitoring program for all A.T. Lands, including training of monitors
2) Cooperation with other A.T. management partners to implement management actions that protect RTE species
3) Coordination of state natural heritage inventories for rare, threatened, and endangered species natural communities and other biological inventories for all Appalachian Trail lands
4) Administration of invasive and exotic species inventories on all A.T. lands, including coordination with three Exotic Plant Management Teams
5) Coordination with the NPS Inventory and Monitoring Network on biological resource issues
6) Administration of the NPS Research Permitting and Reporting System for all scientific research and natural resource activities on Appalachian Trail Park Office lands, ensuring that projects do not negatively impact the natural resources of the A.T.

Physical Science (GIS) Specialist: The Appalachian Trail Park Office Physical Science (GIS) Specialist is responsible for:

1) Compilation and management of GIS and spatially related digital data pertaining to the Appalachian Trail (this responsibility is shared with ATC's GIS specialist).
2) Preparation of maps, presentations, spreadsheets, and other materials to aid in Trail and resource management issues
3) Providing GIS analysis for resource management projects
4) Assists Environmental Protection Specialist with NEPA / Section 106 Compliance
5) Provide oversight and management of projects with management partners including USGS NBII, NatureServe, and NPCA
6) Producing maps and materials for Special Use Permits and Research Permits and coordination of GIS analysis and mapping in support of other programs
7) Responds to public inquiries and data requests
8) Administration and maintenance of APPA servers, computer workstations, laptops, software, and related peripherals and
9) Management of APPA local area network and shared resources
10) Management and Maintenance of GIS and GPS software and hardware

Gypsy moth suppression, rabies control, open areas management, and other natural resource management programs and projects are typically assigned by the Appalachian Trail Park Manager to one or more staff members based on expertise and workload allocation.

Support from other NPS program specialists: The Appalachian Trail Park Office receives program support for natural and cultural resource management from several other

offices of the National Park Service, including the NPS Natural Resource Inventory and Monitoring Program, the Northeast Regional Office, the Olmsted Center for Landscape Preservation, and the Washington Office.

NPS Natural Resource Inventory and Monitoring Program: The NPS Inventory and Monitoring Program provides extensive support to the Appalachian Trail Park Office in development of inventory data for natural resources and identification, tracking, and reporting on significant indicators of ecological conditions, or "vital signs," for the Appalachian Trail. The National Park Service initiated the "vital signs" monitoring program in 1998 to develop long-term monitoring of natural resources in 270 units of the national park system. The Appalachian Trail is one of these 270 natural resource park units.

The Trail passes through six NPS Inventory and Monitoring Networks: the Northeast Temperate, Eastern Rivers and Mountains, National Capitol, Mid-Atlantic, Appalachian Highlands, and Cumberland-Piedmont networks. The Northeast Temperate Network is responsible for coordinating activities related to the Appalachian Trail among the six networks. The Inventory and Monitoring Program has completed a number of studies to obtain baseline inventory information for the Trail, including a draft bibliography of all documents containing references to natural resources on the Appalachian Trail and a land use cover change analysis of ten sections of the Appalachian Trail. Several other inventories are in progress, including a vegetation mapping effort. Two small mammal inventories in the mid-Atlantic states and Maine have recently been completed.

In 2005, the NPS Inventory and Monitoring Program Northeast Temperate Network published *Appalachian Trail Vital Signs (Technical Report NPS/NER/NRTR – 2005/26)*, which documented the current status of knowledge and understanding of eleven "vital signs" for the Appalachian Trail. This report represents a critical step in the development of a full-fledged monitoring program for the Appalachian Trail.

The Northeast Temperate Network employs a full-time Environmental Monitoring Coordinator for the Appalachian Trail. This specialist plays a lead role in coordinating studies and reporting on the condition of identified "vital signs," threats to those resources, and trends in those conditions. Specific priorities for the Environmental Monitoring Coordinator include:

1) Working with the A.T. MEGA-Transect Coordination Team to develop and implement an action plan.
2) Bringing structure to the A.T. MEGA-Transect by providing overall leadership and coordination for the A.T. MEGA-Transect "Program."
3) Developing a catalog of existing projects, programs, and organizations that maintain an interest relevant to the Appalachian National Scenic Trail.

4) Regularly meeting and coordinating, in person and/or by phone, with key APPA and ATC staff as well as existing and potential cooperating individuals, agencies and organizations.
5) Serving as a scientific advisor for APPA and ATC natural resource projects, including evaluating proposed methods for research, inventory, and monitoring projects.

***NPS Air Quality Program*:** Staff at the Appalachian Trail Park Office rely on the NPS Air Resources Division and the NPS Northeast Regional Office Air Resources Coordinator for assistance with air resource issues. To date, that work has consisted of (1) development of air quality baseline data, (2) assistance in preparation of the *Appalachian Trail Vital Signs* report, and (3) assistance in preparation of this *Appalachian Trail Resource Management Plan*. In addition, as part of their regular duties, NPS Air Resources Division staff consider implications for the Appalachian Trail when reviewing relevant permit applications for new air pollution sources, proposed air quality regulations, and other policies, programs, and projects that could affect air quality on the Appalachian Trail.

***NPS Water Resources Division*:** Appalachian Trail Park Office staff also rely on the NPS Water Resources Division for assistance in planning, assembling, and analyzing data on water resources along the Appalachian Trail. The Water Resources Division plans to provide the Appalachian Trail Park Office in late 2008 with a Baseline Water Quality Inventory and Analysis ("Horizon") Report that will identify all water resources on the Appalachian Trail and known impairments to those water resources, and has committed to funding a Level 1 Water Resource Inventory that will begin late in FY 2008 and will conclude during FY 2010.

***NPS Exotic Plant Management Teams*:** The Appalachian National Scenic Trail receives support from the NPS Northeast Region Exotic Plant Management team (EPMT), the Mid-Atlantic EPMT, and the NPS National Capital Region EPMT in controlling invasive exotic plant species on Appalachian Trail Park Office lands. Thus far, the EPMT's have helped to control exotic species at around a dozen locations, particularly natural heritage sites in Virginia, Pennsylvania, and Massachusetts.

***NPS Cultural Resource Management Programs*:** The Appalachian Trail Cultural Resources Compliance Roster, consisting of cultural resources specialists with expertise in specific disciplines, provides review and support for all Section 106 actions on all lands administered by the NPS Appalachian Trail Park Office. In addition, a NPS Northeast Regional Office archaeologist and a NPS Washington Office historian provide technical guidance and support on an array of cultural resource projects and programs. A cultural landscape architect from the NPS Olmsted Center for Landscape Preservation is leading the development of a plan for conducting cultural landscape inventories on the Appalachian Trail.

***NPS Fire Management, Special Use Permitting, and Resource Protection Programs*:** The Appalachian Trail Park Office's Park Ranger is responsible for fire management on Appalachian Trail Park Office lands. The Appalachian Trail Park Office recently completed a Fire Management Plan for the Trail, which is available on the office's website (www.nps.gov/appa). The fire plan supports the current management practice of suppressing all fires on Appalachian Trail Park Office lands. The rationale for this approach is based on a number of factors, including the narrowness of the Appalachian Trail corridor and the proximity of private lands. Site-specific exceptions may be made on a case-by-case basis if needed to preserve significant resource values. The Park Ranger and the Management Assistant are responsible for administration of Special Use Permits, including permits for agricultural uses. Finally, the Park Ranger is responsible for enforcement of laws and regulations to protect park resources, including visitor use, poaching, and Archaeological Resource Protection Act (ARPA) regulations.

***NPS/ATC Exterior Corridor Boundary Survey program*:** Exterior corridor boundary surveys were conducted between 1979 and 2005 as part of the NPS land protection program. The Appalachian Trail Conservancy has accepted responsibility for maintaining corridor boundary markings on these lands, using a combination of staff and Trail club volunteers to carry out the work.

***NPS Palmerton Zinc Superfund Remediation and Natural Resource Damage Assessment Program*:** NPS staff associated with the Washington Office assist the NPS Appalachian Trail Park Office in addressing remedial activity and damage assessment and restoration of NPS lands in the Palmerton Zinc Superfund Site.

2. Resource Management Capabilities at the Appalachian Trail Conservancy

The Appalachian Trail Conservancy has assigned natural resource program responsibilities to a number of its central and regional office staff members. Several ATC staff members also have assumed critical roles in cultural resource management programs. All of the ATC natural and cultural resource management program duties described below are carried out in close cooperation and consultation with staff at the Appalachian Trail Park Office:

Director of Conservation: The Director of Conservation is responsible for oversight and direction for all ATC conservation programs, including all natural and cultural resource management programs. As of June 2008, the Director of Conservation position was based out of the Virginia Regional Office in Blacksburg Virginia.

Director of Conservation Operations: The Director of Conservation Operations provides technical expertise and support to ATC regional offices and Appalachian Trail clubs on a variety of resource management issues, including threats to the Trail and coordination

of Trail management and maintenance programs intended to reduce impacts to Trail resources. These programs include the ATC Trail Crew Program and the ATC Ridgerunner Program, and contract administration for projects ranging from demolition of incidentally acquired structures to training for volunteers in Trail skills.

A.T. MEGA-Transect Interim Program Manager: The A.T. MEGA-Transect Program Manager is responsible for oversight of the A.T. MEGA-Transect program, including the development of a business plan, sustainable partnerships and procedures for the program. As of June 2008, this is an interim one-year position.

Lands and Natural Resources Coordinator: The Coordinator manages programs to identify, conserve and steward lands adjacent to the Appalachian Trail that provide protection for the recreational, natural, scenic, and cultural values of the Appalachian Trail. The Coordinator is also the contact person for the A.T. MEGA-Transect Program and natural resources projects at Headquarters in Harpers Ferry, and works with the Conservation Director and the A.T. MEGA-Transect Program Manager on natural resources programs and projects on a case-by-case basis.

Boundary Program Manager: The Boundary Program Manager is responsible for the maintenance of the Exterior Corridor Boundary Survey markings, and for the coordination and management of the volunteer Trail club-based boundary monitoring program. Although the monitoring of the corridor boundaries is a function that was officially delegated to the clubs, the maintenance of the boundary was not delegated, so that the clubs' participation in this labor is optional.

Regional Directors and Associate Regional Representatives: ATC's regional directors, associate regional representatives, and other regional staff play an active role in virtually every resource management program on the Appalachian Trail. Although responsibilities for some program areas may shift as part of ATC's ongoing reorganization, regional staff currently carry out the following duties with respect to resource management:

1) Leadership or supporting role, as appropriate, in response to development proposals that may affect the Appalachian Trail
2) Assisting in review of state-by-state natural heritage inventories for rare, threatened, and endangered species (RTE) for the Appalachian Trail
3) Assistance in recruitment and coordination of volunteer participation in the Appalachian Trail natural heritage site-monitoring program and other volunteer-based natural resources monitoring programs (including A.T. MEGA-Transect programs)
4) Assistance in identifying priorities for natural heritage site monitoring and coordinating management activities needed to protect occurrences of rare, threatened, and endangered species (RTE) on all Appalachian Trail lands
5) Coordination of volunteer-based activities to maintain open areas

6) Technical assistance and support to volunteer Trail clubs, Trail crews, ridgerunners, agency partners, and other on-the-ground personnel in carrying out on-the-ground projects intended to protect resources, including Trail relocations, road closures, education programs, and other programs designed to protect Trail resources
7) Supervision of permittee activities carried out under Special Use Permits to maintain open areas and other agricultural uses
8) Assistance in invasive exotic species management on Appalachian Trail Park Office lands, including identification of sites where active control measures are needed and coordination of volunteer participation where appropriate
9) Support for cultural resource management studies, including overview and assessment inventories of cultural resources, site-specific archeological surveys, and interpretation
10) Coordination with the NPS Northeast Temperate Network Inventory and Monitoring Program
11) Representation of ATC and Trail club interests in the remediation and restoration processes for the Palmerton Zinc Superfund Site
12) Participation, review, and comment on planning documents, including this document, the *Appalachian Trail Resource Management Plan*
13) Removal of incidentally acquired structures and site restoration.

<u>ATC GIS Specialist: ATC's GIS specialist is responsible for:</u>

1) Compilation and management of GIS and spatially related data pertaining to the Appalachian Trail (this responsibility is shared with ATPO's Physical Science GIS Specialist)
2) Coordination and implementation of GIS mapping and analysis projects, with an emphasis on land protection, development threat and impact analysis, collection of NPS Facility Management Software System (FMSS) information, and publications
3) Produces maps, posters, presentations and other materials to aid Trail management and land conservation efforts
4) Analyzes of the potential impacts from proposed telecommunication facilities, wind towers, powerlines, roads, and other developments along the Trail
5) Creates maps for ATC publications, information services, events, and the web
6) Provides GIS and GPS training and technical support for ATC staff
7) Responds to public inquiries and data requests

E. Threats and Program Needs for Management of Geologic and Soil Resources

Threats to Geologic and Soils Resources

No threats to geologic resources have been identified in the planning process. Acid deposition and erosion resulting from recreational use have been identified as potential threats to soil resources. According to *Camping Impact Management of the Appalachian National Scenic Trail* (Marion 2003), the most common impacts occurring at overnight use sites along the Appalachian Trail include loss of vegetation cover, loss of organic litter, exposure, and compaction and erosion of mineral soils. A second study by Marion of Trail conditions along the Appalachian Trail in Great Smoky Mountains National Park identified soil erosion, multiple treads, excessive root exposure, excessive width, wet or muddy soils, and standing water on the Trail treadway as the primary adverse impacts associated with recreational use of the Trail.

Current Geologic and Soil Resources Program for the Appalachian Trail

The Appalachian National Scenic Trail passes through a number of national parks and forests that are managed by multi-disciplinary resource management staffs that often include geologists and soil scientists. However, the Appalachian Trail Park Office and the Appalachian Trail Conservancy do not currently have any staff that specialize in geology or soils, and issues pertaining to these disciplines rarely occur on Appalachian Trail lands.

Staff at the Appalachian Trail Park Office rely on the NPS Natural Resources Division for assistance with geology and soils resource issues. To date, that assistance has consisted of (1) development of baseline data, and (2) assistance in preparation of this *Appalachian Trail Resource Management Plan*.

Geology and Soils Resources Management Issues and Needs

No geologic resource management issues or needs, other than assembly of geologic inventory baseline data, have been identified in the planning process.

Soil resources data will be compiled as part of the NPS Inventory and Monitoring Program's 12 data sets. Areas affected by acid deposition need to be identified. Site-specific soil erosion and compaction problems are being identified as part of the NPS Appalachian Trail Condition Assessment being conducted by the Appalachian Trail Park Office, ATC, and the Appalachian Trail-maintaining clubs.

F. Threats and Program Needs of Biological Resources

Exotic Plants

Among the primary threats to biological resources that have been documented within the Appalachian Trail corridor are: exotic plants, insects pests, Trail maintenance, trampling, erosion, and plant succession.

One of the most common threats to rare, threatened and endangered species is the presence of invasive exotic plants, or plants that are not native to the Appalachian Mountains that can spread rapidly and negatively impact native plants. Our primary knowledge of the presence and extent of exotic plant species within the Appalachian Trail corridor comes from a survey of selected exotic plants that was conducted by thru-hiker and biologist Adam Canter in 2005. In his inventory, Canter documented the presence, extent, and GPS locations of 24 exotic plant species within 30 feet of the A.T. Though his survey did not cover all areas of the Trail equally well (some Southern areas were hiked too early in the season for exotic plant growth), it nevertheless provides the most comprehensive and most current picture of exotic plants in the A.T. corridor. Canter's inventory of exotic plants is most complete from North Carolina through Pennsylvania, where the growth of exotic plants and vegetation was at its peak when inventoried.

There are a variety of other inventories that have provided additional information and data on exotic plants in the A.T. corridor. In 2002, John Lesh, a student at Appalachian State University, surveyed selected invasive exotic plants along approximately 400 miles of the A.T. corridor in NC and TN, with the exception of Great Smoky Mountains National Park. Between 2000 and 2003, botanist Ted Elliman documented many exotic plant occurrences in the A.T. corridor in NJ, NY, and MA during his inventory and monitoring work of rare, threatened, and endangered plants in these states. In 2005, Elliman inventoried invasive exotic plants in MA as part of his comprehensive inventory of botanical resources in the MA Appalachian Trail corridor. Natural heritage inventories of the A.T. corridor in each of the other A.T. states from 1989 to 2001 documented a relatively small number of exotic plant occurrences, possibly because exotic plants were not deemed to be a significant threat to rare, threatened, and endangered species at the time that the inventories occurred.

Canter's inventory of invasive exotic plants in the A.T. corridor documented a total of 472 occurrences of exotic plants at 250 sites between NC and ME. Of the approximately 15,800 acres of the A.T. corridor that he surveyed, approximately 1,450 acres, or 9.18%, were recorded as being infested with one or more of the 24 invasive exotic plants that he surveyed. If this percentage is applied to the full 270,000-acre A.T. corridor, it would mean that approximately 24,786 acres of the A.T. corridor is infested with exotic plants.

Trailwide, *Rosa multiflora* (multiflora rose) and *Alliaria petiolata* (garlic mustard) were the invasive exotic plants most frequently documented by Canter in the A.T. corridor, with each species being found at more than 80 sites. These species were followed in the number of occurrences documented by: *Lonicera japonica* (Japanese honeysuckle), with about 60 occurrences, and *Microstegium vimineum* (Japanese stiltgrass), *Ailanthus altissima* (tree-of-heaven), and *Coronilla varia* (crown vetch), each with approximately 40 occurrences documented. *Eleagnus umbellata* (Autumn olive), *Berberis thunbergii* (Japanese barberry), *Centaurea biebersteinii* (spotted knapweed), *Celastrus orbiculatus* (Oriental bittersweet), and *Polygonum perfoliatum* (mile-a-minute) were found at 10 to 20 locations Trailwide.

Georgia/North Carolina / Tennessee

Due to the earliness of the season (March), Canter's 2005 inventory did not document any invasive exotic plants in GA. In an inventory of rare, threatened, and endangered species in 2000, two occurrences of *Celastrus orbiculatus* were the only exotic plants documented within natural heritage sites along the A.T..

In NC and TN, Canter's 2005 survey documented 60 occurrences of 12 invasive exotic plant species at 34 locations within the A.T. corridor. *Rosa multiflora* was the most frequently documented exotic plant in these states (18 occurrences), followed by *Coronilla varia*, *Lonicera japonica*, and *Poulounia tomentosa* (princess tree). Approximately two-thirds of the exotic plant occurrences that Canter documented in these states were at road crossings of the A.T., with most of the occurrences extending no further than one-fourth mile from the road crossing. Canter's survey of exotics in NC and TN occurred in the early spring, so some later developing species were not observed during that survey.

In a 2002 exotic plant inventory of the A.T. in NC and TN, college student John Lesh documented 63 occurrences of 13 invasive exotic plants along 400 miles of the A.T. in these two states (excluding Great Smoky Mountains National Park). This study documented a similar number of exotic plant species and occurrences, though there were some differences in the particular species documented, partly because Lesh's study occurred during the height of the growing season in mid-summer. Lesh indicated that more than 90% of the exotic plant occurrences were found at road crossings, power lines, or other anthropogenic disturbances. All but 3 of the exotic plant species locations were found below 4,000 feet in elevation. The primary exotic species documented by Lesh along the A.T. corridor in North Carolina and Tennessee were *Coronilla varia*, which was found at 15 locations, followed by *Lespedeza cuneata* (Chinese lespedeza), *Microstegium vimineum*, *Pueraria lobata* (kudzu), *Carduus (or Circium) nutans* (thistle), and *Albizia julibrissin* (mimosa), each of which was found at 6-8 locations along the A.T.. In a 1993 natural heritage inventory, exotic plants were documented in only a single A.T. natural heritage site in NC, and in 1996, exotic plants were an observed threat in 7 of the 58 natural heritage sites along the A.T. in TN.

Virginia

In Virginia, 210 occurrences of 14 species of invasive exotic plants were documented by Canter at 116 sites in the A.T. corridor. Of the 533 miles of the A.T. in VA, approximately 863 acres, or 22% of the area surveyed (within 30 feet of the Trail tread), was documented with invasive exotic plants. Approximately 43% of the exotic plant occurrences were found to be located at anthropogenic disturbances along the A.T., primarily roads and pasture land. The most frequently documented occurrences of invasive exotic plants in the A.T. corridor of VA were *Alliaria petiolata* and *Rosa multiflora*, with about 50 occurrences each. More than one-half of the exotic plant acreage in VA was documented with *Alliaria petiolata*, and the most southerly long, continuous infestation of *Alliaria petiolata* occurred on Peters Mountain near Pearisburg. Also documented in VA were more than 20 occurrences each of *Lonicera japonica*, *Ailanthus altissima* (tree-of-heaven), and *Coronilla varia*. The most heavily infested exotic plant areas along the A.T. in VA were within Shenandoah National Park and in the area north of the park. A 1994 inventory of natural heritage sites in VA documented that 13 exotic plant species were found within 8 out of state's 73 rare, threatened, and endangered species sites within the A.T. corridor. In addition to the exotic plants noted above, populations of *Celastrus orbiculatus*, *Lythrum salicaria* (purple loosestrife), *Sorghum halapense* (Johnson grass) and *Lespedeza cuneata* were noted within natural heritage sites along the A.T..

West Virginia and Maryland

Moving north along the A.T., exotic plant occurrences were frequently documented along the relatively short sections of the A.T. in the Mid-Atlantic states of WV and MD. In WV, approximately 37% of the A.T. was documented with invasive exotic plants, and in MD, approximately 55% of the A.T. corridor was documented with exotics. In WV, 18 occurrences of 8 species of exotic plants were found, and in MD, 36 occurrences of 8 species were found. *Alliaria petiolata*, *Lonicera japonica*, *Rosa multiflora*, and *Ailanthes altissima* continued to be among the most frequently documented species, along with *Polygonum perfoliatum* (knotweed) and *Microstegium vimenium* (Japanese stiltgrass). *Alliaria petiolata* occupied long stretches of the A.T. in both WV and MD. Earlier inventories of A.T. natural heritage sites in 1996 and 2000 documented that exotic plants were found in all 8 rare, threatened, and endangered species sites in WV and in 6 of the 8 natural heritage sites in MD.

Pennsylvania

The PA portion of the A.T. corridor was also heavily infested with invasive exotic plants, with approximately 21% of the area surveyed by Canter being infested. In PA, 92 occurrences of 11 exotic plant species were documented at 36 locations along the A.T.. The five most common species documented in PA were *Microstegium vimineum*, *Ailanthus altissima*, *Alliaria petiolata*, *Rosa multiflora*, and *Lonicera japonica*. *Microstegium viminium* was the most frequently documented exotic species along the A.T. in PA, being found at about 25 locations on 116 acres in the state's A.T. corridor. More than 60% of the *Microstegium vimineum* occurrences documented along the

entire length of the A.T. were in PA. Many of the densest coverages of exotic plants were found in PA. Exotic plants have been documented in 7 of the rare, threatened, and endangered species sites in PA.

New Jersey

In NJ, 24 occurrences of 6 invasive exotic plant species were documented by Canter at 13 locations within the A.T. corridor. *Alliaria petiolata*, *Centaurea biebersteinii*, and *Microstegium vimineum* were the most frequently documented exotic plants along the A.T. in NJ. The A.T. within Delaware Water Gap National Recreation Area was relatively free of invasive exotic plants at the time of the 2005 survey. Two occurrences each of *Berberis thunbergii* (Japanese barberry), and *Lythrum salicaria* (purple loosestrife) were also documented along the A.T. in the state. In 2000, botanist Ted Elliman estimated that about 85 acres of *Alliaria petiolata* were found in several A.T. natural heritage sites in NJ. Elliman also documented populations of *Berberis thunbergii*, *Lonicera japonica*, *Lonicera morrowii* (Morrow's honeysuckle), *Microstegium vimineum*, *Rhamnus cathartica* (common buckthorn), *Rhamnus frangula* (European buckthorn), *Rosa multiflora*, and *Lythrum salicaria* in 4 natural heritage sites along the A.T. in NJ; these populations generally ranged from 1-5 acres in size.

New York

In NY, Canter documented occurrences of *Berberis thunbergii*, *Ailanthus altissima*, and *Alliaria petiolata*. *Berberis thunbergii* was very invasive south of Bear Mountain and in Harriman State Park. In 2000, Elliman documented 12 occurrences of 10 exotic plant species at 4 natural heritage sites within New York's A.T. corridor. In addition to the plants documented by Canter, Elliman observed one population each of *Phragmites australis and P. communis* (common reed), *Lythrum salicaria*, *Phalaris arundinaceae* (reed canary-grass), *Celastrus orbiculatus*, *Euonymus alatus* (winged burning bush), *Rhamnus cathartica*, and *Rosa multiflora*. Additional populations of invasive exotic plants likely occur outside of A.T. natural heritage sites in NY.

Connecticut

In CT, 12 occurrences of 4 of the invasive exotic plant species that Canter surveyed in 2005 were found at 6 locations along the A.T., with *Berberis thunbergii* and *Alliaria petiolata* the two most frequently observed plants. In addition to these two species, Elliman found *Celastrus orbiculatus*, *Euonymus alatus*, *Lonicera morrowii*, *Rhamnus cathartica*, and *Rosa multiflora* to be frequent and locally abundant in the uplands of the A.T. corridor during a 2003 survey. *Lythrum salicaria* was the only invasive exotic plant that Elliman found was a major problem in the wetlands of the A.T. corridor. *Centaurea maculosa* (spotted knapweed), *Cynanchum louisae* (black swallow-wort), and *Microstegium vimineum* were documented in low numbers in the corridor during the 2003 survey. Elliman documented exotic plants within 4 A.T. natural heritage sites in CT.

Massachusetts

In MA, botanist Ted Elliman conducted a comprehensive invasive exotic plant inventory of the full width of the A.T. corridor in the state in 2005. He documented a total of 34 invasive exotic plant species covering approximately 200 acres at 19 locations in the A.T. corridor. Elliman noted that 9 of the exotic species were widespread and problematic for rare flora and high-quality habitats. In mesic forests and woodlands, *Alliaria petiolata*, *Berberis thunbergii*, *Euonymus alatus*, and *Lonicera morrowii* were widespread, and in old fields and thickets, *Rosa multiflora*, *Celastris orbiculatus*, and *Lonicera morrowii* were widespread. In wetlands, *Lythrum salicaria*, *Phalaris arundinacea*, and *Phragmites* were the most widespread and problematic invasive exotic plants. Elliman documented that 18 of the 42 natural heritage sites in the MA A.T. corridor contained invasive exotic plants in 2005. The most frequently documented invasive exotic plants within natural heritage sites in MA were *Berberis thunbergii* (14 sites), *Alliaria petiolata* (9 sites), *Phalaris arundinacea* (8 sites), and *Lonicera morrowii* (7 sites). In an earlier 1999 survey of the A.T. in MA, Elliman documented 18 exotic plant species in only 9 of the natural heritage sites along the A.T., which confirms the spread of exotic plants along the A.T. in MA between 1999 and 2005.

Vermont, New Hampshire, and Maine

In VT, NH, and ME, invasive exotic plants were virtually absent at the time of the Canter inventory in 2005. Only four occurrences of invasive exotic plants that Canter surveyed were documented in the A.T. corridor in Vermont, and only one exotic plant occurrence was documented in New Hampshire. *Phragmites australis* and *Polygonum cuspidatum* were found at two sites each, and *Centaurea biebersteinii* and *Lythrum salicaria* were found at one site each. No invasive exotic plants were documented along the northernmost 350 miles of the A.T.. None of the 1990's natural heritage inventories of the A.T. for VT, NH, and ME documented any exotic plants within natural heritage sites.

In summary, more than 500 invasive exotic plant occurrences have been documented within the Appalachian Trail corridor. More than 80 exotic plant species have been documented along the A.T., though the number of these exotic species that are deemed to be problematic invasive exotic plants is substantially lower. The presence and coverage of invasive exotic plant species is greatest in the Mid-Atlantic states from Virginia through Pennsylvania, states in which 20% or more of the A.T. has been documented with invasive exotic plants. The presence of invasive exotic plants is minimal or does not exist at both ends of the A.T.—particularly from Vermont to Maine. The coverage of invasive exotic plants appears to be on the increase in at least some of the A.T. states. While invasive exotic plants are commonly found at road crossings of the A.T., a significant number of them are found within rare, threatened and endangered species sites. Exotic species have been documented from more than 60 rare, threatened, and endangered species sites in the A.T. corridor, where their presence has the potential to cause extirpation of some of the rare species.

Exotic Insect Pests and Diseases

Gypsy Moth

The European gypsy moth, *Lymantria dispar*, is a major defoliator of hardwood trees that was introduced into Massachusetts in the 1860's. Between 1900 and 1934, the gypsy moth spread throughout most of New England. By the 1960's it had spread into much of eastern New York and into northeastern Pennsylvania and New Jersey. The gypsy moth defoliated approximately 72 million acres from 1924 to 1996, with about one-half of the defoliation occurring between 1982 and 1992.

Animated Map of Gypsy Moth Infestation 1900-2005
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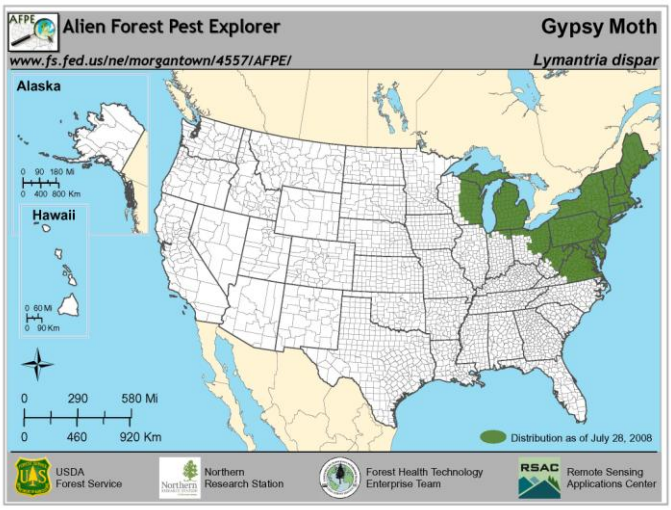
During the 1980's and 1990's, the gypsy moth advanced into the oak forests of Maryland, West Virginia, and Virginia. The first isolated gypsy moth infestation in Virginia was in Shenandoah National Park in 1969, but the natural spread of gypsy moths did not reach northern Virginia until about 1980. Since then, the gypsy moth has continued to move south and west and now covers more than two-thirds of Virginia. By 2010 it is expected that virtually every county in Virginia will experience some level of gypsy moth impact. Since 1984, the gypsy moth has defoliated about 4.5 million acres in Virginia and more than 1 million acres in West Virginia. While the gypsy moth larvae can defoliate more than 300 different plant species, oaks are a preferred food, and they are a dominant component of the central and southern Appalachian forests. Tree species vary in their ability to recover from defoliation, with some trees dying after one defoliation and other trees dying only after several defoliations. The defoliation and death of trees can impact plants in the understory that require shade, as well as potentially impact animals that utilize the forest.

In general, the gypsy moth is currently spreading at a rate of about 21 km/year along its border to the west and south. The rate of spread is affected by the controls implemented. Isolated infestations in NC, TN, and GA have been eradicated. If isolated infestations are not eradicated, it is predicted that 90 percent of the area from Virginia southward will become generally infested by 2010.

Eradication and the Slow the Spread Project are methods used to prevent or postpone the establishment of gypsy moth populations in areas where it currently does not exist. Eradication methods include using the chemical pesticide “Dimilin”, or the biological pesticides, *Bacillus thuriengensis* and “Gypchek”, the latter being a formulation of the naturally occurring gypsy moth virus. In 1999 the USDA Forest Service implemented the National Slow the Spread of the Gypsy Moth Project across the 1,200-mile gypsy moth frontier from North Carolina through Minnesota. Scientists believe that it is impossible to stop gypsy moth spread, but that it is possible to reduce the rate of spread by 50% or more.

Gypsy moth defoliation and subsequent tree mortality have altered forest composition and structure at many sites along the Appalachian Trail corridor in Virginia. Of particular concern are old growth forests and other significant forest communities. Rare plant and animal populations may also be adversely impacted as tree mortality results in changes to light and moisture regimes or fosters the growth of light-loving invasive plant species.



The impact of the gypsy moth on the Appalachian Trail corridor in Virginia is better documented than in other A.T. states, probably because gypsy moth infestation was active or recent at the time of the natural heritage inventory in the early 1990’s. Evidence of gypsy moths was found in 38 of the 73 natural heritage sites documented within Virginia’s Appalachian Trail corridor. The inventory recorded gypsy moth damage as far south as Apple Orchard Mountain Natural Heritage Site, and it is likely that the gypsy moth has spread further south into additional VA natural heritage sites. In many of the natural heritage sites in northern Virginia, gypsy moth damage was documented as being heavy or severe. At one natural heritage site in Shenandoah National Park, up to 90% of the oaks had been killed in local areas. The inventory noted that gypsy moth defoliation had resulted in open canopies that had allowed exotic and invasive native species to become established. At several natural heritage sites, it was stated that the gypsy moth was a threat to significant old growth forest, but that at most sites, the gypsy moth appeared to have little or no effect on a site’s rare species. However, the potential for impact to rare plant and animal populations exists, as tree mortality results in changes to light and moisture regimes or fosters the growth of light-loving invasive plant species. In addition to attacking oaks, the gypsy moth threatened the rare *Betula papyrifera* (paper birch) and *Betula*

populifolia (gray birch) at five natural heritage sites within VA's A.T. corridor.

The inventory for the Appalachian Trail corridor for West Virginia found in 1996 that the gypsy moth was not a threat in Jefferson County at the time, but that past impacts were extensive. The inventory noted that the canopy gaps created are a favored habitat for invasive exotic species.

The natural heritage inventory of the Appalachian Trail corridor in Maryland in 2000 found that defoliation of the upper canopy tree species was severe and that it threatened the overall forest community structure. State of Maryland entomologists sprayed forests along the A.T. in Maryland in the spring of 2000, but a botanist surveying for rare species along the Appalachian Trail found gypsy moth caterpillars in good numbers during the month following the spraying.

In 2007 a new outbreak of gypsy moths defoliated large segments of the Appalachian Trail from Virginia to Pennsylvania. One of the areas most heavily impacted is the northernmost area of the A.T. in Virginia, West Virginia, Maryland, and Pennsylvania. Aerial surveys and gypsy moth egg mass counts documented approximately 500 acres of heavily impacted land in VA, 500 acres in the Eastern Panhandle of WV, 600 acres in Maryland, and at least 300 acres in Pennsylvania. One of the heavily impacted areas within the A.T. Corridor is around Bears Den Shelter in VA and another area is very close to Shannondale subdivision. USDA Forest Service funds were sought to control these outbreaks using Bt; however, the funding to do this work was not approved. Other funds were sought to treat gypsy moth impacted forest, and in May 2008, approximately 600 acres of NPS A.T. land in MD were treated, 234 acres of NPS and ATC land were treated in WV, and 292 acres of NPS land were treated to suppress gypsy moths in Pennsylvania.

Almost two decades ago, the PA natural heritage inventory (1990) documented severe defoliation from gypsy moths at several natural heritage sites in the A.T. corridor, and noted in some locations that much of the forest canopy is damaged or dead. At several additional sites, the natural heritage inventory stated that insecticides used to control gypsy moths could harm several rare animal populations.

In the Connecticut Natural Heritage Inventory, there was one reference to a prior heavy gypsy moth infestation that had opened up the forest canopy, possibly benefiting an endangered species population. There were no other references to insect diseases in any of the New England inventories.

Oak Decline

In the southern Appalachians from Virginia southward, about 1.7 million acres of vulnerable oaks were found to be affected by oak decline at the time of the Southern Appalachian Assessment in 1996. North Carolina and Virginia have the highest

incidences of oak decline. About 19% of national forest land in the southern Appalachians had oak decline damage at the time, with the highest incidences in George Washington and Jefferson National Forests. Oaks will not be eliminated from decline-affected areas, but their numbers and diversity are being reduced. The area of greatest impact will be immediately behind the advancing front of the gypsy moth.

Hemlock Woolly Adelgid

The hemlock woolly adelgid, *Adelges tsugae*, an insect species native to Asia, was first identified in the eastern United States in 1951 in Richmond, VA. It was discovered in the Shenandoah Mountains of Virginia in the 1950's. From 1970-1985, the adelgid occupied discrete areas in central and southwest Virginia, extreme southeast Pennsylvania, and Long Island, New York. From 1985-1995, the adelgid expanded westward in Pennsylvania and northeastward into New Jersey, New York, and Connecticut. During the early 1990's, the adelgid spread into most of the remaining area of western Virginia. In the late 1990's, the adelgid moved into far western Massachusetts. Within the last few years, the adelgid had spread into nearly all of western North Carolina, as well as into east Tennessee and northeast Georgia. In the next few years, the adelgid is expected to spread into northern New England and further into Tennessee and Georgia, encompassing the full the ranges of both Eastern hemlock and Carolina hemlock.

Animated Map of Hemlock Wooly Adelgid Infestation 1951-2004
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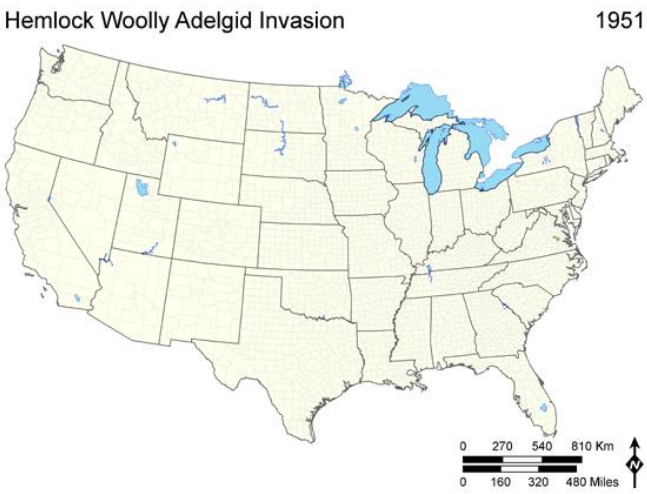
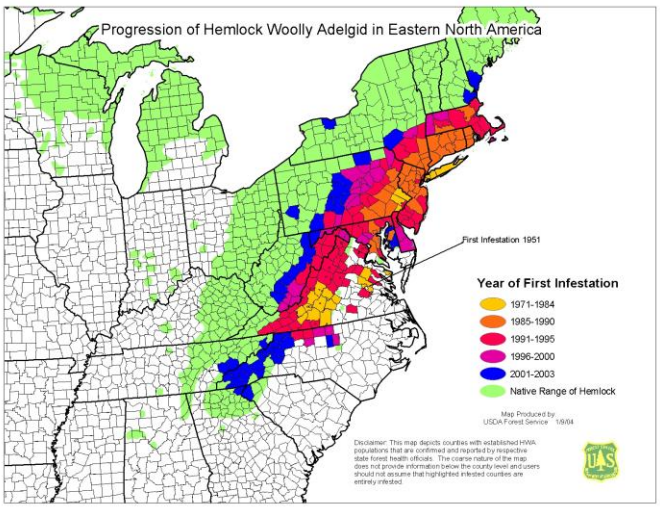


The hemlock woolly adelgid kills hemlock trees by sucking sap from the twigs of affected trees. The adelgid is spread by wind, birds, or mammals. Heavy infestations have killed trees in as little as four years, but some trees have survived infestations for more than ten years. Individual hemlock trees can be protected by spraying or soil treatments, but such treatment may be impractical for large stands of trees. Biological controls for the adelgid hold some promise for protecting hemlocks, but progress has not kept pace with the growing spread. Forest ecologists believe that the adelgid endangers the survival of both Eastern and Carolina hemlocks throughout the range of these species in the Appalachians. The loss of the Eastern hemlock will negatively impact riparian ecosystems and may result in a substantial reduction in habitat quality for birds and other wildlife. The ecological impact of losing the Carolina hemlock, which is a globally

rare species found on ridges and rock outcrops in the Southern Appalachians, is less certain.

The hemlock woolly adelgid was first reported in Virginia in 1951, and it has since spread over most of the state, infesting and killing both Eastern and Carolina hemlock. In 1994 the Virginia Natural Heritage Inventory indicated that the hemlock woolly adelgid represented a potentially severe threat to several significant old-growth hemlock forests along the Appalachian Trail in Virginia. The inventory indicated that the adelgid may also indirectly impact rare plant and animal populations in Virginia. For instance, the globally rare *Buckleya distichopylla* (piratebush) is a hemiparasite whose host species is frequently a species of hemlock. As hemlock dies out, piratebush populations that use hemlock as a host are likely to be negatively impacted. In the Virginia natural heritage inventory (1994), the only location where the hemlock woolly adelgid was observed within the Appalachian Trail corridor was at James River Gorge, where significant mortality had occurred. It has no doubt since spread to many other locations along the Trail in Virginia.



A survey of hemlock health and the presence of the hemlock woolly adelgid along the Appalachian Trail was conducted by thru-hiker Adam Canter in 2005. This survey documented that the hemlock woolly adelgid had spread as far south on the A.T. as Georgia. Of the 9 hemlock stands documented in GA, only 2 were infested with the hemlock woolly adelgid. The southernmost documentation of the hemlock woolly adelgid along the A.T. was at the U.S. 76 crossing at Dicks Creek Gap.

In NC and TN, the impact of the hemlock woolly adelgid increases significantly. Fifty-one of 78 hemlock stands (or 65%) were infested with hemlock woolly adelgid. NC and TN had the largest number of hemlock stands of any area along the A.T. In 2005, all of the hemlock stands documented on the A.T. in NC and TN were in good condition. The distribution of infested hemlock stands in NC and TN was somewhat random, with some uninfested stands sandwiched between infested areas. In these states, some of the hemlock stands contained significant numbers of Carolina hemlock, a globally rare species, which could be impacted more severely than the more widespread Eastern hemlock.

In Great Smoky Mountains National Park (TN/NC), the hemlock woolly adelgid was

discovered in April 2002, and by the fall of 2003, most areas of the park were at least lightly infested. Only the initially infested areas are showing crown thinning, and no mortality has yet been recorded. The park has nearly 5,000 acres of hemlock-dominated forests, including 700 acres of old growth hemlock. Management activities in the park include insecticide treatments and the release of *Pseudoscymnus tsugae* beetles, which are a biological control for the adelgid. In 2003 the University of Tennessee began a multi-year agreement with the park to produce *P. tsugae* for release in the park and in other nearby infested National Park Service units. Canter's 2005 inventory documented few hemlocks along the A.T. in Great Smoky Mountains National Park, primarily because the Trail follows high ridgelines in the park that are outside the normal altitudinal range of two hemlock species.

In Virginia, Canter documented that all 48 hemlock stands contained hemlock woolly adelgid. Twenty-four of the stands were good in appearance, primarily located in the southern part of the state. Eight hemlock stands were in fair condition, 8 were in poor condition, and 8 contained fully dead trees. Most of the dead hemlock stands documented were in Shenandoah National Park in northern Virginia. Tree health began to significantly decline from around Pearisburg northward.

In Shenandoah National Park, the hemlock woolly adelgid was first detected in 1988, and the presence of the adelgid soon became widespread within the park. In 1990 and 1991, hemlock woolly adelgid was found in all 94 of the park's hemlock study sites. In a 1997 study of hemlocks in Shenandoah NP, 35% had heavy infestations of hemlock woolly adelgid, 21% had medium infestations, 26% had light infestations, and 17% had no evidence of infestation. The heaviest infestations were at lower elevations, and the areas absent of the adelgid appeared to be in the park's highest elevations, possibly due to late winter and early spring cold snaps. The adelgid was absent along the A.T. between Big Meadows Campground and Fisher's Gap. Treatment of hemlock woolly adelgid with insecticidal soap began in 1999.

No hemlock stands were documented by Canter in West Virginia, except for the Mill Creek Site on the VA-WV border. Hemlocks observed in the vicinity of Harpers Ferry were either dead or in poor condition.

The hemlock woolly adelgid has been present in Maryland for about 20 years, but only recently began to affect hemlock health. The adelgid has been present at Cunningham Falls State Park near the Appalachian Trail since 1990, but hemlock only began to decline within the park in the past few years. In 2005, Canter documented only three hemlock stands, all of which were heavily infested and were fair to poor in appearance.

In November, 2007, the MD Department of Agriculture and the NPS Appalachian Trail Park Office released 500 beetles on ten hemlock trees infested with hemlock woolly adelgid. This represents the first release of biological controls to reduce the impact of the hemlock woolly adelgid on National Park Service A.T. lands outside of existing

national park units along the Trail.

In PA, Canter documented 22 hemlock stands, all of which were heavily infested. Fifteen of the hemlock stands were in fair condition and 7 were in poor condition. Some stands had up to 80% mortality.

At Delaware Water Gap National Recreation Area in PA and NJ, the hemlock woolly adelgid was detected in 1989. In 1995 it was present at about 50% of the hemlock sites examined throughout the park, and in 1999 it was documented in 95% of the hemlock sites. Between 1993 and 2002 the percentage of hemlock trees in 81 plots that were rated healthy declined dramatically from 92% to 28%. In 2002, 15% of the plot trees were dead. Crown changes became noticeable within three years of infestation; however, it was noted that crown conditions did not decline progressively each year. *Pseudocymnus tsugae* beetles were first released in the park in 2000 in an effort to control the adelgid.

In a NJ study from several years ago, hemlock mortality was over 90% in about half of the plots studied, mostly as a result of the adelgid, but also from drought and secondary pests such as hemlock borer and elongate hemlock scale. All areas in New Jersey where the hemlock is still somewhat healthy have received releases of the beetle *Pseudoscymnus tsugae.* A total of 271,000 beetles have been released at 61 sites since 1998.

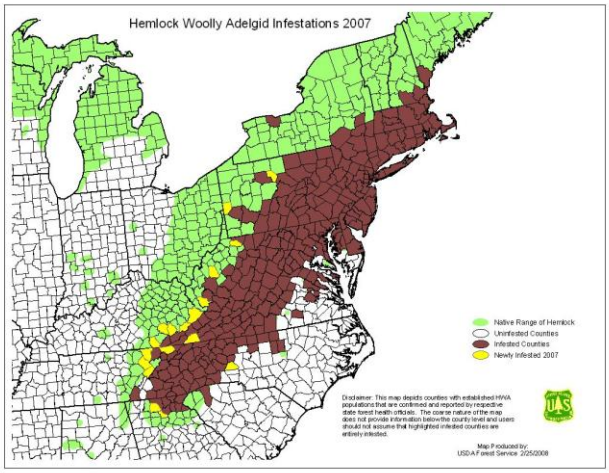
In 2000, botanist Ted Elliman, who conducted the natural heritage inventory for the Appalachian Trail in New Jersey, observed that the impact of the hemlock woolly adelgid on the Eastern hemlock was devastating along the Trail in that state. The 2005 Canter study documented only 3 hemlock stands along the A.T. in NJ, with most of the trees already experiencing mortality.

In NY, Canter documented 9 occurrences of Eastern hemlock along the A.T.. The overall appearance of stands improved from south to north, with 7 of the stands being in fair condition and 2 stands in good condition.

In central Connecticut, the impact of the hemlock woolly adelgid has been substantial. A study (Orwig, 2004) indicates that hemlock mortality has risen to over 60% in half of the stands inventoried in the region, and it has increased 5% to 15% a year since the time that plots were established in 1995. This study also notes that the health and vigor of remaining trees has deteriorated in all stands, with the majority of trees retaining less than 25% of their foliage. The beetle *Pseudocymnus tsugae* has been found to be a good biological control for the hemlock woolly adelgid, and between 1995 to 2002, 172,000 adult *P. tsugae* were released at 20 sites in Connecticut. In sites where *Pseudoscymnus tsugae* beetles were released to control the adelgid, there were low adelgid populations and some hemlock recovery. The elongate hemlock scale, *Fiorinia externa*, is also contributing significantly to the demise of hemlock health in the state.

In 2003, the botanist who conducted a natural heritage inventory of the Appalachian Trail corridor in Connecticut observed that the only location where the hemlock woolly adelgid was present within the Appalachian Trail corridor was at Schaghticoke Mountain. In 2005, Canter documented that the hemlock woolly adelgid was having a large impact in some areas of the Trail corridor, while other stands remained uninfested. Of the 9 hemlock stands documented by Canter in CT, 6 stands were infested and in good condition, and 3 stands were free of the hemlock woolly adelgid.

In a 4,000 square kilometer transect through the state of Massachusetts, over 5,000 hemlock stands with more than 10% hemlock have been mapped. Almost 50% of the 80 hemlock stands that were sampled in 2002 and 2003 had hemlock woolly adelgid, although overstory hemlock mortality is still very low. The hemlock woolly adelgid was found within a few kilometers of Vermont. In MA, Canter documented 8 stands of Eastern hemlock in 2005, and all 8 of them were free of the hemlock woolly adelgid and in good appearance.

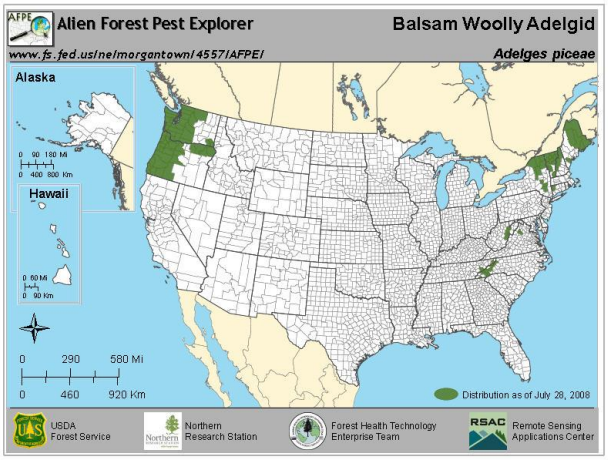


In northern New England, Canter documented that no hemlock stands were infested with the hemlock woolly adelgid in 2005. In VT and NH, Canter found that all 8 stands of hemlock were uninfested with hemlock woolly adelgid in 2005 and in good appearance. In New Hampshire, hemlock woolly adelgid has been found on native hemlock in four of the southernmost counties, far south of the Appalachian Trail corridor in the state. In Maine, Canter documented 10 hemlock stands along the A.T., and all of them were uninfested with hemlock woolly adelgid and in good condition. Long continuous uninfested stands of hemlock were observed along the A.T. in Maine.

Balsam Woolly Adelgid

The balsam woolly adelgid (*Adelges piceae*) is a non-native insect that has drastically altered the southern Appalachian spruce-fir forest ecosystem by attacking native species of fir or balsam. This adelgid is believed to have been introduced from Europe into in the southern Appalachians in the 1930's via reforestation experiments, and it was first detected in native forests in the Black Mountains of North Carolina in 1957. From that time until the early 1980's, the insect spread to all natural Fraser fir or balsam populations in the southern Appalachians, including populations along the Appalachian Trail in North Carolina, Tennessee, and Virginia. Since its introduction, approximately

64,700 acres of Fraser fir have been infested. In 2003 high populations of the adelgid were found in all infested areas. The balsam woolly adelgid produces at least two generations per year, and it is primarily disseminated by wind, but also by gravity, humans, nursery stock, and animals. Mature Fraser fir or balsam trees are most susceptible to adelgid attack, and death usually occurs within five years after first attack. Younger Fraser firs are more resistant to attack, and regeneration is good in many locations. Because not all age classes of fir are affected by the adelgid, there is some uncertainty as to whether the adelgid will cause the elimination of the species. Chemical control for individual trees is effective, but extremely costly.



The impact of the balsam woolly adelgid on the Fraser fir is more pronounced because the Fraser fir is a globally rare species that has a very limited range on a few high elevation mountain summits, generally above 5500 feet, in the southern Appalachians. At the highest elevations, the fir appears almost exclusively in pure stands, and at somewhat lower elevations, it is mixed with red spruce. A large portion of the Appalachian Trail within Great Smoky Mountain National Park passes through spruce-fir forest. The Trail also passes through spruce-fir forest in the Roan Mountain area on the North Carolina and Tennessee border and within Mt. Rogers National Recreation Area in southwest Virginia. The Roan Mountain and Mt. Rogers areas have among the highest concentrations of globally rare species along the entire Appalachian Trail, and loss of the Fraser fir forest canopy can have a high impact on some of these threatened and endangered plants and animals. One example of an animal that may be impacted is the federally endangered spruce-fir moss spider (*Microhexura montivaga*). Another species, the Fraser fir angle, is entirely dependent on the Fraser fir.

The balsam woolly adelgid is also a threat to balsam fir (*Abies balsamea*) at the summits of Stony Man Mountain and Hawksbill Mountain along the A.T. in Shenandoah National Park, Virginia. In Virginia, balsam fir is found only on these two mountains. The impact of the balsam woolly adelgid on *Abies balsamea* in New England is unknown.

Beech Bark Disease

Beech bark disease is having a substantial impact on American beech (*Fagus grandifolia*), one of the more common components of deciduous forests throughout much of the Appalachians. Beech is an important species for wildlife, providing mast and den habitat for species like black bear. Beech bark disease results from two causal agents, the beech scale insect, *Cryptococcus fagisuga*, and a fungus, *Nectria coccinea faginata*. The beech scale insect penetrates the bark, allowing the fungus to invade. The disease arrived in Nova Scotia around 1890, and it had spread southward into Maine and Massachusetts by 1932. By 1960 beech bark disease had spread throughout New England and into New York, and by 1975 the disease had spread into New Jersey and Pennsylvania. By 1980 it had spread into West Virginia, and by 1993, it was reported in Great Smoky Mountains National Park in North Carolina and Tennessee. Tree mortality has intensified around the Great Smoky Mountains and the Blue Ridge Parkway, and the disease has moved into Nantahala and Pisgah national forests in North Carolina and Roan Mountain State Park in Tennessee. The disease has also spread into several counties of far western Virginia. The presence of beech bark disease within the Appalachian Trail corridor has been observed in Massachusetts and Connecticut, and the disease is likely present along the corridor in other states as well.

Animated Map of Beech Bark Disease 1935-2006
Please Launch from digital .pdf

Southern Pine Beetle

The Southern pine beetle (*Dendroctonus frontalis*) is considered the most serious insect pest of pine in the South. In contrast to the other insect pests noted, the Southern pine beetle is a native insect, with a broad range from Pennsylvania to the Gulf Coast. While infestations of this insect come and go across its range, the insect is almost always epidemic somewhere in its range. From 1999 to 2002, infestations were concentrated in the southern Appalachians, but the beetle outbreak subsided dramatically in 2003. The Southern pine beetle can attack and kill all species of pines, but prefers shortleaf,

Virginia, pond, pitch, and loblolly pines. White pine losses have also been heavy in the southern Appalachians. The specific impact of the Southern pine beetle on pines within the Appalachian Trail corridor is not known.

Other Exotic Pests

Among the other notable insect pests that are impacting native plant species in the Appalachians are butternut canker, dogwood anthracnose, dutch elm disease, and chestnut blight. Butternut canker is a fungus that has killed at least 75% of the butternut (*Juglans cinera*) trees in the southern Appalachians during the past three decades. Dogwood anthracnose is a fungus that was first reported in New York in 1978, and it has since caused significant mortality to the native *Cornus florida* throughout much of its range from Georgia to southern New England. Chestnut blight is an exotic fungus that between 1900 and 1940 killed most mature American chestnut (*Castanea dentata*) trees throughout its range. The chestnut was a dominant tree in the Appalachians that has since been replaced by oaks and other hardwoods. Chestnut root sprouts will often live for five or ten years before being killed by the blight, and occasionally chestnuts will reach the size of a small tree.

Trail Maintenance

Many of the 14 state natural heritage inventories for the Appalachian Trail corridor have indicated that Trail maintenance is among the most frequently mentioned impacts to rare, threatened, or endangered (RTE) species along the Trail. Approximately 200 occurrences of RTE species at 145 natural heritage sites have been identified as being immediately adjacent to the Appalachian Trail (within approximately three feet of the Trail tread) and thus could potentially be impacted inadvertently by Trail maintenance activities. Some impacts of Trail maintenance on RTE plant species have been documented, but the potential for impacts is present at a much greater number of locations.

The potential for Appalachian Trail maintenance to impact RTE species has been most frequently documented in Tennessee and North Carolina. In these two states, approximately 90 occurrences of RTE plant species at 63 natural heritage sites were documented as being potentially threatened by Trail maintenance. Among the sites where the potential for Trail maintenance impact is greatest are: Roan Mountain, TN/NC; Doll Flats, TN; Laurel Fork South, TN; Canute Place, TN, Dennis Cove, TN, and Big Rock Spring, NC. The potential for impact to RTE species from Trail maintenance is particularly significant in the Roan Mountain to Hump Mountain area because of the large concentration of RTE species there. More than one-half of the species threatened by A.T. maintenance in North Carolina and Tennessee are globally rare species. Among the RTE species potentially impacted by Trail maintenance are trees such as *Tsuga caroliniana* (Carolina hemlock), shrubs such as *Buckleya distichophylla* (piratebush), and herbaceous plants such as *Geum geniculatum* (bent avens) and *Prenanthes roanensis*

(Roan rattlesnake root), all of which are globally rare.

In Georgia, 18 RTE plant occurrences at 16 natural heritage sites are located within the zone of potential Trail maintenance impact. As in NC and TN, the majority of the RTE occurrences within the Trail maintenance zone are globally rare species. Most of the RTE occurrences that could be impacted by Trail maintenance in Georgia are herbaceous plants or vines, but a few are shrubs.
In Virginia, 38 RTE plant occurrences are located beside the A.T. in 20 natural heritage sites within the zone of potential Trail maintenance impact. Many of the occurrences are of globally rare species. Eight of the RTE occurrences within the zone of Trail maintenance impact are within Shenandoah National Park. Sixteen of the RTE species occurrences subject to Trail maintenance impact are located within the Pine Mountain, Mt. Rogers, and Whitetop Mountain natural heritage sites within Mt. Rogers National Recreation Area

In the Mid-Atlantic states, there are smaller numbers of RTE plants that could be potentially harmed by Trail maintenance. In Maryland, there are seven RTE plants that are adjacent to the Trail, some of them along that portion of the A.T. that follows the Chesapeake and Ohio Canal Towpath, where maintenance may not be necessary. In Pennsylvania, seven RTE species that could be damaged by Trail maintenance are located at Mt. Minsi, Big Offset Barren, Bernheisel Bridge, Big Flat Barren, Little Gap Barrens, and Hunters Run natural heritage sites. Two of these sites, Big Offset Barren and Hunters Run, have globally rare species immediately beside the Trail. In New Jersey, only three RTE plant species might be harmed by Trail maintenance, and in New York, six RTE plants might be damaged by Trail maintenance.

In New England, there are 38 occurrences of RTE plants located beside the A.T. that could be impacted by Trail maintenance. These occurrences are found in 30 natural heritage sites. The largest number of RTE plant occurrences documented beside the Trail are in Massachusetts, where 18 occurrences have been noted at 16 natural heritage sites. In Connecticut, only five RTE plant occurrences are potentially subject to Trail maintenance impact. In Vermont and New Hampshire, three RTE plant occurrences in each state could be damaged by A.T. maintenance. In Maine, nine RTE plant occurrences could potentially be damaged by Trail maintenance.

Trampling

Because of their location beside the Appalachian Trail tread, many of the RTE species occurrences that could be damaged by Trail maintenance damage are also subject to damage by trampling. The state natural heritage inventories for the A.T. have documented approximately 131 natural heritage sites with RTE plant species that have been or could be impacted by trampling. This represents about one-fourth of the total number of natural heritage sites documented along the full length of the A.T.. It is possible that some RTE species in the Trail tread may have already been extirpated by

trampling, such as *Phlox amplifolia* (large-leaved phlox) in southern Virginia. At some locations, such as viewpoints at mountain summits, trampling may be the most serious potential impact at a site. The states where trampling has been most frequently reported as a threat to RTE species are Virginia, North Carolina, and Georgia.

In Georgia, trampling was documented at 10 of the 41 natural heritage sites identified along the Trail in the year 2000. Trampling was a problem at popular Blood Mountain, which is the most significant natural heritage site along the Trail in Georgia. The rock outcroppings that provide views for hikers are the habitat for most of the site's rare species, some of which are globally rare. While many of the rare plants in rock crevasses appeared to be untrampled, there was some damage noted to populations of *Potentilla* (or *Sibbaldiopsis*) *tridentata* (three-toothed cinquefoil) and *Paronychia argyrocoma* (silverling) on rock outcrops near the Blood Mountain summit and Trail shelter. At Little Bald Knob Natural Heritage Site, moderate trampling of *Juncus gymnocarpus* (naked fruit rush) was observed at the Coward Gap spring and in the Trail/roadbed. Other natural heritage sites in Georgia where trampling was noted as an existing or potential threat are Brookshire Gap, Liss Gap, Rocky Mountain, Snake Knob, Bird Gap, Plumorchard Gap, Wheeler Knob, and Tray Mountain.

In North Carolina, hiker trampling has been reported as a threat to RTE resources at 16 natural heritage sites, many of them rocky outcrops or balds. Among the sites where trampling is a threat are three of the seven natural heritage sites in the very significant Roan Mountain area on the North Carolina-Tennessee border. Trampling has also been documented as a threat at the important Standing Indian and Hot Springs natural heritage sites. Other natural heritage sites where trampling is an identified threat are Whiterock Cliffs, Walker Gap, Cheoah Bald, Rocky Bald, Bald Mountain, Chestoa, Yellow Mountain, High Rocks, Standing Indian Shelter, Big Butt/Albert Mountain, and Pinnacle Mountain. At Big Butt/Albert Mountain Natural Heritage Site, trampling was evident, even though a fence was present at the site. In Tennessee, trampling was a potential or existing impact at Laurel Fork Bluff, Iron Mountain Shelter and Spring, Lindy Camp Bog, Stony Creek Bog, and John's Cranberry Bog.

In Virginia, hiker trampling was identified as a threat at 31 natural heritage sites. The impact of hiker trampling was found to be greatest in glades and on rock outcroppings, because of the views that they often afford. The Virginia natural heritage inventory indicated that trampling is particularly severe along the A.T. in Shenandoah National Park, where recreational use is high. Among the natural heritage sites where trampling was an identified impact in Shenandoah National Park are Mt. Marshall, Hogback Mountain, The Pinnacle/Mary's Rock, Stony Man Mountain, Little Stony Man, Hawksbill Mountain, Franklin Cliffs, and Hightop. The inventory reported that the cliff-top overlooks at Stony Man Mountain and Little Stony Man were almost denuded. The plant most frequently impacted by trampling along the A.T. in Virginia is *Solidago simplex* var. *randii* (Rand's goldenrod), whose habitat is rock outcrops. Trampling is a threat to glade communities at Overall Run Falls, Stony Man Mountain, and Hawksbill

Mountain. In addition to trampling, the Hawksbill Mountain Natural Heritage Site has a wide array of other identified threats, including deer browsing, exotic plants, gypsy moth, balsam woolly adelgid, succession and interspecific competition, and possibly air pollution and acid rain.

North of Shenandoah National Park, hiker trampling was identified as a threat at Reservoir Hollow and Moore Run on ATPO land. On USDA Forest Service land south of Shenandoah National Park, trampling was a threat on the rock outcrops of Three Ridges Mountain (Hanging Rock and Flattop), Mt. Pleasant, and Dismal Creek. At Kelly Knob, trampling and Trail maintenance may have eliminated the population of *Phlox amplifolia*. Damage to vegetation from campfires and impromptu campsites was a threat at Cedar Cliffs, Three Ridges Mountain, and Spy Rock natural heritage sites. Hiker trampling was also identified as a problem at the major natural heritage sites at Mt. Rogers and Whitetop Mountain. At Pine Mountain, Mt. Rogers, and Whitetop Mountain within Mt. Rogers National Recreation Area, trampling by cattle and ponies was identified by the Virginia natural heritage inventory as a major threat to RTE plant species.

In Maryland, trampling was noted at four of the eight natural heritage sites along the Trail, one of which is the rock outcrop community at Weaverton Cliffs. In West Virginia, trampling was identified as a major threat along the Potomac and Shenandoah rivers near Harpers Ferry.

In Pennsylvania, hiker trampling was an identified threat at the majority of the 15 natural heritage sites identified in the 1990 A.T. natural heritage inventory. Among the sites where trampling was an observed or potential threat are: Mt. Minsi, Big Offset Barren, Little Gap Barrens, Rausch Gap, and Bernheisel Bridge. At Big Offset Barren, the A.T. bisects the population of the globally rare *Carex polymorpha* (variable sedge); however, the Trail edge may provide good habitat for this species due to increased light.

In New Jersey, the A.T. natural heritage inventory reported in 2000 that trampling was a threat at Maple Hill, Price's Switch and Dunnfield Creek natural heritage sites. At the Dunnfield Creek site, three populations of RTE species were identified as vulnerable to trampling, and one of them (*Aristolochia serpentaria* or Virginia snakeroot) has since been extirpated. In New York, trampling is a recently documented threat at Buchanan Mountain, Arden Mountain, Black Mountain, and Cat Rocks natural heritage sites.

In New England, trampling is a threat noted at 30 natural heritage sites. In Connecticut, a 2004 natural heritage inventory of the Appalachian Trail corridor documented trampling impact at Lion's Head and Wachocastinook Ravine, Bear Mountain, Great Falls, and Bulls Bridge natural heritage sites. At the very significant Bulls Bridge Natural Heritage Site, several of the site's rarest species are threatened by trampling, and at least one subpopulation of *Onosmodium virginianum* (Virginia false-gromwell) appears to have been extirpated by trampling. In Massachusetts, trampling was documented at

Upper Sherman Brook, Greylock Summit, Old Adams Road, Kitchen Brook Drainage, Crystal Mountain, Cady Brook, April Hill Farm, Jug End Road, and Mt. Race natural heritage sites. Two of the plants most threatened by trampling in Massachusetts are *Luzula parviflora* var. *melanocarpa* (black-fruited woodrush) and *Solidago simplex*, var. *randii* (Rand's goldenrod).

In Vermont, trampling was noted as a threat at three natural heritage sites: Perkins Road, Stratton Mountain, and Glastenbury Mountain. In New Hampshire, trampling was noted as an existing or potential threat at Holts Ledge, Mt. Moosilauke, Mt. Garfield, Eagle Lakes, Lakes of the Clouds and Monroe Flats, Mt. Madison, and Mt. Success natural heritage sites. Off-Trail hiking in the extensive alpine area of the Presidential Range is a threat to rare plant populations there. Rock climbing was noted as a potential impact at the Holts Ledge. In Maine, trampling impact on natural heritage sites is most prevalent on mountain summits with good vistas, including Mt. Carlo, Goose Eye Mountain, Mahoosuc Mountain, Baldpate Mountain, and Moxie Bald Mountain. On some of these summits, trampling impacts the very rare alpine plant community. Trampling is also a threat to rare plant populations at Grafton Notch State Park and Little Wilson Falls natural heritage sites.

Erosion

Another threat that sometimes results from high recreation use is erosion. Erosion of the Appalachian Trail was cited as a threat at approximately 25 natural heritage sites Trailwide. In North Carolina, erosion was having an impact at Grassy Ridge, Unaka Mountain, Cherry Gap, Temple Ridge, Bald Mountain, and Hot Springs/Lover's Leap. In Tennessee, erosion was observed to be a problem at Laurel Falls, Blackman Branch Campsite, Iron Mountain Vista, and Highway 91South natural heritage sites. In Virginia, erosion was noted as a threat at Mount Pleasant, Whitetop Mountain, and Whitetop Laurel Slopes natural heritage sites. In Pennsylvania, erosion was noted at Little Gap Barrens and Rattling Run Seep natural heritage sites. In Massachusetts, erosion was having an impact at Cady Brook Natural Heritage Site.

In New Hampshire, erosion was impacting rare plant populations at Mt. Garfield, Mt. Eisenhower, and Lakes of the Clouds and Monroe Flats. In Maine, erosion was identified as a threat at Mount Carlo, Mahoosuc Mountain, Whitecap Mountain, Potaywadjo Ridge, and Northern Nahmakanta natural heritage sites.

Sedimentation

Sedimentation was noted as an actual or potential threat to natural heritage resources at more than ten sites in North Carolina and two sites in southern Virginia. Erosion, trampling, camping, and logging were given as the causes of sedimentation at natural heritage sites within the A.T. corridor. The species most frequently impacted by sedimentation is the globally rare aquatic lichen *Hydrotheria venosa*. Sedimentation may be a problem along the A.T. in other states as well.

Logging

Logging was identified as a potential threat at more than 40 natural heritage sites in the A.T. corridor, particularly in Vermont, New Hampshire, Maine, and North Carolina. At some locations, the natural heritage inventories noted that the threat of logging outside of a natural heritage site could have an impact within the site, especially when the site is a wetland or fen. At some locations within the A.T. corridor, logging may be a reserved right on some tracts of land.

Collection and Poaching

Collection of rare, threatened, and endangered plants and poaching of animals was noted as a threat at more than 30 natural heritage sites Trailwide. *Panax quinquefolius* (ginseng) was the species most frequently cited as being threatened by collection. Other species cited as being subject to collection are *Cypripedium* species (lady slippers), *Listera smallii* (kidney-leaved twayblade), other orchids, *Iris verna* (dwarf iris), and *Trillium* species. One globally rare species whose collection has been observed is the globally rare *Lilium grayi* (Gray's lily), a species that is currently being considered for Federal Threatened or Endangered status. The animal species that is most frequently noted as being subject to poaching and killing is *Crotalus horridus* (timber rattlesnake). Rare salamander species are also listed as being subject to collection.

Plant Succession

Plant succession was listed as a threat to rare, threatened, and endangered species at more than 20 natural heritage sites Trailwide. In Massachusetts, plant succession was noted as a threat to *Amelanchier bartramiana* (Bartram's shadbush) at Mt.Williams and to *Ribes triste* (swamp red currant) at Tully Mountain. In Pennsylvania, plant succession was given as a threat to the *Prunus pumila* (sand cherry) populations at Mt. Minsi and Totts Gap and the *Carex polymorpha* population at Big Offset Barren. Plant succession was also listed as a potential or existing threat at Rausch Gap and Big Flat Barren natural heritage sites in Pennsylvania. In Virginia, plant succession was listed as a threat to *Betula papyrifera* (paper birch), *Alnus incana* ssp. *rugosa* (speckled alder), and *Carex polymorpha* (variable sedge). Plant succession was also listed as a possible threat to the federally endangered *Plethodon shenandoah* (Shenandoah salamander) and the state endangered *Thryomanes bewickii altus* (Appalachian Bewick's wren). In North Carolina, plant succession may encroach on the grassy balds at Big Bald and in the Roan Highlands area, which are the habitat of numerous rare, threatened and endangered species.

Deer Browsing

In Pennsylvania, deer browsing has been a threat to the globally rare *Euphorbia purpurea* (glade spurge) at Hunters Run and to *Prunus pumila* (sand cherry) at Mount Minsi. At Hunter's Run, all populations of *Euphorbia purpurea* were fenced in 2002 to counter the threat of deer browsing, and the individual plants have become much more vigorous. In Virginia, deer browsing was noted as a threat at more than ten natural heritage sites along the A.T. in Shenandoah National Park. In Tennessee, John's Cranberry Bog Natural Heritage Site was receiving some impact from deer.

Other Threats

The state natural heritage inventories have documented a wide range of other existing or potential threats to natural resources in the A.T. corridor, though they are not as frequently cited as the threats previously mentioned.

Various types of development are noted as threats along the Trail, including ski Trail development (Pico Peak and Shrewsbury Peak, VT and Saddleback Mountain, ME), housing developments (Buzzard Rock to Wilson Gap and Crescent Rock, WV), landscaping and maintenance along a railroad line (Housatonic River, CT and Hunters Run, PA), and utility line clearing (Beartown Woods and Little Gap Barren, PA). Roadwork and maintenance were noted as threats at Upper Crabtree, VA; Whitetop Laurel, VA; High Rock/Sams Gap, NC; Warner Hollow, MD; Millbrook, NJ; and roadside mowing was noted as a threat to natural heritage resources at Hazeltop Ridge, Horsehead Overlook, and Whitetop Mountain in VA, and Vossburg Hills, MA. Other developments that could impact natural heritage resources along the A.T. include Crawford Path-Mt. Washington, NH, and Mt. Greylock, MA. Trail relocations, shelter construction, and vista clearing were noted as threats to natural heritage resources at a few locations along the Trail.

Recreation use other than hiking was listed as a threat to natural heritage resources at some locations along the A.T.. Off-road vehicles have been documented as problematic at Doll Flats, TN; Bear Mountain, CT; Hunters Run, PA; Whitetop Mountain, VA; Hughes Gap, NC; Temple Ridge, NC; Cheoah Gap, NC; and Dalton Gap, ME. Several of these sites are among the most important natural heritage sites along the A.T.. Horse use along the Trail was documented as a threat at Taylor Hollow and Unaka Mountain in NC. Grazing or trampling by horses and cattle was noted as threats to natural heritage resources at the important Mt. Rogers and Pine Mountain natural heritage sites in Virginia and at Bishop Hollow Natural Heritage site in Tennessee. Rock climbing was noted as a threat to rare species at a few locations along the Trail. Overfishing was noted as a potential threat at Bald Mountain Pond and Rainbow Lake along the A.T. in Maine.

Competition from invasive native plant species, such as blackberry and poison ivy, was noted as a threat to natural heritage resources at Stover Branch and Turkeypen Gap, TN;

Roan Mountain, NC/TN; Upper Goose Pond, MA; and Blue Ridge Gap, GA.

Damming by beavers was noted as an existing or potential threat to rare plants and natural communities in New Hampshire, Vermont, Massachusetts, and Virginia.

A variety of threats to water resources were noted in the natural heritage inventories. Groundwater contamination was noted as a potential or existing threat at Reservoir Hollow, Calf Mountain Springs, McCormick Gap, Dripping Rock, and Hickory Spring in VA and at Lindy Camp Bog and Rich Knob in TN. Groundwater withdrawal or alteration of site hydrology were noted as possible threats at several of these same sites, as well as at hiker huts adjacent to natural heritage sites in New Hampshire's White Mountains. Other water-related threats noted at one or more natural heritage sites in the A.T. corridor are agricultural drainage, dumping, wetland drainage, flooding, and lake eutrophication. The use of herbicides or pesticides was noted as a potential threat at some sites, including several in northern Virginia, where the globally rare Blue Ridge Mountain amphipod is found. Poor sanitation or human waste were noted as problems at a few natural heritage sites, including the important Bulls Bridge site in Connecticut.

Air pollution or acid rain are known or suspected threats to natural heritage resources at several locations along the A.T., including Great Smoky Mountains National Park, NC/TN; Roan Mountain, NC/TN, and Shenandoah National Park, VA.

Fire suppression was noted as a threat at several natural heritage sites along the Trail, where plant communities or individual species are believed to be fire dependant.

Current Biological Resources Programs for the Appalachian Trail

1. Natural Heritage Inventory Program

Between 1989 and 2001, natural heritage inventories were completed in each of the 14 states through which the Appalachian Trail passes. These inventories, which were conducted by state natural heritage programs or contractors using the state's natural heritage program inventory protocols, documented rare, threatened, and endangered (RTE) species and rare or exemplary natural communities on all Appalachian Trail lands (defined as all Appalachian Trail Park Office land and other public lands within 500 feet of the Appalachian Trail footpath). All 14 of the Appalachian Trail natural heritage inventories documented vascular plants on Appalachian Trail lands, and all of them documented some rare or exemplary natural communities. However, documentation of RTE vertebrates on Appalachian Trail lands varied significantly from state to state. In a few states, non-vascular plants and selected invertebrates were inventoried. The natural heritage inventory reports prepared for each state describe and map each species and natural community, and list threats and management recommendations to protect them. The State Natural Heritage Offices and independent biological

contractors conducted the inventories and prepared the inventory reports.

Initially, the Appalachian Trail Park Office (APPA) and the Appalachian Trail Conservancy (ATC) shared responsibilities for coordinating the effort. Between 1989 and 1997, ATC assumed responsibility for the program. From 1997 to the present date, the APPA Natural Resource Specialist has coordinated the program. The contract or cooperative agreement administrators for the Appalachian Trail natural heritage inventories have been the APPA Natural Resource Specialist and/or the ATC Regional Representatives and Trail Management Director. The APPA Natural Resource Specialist, ATC regional staff, other agency staffs and Trail club volunteers have reviewed the inventories. Funding for the inventories has come from many sources: APPA, ATC, the USDA Forest Service, the National Forest Foundation, state agencies, corporate sponsors, and a variety of private, non-profit foundations and organizations.

See *Table III.E.1, Inventories of Natural Heritage Resources along the Appalachian Trail, by State*.

Information from the natural heritage inventories was initially input into TREAD, a relational database developed by the Appalachian Trail Conservancy to store and analyze Trail management data. In 2002 and 2003, the data from the A.T. natural heritage inventories were exported into an Access database. Locations of RTE species occurrences from each of the A.T. inventories have been entered into a geographic information system by the APPA Physical Science (GIS) Specialist and several interns.

2. Natural Heritage Monitoring Program

The primary purpose of the Appalachian Trail natural heritage monitoring program is to track the status and trends of the rarest or most threatened plants, animals, and natural communities located along the Appalachian Trail. Each of the natural heritage inventories for the 14 Appalachian Trail states recommended that many of the RTE species and sites be monitored on a regular basis. After the completion of each inventory, volunteer monitors were sought from the Appalachian Trail clubs and trained during one-day monitoring workshops to conduct some basic monitoring of the rarest or most threatened species within their club's section of the Appalachian Trail. APPA natural resource staff, along with staff from the State Natural Heritage Offices, the USDA Forest Service, botanical contractors, and ATC have provided training to the Appalachian Trail natural heritage monitors. Similar data are recorded in all states, though the monitoring form has been modified several times during the last few years. Monitoring workshops for natural heritage resources in Pennsylvania, New Hampshire, Vermont, Connecticut, and North Carolina were held during the early 1990s, and workshops for each of the remaining states were held from 1998 to 2004. Additional natural heritage monitoring workshops have been held in most of the A.T. states since 2001.

Since 1990, approximately 160 volunteer natural heritage monitors have been trained to monitor RTE plants, animals, and communities at approximately 30% of the 515 natural heritage sites identified on Appalachian Trail lands. More than 95% of the occurrences placed in the monitoring program are of rare plants, with only a few rare animal species (birds) or plant communities placed into the program. The monitoring of rare birds has met with less success than the monitoring of rare plants. Most volunteer natural heritage monitors have been from Trail clubs, though in recent years, monitors from outside the Trail clubs (*e.g.*, Sierra Club and New England Wild Flower Society) have been sought.

A monitoring coordinator coordinates the volunteer monitors within each state or region. Primary responsibilities of the monitoring coordinators include seeing that the assigned volunteers monitor their sites and submit their reports annually, as well as seeking replacement monitors for sites that need new monitors. State coordinators for the Appalachian Trail volunteer natural heritage monitoring program currently include staff from the ATC regional offices, the Appalachian Mountain Club, and the New York-New Jersey Trail Conference, as well as volunteer monitoring coordinators from the Maine Appalachian Trail Club, the Appalachian Mountain Club, the Potomac Appalachian Trail Club, and the Georgia Appalachian Trail Club. The APPA Natural Resource Specialist is responsible for overall coordination of the Appalachian Trail natural heritage monitoring program.

For many years, monitoring data from the volunteer natural heritage monitoring reports were put into the TREAD database at ATC. In 2002 and 2003, these data were exported into Access. Data from the monitoring reports have been entered primarily by ATC volunteers, but also by ATC staff.

Approximately 50-60% of the 130 natural heritage sites in the Appalachian Trail natural heritage monitoring program are typically monitored each year. Monitoring success is usually good after a workshop, but declines over the years as volunteers move or lose interest. To maintain a strong program, new monitors need to be recruited by the state and club monitoring coordinators and trained regularly by natural resource staff at ATPO, ATC, or by the contract botanists who conducted the inventories. Improvements in data collection and management also needs to occur. Though the same monitoring form is utilized Trailwide, there is considerable variation in the thoroughness of the data that are collected by volunteers.

In 2002 and 2003, a botanical contractor monitored approximately 50 priority natural heritage sites (about 25 each year) in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, and Pennsylvania. This monitoring effort provided a professional botanical evaluation of the status, trends, and threats of the sites that were monitored. At a number of sites, the botanist assisted a volunteer natural heritage monitor in locating the species to be monitored. Funding for this project was provided by the APPA.

3. Natural Resource Management Projects

The natural heritage inventories that were prepared for each of the 14 Appalachian Trail states between 1989 and 2001 documented the status of and threats to more than 2,100 RTE species and rare or exemplary natural communities. Taken as a whole, the inventories contained several thousand management recommendations to protect RTE species and rare or exemplary natural communities. Among the most frequently cited management recommendations are: monitoring the site, informing Trail maintainers of plants that could be damaged during Appalachian Trail maintenance, controlling exotic species, vegetative manipulation to remove competing species, relocating the Trail, controlling erosion, using ridgerunners to discourage inappropriate or illegal uses, and use of signage to educate users.

Other than monitoring, one of the most frequent management recommendations in the natural heritage inventories was to inform Trail maintainers of the presence and location of threatened and endangered species so that they would not inadvertently harm them during their maintenance work. To address this recommendation, in 2001 the APPA Natural Resource Specialist and ATC volunteers and staff prepared approximately 200 rare plant identification sheets of RTE plants that had been documented immediately beside the tread of the Appalachian Trail. Each rare plant identification sheet included an illustration and color photo of the plant, along with a non-technical description of the plant, the best time to identify the species, and a topographic map showing the location of the plant along the Appalachian Trail. The rare plant identification sheets were distributed through Appalachian Trail club leaders to those maintainers on whose Trail sections these plants are found, along with an instruction sheet explaining the project and how to avoid harming the rare species.

Along with monitoring, controlling invasive exotic plants (described below), and informing Trail maintainers of RTE plants by the Trail tread, other management recommendations from the Appalachian Trail natural heritage inventories have been implemented to protect RTE species along the A.T.. At one natural heritage site in Massachusetts, a short Trail relocation was made so that the Appalachian Trail would avoid passing through a population of the state endangered *Agrimonia parviflora* (agrimony). In Pennsylvania, fencing was erected around five subpopulations of the globally rare *Euphorbia purpurea* (glade spurge) to protect the plants from herbivory by deer or other wildlife. Signage informing hikers of rare plants has been erected in Maine. Scree walls have been constructed on either side of the Trail footpath on alpine summits in New Hampshire to restrict visitor use. Several areas, including the Roan Mountain area of NC/TN, are maintained as open areas through mowing or grazing. Ridgerunners also educate hikers in appropriate backcountry use, to minimize

recreational impacts on natural resources, including rare plants and animals. Management projects have been implemented by the APPA Natural Resource Specialist, ATC regional staff and volunteers, and by a contract botanist funded by the APPA.

4. Invasive Exotic Species Management Program

The APPA Natural Resource Specialist has been responsible for overall coordination of the Appalachian Trail Exotic Species Program. Additional coordination has been provided by ATC regional staff. Utilization of NPS Exotic Plant Management Teams has been critical to accomplishing invasive exotic species control along the A.T..

Interest by ATC staff and volunteers in the management and control of invasive exotic plant species began to grow about ten years ago. In 2001, the ATC Board of Managers adopted a three-pronged policy on invasive exotic species: education, monitoring, and control. Priority for controlling invasive exotic species is given to RTE species occurrences that are threatened by exotics and to locations that would have the highest likelihood of successful treatment. Several workshops have been held at ATC Biennial Conferences during the past seven years to educate ATC members about the invasive exotic species problem and what can be done about it. Workshops at ATC gatherings have been provided by the APPA Natural Resource Specialist, the NPS Exotic Plant Management Team Liaison for the National Capital Region, and a USDA Forest Service botanist. Over the last few years, volunteers from Trail Clubs and environmental groups have become increasingly interested in tackling the invasive exotic species problem along the A.T.. In 2008, approximately 20 monitoring events utilizing more than 150 school and environmental group volunteers have performed invasive exotic plant control along the A.T., mostly in northern Virginia.

Knowledge of where invasive plant exotic species are located on Appalachian Trail lands has been growing rapidly. Some of the state natural heritage inventories prepared for the Appalachian Trail between 1989 and 2001 documented the presence of many invasive exotic species, especially some of the more recent inventories. Since 1997, a botanical contractor has documented invasive exotic plant occurrences on Appalachian Trail lands in Massachusetts, New York, New Jersey, and Connecticut, particularly where they are co-located at rare, threatened, and endangered species sites. In 2002 an Appalachian State University student documented the presence of exotics along 400 miles of the Appalachian Trail in North Carolina and Tennessee (excluding Great Smoky Mountains National Park), and he found that most occurrences of exotic plants were located at road crossings of the Appalachian Trail. In 2005, Virginia Tech graduate Adam Canter completed a survey of 24 invasive exotic plant species on the entire Appalachian Trail. The Canter survey documented a total of 472 occurrences of exotic plants at 250 sites along the A.T.. This study found that the greatest percentage of the A.T. to be impacted by exotic species coverage occurred in the Mid-Atlantic states.

For several years beginning in 2002, a monitoring program of invasive exotic plants on

and adjacent to Appalachian Trail lands began in the southern Appalachians. Utilizing APPA and other funding, the Southern Appalachian Man and the Biosphere (SAMAB) Program trained and managed groups of volunteers to document and monitor the presence of 15 invasive exotic species from northeast Georgia to southwest Virginia. In 2008 a group from the Georgia A.T. Club conducted an inventory of invasive exotic plants along a 40-mile stretch of the A.T. in GA.

Also in 2002, the APPA Natural Resource Specialist sought assistance from the NPS National Capital Region Exotic Plant Management Team (EPMT). That EPMT mapped exotic species occurrences at three RTE species sites in northern Virginia and southern Pennsylvania, and the team has since undertaken herbicide control at two of the sites. In 2004, APPA began coordinating additional exotic plant control projects in Pennsylvania with the NPS Northeast EPMT, and in 2008 this EPMT, along with a Weed Team from the Student Conservation Association, began invasive exotic plant control at five RTE species sites in MA. In 2006, the Mid-Atlantic EPMT began to do exotic plant control along a segment of the A.T. in northern VA. In 2007, the Mid-Atlantic EPMT program expanded to coordinate student and environmental volunteer groups to physically remove exotic plants from the A.T. corridor in northern VA. Also in 2008, The Nature Conservancy is controlling invasive exotic plants at several sites on NPS Appalachian Trail lands in MA and CT

In 2002 and 2003, a contract botanist funded by the APPA undertook some small-scale manual removal of invasive exotic species at a handful of RTE species sites along the Appalachian Trail from New Jersey to Massachusetts. The botanist was occasionally assisted by ATC volunteers.

5. Botanical Inventory Work in Connecticut and Massachusetts

In 2003, Ted Elliman, a botanical contractor funded by the APPA, inventoried all vascular plant flora found on Appalachian Trail lands in Connecticut. This botanist also documented all vegetation community types within the A.T. corridor in CT. RTE species populations were re-inventoried. A report on this work was completed in 2004.

In 2005, Elliman undertook a similar comprehensive field survey of all vascular plant flora, RTE species occurrences, exotic plant occurrences, and all vegetation community types within the A.T. corridor in MA. Invasive exotic species were found to be a threat at more than one-half of the RTE species sites along the A.T. in MA. Thirty-one vegetation community types were documented within the A.T. corridor in MA. A report on this work was completed in 2007.

This comprehensive botanical work that has occurred in CT and MA could be duplicated along the A.T. corridor in additional states, either on all A.T. corridor lands or only in states where NPS A.T. land is located.

6. Open Areas Management Program

Approximately 4,490 acres of open areas need to be maintained to provide habitat diversity and scenery. Roughly 955 acres are kept open under agricultural special use permit arrangements; and another 300 acres, on average, are mowed annually by contractors and volunteers. However, numerous former fields and pastures are being lost to succession. Funding is needed for equipment and contract personnel

Biological Resource Management Needs

Evaluate threats and management recommendations in the Appalachian Trail natural heritage inventories for the highest priority RTE species and sites on Appalachian Trail Park Office land. The 2,100 RTE species and community occurrences and 515 natural heritage sites have been prioritized Trailwide, based on their global and state rarity and federal and state status. More than 300 RTE species occurrences on Appalachian Trail Park Office land have also been prioritized. The 100 highest priority RTE species occurrences on Appalachian Trail Park Office land have been evaluated for the level of threat to those occurrences, based on the information provided in the Appalachian Trail natural heritage inventories. However, many of those threats have not been assessed in the field for a decade or more. An on-the-ground evaluation of the current threats and management options for protecting these species needs to occur, with a decision made as to what management actions should be implemented at each site. Discussions and coordination with managers of other Appalachian Trail lands could occur regarding the protection of RTE species that are not on Appalachian Trail Park Office land.

Implement management actions to protect the highest priority RTE species occurrences and sites on Appalachian Trail Park Office land. Among the management actions that could be implemented are exotic plant control, vegetative manipulation to remove competing species, placement of scree walls to define the Trail and reduce trampling, relocating the Trail, controlling erosion, and placement of signs to educate users. Implementation of many management actions would rely heavily on the use of ATC and other volunteers. Additional staff and volunteer resources are needed to evaluate, coordinate, and implement management actions at RTE species sites on Appalachian Trail Park Office land. In some cases, if management actions are not taken, some RTE species occurrences will be lost due to a variety of threats.

Additional expertise in wildlife biology or zoology is needed in order to address wildlife management issues on the Appalachian Trail. Approximately 200 occurrences of RTE vertebrates and invertebrates have been identified on Appalachian Trail lands in the few states where inventories of some RTE animals have occurred. Many more RTE vertebrates are likely to be identified in future RTE inventories of the Appalachian Trail. At the present time, almost no monitoring is occurring for any vertebrates or

invertebrates on Appalachian Trail lands. A wildlife biologist would be able to establish a wildlife monitoring program for the Appalachian Trail and evaluate and implement wildlife management recommendations from the Appalachian Trail natural heritage inventories.

Monitoring of rare and exemplary natural communities on Appalachian Trail lands is needed in order to assess vital signs, trends, and threats to those communities. Currently, almost no monitoring of rare or exemplary communities occurs on Appalachian Trail lands. Management actions to protect these natural communities could also be assessed and implemented on Appalachian Trail Park Office land. In addition, there could be additional collaboration with other federal and state agencies regarding the protection of natural communities on land that they manage. The state natural heritage inventories identified more than 450 occurrences of rare and exemplary natural communities on Appalachian Trail lands, so there is no shortage of significant resources to be monitored and protected. Among the rare natural communities that have been identified on Appalachian Trail lands are alpine tundra, subalpine krummholz, subalpine spruce fir forest, grassy balds, fens, calcareous seepage swamps, and pitch pine-scrub oak barrens. The only alpine area in the national park system in the Eastern United States is located on NPS A.T. land in Maine. The A.T. passes through nine diverse ecosystems along its route from GA to ME.

Continue to develop a program to inventory and monitor exotic plants and insect pests on Appalachian Trail lands. Though many invasive exotic plant species were documented along the A.T. corridor from GA to ME in 2005, that survey was not as complete in GA and from NJ to MA. The presence, extent, and threat level at individual exotic species sites should be documented for GA, NJ, NY, and CT. Exotic species occurrences have been documented in only a handful of occurrences in VT, NH, and ME, and additional inventory work in these states could confirm whether invasive exotic plants have become an increasing problem along the A.T. corridor there. Concentration on inventory and monitoring of exotics could be given to Appalachian Trail Park Office lands or to sections of the Trail with the highest priority RTE species occurrences. A primary goal of this inventory and monitoring work would be to prioritize RTE species sites on Appalachian Trail Park Office land for exotic species control. The inventory and monitoring of exotic species could also provide early warnings to land managers regarding new occurrences of exotic species that might be easily controlled.

Control exotic species at high priority sites on Appalachian Trail Park Office land. The presence of invasive exotic plants has been documented on several thousand acres in the A.T. corridor, and its presence continues to grow and expand into new areas. Mapping and control of invasive exotic plants currently utilizes three NPS Exotic Plant Management Teams (EPMTs) to a limited degree. Generally, only about two sites per year can receive exotics control by each of three NPS EPMTs. Exotic species can be removed by chemical, physical, or biological means, but the NPS EPMT's largely rely on the use of herbicides. In order to more quickly protect a greater number of RTE species

and rare or exemplary communities from invasive exotic plants, an Appalachian Trail Exotic Plant Management Team could be established to control invasive exotic plants solely on Appalachian Trail Park Office land. Exotic species could also be controlled at locations where they have just begun to invade an area. An EPMT dedicated to the Appalachian Trail could control a much greater number of exotic plant sites before RTE species sites are severely impacted.

Additional staff resources are needed to coordinate the inventory, monitoring, and management of invasive exotic plants and insect pests that are impacting Appalachian Trail biological resources. Inventory and monitoring of exotic plants and insect pests could occur Trailwide, but control of exotics would occur only on Appalachian Trail Park Office land. This person would be responsible for prioritizing exotic plant sites for control. They could also take the lead in establishing an EPMT for Appalachian Trail Park Office lands. This individual also would develop an Integrated Pest Management Program for Appalachian Trail Park Office lands. They would identify locations that have been invaded by the gypsy moth, hemlock woolly adelgid, and other insect pests and would evaluate those occurrences for control. This person would take the lead in controlling exotic insect pests at high priority locations on Appalachian Trail Park Office land. They would also coordinate with other agencies that wished to control insect pests on Appalachian Trail Park Office land. A program to monitor health threats, such as West Nile Virus and Lyme Disease, on Appalachian Trail lands could also occur.

Inventories of RTE vertebrates are needed in many Appalachian Trail states. Inventories for RTE vertebrates are incomplete and vary from state to state. For example, some states such as Massachusetts and Virginia inventoried RTE species in each of the four vertebrate groups (mammals, birds, reptiles and amphibians, and fish), while other states such as New Jersey and Maryland did not inventory any RTE vertebrate groups. Funding is needed to complete an inventory of RTE vertebrates in states with Appalachian Trail Park Office land that have not received inventories of all vertebrate groups. These inventories would provide knowledge of the presence of and threats to RTE vertebrates on Appalachian Trail lands, which is needed in order for these resources to be protected. An inventory of small RTE mammals in Pennsylvania, New Jersey, New York, and Connecticut was completed in 2007, and an inventory of small mammals, bats, and lynx was completed in Maine in 2008. Additional RTE mammal inventory work will likely be needed in the A.T. corridor in these and other states. Inventories of all RTE mammals are needed in Massachusetts, Maryland, West Virginia, and a portion of Virginia. Inventories of RTE birds on NPS Appalachian Trail lands are needed in Maine, Connecticut, New York, New Jersey, Pennsylvania, Maryland, and West Virginia. Inventories of RTE reptiles and amphibians are needed in Maine, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Maryland, and West Virginia. Inventories of RTE fish may be needed on NPS Appalachian Trail lands in order to provide a complete picture of RTE vertebrates along the Trail. Some limited inventory work on vertebrate groups has been done in some states, but a thorough inventory of all vertebrates has not been completed in any state. Inventories on non-Appalachian

Trail Park Office land in Virginia could also occur. Particularly in the southern Appalachian states, there is good potential for finding occurrences of RTE vertebrates, since the region has such a high number of globally rare species.

Additional monitoring of high-priority RTE species occurrences on Appalachian Trail lands is needed in order to understand the status, trends, and threats to those resources. The Appalachian Trail Natural Heritage Monitoring Program was evaluated in 2007 and 2008, and a large number of recommendations were made to improve and expand the program. The evaluation identified program strengths and weaknesses in recruitment, training, monitoring, and support of volunteer monitors, as well as in data collection and analysis. Many high priority RTE species sites are currently without an active monitor, and some sites that are monitored need to be assessed more thoroughly. Increased staff and volunteer resources are needed to implement many of the recommendations in the recent evaluation of the A.T. Natural Heritage Monitoring Program. Additional monitoring of RTE species sites by staff, a contract biologist, and volunteers is one of the many monitoring recommendations made in the evaluation report. Another recommendation is to increase consultation with other Appalachian Trail land management agencies and state natural heritage offices regarding monitoring of RTE species within the A.T. corridor.

A vegetation map of Appalachian Trail lands is needed, particularly for those sections of the Trail located on Appalachian Trail Park Office land. Vegetation mapping will provide a more complete picture of the plant communities that are found on Appalachian Trail lands. Completing a vegetation map for the Appalachian Trail will also fulfill one of the twelve basic natural resource inventories of the NPS Inventory and Monitoring Program. Vegetation maps also would provide useful information on agricultural use, development, and impervious surfaces on or adjacent to the Trail. Initial work to prepare for vegetation mapping of the A.T. was begun in 2007 in a cooperative agreement with NatureServe, but a large amount of funding will be needed to actually do the aerial photography and vegetation mapping of the A.T. corridor

Species lists to determine 90% of vascular plant and vertebrate species need to be prepared to meet one of the goals of the NPS Inventory and Monitoring Program. Thus far, an inventory of all vascular plants has been conducted on Appalachian Trail lands in only two states, Connecticut and Massachusetts. A cost assessment and comparison for doing this work should be prepared to determine whether this Inventory and Monitoring goal should be completed for 1) all Appalachian Trail lands, 2) states containing Appalachian Trail Park Office lands, or 3) solely Appalachian Trail Park Office land.

Open areas need to be maintained. Approximately 4,490 acres of open areas need to be maintained to provide habitat, diversity, and scenery. Roughly 955 acres are kept open under Special Use Permits administered by the Appalachian Trail Park Office; and another 300 acres are mowed annually by volunteers or contractors. However,

numerous fields and pastures are being lost to succession. Funding is needed for equipment and contract personnel.

An integrated GIS-supported database of RTE occurrences needs to be updated and matched with state natural heritage program data. Data needs to be entered, corrected, mapped, and matched with state natural heritage program data.

G. Air Resources

Air Resource Threats

There are currently four major air quality threats on the Appalachian National Scenic Trail:

(a) Regional haze adversely affects visibility. Views, vistas, and scenery are key components of the recreational opportunities provided by the Appalachian National Scenic Trail. Visibility is seriously degraded along much of the Trail. Degradation is a result of a variety of factors, but is principally due to the presence of fine sulfate particles in the air. Recent IMPROVE data indicates that sulfates are responsible for 60 to 75 percent of visibility impairment in the eastern United States. In their 1990 State of Science and Technology report on acid rain, the National Acid Precipitation Assessment Program (NAPAP) estimated that under natural conditions, without the influence of human-caused air pollution, visual range in the eastern United States is approximately 90 miles. Median annual visual ranges in Shenandoah National Park and Great Smoky Mountains National Park have been measured at 24 miles or less, with median summertime visual ranges of 12 miles or less. Visual ranges have been measured in Great Smoky Mountains National Park at one mile or less during severe haze episodes.

(b) Elevated nitrate and sulfate levels contribute to acid deposition, which can adversely affect streams, water bodies, soils, and terrestrial and aquatic organisms. The Appalachian Mountains receive some of the highest deposition rates in North America. Deposition effects have not been studied on the Appalachian Trail; however, acidification and associated adverse effects have been observed at Great Smoky Mountains National Park, Shenandoah National Park, and a number of National Forests in the Appalachian Mountains. Therefore, there is a high probability that soil and surface water acidification, soil nutrient imbalance, and plant and animal species loss is occurring on the Trail as a result of acid deposition.

(c) Poor air quality can adversely affect the health of visitors and workers on the Appalachian Trail. High ozone concentrations cause respiratory problems in humans and are a particular concern for those who are engaging in strenuous aerobic

activity, such as hiking or Trail maintenance. High ozone levels can be dangerous for people with respiratory problems like asthma, and can even temporarily reduce lung function in healthy individuals. Data collected at nearby ozone monitors indicate that summertime ozone concentrations reach levels on many sections of the Appalachian Trail that are harmful to humans.

(d) High levels of ozone adversely affect vegetation. Ozone damages sensitive plant species by causing a visible spotting or "stipple" on the upper surface of the leaves. Ozone can affect plant physiology by reducing growth, increasing susceptibility to disease, and increasing senescence. Some plant communities along the Appalachian National Scenic Trail may be threatened by increases in ozone. Ozone can cause reduced photosynthesis, reduced growth, premature aging, and leaf loss with or without the occurrence of foliar injury. A list of ozone-sensitive species found on the Appalachian Trail is provided in *Appendix E, Ozone Sensitive Species Found on the Appalachian Trail*. A recently-completed risk assessment indicates ozone concentrations on many sections of the Trail likely reach levels that are harmful to these sensitive plant species. Therefore, plant communities along the Appalachian National Scenic Trail may be threatened by current or increased levels of ozone. This is a particular concern for high-elevation, ridge-top communities, where elevated ozone concentrations are frequently more prevalent.

Current Air Resource Programs on the Appalachian Trail

The Appalachian National Scenic Trail passes through a number of national parks and forests with well-established air quality monitoring programs. In addition, numerous air quality monitoring stations are located proximate to the Trail.

However, the Appalachian Trail Park Office and the Appalachian Trail Conservancy do not currently have any staff dedicated to air resources and have not actively participated in, reviewed, or commented upon air quality issues affecting the Appalachian Trail. Staff members at the Appalachian Trail Park Office rely on the NPS Air Resources Division, the NPS Northeast Regional Office Air Resources Coordinator, and the NPS Air Quality Ecological Effects Coordinator for assistance with air resource issues. To date, that assistance has consisted of (1) development of air quality baseline data and (2) assistance in preparation of this *Appalachian Trail Resource Management Plan*. In addition, as part of their regular duties, the Washington Office and Northeast Regional Office Air Resources personnel evaluate the potential effects of air pollution sources when reviewing relevant permit applications.

The Appalachian Trail Conservancy has initiated a pilot program to expand upon the Appalachian Mountain Club's VizVol Program in New England. This program, which is being administered by ATC's environmental monitoring coordinator, is still under development. Viz Vols provides volunteers with cameras to document visibility and ozone monitors to measure ozone levels. Data are compiled by Appalachian Mountain

Club staff. In addition, the Conservancy follows and occasionally participates in national air quality issues through coordination with the Hikers for Clean Air coalition.

Air Resource Management Issues and Needs

The overriding needs for managing air resources along the Appalachian Trail are (1) to develop a coherent, comprehensive process for measuring air quality and air pollution effects along the entire Appalachian Trail and (2) to retain sufficient staff capability to analyze and report on air quality conditions along the Trail to the public, the department, the Environmental Protection Agency, and Congress.

Given that one of the purposes of the Appalachian National Scenic Trail is to preserve scenic qualities along the Trail, visibility impairment should be an area of particular concern for Appalachian Trail managers. Monitoring visibility impairment along the Appalachian National Scenic Trail could be accomplished by combining particle data from existing (and potentially new) IMPROVE sites with photographic data from existing (and potentially new) Webcam sites along the Trail. A series of monitors at key locations along the Trail would allow Appalachian Trail managers to document the range of visibility conditions, determine trends in visibility degradation, and compare and contract visibility parameters at different points on the Trail.

Trail managers need to have a better understanding of ozone levels along the Trail, as well as the potential risks that ozone concentrations may cause for hikers and Trail workers. In addition, based on 1995-1999 interpolated SUM06 ozone values, ozone concentrations along the Trail are high enough to cause foliar injury and/or growth effects of ozone-sensitive vegetation. Such effects are likely to occur anywhere except those segments of the Trail in upper Massachusetts, Vermont, New Hampshire, and Maine. Species with documented sensitivity to ozone occur on the Trail; however, to date, ozone injury surveys have not been conducted. Surveys need to be conducted along the Trail that focus on good bioindicator species (i.e., species with well-documented symptoms), using accepted protocols and concentrating on areas with a high likelihood of injury (e.g., high SUM06 values and high soil moisture). The program would establish long-term monitoring plots, document the extent of injuries to vegetation, verify cause and effect relationships, and prepare credible scientific documentation of effects.

Finally, acid deposition is a potential threat to Trail aquatic and terrestrial resources. Trail managers need to survey Appalachian Trail soils and surface waters to determine their sensitivity to acid deposition, then monitor changes in soil and water chemistry, species composition, and population densities in acid-sensitive areas.

H. Water Resources

Water Resource Threats

There are four general threats affecting Appalachian National Scenic Trail water resources:

a. Climate Change. Annual variation in climatic conditions is normal, however, a growing body of evidence suggests a trend toward warmer climatic conditions and that the rate of climatic change may be increasing. Water resources, just like every other resource type are susceptible to climate change and may be dramatically altered as a result of modified climatic conditions. For example, if atmospheric moisture levels increase and result in higher levels of precipitation, base and storm water levels will likely increase and may cause alterations to stream morphology. There are a number of scenarios that may occur depending on what climatic changes manifest themselves. If stream temperatures rise, conditions that support fish populations that are currently at the edge of their range may cease to exist and those populations may become extirpated. Likewise, if temperatures rise sufficiently, the forms of precipitation may shift with snow becoming less common in southern high elevation areas; the duration of snowpack may decrease; and, ice free days may increase for lakes and ponds. Given that some amount of change is likely to occur, some alteration in aquatic and vegetative species composition and stream and lakeshore morphology is likely. Species composition alteration or mortality may affect water quality.

b. Wet and dry deposition. The Appalachian Mountains receive some of the highest nitrate, sulphate, and heavy metal deposition rates in North America. Although deposition effects have not been studied along the Appalachian Trail specifically, acid deposition and associated adverse effects have been studied in Great Smoky Mountains National Park, Shenandoah National Park, the Adirondack Park and a number of National Forests in the Appalachian Mountains. Based on the results from these investigations, it is reasonable to anticipate that soil and surface water acidification, soil nutrient imbalance, as well as plant and animal species loss may be occurring within the Appalachian Trail region. While sulfur deposition has decreased since the 1990 Clean Air Act standards were enforced, ecosystem recovery along the Appalachian Trail is not well understood and may be happening more slowly than expected. Episodic acidification has been demonstrated during spring snowmelt and rain events, which is a stress to the aquatic environment.

c. Nutrient enrichment. Waters that receive high levels of nutrients, usually nitrogen and phosphorus, typically show high levels of primary productivity. Highly productive systems are termed eutrophic, whereas systems characterized by low productivity are termed oligotrophic. Eutrophic conditions are more

common where the native soils have higher natural levels of nutrients and/or in systems that are located relatively 'low' in their respective watersheds. Conversely, waters that are positioned higher in a watershed are typically less nutrient rich than waters positioned lower in the same watershed. Two leading anthropogenic causes for eutrophic conditions include agricultural and development activities, and under extreme circumstances affected waters may be deemed hyper-Eutrophic. The Appalachian Trail, which is typically positioned high in the watersheds through which it passes may be less affected by either these two leading causes of nutrient enrichment than by atmospheric inputs of nutrients and human waste disposal because it is positioned 'above' these sources. Waters that are typically impacted by agriculture or development are positioned "downstream" of the impacts, thus, the impacts that threaten the Appalachian Trail region must either arrive atmospherically or with the users of the Trail itself. Increased inputs of nutrients at higher elevations, either through atmospheric deposition (e.g., ammonium) or by imprudent human waste disposal (e.g., privies located too close to a stream or pond) may dramatically alter stream species composition by favoring species that are better able to utilize the increased nutrient concentrations; and, may cause public health concerns related to increased levels of fecal bacteria.

d. Erosion. Like the other potential threats, erosion is a natural process, and under normal conditions natural erosional forces help enforce stream stability, provide a natural source of nutrients, and provide material for land formation. However, unlike the aforementioned three threats, erosion is the consequence of other activities and not the cause itself. Increased rates of erosion may destabilize streams and may result in the loss of land, including Trails and properties and may be the result of causes such as: increased inputs of water into an otherwise stable system (i.e., a severe storm event); problems with bridges or crossings (i.e., improper positioning or sizing of culverts or bridges); physical disturbances to banks or shorelines; or soil compaction (i.e., concentration of foot traffic leading to increase in soil density and water runoff versus water infiltration). Changes to natural erosion patterns may be episodic or incremental, but in either case they may lead to habitat alteration within the water resource itself, or in the case of more dramatic events to adjacent lands. Increased sediment load may change stream substrate and impact breeding and refuge opportunities.

Current Water Resource Programs on the Appalachian Trail

The Appalachian National Scenic Trail passes through a number of national parks and forests with well-established water quality monitoring programs. In addition, numerous water quality monitoring stations are located proximate to the Trail. However, the Appalachian Trail Park Office and the Appalachian Trail Conservancy do not currently dedicate any resources solely to water resources and have not actively participated in,

reviewed, or commented upon water quality issues affecting the Appalachian Trail. Staff members at the Appalachian Trail Park Office rely on the NPS Water Resources Division (WRD) and the NPS Northeast Regional Hydrologist for water resource issues for guidance and input on water resource related issues affecting the Trail.

The Appalachian Trail Conservancy and the Appalachian Trail Park Office have jointly administered a volunteer Water Quality Monitoring Program. Data from the volunteer effort is relatively wide-spread and not targeted toward a specific resource type or concern. Volunteer monitoring is and economical and essential component of the A.T. water monitoring program, and like any such program it will require stringent QA/QC, data archival, and periodic review.

The NPS Water Resource Division is currently funding (FY 2008) a Level 1 Water Resource Inventory for the Trail that will help resource managers identify areas of concern and data gaps; locations to target for future monitoring; and, will help set a baseline for future water quality monitoring activities. The Northeast Temperate Network is also funding an effort to review existing volunteer appropriate water quality monitoring protocols with the intention of adapting one or a combination of several protocols to develop a single water quality monitoring protocol that will be implemented along the Trail.

Water Resource Management Issues and Needs

The overriding needs for managing water resources along the Appalachian Trail are (1) to develop a coherent, comprehensive process for measuring water quality and associated ecological effects along the entire Appalachian Trail and (2) to analyze and report on water quality conditions along the Trail to the public, the department, the Environmental Protection Agency, and Congress.

I. Threats and Program Needs for Cultural Resources

This section identifies threats to and issues concerning management of cultural resources, describes the status of cultural resource management programs for the Appalachian National Scenic Trail, and describes overall cultural resource management program needs.

Cultural Resource Management Threats

(a) Significant Trail features may be adversely affected by Trail use and management. In some circumstances, the Trail footpath and facilities themselves are significant. Approximately 20 Trail shelters constructed by the Civilian Conservation Corps (CCC) survive, and perhaps a dozen more constructed by Trail clubs during the early years

of the Trail project still exist. The CCC also built sections of the Appalachian Trail footpath itself in the 1930s. Historically significant Trail sections and contributing features need to be identified, so that they are not inadvertently destroyed.

(b) Cultural resources are deteriorating as a result of natural and man-made causes, without programs or actions in place to protect and stabilize them. A significant (though largely unknown) number of structures, sites, and artifacts are or will be in poor condition in the next ten years, due to the effects of weather and environmental conditions. Structures are particularly vulnerable.

Sites that need immediate attention (as well as evaluation for their potential eligibility for the National Register) including the Canopus Hill Inoculation Station in Dutchess County, New York, several lime kilns in Massachusetts and Connecticut, ironworks in New York and northern New Jersey, and the Yellow Springs Village, Inclined Plane, Mine Works, and Stone Tower in east-central Pennsylvania. Several other structures, such as the Prosper Hill Ski Tow in Woodstock, Vermont, and the Rocky Run Shelter in Washington County, Maryland, has been stabilized, but additional funds may be needed to fully restore them.

Twenty-one potentially significant sites listed in the Cultural Resource Survey of the Appalachian Trail in Connecticut were identified as deteriorating, due to environmental and human impacts. An unknown number of additional sites on Trail lands in other states also are deteriorating as a result of environmental and human impacts.

(c) Cultural resources are being vandalized, relic-hunted, or removed from Trail lands. Some sites, such as the site of the Battle of South Mountain at Fox's Gap, have been the focus of relic hunters. An ARPA violation that occurred at the site in 2002 is still under investigation. Signage and monuments at the site have been vandalized or covered with graffiti.

Seven culturally significant sites listed in the *Cultural Resource Survey of the Appalachian Trail in Connecticut* showed indications of relic-hunting or pot-hunting; and 25 potentially significant sites listed in the inventory were identified as being vandalized or vulnerable to vandalism.

Public interest in other sites, such as the Ring Quarry Prehistoric Mining District in New Jersey and the Canopus Hill Inoculation Station in New York, has been encouraged by local avocational historians and cultural resource enthusiasts, which may lead to additional incidents of vandalism or relic-hunting. An unknown number of additional sites on Trail lands in other states also are subject to vandalism and relic-hunting.

(d) Cultural resource sites are affected by illegal uses, including off-road vehicle use, in

culturally sensitive areas along the Trail. Off-road vehicles were identified as a threat to 34 cultural resource sites (primarily roads and charcoal hearths) in the *Cultural Resource Survey of the Appalachian Trail in Connecticut*. An unknown number of additional sites on Trail lands in other states also are subject to illegal off-road vehicle use.

(e) Some archaeological sites are affected by public use of the Trail and Trail facilities in culturally sensitive areas along the Trail. Recreational uses of the Trail, particularly in overnight use areas, can adversely affect historic and prehistoric resources. Five cultural resource sites were identified in the *Cultural Resource Survey of the Appalachian Trail in Connecticut* as being adversely affected by camping and hiking activities. Relocations of the Trail were proposed to mitigate ongoing impacts to two sites. An unknown number of additional historic sites on Trail lands in other states also are subject to adverse impacts from Trail use.

(f) Cultural landscapes in many areas along the Trail are potentially affected by residential, commercial, industrial, and infrastructure developments on adjacent lands. In its 14-state traverse, the Appalachian Trail passes through many different cultural landscapes – most of which face development pressure that threatens to change the character of the landscape and the Trail. Although a corridor of land has been acquired to protect the Trail, the sights and sounds of civilization intrude upon the Trail environs in many areas. This is particularly true in heavily developed areas in the Mid-Atlantic Region, where a relatively narrow corridor of land protects the Trail. For example, in 2004, a 400,000-square foot commercial warehouse was constructed immediately adjacent to the Appalachian Trail in the Cumberland Valley of Pennsylvania, converting a view of woodlands and farm fields to a view of a parking lot and the side of a warehouse. Another example is a proposed racetrack that would be located within 2,000 feet of the Appalachian Trail in east-central Pennsylvania. If built, the facility would change a comparatively remote woodland setting for the Trail into a near-urban environment. While some local governmental agencies are well aware of the Trail and make land use decisions that consider Trail values, others do not.

Current Cultural Resource Management Programs

The Appalachian Trail passes through many places that have well-established cultural resource protection and interpretation programs like Harpers Ferry National Historical Park and Pine Grove Furnace State Park. Each National Forest and National Park crossed by the Appalachian Trail has an established cultural resource management program, as do many of the state park units for parks with a cultural emphasis.

For much of the Trail, however, management programs for cultural resources are few and far between, particularly on recently acquired Appalachian Trail Park Office lands. On these Appalachian Trail Park Office lands, cultural resource management programs

and projects are carried out by the Environmental Protection Specialist as an ancillary duty, with significant project-level assistance and expertise provided by the NPS Northeast Regional Office, the NPS Washington Office, the Appalachian Trail Conservancy, and other federal, state, and non-governmental organization partners. This team has completed the following programs and major projects in the past five years:

- *Cultural Resource Overview and Assessment of the Appalachian Trail in Pennsylvania*, D. Snow and S. White, The Pennsylvania State University Department of Anthropology (1999; updated 2002)
- *Historic Context for the Appalachian National Scenic Trail*, R. Grumet, National Park Service Northeast Regional Office (2002)
- *Appalachian Trail: Status of Cultural Resources*, R. Grumet, National Park Service Northeast Regional Office (2002)
- *A Gap in Time: Context, Archaeological Inventory, and Management Recommendations for the Fox Gap Section of the South Mountain Battlefield*, J. Baker, Indiana University of Pennsylvania (2003)
- Cultural Resource Survey of the Appalachian Trail in Connecticut, N. Bellantoni, K. Keegan, W. Keegan (2004)
- Cultural Resource Training Program for Appalachian Trail Volunteers in the Mid-Atlantic Region, J. Barnes (2004)
- *An Archaeological Assessment of the Brown Mountain Community*, J. Barnes (2005 – 06)
- *Methodology for Inventorying Cultural Landscapes of the Appalachian Trail (draft)*, Margie Coffin Brown, Maciej Konieczny (2006)

The cultural resource context for the Appalachian National Scenic Trail, a summary of applicable laws and policies affecting cultural resources, and an overview of cultural resource studies that have been conducted on Appalachian Trail lands are provided in two documents prepared by Dr. Robert Grumet of the NPS Northeast Regional Office, titled *Appalachian National Scenic Trail Historic Contexts* (2002) and *Appalachian Trail: Status of Cultural Resources* (2002).

The cultural resource surveys in Pennsylvania and Connecticut contain data on resource location, significance, condition, and threats for approximately 450 Archaeological Site Management Information System (ASMIS) records.

In addition, the Appalachian Trail Park Office conducts thorough compliance reviews for all project-level undertakings on Appalachian Trail Park Office lands and consults with the appropriate State Preservation Office in accordance with Section 106 of the National Historic Preservation Act. Surveys are conducted by qualified archaeologists, historians, and other cultural resource specialists as appropriate, and Forms for Assessment of Actions Having an Effect on Cultural Resources are prepared for each project, circulated

for review and approval by the appropriate specialists listed on the Appalachian Trail Cultural Resource Management Roster, signed by the Park Manager, forwarded to the appropriate State Preservation Office, and kept on file as part of the administrative record. Typically, between ten and 20 federal actions (distributed among eight to ten states) of small scope and area of potential effect are processed each year. The combined area affected by these proposed actions and surveys is typically less than five acres per year.

However, significant needs remain in every aspect of cultural resource management to adequately protect, manage, and interpret cultural resources along the Appalachian National Scenic Trail. Table III.I.1 below describes the current status of cultural resource documentation:

Table III.I.1 Status of Cultural Resource Documentation for the Appalachian National Scenic Trail

Historic Context for the Appalachian Trail	completed 2002
Park Administrative History	not done*
Historic Resource Survey	not done
Archaeological Overview and Assessment	in progress
Cultural Landscape Inventory	In progress
Cultural Landscape Reports	not done
List of Classified Structures	not done
Museum Catalog Records for the National Catalog	not done
Ehtnographic Overview and Assessment	not done
National Historical Landmark and National Register identification and documentation	completed only for specific sites
Section 106 compliance	completed for all projects
Curation agreement	done**

*Archival records on the design and construction of the Appalachian Trail are maintained and catalogued by the Appalachian Trail Conservancy

**An arrangement currently exists with the NPS National Capitol Region Museum Resource Center for curation of artifacts and objects located during archaeological surveys on the Appalachian Trail

Cultural Resource Management Needs

The Appalachian Trail Park Office and the Appalachian Trail Conservancy need to develop Trail-wide resource management programs (such as conducting systematic state-by-state inventories of cultural resources along the entire Appalachian Trail or a Cultural Landscape Inventory for the Appalachian Trail), as well as site-specific cultural resource management programs and projects on lands administered by the Appalachian Trail Park Office. The following program and project needs have been identified:

(a) Comprehensive data on the location, condition, and significance of cultural resources along the Trail is not available. The primary shortcoming facing managers of cultural resources on the Appalachian National Scenic Trail is the lack of systematic, comprehensive inventory data on a Trail-wide scale. With a few notable exceptions (the cultural resource inventories in Pennsylvania and Connecticut, and several other studies that have been conducted by other agencies or volunteers using different methodologies), the Appalachian Trail Park Office has only limited and sporadic data on archaeological resources derived from project specific surveys on Appalachian Trail Park Office lands. One of the primary needs for Trail managers is to conduct similar inventories in the remaining 12 Trail states from Maine to Georgia, so that managers can make informed decisions and establish protection priorities for cultural resources. Although the Appalachian Trail Park Office and the Appalachian Trail Conservancy initiated a program in 1999 to obtain consistent, comprehensive data about cultural resources along the Trail, only two inventories have been completed and funding for additional inventories has been difficult to obtain.

(b) National Register nominations need to be undertaken for a number of significant cultural resources, including the Appalachian Trail itself.

Two National Historic Landmarks and 19 National Register of Historic Places properties have been identified along the Appalachian National Scenic Trail corridor. None of these sites, with the exception of portions of the Trail located within the Boiling Springs Historic District and the Falls Village District, are located on lands administered by the NPS Appalachian Trail Park Office. However, perhaps hundreds of potentially eligible sites along the Trail – from the site of the last stand of Shay's Rebellion to several prehistoric rock shelters in central Virginia – exist and await National Register nomination.

In addition, there is little question that the Appalachian Trail is eligible for the National Register of Historic Places. Benton MacKaye, a regional planner and visionary of the early twentieth century, articulated his vision for the Trail in 1921. The Appalachian Trail Conservancy has guided development and promotion of the Trail since 1925. The Appalachian Trail, which is heralded as one of the first major acts of regional planning promoting the concept of a linear protective corridor or greenway, was initially completed in 1937.

No study of the potential eligibility of the entire Appalachian Trail has ever been conducted. Remarkably, only one section of the Appalachian Trail – in northern New Jersey – has been nominated to the National Register of Historic Places. However, even that nomination is somewhat questionable. Despite several attempts, no documentation has ever been found that supports the nomination other than the nomination form itself. Further, the nomination form identifies the location of the

Appalachian Trail at its former location, along a county road, instead of in its current location within a protected corridor.

(c) Section 106 surveys need to be done for Trail-management projects in a timely manner. Until 2003, the NPS Valley Forge Center for Cultural Resources provided the majority of available services for conducting Section 106 compliance. Harpers Ferry National Historical Park also contributed services. However, since 2003, the Center was unable to assist in review of Trail-management projects. The Appalachian Trail Park Office has obtained the services of Harpers Ferry National Historical Park staff and private contractors on an as-needed basis, but there is little assurance that these arrangements will continue. Funding for an archaeologist is needed to conduct Section 106 clearances for approximately six to 10 structure-removal projects per year. Funding also is needed for a historian or architectural historian (or funds to contract for the regular services of an historian/architectural historian) to conduct Section 106 clearances for approximately six to 10 structure-removal Trail projects per year. Although the Appalachian Trail's Cultural Resource Management Section 106 Advisory Roster is currently fully staffed, it will need to be maintained over time.

(d) Cultural resource data needs to be stored, managed, and protected in GIS, as well as entered into NPS cultural resource databases. Existing data that has been obtained through state-by-state cultural resource inventories, Section 106 reviews, and other projects needs to be collected and entered into a the NPS Archaeological Site Management Information System (ASMIS). In addition to entering the data that currently exists on these 450 records, a data entry specialist could enter data on new records as additional studies are conducted. More importantly, a GIS is needed to provide a spatial reference for all cultural resource data.

(e) A Cultural Landscape Inventory (CLI) needs to be conducted to provide a comprehensive approach to guide management decisions regarding historical documentation, analysis of existing conditions, and treatment alternatives. A CLI would provide baseline information for cultural landscapes along the Trail, including location, resource identification, historical development, landscape characteristics and features, and management. The CLI database structure is designed to address landscapes of varying scale and physical complexity. Since the Appalachian Trail is an aggregation of land ownerships, the CLI would be entered into the NPS Servicewide database for those areas where NPS has or plans to acquire legal interest. To be consistent and comprehensive for the entire Trail, however, the CLI methodology can be applied to the entire Trail. Ideally, baseline cultural landscape database information would be linked to a GIS map for the entire Trail. An initial survey could focus on baseline information for landscapes, while more in-depth inventories could be prioritized for component landscapes and features.

(f) A List of Classified Structures needs to be prepared. Although few incidentally

acquired structures along the Trail appear likely to have historic significance, a number of Appalachian Trail shelters constructed by Trail clubs or the Civilian Conservation Corps in the early days of the Appalachian Trail project are likely to be historically significant. A study of these structures needs to be conducted to provide managers with baseline data on the location, description, and historical significance of historic structures that have historical, architectural, or engineering significance.

(g) Ethnographic data does not exist. An ethnographic study or an ethnographic landscape study needs to be prepared to identify significant associations with cultures and, if appropriate, identify landscape features of significance to those cultures.

(h) Intensive surveys need to be conducted at a number of sites, particularly at sites that are threatened by natural or human factors. More than 400 archaeological sites listed in the Connecticut and Pennsylvania inventories alone require further field investigation. While most of these sites are not threatened by any imminent proposed development, the Fox Gap Site of the Battle of South Mountain, the Ring Quarry Prehistoric Mining District, the Canopus Hill Inoculation Station, and dozens of other sites need further investigation before critical data is lost or destroyed.

(i) HABS/HAER drawings or other documentation needs to be conducted on a number of Appalachian Trail-related structures, including several Adirondack-style shelters built by the CCC. An inventory of Trail shelters prepared by a volunteer in 2003 identified 93 Trail shelters along the Appalachian Trail that the Civilian Conservation Corps constructed or reconstructed in the 1930s and early 1940s. Although the Trail has been relocated away from some of these shelters and many other shelters have been removed or abandoned, several dozen still remain. Most of these have been extensively renovated or rebuilt by Appalachian Trail-maintaining clubs as part of their ongoing maintenance of the Appalachian Trail. Some, however, are relatively unmodified. In 1998, the Appalachian Trail Park Office and the NPS Northeast Regional Office conducted a comprehensive photo-documentation project for the Piazza Rock Shelter in west-central Maine, which needed replacement due to environmental concerns. In 2003, the Appalachian Trail Park Office and Appalachian Trail Conservancy facilitated the production of HABS/HAER drawings for the Rocky Run Shelter, a shelter located on Maryland Department of Natural Resources lands that is currently being restored by the Potomac Appalachian Trail Club under a grant from Preservation Maryland.

Approximately 143 structures that were acquired as part of the protection program for the Appalachian Trail still remain on Appalachian Trail Park Office lands. The vast majority of these structures are residential buildings, garages, outbuildings, swimming pools, and farm buildings. At least 139 of these incidentally-acquired structures, which have no connection to the Appalachian Trail and which are not needed for Trail management, are slated for removal. Prior to removal, a review is

conducted to evaluate each structure for its potential significance in accordance with Section 106 of the National Historic Preservation Act. To date, no structures with any historical significance have been identified that will be removed; however, should any be identified in the future, HABS/HAER drawings or other appropriate documentation will be needed.

(j) Interpretation of cultural resources along the Trail needs to be coordinated. Since its inception in 1925, the Appalachian Trail Conservancy – in concert with its Trail-maintaining clubs – has provided visitors to the Trail with guidebooks, maps, and a vast array of other information about the Appalachian Trail. Until recently, ATC's guidebooks provided only general, summary information about cultural resources along the Trail, as well as locational information to specific locations by mileage reference. In 2001, ATC began using a new format in its guidebooks that provides more detailed interpretive narratives about individual scenic, natural, and cultural features of the Trail. ATC and its affiliated Trail clubs have indicated a strong desire to work with the Appalachian Trail Park Office in interpreting cultural features that have been identified through the cultural resource inventories, where interpretation is appropriate. Although much of this effort is volunteer-based, additional resources are needed to assist volunteers in preparing interpretive themes and information.

(k) Visitors should be provided with opportunities to become informed and educated about the historic significance of the Appalachian Trail, the landscape crossed by the Trail, and the historic role of the Appalachian Trail Conservancy and its Trail-maintaining clubs in creating and preserving the Trail. The vast majority of hikers on the Appalachian Trail and the vast majority of the public know little or nothing about the history of the Trail itself, or the critical roles that the Appalachian Trail Conservancy and its member clubs have played in its development, protection, and management. Additional interpretive staff is needed to assist volunteers in developing interpretive measures to enhance the public's experience and appreciation for the Trail.

(l) An agreement for curation and archival storage of museum artifacts obtained during surveys of Appalachian Trail Park Office lands has not been established. Although the National Park Service's Museum Resource Center in Landover, Maryland, has accepted a limited number of archaeological resources from the site of the Battle of South Mountain at Fox's Gap for curation and storage, no central archive or repository for artifacts removed from Appalachian Trail Park Office lands currently exists. The Appalachian Trail Park Office needs to negotiate with the Museum Resource Center or another facility for additional storage of museum objects.

(m) The Appalachian Trail Conservancy currently stores archival records pertaining to the development of the Appalachian Trail in its headquarters office in Harpers Ferry, West Virginia. The storage area is not suited for permanent document storage. A more appropriate, climate-controlled facility and an archivist are needed to

catalogue, organize, digitize, and preserve archival records.

(n) Cultural resource management programs need to be integrated with ongoing Trail-management and natural resource management programs. Cultural and natural resources are often managed independently, instead of interdependently. A coordinated approach is needed to ensure that all resources are managed with an awareness and appreciation for other resources.

(o) Field personnel are needed to identify and process ARPA cases to provide adequate protection for cultural resources, deter vandalism, and prosecute ARPA violations. The Appalachian Trail Conservancy has increased its management presence along the Trail significantly through its Ridgerunner and Caretaker Program and the Appalachian Trail Park Office has added an additional law enforcement ranger. However, the sheer expanse of the Appalachian Trail land base makes it exceedingly difficult to monitor or respond to reports of vandalism of cultural features. Personnel and funding shortfalls present additional problems in the protection of remote areas from resource vandalism and destruction. Funds are needed to pursue existing ARPA violations and deter new ones. Funds also are needed to develop a cadre of trained volunteer cultural resource monitors that are able to recognize signs of cultural resource looting and report incidents to law enforcement personnel.

(p) Educational and interpretive programs are needed to ensure that visitors are aware of and respectful of cultural resources along the Trail. Interpretive media are needed to enhance vistors' knowledge and understanding of significant cultural resources on Appalachian Trail lands. ATC guidebooks in particular could be used to highlight significant cultural features and elaborate on historic events and cultural landscapes.