

## Protocol Development Summary

**NETN Protocol:** Open Uplands Vegetation

**NETN parks where protocol will be implemented:**

Acadia NP (ACAD), Appalachian NST (APPA)

**Justification/issues being addressed:**

The Northeastern Temperate Network (NETN) is comprised of northeastern parks containing temperate forested ecosystems and associated open upland and other ecological systems. This protocol addresses the terrestrial open upland vegetation occurring at higher elevations within ACAD and APPA. These open uplands fall primarily into three NatureServe ecological systems: 1) Laurentian-Acadian Acidic Rocky Outcrop, which is comprised of pine or oak woodlands, often accompanied by low heath shrubs, as well as areas of dwarf shrubland occurring on and around rocky summits; 2) Acadian Subalpine Woodland and Barrens and 3) Acadian Alpine Barrens. The subalpine and alpine systems occur only within APPA and are characterized by dwarf shrubs, lichens, and areas of sparse vegetation.

A suite of anthropogenic and natural forces of change are currently impacting the diversity, structure and condition of these open upland systems. Chief among these agents of change are climate change, acidic deposition, the impacts of trampling by visitors. High elevation species are particularly at risk to changing climatic conditions, as there is less opportunity for migration as change occurs. High elevation systems are likely to receive higher acidic inputs, due to direct inputs from cloudwater, while at the same time the thinner, acidic soils occurring within these systems are less able to buffer acidic inputs. The open nature of the vegetation in these systems, particularly near summits and within alpine and subalpine barrens, can lead to increased trampling by visitors who intentionally or unintentionally stray from designated trails. In addition, some of these open upland systems are dependant upon fire regimes which have been altered by management and global change. Finally, exotic species invasions are of concern within open uplands as they are within most NETN ecological systems.

This protocol addresses the high elevation – uplands, invasive exotic plants, invasive exotic animals, acidic deposition & stress, and visitor usage vital signs, all ranked high priority by NETN. Some of these vital signs will also be addressed by other protocols.

**Specific monitoring questions and objectives to be addressed by the protocol:**

Our overall goal is to monitor the status and trends of NETN ecological resources in order to assess ecological integrity and the impacts of key agents of change acting upon these resources, and to inform management decisions affecting these resources. Our specific objectives within this protocol are to: 1) Establish a monitoring strategy employing permanent plots representative of broad topo-edaphic classes at higher elevations within ACAD and APPA; 2) Monitor temporal change in floral diversity and condition within these systems; 3) Monitor the impacts of acidic deposition upon vegetation within these systems; 4) Monitor the impacts of trampling by visitors upon soil and vegetation; 5) Monitor the frequency and intensity of the fire regime within some open woodlands and dwarf shrublands; 6) Monitor the onset, spread and effects of specific invasive exotic species within these systems; 7) Monitor vegetation change along

altitudinal gradients; 8) Compare current measurements to baseline measures from other sites, historical records and modeling efforts, in order to assess the ecological integrity of these systems; and 9) Inform management decisions impacting open upland systems such as NPS exotic species control, trail development and maintenance, fire suppression, and visitor regulations, and federal pollution control legislation and energy policy.

Specific monitoring questions this protocol will address are:

How are multiple anthropogenic and natural forces of change altering the diversity and condition of high elevation open upland ecosystems at ACAD and APPA? What are the spatial and temporal trends associated with this change? How do current measurements of diversity and condition compare to baseline measurements and historical records? What do these measurements tell us about the ecological integrity of these systems?

To what degree has acidic deposition altered foliar nitrogen content in vegetation in these open uplands, and what are the spatial and temporal trends of this impact?

To what degree do trampling impacts alter soil compaction and vegetation diversity and condition in these open uplands? What are the spatial and temporal trends associated with this change?

What is the frequency and intensity of fire within the open pine woodlands and dwarf shrublands at ACAD, and how is change in the fire regime over time related to species composition?

What is the current spatial distribution, abundance, and rate of spread within NETN high elevation open uplands of key invasive exotic species? What are the impacts of these species on native plant diversity?

Is the elevational range occupied by various species changing over time, and what is the relationship of this change to climatic data?

### **Basic approach:**

We plan to monitor the diversity and condition of high elevation open upland vegetation within a series of permanent plots stratified upon broad topo-edaphic classes, such as those corresponding to NatureServe Ecological system classifications. In addition, we plan to monitor impacts of specific stressors such as acidic deposition and trampling by visitors within some ecological systems. Table 1 outlines possible measures within specific open upland ecological systems at NETN. We plan to incorporate altitudinal transects into the sampling design, in order to monitor change in vegetation range as is expected to occur due to climatic change.

Table 1: Possible measures for monitoring within NETN open upland systems.

Possible Measure	Ecological System			
	Laurentian-Acadian Acidic Rocky Outcrop		Subalpine or Alpine	
	Pine or Oak Woodland	Dwarf shrubland	Subalpine Woodland	Subalpine or Alpine Barrens
Vascular plant diversity	X	X	X	X
Non-vascular plant diversity		?		?
Tree regeneration/mortality	X	?	X	
Vegetation condition	X	X	X	X
Light penetration/LAI	?		?	
Pest/pathogen presence	X		X	
Invasive exotic species presence/abundance	X	X	X	X
Foliar N content	X		X	
Fire frequency	X	?		
Trampling impacts	X	X	X	X
Vegetation change along altitudinal transect	X	X	X	X

**Principal investigators and NPS lead:**

This protocol will be developed jointly by SUNY ESF and NatureServe under cooperative agreements with PI James Gibbs and Geri Tierney, both of SUNY ESF, and with PI Don Faber-Langendoen of NatureServe. NETN network coordinator Brian Mitchell is the NPS lead.

**Development schedule, budget, and expected interim products:**

Due to funding limitations for protocol development and implementation, protocol development is currently on hold.

The budget for development of this protocol is estimated to be \$20,000, which includes partial salary for a SUNY post-doctoral associate responsible for drafting SOPs, and costs for field testing draft protocols.