INVENTORY AND MONITORING IN SUPPORT OF MANAGEMENT FOR RARE COMMUNITIES

CHEROKEE NATIONAL FOREST AND USGS

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EXECUTIVE SUMMARY

The Cherokee National Forest Revised Land and Resource Management Plan designates certain areas of the Forest as rare biological communities and sets forth management guidelines for their maintenance and restoration. However, a detailed assessment of site threats is lacking, no system of monitoring is in place, and the appropriate course of management is not immediately obvious at many sites. There is also no information on relative threat severity among sites and thus no sense of priority in delivering management to sites. The main tasks of this work were to (1) develop a standardized site monitoring protocol, (2) conduct a current inventory of each site and assess each one for threats to its persistence and integrity, (3) summarize monitoring results, review published literature, and provide other scientific assistance to support the CNF in developing a management plan for each site, and (4) develop a ranking of site importance and threat severity to aid the CNF in establishing a management schedule for the sites.

We conducted baseline monitoring of plant communities at 19 of 26 rare community sites, and we provide recommendations for continuing existing monitoring or establishing new monitoring. We also provide results of a threats assessment survey that was completed by knowledgeable experts familiar with the sites. Information on threats was combined with indices of each site's "irreplaceability" (relative biodiversity value) to produce a ranking of sites on a scale of conservation management need. Six sites (Colten's Cliff / Wolf Ridge, Haw Knob, Nolichucky Cliffs, Fagall-Birch Branch, Moffett-Laurel, Whetstone Branch) were placed in a category of immediate management urgency (complete results in Table 1.1 and Figure 1.2):

Rank	Site	Rank	Site
1	Colten's Cliff / Wolf Ridge	14	Sheeds Creek
2	Haw Knob	15	Bullet Creek
3	Nolichucky Cliffs	16	Horse Hitch Gap
4	Fagall – Birch Branch	17	Griffith Branch
5	Moffett-Laurel	18	North River / Queen Cove
6	Whetstone Branch	19	Sugar Cove
7	Cliff – Temple Ridge	20	Cutshall Bog
8	Ripshin Ridge	21	Lindy Camp Bog
9	Little Toqua Creek	22	Dry Branch
10	Devil's Kitchen Branch Bog	23	East Fork Higgins Creek
11	Pine Knob	24	Stony Creek Bog
12	Iron Mountain South	25	Jones Branch Bog
13	John's Bog	26	French Broad Shale Slopes

Forest-wide, the threats assessment survey revealed that ecological integrity of every site was threatened by invasive species and recreation impacts. In addition to these two universal threats, four other general threats (and their contributing factors) were found to be important at more than half of the sites: undesired forest conversion, impacts of forestry roads, impaired hydrology and water quality, and overexploitation of species. We provide an overview of these threats, and we provide general management recommendations to address them.

This report is divided into three sections. The first section provides details of the field and analytical methods, site ranking results, and summaries of forest threats and general management approaches. The second section provides detailed information for each site, including an overall community description, a summary of sampling results, and a set of management recommendations, listed in order of threat severity at the site. The third section is an electronic archive (CD-ROM) of survey data, field data, and photomonitoring images.

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Section 1: CNF RARE COMMUNITIES OVERVIEW

1.1. Introduction

The Cherokee National Forest (CNF) Revised Land and Resource Management Plan (U.S. Forest Service 2004; hereafter, LMP) designates certain areas (approx. 6,591 ac total) of the Forest as rare biological communities and targets them for special management. These 26 areas (9–1,692 ac; Figure 1.1) are those that either (1) comprise forest communities that are rare at the scale of larger ecological units of the Forest or (2) that contain or provide habitat for individual plant or animal species or associations (collectively, "elements") that are of national, regional, or state conservation significance (i.e., species identified as threatened, endangered, sensitive, or locally rare). Thus, the conservation of rare communities within the CNF contributes to the maintenance of forestwide biological diversity.

Prescription 9.F of the LMP sets forth specific management guidelines for the general goal of maintaining and restoring rare communities. The LMP provides a cursory assessment of threats and management needs for each site. However, a detailed assessment of threats is lacking, and the appropriate course of management is not immediately obvious at many sites. No system of monitoring is currently in place that could inform managers about outcomes of their management actions. Moreover, there is no information on relative threat severity among sites and thus no sense of priority in delivering management to sites.

The purpose of this work was to implement a monitoring program that provides the information necessary to develop a management prescription for each site, to schedule site management activities, and to assess outcomes of management. Our main tasks were to (1) develop a standardized site monitoring protocol, (2) conduct a current inventory of each site and assess each one for threats to its persistence and integrity, (3) summarize monitoring results, review published literature, and provide other scientific assistance to support the CNF in developing a management plan for each site, and (4) develop a ranking of site importance and threat severity to aid the CNF in establishing a management schedule for the sites.

1.2. Previous Assessments of Rare Communities

The 9.F Rare Community Sites were identified and initially assessed from 1999 to 2003 by personnel from Tennessee Department of Environment and Conservation (TDEC), NatureServe, and Cherokee National Forest (Major *et al*. 2000). These assessments compiled occurrences of elements of concern and identified important vegetative associations found within the sites. *Qualitative* assessments were based on rapid walk-through site visits and species checklists. The more *quantitative* assessments were conducted on relevé plots (Mueller-Dombois and Ellenberg 1974) that were subjectively placed in communities of interest.

Based on their field assessments, the 1999-2003 survey teams identified twenty-one vegetation associations according to the International Vegetation Classification (IVC), administered by NatureServe (2007). Some associations were themselves elements of concern. Threats facing the communities were also initially identified.

1.3. Field and Analytical Methods

1.3.1 Field Sampling Methods

We used a stratified random sampling design to sample vegetation diversity, structure, and composition on 19 of the 26 rare community sites. We established line transects across the dominant landscape gradients of each site and randomly positioned sampling plots at 100-m intervals within stands that appeared to be similar to expected associations. We collected data on 304 plots across the sites. Each 10-m radius (314 m^2, 0.0314 ha) circular plot was divided into quadrants using the transect center line and a second, perpendicular line.

Several locational and environmental characteristics were recorded for each plot. We noted GPS coordinates of its position, soil moisture category (xeric, submesic, mesic, supermesic, or hydric), aspect category (as the prominent downward slope of the plot: S, SE, E, NE, N, NW, W, or SW), and percent canopy coverage (using a spherical densiometer, Forestry Suppliers, Model C). Plot elevation (m) and topographic shape (ridgeline, slope, cove, flat, toe) were found by locating its coordinates on a digital elevation map in Terrain Navigator Pro (Maptech Incorporated 1999).

We recorded species and crown stratum, based on trunk diameter class at 1.4 m (DBH) for all trees >2 m tall in the plots. Those with DBH ≤5 cm were classified in the understory stratum, individuals with DBH 5-20 cm were classified in the subcanopy stratum, and trees with DBH >20 cm were classified in the overstory stratum. We randomly chose one quadrant of each plot for sampling of saplings, vines, and shrubs. Saplings were defined as stems of tree species with heights of 0.2 - 2 m. Numbers of individuals of all sapling and sprawling vine species within the selected quadrant were tallied. We multiplied these counts by four to extrapolate to entire plots and to facilitate easy comparisons among the strata. Abundance of shrub species was categorized based on percent ground cover; cover classes included one (<1%), two (1-20%), three (21-40%), four (41-60%), five (61-80%), and six (81-100%). Voucher plant specimen were collected in the field and archived at the University of Georgia Herbarium in Athens, Georgia.

We also searched for threatened or endangered species (TES) and measurable threats, and we set up monitoring efforts for many that we found. Monitoring techniques include photomonitoring of woody encroachment and OHV effects, counting individuals and measuring extent of area coverage of TES and invasive species, and establishing descriptive line transects across wetlands, meadows, and areas impacted by recreation. More complete descriptions of these methods may be found in the Summary of Threats and Recommended Management Actions (see §1.5) and the individual site management plans (see §2.1 through §2.26).

1.3.2 Data Analysis

We performed a hierarchical cluster analysis to group plots of similar composition (McCune and Mefford 1999). Rare tree and vine species in each stratum (with <3 total occurrences) were dropped from the data. We standardized the raw data for trees and vines to species maxima by dividing all counts for a species in a stratum by the highest count obtained across all plots for that stratum, which gave more equal weight to less abundant species (Kent and Coker 1992). We standardized the shrubs the same way, but by dividing all cover classes by the maximum cover class. Our linkage method was flexible beta, set at a space expanding value

of –0.25 to decrease occurrence of chaining (McCune *et al*. 2002). We used the Sorenson-Bray distance measure, which was compatible with the chosen linkage method and was relevant for heterogeneous ecological data (Beals 1984). The results of this hierarchical cluster analysis defined site-groups. A site-group consisted of all the plots in a given site that were grouped together in the cluster analysis, at 25 – 37.5% information remaining.

Species compositions of these site-groups were compared to the expected community compositions. Expected compositions were defined on the basis of NatureServe (2007) associations listed as present in that site.

We calculated the relative frequency (f) and relative density (d) of each species in each stratum for each site-group following Curtis and McIntosh (1951), where

f = (frequency of species (*i*)/sum of frequency values for all species)*100

and

d = (number of individuals of species (*i*)/total number of individuals of all species)*100.

Then, we summed relative frequency and relative density to get the Importance Values (IVs) for each species occurring in each stratum. The total IV for each stratum was 200. We then calculated proportional IVs for the tree species occurring in the stand unit by dividing each IV in the stratum by the largest IV in that stratum (Buell *et al.* 1966). We considered the dominants to be the species that have proportional IVs ≥ 0.50.

To measure the degree of resemblance between actual associations and expected associations we calculated Sorenson's similarity index (S) as

$$S = 2a/(2a+b+c),$$

where a = the number of species shared between the expected and the actual association, b = the number of species that occurred in only the expected association, and c = the number of species that occurred in only the actual association (Krebs 1999). We did these calculations between each site-group's overstory dominants and the overstory species in that site's expected associations. Resulting values were between zero (no similarity) and one (full similarity). We considered values of 0.50 or greater to indicate that actual associations were similar to expected associations. We used only the overstory tree strata occurrences to build the indices except for comparisons to one expected association (*Betula alleghaniensis* / *Acer spicatum*) that had only one expected dominant species in the overstory and one in the subcanopy. With one exception (*Quercus rubra* association), all expected associations contained two or more dominant species, or they contained one or more optional dominants in the overstory. When there was one optional dominant we did not count it as a missing requirement if the site-group did not contain it, but did count it if it was present. If there were two or more optional dominants that did not occur in the site-group we penalized it one less than the number of optional species. This prevented us from over-penalizing a site-group for lacking optional dominants. Thus, if a site-group contained none of three optional dominants of an expected association, we would count two in the sum for variable b (number of species unique to the expected association) in the Sorenson's similarity index equation. For example *Pinus pungens, Pinus rigida* – (*Quercus prinus*) must contain either *Pinus* species, but *Quercus prinus* would be an optional occurrence. Therefore, no penalty would be a given to a site-group if the only dominant it contained was one of the expected *Pinus* species (variable a =1, b = 0, and c = 0 for S = 1.00.). The optional species were contained within parentheses and/or are separated by commas in the association names.

We assigned shade tolerance ratings based on Burns and Honkala (1990). We calculated density, D, as stems/hectare for each species in each stratum by the formula,

$$D = (\sum \text{individuals of species } i \text{ / \# plots in site group}) * 31.847,$$

where 31.847 is the conversion factor for the 0.0314 ha plots. We used these density calculations to construct size distributions for the populations of each potentially dominant tree species within each site-group. Our interpretations of these distributions followed the precedent set by Whipple and Dix (1979). Our four size classes minimized error in the curve caused by differential growth rates of species (Peet and Loucks 1977). For populations with many seedlings and decreasing density in increasingly larger strata (approximating an inverse "J" size distribution), we inferred that the species will likely be self-perpetuating on the site. We interpreted bimodal and "no trend" distributions as indicative of species with irregular and aperiodic recruitment events, and unimodal and decreasing distributions as indicative of species with decreasing populations.

If intolerant species dominated the overstory of a site group, the lower strata were dominated by tolerant species, and the size distributions indicated the intolerants were not self-perpetuating, we concluded that the site group was still in compositional transition. If tolerant or intermediate species dominated all strata and had inverse-J size distributions, we concluded that the group had reached a stable state.

1.3.3 Site Prioritization Methods

To rank rare community sites for conservation action, we used a version of the approach described by Sutter and Szell (2006). Their method produces a composite ranking score from assessments of three criteria: (1) known or perceived threats to the community, (2) relative biodiversity (uniqueness of constituent elements of the community), and (3) conservation opportunity. We ranked CNF rare community sites on the basis of only the first two criteria.

Relative Threat Status

Using field visits and query of knowledgeable experts, we assessed each site for threats in terms of both severity and extent. To facilitate comparison with other studies, we used a checklist of potential threats (Table 1.3) compiled by Sutter and Szell (2006). When our field observations identified a threat anywhere on the site, we assigned it to one of four severity classes as used by Sutter and Szell (2006):

- LOW (historically has or is likely to slightly impair conservation targets and is easily reversible within five years),
- MEDIUM (historically has or is likely to moderately degrade targets and is possible to reverse within next five years),
- HIGH (historically has or is likely to seriously degrade targets and is possible to restore but with high cost and difficulty within the next five years), and
- VERY HIGH (historically has or is likely to destroy or eliminate targets and is irreversible within the next five years).

We also assigned each threat a similar rank for the extent of its occurrence:

- LOW (historically has or is likely to impact <10% of conservation target occurrences at the site),
- MEDIUM (historically has or is likely to impact 10-25% of conservation target occurrences),
- HIGH (historically has or is likely to impact 25-50% of conservation target occurrences), or
- VERY HIGH (historically has or is likely to impact >50% of conservation target occurrences).

We defined "conservation target" as either a state or federally listed species or an expected community type ranked S1 to S2 or G1 to G2 by NatureServe (2007). State listed S1 and S2 targets are those that are extremely (<5 occurrences) or very rare (6-20 occurrences) in the state of Tennessee and are vulnerable to statewide extirpation. Globally listed G1 and G2 targets are those which are extremely rare (<5 occurrences) or very rare (6-20 occurrences) and are vulnerable to global extinction. "Occurrences" refer to populations of the species, not individuals.

Our field-based evaluations were combined with survey results from 12 knowledgeable experts who were familiar with the sites of interest and their surrounding areas. Given the same list of potential threats (Table 1.1) and using the criteria above, each participant was asked to rank the severity and the extent of each threat believed to have previously occurred or to be currently active at each site. Including our own field-based assessments, threat status for each site was summarized from 2-5 responses per site.

For each respondent's assessment of a site (expert opinion or field-based assessment), the severity and extent rankings were combined into a joint ranking according to the matrix of Sutter and Szell (2006). The joint ranking was converted to a numeric score, the Relative Threat Status (RTS), first by multiplying the frequency of occurrence of each rank class by a weighting value 5^k, where k = 0, 1, 2, or 3 according to the rank class L, M, H, and VH, respectively, then by summing the products (Sutter and Szell 2006). For example, a site with 4 threats in rank class L, 2 threats in rank class H, and 1 threat in rank class VH would receive an RTS score of $4\times5^0 + 0\times5^1 + 2\times5^2 + 1\times5^3 = 179$. For each site, we used bootstrap sampling to compute the mean RTS score and its variance over all respondents.

This methodology departs from that of Sutter and Szell (2006) in four potentially important ways, yet preserves the basic approach. First, Sutter and Szell (2006) recommended that RTS values for the severity and extent of threats at each site be assigned by consensus among knowledgeable professionals in the ecoregion that are familiar with the conservation areas. We were unable to hold a meeting of this magnitude, so we sent out standard survey forms instead, asking participants to respond with threat rankings only for sites for which they possessed high levels of knowledge. Second, we did not provide informative spatial layers of roads, land uses, utilities, etc. in the surveys, nor did we provide threat maps. However, we did include the USGS topographic quad name where each site is mapped, the size (ha) and approximate boundaries of each site, and the identifications of all expected communities and of all federal and state listed species that occur on each site. Third, we did not calculate the relative conservation opportunity of each site. This was deemed a task too large for the survey technique. Fourth, we did not conduct two separate RTS rankings for historical and active threats, which would have been feasible if we had held a meeting. Despite these differences, our

approach is similar to the original Sutter and Szell (2006) method, and lays the foundation for direct comparison with future applications of the same method.

Relative Biodiversity Value

We followed the approach of Sutter and Szell (2006) to compute the relative biodiversity value of each conservation target. First, we counted all sites on which a conservation target occurred and took the inverse of that number (i.e., n^{-1}) to reflect the target's uniqueness among sites. Then, we summed the uniqueness values of all the targets occurring on each site to obtain the site's index of irreplaceability (IRR) (Sutter and Szell 2006). For example, if the target occurred in 4 conservation areas, its uniqueness value is ¼ or 0.25. Then, if Site X had a total of two conservation targets, both with uniqueness values of 0.25, the IRR value for that site would be the their sum, i.e., 0.50. An implicit assumption in the use of this index is that our ability to detect conservation targets was identical across targets and sites. Otherwise, this index will under-represent sites containing targets that are generally harder to detect (i.e., fewer or more secretive species; site access difficulties) than those elsewhere. Note that the uniqueness value is based on how often a target occurs among these 26 sites, so it may overestimate uniqueness if a target occurs elsewhere in CNF but not among these sites.

Composite Ranks

As recommended by Sutter and Szell (2006), we plotted site-specific values of $\log_{10}(IRR+1)$ against mean values of RTS. Sutter and Szell (2006) divided the plot area into 4 regions of priority based on arbitrary thresholds identified on the two axes. Sites of highest priority (NOW – RIGHT NOW) were those with IRR scores exceeding 75% of the maximum data value of IRR. Sites of next greatest priority (NOW) were those with RTS scores exceeding $2\times5^3 = 250$ (i.e., ≥2 threats in the VH class) and not already placed in the NOW – RIGHT NOW priority class. Sites of the 3rd-ranked priority (SOON) were those not already placed in the highest two classes and either (1) having IRR scores exceeding 50% of the maximum data value of IRR or (2) having RTS scores exceeding $2\times5^2 = 50$ (i.e., ≥2 threats in the H class). All sites not meeting these thresholds were assigned the lowest priority (LATER). Conditional on these classification rules for prioritization, it is possible to assign numerical composite ranks (1-26) to sites on the basis of 2-dimensional position within regions of the plot.

We note that thresholds for priority classifications are defined in absolute terms with respect to the RTS score and in relative terms (percentages of the maximum value of IRR) with respect to the IRR score. Consequently, the procedure guarantees that at least one site will receive the highest priority ranking (NOW – RIGHT NOW), whereas it is possible that no site may receive the second highest ranking (NOW).

Sensitivity of composite rankings to index assumptions

Any numerical index of an area's conservation status or biological integrity is a subjective measure because it reflects biases of the creator and ignores uncertainties about the system. The Sutter and Szell (2006) approach to prioritizing areas for conservation action is no exception, and it is reasonable to assume that the ranking outcome is sensitive to the specific assumptions in that approach.

We conducted a limited sensitivity analysis of the Sutter and Szell (2006) model assumptions. We computed composite ranks under variations of assumptions used in the creation of the RTS and IRR values. For RTS, we varied the base *x* used in the assignment of

weights x^k to frequencies of composite threat rankings. We considered values smaller ($x = 2$) and larger ($x = 7$) than the Sutter and Szell (2006) value of $x = 5$. These choices of values had the effect of diminishing or magnifying, respectively, differences among threat levels, relative to the default value. The base used also influenced the thresholds used in the priority classes, therefore, we used threshold values $2\times x^2$ and $2\times x^3$ in determining site rankings. For IRR, we varied the value of the exponent applied to the count of sites, i.e., n^{-x}. We considered values smaller ($x = 0.5$) and larger ($x = 2$) than the Sutter and Szell (2006) value of $x = 1$. These choices placed smaller or greater emphasis on differences in uniqueness, respectively, than the default value. We computed composite rankings under each of the nine combinations of RTS base values (2, 5, 7) and IRR exponent values (0.5, 1, 2), and we compared values derived under the eight alternative scoring schemes to those obtained by use of the Sutter and Szell (2006) default values.

1.4. Site Prioritization Results

The Sutter and Szell (2006) site ranking approach identified 6 sites (Colten's Cliff / Wolf Ridge, Haw Knob, Nolichucky Cliffs, Fagall-Birch Branch, Moffett-Laurel, Whetstone Branch) in the highest action urgency category NOW – RIGHT NOW, but none in the next greatest class (Table 1.1, Figure 1.2). Variability in the judgment of relative threat status was substantial for many sites, but in few cases (e.g., Sugar Cove and Cutshall Bog; Figure 1.2) was the variation large enough to make classification equivocal. Whereas variation in the RTS response could be estimated, we had no means to do so for IRR; thus, absence of standard error bars along that axis indicates lack of appropriate data rather than high precision in the measure (Figure 1.2).

Our sensitivity analysis was limited and did not explore many of the assumptions and rules used in the Sutter and Szell (2006) approach. Nevertheless, we found that placement of sites into action categories and assignment of numerical rankings were moderately sensitive to choice of scoring scheme. By any method, no sites other than the six above were ever classified in the category NOW – RIGHT NOW, but some methods placed as many as three of the urgent-priority sites in a lower-priority category (Table 1.2). Among the remaining sites, prioritization ranks differed substantially among scoring schemes, with a site's rankings varying by as much as 11 positions (Pine Knob, Ripshin Ridge; Table 1.2).

1.5. Summary of Threats and Recommended Management Actions

To provide a Forest-wide perspective of relative importance of threats, we ranked the threats across all 9.F sites. We averaged the combination scores of severity and percent occurrence for each threat across respondents. Means with higher values reflect threats of greater importance, in the opinions of the respondents (Table 1.3).

Survey respondents indicated two threats occurring at every site (Table 1.3): invasive species and recreation. Four broad categories of threats (and their contributing factors) were thought to occur at half or more of the sites (Table 1.3): undesired forest conversion, impacts of forestry roads, impaired hydrology and water quality, and overexploitation of species.

Invasive species. Invasive plant or animal species were believed to threaten ecological integrity at every site. The most common invasive plant species is *Microstegium vimenium*, a summer annual grass, which has become established in many wet areas. Several other plant species are imported in the manure of horses ridden recreationally throughout the Forest. Miller

(2003) provides information on identification and control of invasive plant species. The wild hog (*Sus scrofa*) is a significant invasive species threat at some sites.

Recreational activity. Threats associated with recreational activity were indicated to occur at every site. Some activities in conjunction with this threat include trampling, species collecting, off-highway vehicle (OHV) use, rock climbing, horseback riding, human waste runoff, and littering.

Forest conversion. Different contributing factors may result in undesired forest conversion through natural succession or stand-level mortality. Parasites and pathogens including southern pine bark beetle (*Dendroctonus frontalis*), hemlock woolly adelgid (*Adelges tsugae*), and balsam woolly adelgid (*A. piceae*) have already impacted forest stands, whereas others such as beech bark disease (fungi *Nectria coccinea* var. *faginata* or *N. galligena*) and sudden oak death (fungus *Phytophthora ramorum*) will likely soon appear. Woody encroachment threatens the persistence of certain wetland and bald habitats, and a hardwood understory has established on sites once dominated by fire-tolerant pine species. The alteration of the historic fire regime – in particular, the suppression of fire – has led to regeneration failure of table mountain pine (*Pinus pungens*) at some sites and establishment by woody species in bogs, balds, barrens, and cliff communities. Beyond exclusion of fire, some forestry practices are incompatible with persistence of these communities, for example, timber harvesting within TES habitats.

Forestry roads. Forestry roads allow the public to easily access the sites, especially with motor vehicles that then travel off road through TES populations and sensitive areas. Roads also increase fragmentation of the forest, adversely affect hydrology and water quality, and provide invasion conduits for undesired species.

Hydrology and water quality. Impaired hydrological function and water quality, in particular, channel modification, erosion, and sedimentation, are widespread threats. Invasive species, recreation, roads, and incompatible agricultural or extractive uses are the principal agents of these threats.

Overexploitation of species. Overexploitation of plant and animal species is a widespread threat. This threat arises through direct means, e.g., collection of species, or indirectly, e.g., recreation-caused disturbance of sensitive species.

All remaining threats indicated by the survey respondents occurred at fewer than half of the 9.F sites (Table 1.3). All threats will be discussed in greater detail below, and within some of the site summaries (Part 2).

1.5.1. Overview of Management Actions

In subsequent sections, specific management recommendations are provided to address each type of threat. Below are general descriptions of management actions that are most commonly recommended.

Monitoring

Monitoring achieves two purposes: (1) to assess the status of the community and level of disturbances, and (2) to evaluate effectiveness of any management actions employed. Types of monitoring to be recommended are described below.

Systematic forest monitoring. Systematic transect-based plots that were set up on most of the 9.F sites (see Field Sampling Methods) may be re-surveyed periodically to assess forest

composition state, status of desired species, and success of any forest stand actions undertaken. Each plot was set up with a 10 m radius. Tree species were categorized by size class: understory trees (>2 m tall and ≤5 cm DBH), subcanopy trees (5-20 cm DBH), and overstory trees (>20 cm DBH). Saplings (0.2-2 m tall) were counted in a randomly selected quarter plot and extrapolated to the whole plot by multiplying by 4. Seedlings were categorized in the field layer with herbaceous species. Coverages by shrubs were categorized as <1%, 1-20%, 21-40%, 41-60%, 61-80%, and 81-100%.

Simple transect monitoring. Status of patch-type communities that are prone to forest succession (e.g., bogs, balds, and grassy ridges) may be monitored via a permanent arrangement of GPS-recorded simple transects. Transect line arrangement can be regular (e.g., parallel or radial transects) or irregular, but they should cross the habitat of interest and portions of the surrounding habitat. During monitoring, take note of canopy coverage, species composition, or vegetation types, and record transect locations where these metrics noticeably change.

Monitoring of discrete plant populations. Monitoring can be targeted at plant populations of interest that occur in discrete patches, whether they occur in continuous mats or as collections of distinct individuals. For species that grow densely, such as *Microstegium vimenium*, or in mats, such as *Sphagnum*, each patch can be GPS-registered and measured according to the length and compass direction of the major axis of distribution and the length of the perpendicular minor axis. For TES and other species that may be individually identified, the distributional information above may be augmented with data summarized from individual plants, including GPS locations of individuals (or some marked central reference point from which individuals can be mapped), counts of flowering and reproductive individuals, and overall qualitative description of population status (i.e., categories ‘vigorous’, ‘stable’, ‘fair’, and ‘poor’ for consistency with previous population assessments). Photomonitoring from permanently established vantage points is a useful technique to document changes in population spatial patterns over time. Photomonitoring points should be georeferenced, and each photo should indicate the date, time, location, and camera orientation.

Monitoring of disturbances. Hydrological disturbances (erosion, sedimentation) and disturbances associated with recreation (foot trails, campsites, OHV use) should be measured annually and photomonitored, where possible. Record the GPS coordinates, descriptive location, dimensions (depth, length, width), and orientation of erosion channels. The GPS location of each sedimentation occurrence should be recorded, as well as the compass direction, length of the major axis, and length of the perpendicular minor axis of each sedimentation input. Foot trails, stream crossings, campsites, and popular off-trail areas (overlooks, cliff faces, stream banks, switchbacks) should be photomonitored to record changes in their condition, evidence of harm to species and communities, and effectiveness of management actions. Photomonitoring should also be used to document OHV activity. For all types of disturbances, it is important to monitor the species and communities affected as well as the disturbance itself.

Monitoring of water conditions. At many of the wetland sites, monitoring of water quality or water level should be conducted periodically. Protocols for assessing chemical, physical, and biological aspects of water quality can be found in USGS’s National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated).

Exclusion of Human Activity

Recreation impacts were considered to be threats at every 9.F site. Therefore, tactics to reduce, redirect, or exclude human access to sites appear in many of the management recommendations. In most cases, signage or access barriers are recommended.

Signage. Signage is intended to discourage activities or behaviors harmful to the resource, or to encourage ones that are beneficial or benign. At sites that experience high visitation or are adjacent to developments, general signage informing Forest users of the ecological sensitivity of the community could be effective in reducing dispersed activities that denigrate the site (e.g., trampling, littering, off-trail use, specimen collecting, etc.). Signage alone may also be effective in restricting foot, OHV, and horse access to highly-impacted areas and travel routes; however, in many situations, signage must be used in conjunction with physical barriers.

Access barriers. Physical barriers to access may be required in circumstances where further recreational use will substantially alter a site's physical or biotic characteristics. Low fences along foot trails should discourage effects of off-trail use (trampling, denuding of vegetation, littering). Entrances to caves that provide habitat to species or communities of concern should be fitted with locking gates. Access points to trails and roads used by OHVs or horses may require gating. Where access points are dispersed, boulders or sturdy fencing may be necessary to restrict OHV access. With any of these structures, accompanying signage would help users understand the biological sensitivity of the site and the need for access restrictions. Concurrent with any access closure, sanctioned trails and roads within the Forest should be marked and well-maintained, and their locations and routes publicized.

Habitat Manipulation

Some management recommendations call for the direct manipulation of habitats to achieve or retain desired species compositions. Types of habitat manipulation include prescribed burning, mowing, selective suppression of vegetation, and fertilization.

Prescribed burning. As natural fire regimes have been altered, certain forest habitats and wetland communities adapted to periodic fire are succeeding into closed-canopy, fire-intolerant conditions. In stands of *Pinus pungens*, burns of medium to high intensity are recommended to encourage pine regeneration and to suppress hardwood understory cover. Where it may be safely done without threatening TES populations, prescribed burning is also recommended for maintenance of early successional habitats on balds and ridges. Prescribed fire may also be used to increase light availability in bog habitats, however, fire application in bogs is often challenging because of risk of escape or damage to sensitive plant populations.

Mowing. Mowing or bush-hogging may be used to maintain habitats in early successional states, particularly in areas that cannot be safely burned. However, mowing may not be as effective as fire in preventing re-sprouting of woody species, therefore, other means to kill the rootstock, such as herbicide application or repeated mowing, may be required.

Selective suppression of vegetation. Where burning or mowing is not practical, selective treatment of individual woody stems is an option. Girdling of trees increases light on the forest floor, provides snag habitat, and ultimately produces downed woody debris for terrestrial organisms. Group cuts immediately provide larger canopy openings and permit more light to reach the forest floor. Where hydrological conditions permit, herbicide may also be applied to kill individual stems or root stock and – in very specific circumstances – to patches of invasive plant species.

Fertilization. Application of fertilizer may help forest species withstand attacks by invasive parasites or pathogens. For example, increasing the nitrogen content of the soil by manually applying fertilizer may help increase cone production of short-lived mature *Abies fraseri* (Arnold *et al*. 1992) attacked by the balsam woolly adelgid (*Adelges piceae*).

Maintenance and Repair of Hydrological Functions

At many sites, actions are needed to reduce or eliminate agents that contribute to erosion, sedimentation, channel modification, and reduced water quality, or to repair hydrological degradation that has occurred. Below are actions that affect hydrology either directly or indirectly.

Direct manipulation of hydrology. Management of water flow or the repair of hydrological function can be effected by directly manipulating the physical environment. Water bars (North Carolina Division of Forest Resources 2006) divert rainwater off roadways, dissipating the erosive energy carried by water over long distances. Barriers such as silt fences or hay bales may be installed to prevent sedimentation into streams and bogs from point and non-point source locations. Stream banks prone to or currently experiencing erosion may require repair and reinforcement with braced mesh or other materials. Water fluctuations jeopardize the persistence of some bogs, therefore, installation of water control structures on these bogs may be required.

Indirect manipulation of hydrology. Actions that buffer or isolate disturbance agents allow areas to recover from hydrological damage and prevent future degradation. Gating roads, redesignating use classes of roads, and relocating trails and stream crossings serve to remove recreational users from areas particularly prone to hydrological degradation. Acquisition of parcels adjacent to a site provides an area that can be managed as a protective buffer of the hydrological feature. Where wetlands are particularly sensitive to disturbance by wild hogs or humans, enclosure of the area with fencing may be necessary.

1.5.2. Specific Threats by Category

The sections immediately following summarize the nature of the most important threats and their relative degree of importance to survey respondents, listed in order of severity (rank of average threat score in parentheses; Table xxx). Threats that are induced or facilitated by the focal threat are indicated in **bold**.

Invasive Species (1)

Invasive species were judged to be a threat at every 9.F site. Establishment of invasive species can lead to other threats, including **forest conversion**, **channel modification** and **erosion**, as well as the introduction of other **invasive species**. Search for and monitor sites for invasive plant species, many of which are documented in Miller (2003). Once discovered, invasive populations should be monitored closely according to protocols described above. Actions against invasive plants include herbicide application, manual removal, and prescribed burn. Appropriate actions vary depending on site characteristics. For example, wetland areas should not be treated with herbicides, nor should *Sphagnum* bogs be burned. Whatever management action is chosen, it should be conducted in conjunction with close monitoring of the invasive species and any TES species that occur with or adjacent to the invasives. Monitoring

efforts would enable quick action should the invasives start to become established or compete with TES species.

Horse manure is a source for plant species invasions throughout the Cherokee National Forest and on 9.F sites. Management options to reduce risk of invasions from this source include requiring the use of certified weed-free forage for two weeks prior to and during entry into the Forest or requiring manure bags on all horses when in the Forest. However, the most practical option may be to exclude horses from critical areas. Locations that contain TES species, highly erodible lands, or wetlands and streams should be off-limits to horse travel. Signage on sites should explicitly allow or exclude horses on certain trails (e.g., "Please keep horses to designated trails", "Please keep horses on roads").

Microstegium vimenium, a summer annual grass, is the most common invasive species encountered and is established throughout several of the 9.F sites. Manual removal, repeated annually, is the most effective control option, but excessive disturbance of soils encourages spread of the grass. Conducting manual removal in late summer, after flowering but before seeds mature, will minimize regeneration. If manual removal is not effective, imazameth (Plateau) may be the safest herbicide to use, but an isolated area down slope from elements of concern should first be tested to determine whether the herbicide will be absorbed and what non-target species would be affected (Global Invasive Species Database 2007). A second test in the vicinity of individual non-target species of concern that are down stream and isolated from their populations would provide further information about the likely impacts of broader application. Burning is a less effective control option, and is not recommended in wetlands containing plant communities sensitive to fire (e.g., the forested acid seep community CEGL007443) .

At some sites, wild hogs (*Sus scrofa*) are rooting in and around stream and bog areas. This disturbance removes litter cover and facilitates invasion by *Microstegium vimenium* and other undesirable plant species (Schiffman 1996). Soil disturbances should be minimized to protect water quality, safeguard TES species habitats, and help curb invasions of vegetative species. Therefore, wetland areas should be fenced to exclude *Sus scrofa*.

Recreation (2)

Inappropriate forms or intensities of recreation contribute to other Forest threats including **channel modification**, **sedimentation**, **erosion**, **impaired water quality**, introduction of **invasive species**, **forest conversion**, and **species overexploitation**. Undesirable effects of recreation include trampling or collecting elements of concern, compaction and denuding of dispersed campsites, human waste inputs in the environment, damage to wetland areas and cliff faces, and increased litter. Appropriate targets of monitoring are the species affected by these activities and the activities themselves. Recreation impacts on TES species or overall habitat quality on these sites should be addressed with management actions, including area closure, as necessary. Monitoring should precede and follow any management action implemented.

Dispersed campsites at North River Queen Cove and Stony Creek Bog should be closed, with appropriate signage to inform the public. At other popular areas, annual litter clean-ups should be implemented. The need for this action may grow over time, as increasing development near sites causes increased accessibility and casual visitations.

Rock-climbing and trampling of off-trail areas are likely to increase in occurrence at Colten's Cliff / Wolf Ridge because its popularity and ease of access. As of 2005, no signs of rock climbing were evident on the cliffs. Plants and organic matter tucked into rock crevices occur over much of the cliff area, and their presence reduces the appeal to rock climbers (Kuntz

and Larson 2006). Nevertheless, signage at the parking lot trailheads at both Carver's Gap and near the summit of Roan Mountain would help keep users on the trail and away from the cliffs. Signs ("Fragile species / Please stay on trail") would be more effective than word of mouth or pamphlets because the request would be in front of every individual entering the trail. Newly discovered paths leading to the cliffs should be blocked with new signs ("Restoration area / Keep out"). Similar management recommendations also apply to Nolichucky Cliffs: rock climbing effects should be monitored, and if necessary, sensitive areas around rock outcrops and cliffs should be closed.

Whetstone Branch is a popular destination for horseback riders. Horses should be excluded from areas with TES species, streams, and bogs and redirected to designated trails along xeric ridges and slopes. To reduce opportunities for introductions of invasive plant species, all horses on the Forest could be required to wear manure bags or to be placed on certified weed free forage.

At Cliff –Temple Ridge, trampling may occur as users veer off trail to vistas overlooking the Nolichucky River. Signage posted on the Appalachian Trail near these vistas may help reduce trampling (e.g., "Fragile ecosystem / Tread carefully"). Signage may help curb damage at other sites, too. Place signs between trails and areas of concern or at site entry points.

On Dry Branch, Cutshall Bog, Devil's Kitchen Branch Bog, Moffett Laurel, Ripshin Ridge, Fagall-Birch Branch, Jones Branch Bog, and Whetstone Branch, roads should be gated to keep motor vehicle traffic from causing damage. Gating would give road ruts time to heal and still allow managers access to sites. On several of these sites, roads provide unauthorized access for dispersed vehicular travel. Vehicles cross perched water tables on Whetstone Branch and the stream at Jones Branch Bog, damage streamside habitat at Devil's Kitchen Branch Bog, cut through TES species populations at Ripshin Ridge and Whetstone Branch, and criss-cross slopes at Moffet Laurel and Dry Branch. Making access more difficult would help curb this damage to the sites.

Parasites / Pathogens (3)

Many forested 9.F sites are experiencing or are at risk of attack by parasites or pathogens. These agents may result in large-scale **forest conversion** or facilitate the introduction of **invasive species**.

Southern pine bark beetle (*Dendroctonus* spp.) has killed much of the pine overstory on the Little Toqua Creek, Bullet Creek Botanical Area, and Horse Hitch Gap sites. Burning the uplands at Bullet Creek may increase light levels and regenerate pines. Care should be taken to avoid burning the bog proper, though. The presence of *Sphagnum* spp. helps maintain the bog's acidity, a necessary habitat characteristic of *Platanthera integrilabia.* Burns may also facilitate regeneration of pines in the other two impacted sites. All three sites should be monitored for pine regeneration.

The hemlock woolly adelgid, *Adelges tsugae*, is infesting *Tsuga* populations across the eastern range. *Tsuga caroliniana* has a restricted habitat and is less common on the landscape than *Tsuga canadensis*, but both tree species are susceptible to the adelgid. *Tsuga* succumb to the adelgid within five to ten years. Currently options to combat the adelgid are limited. Individual trees may be protected via injection treatments, but the expense prohibits forest-wide application (Hale 2004). Introduction of a natural adelgid predator, *Pseudoscymnus tsugae*, can help suppress adelgid population growth in forest settings. Supplies of the predator are limited, but attempts should be made to obtain and release in as many sites as possible. The predator

beetle will not prevent the adelgids from appearing, nor will it completely eradicate the adelgid from a given area, but it may slow the decline long enough for another more viable treatment to be found.

Populations of the spruce–fir forest's codominant, *Abies fraseri*, are threatened by the balsam woolly adelgid (*Adelges piceae*). The adelgid weakens *Abies fraseri* and mature trees eventually die from secondary diseases and pests after the adelgid attacks. Young recruits are more able to withstand infestations (Burns and Honkala 1990), but over time, total reproduction may gradually decrease (Busing *et al*. 1988). Increasing the nitrogen content of the soil by manually applying fertilizer may help increase cone production of the short-lived mature trees (Arnold *et al*. 1992).

Beech bark disease (fungi *Nectria coccinea* var. *faginata* or *N. galligena*) is already or soon to be present in the Cherokee National Forest. The disease may inflict substantial mortality (≥80%) in dense stands of *Fagus* (Houston 1994) and cause stand conversion to *Betula* species. Forest plot monitoring is recommended for surveying for presence of this disease and *Fagus* mortality.

Sudden Oak Death (fungus *Phytophthora ramorum*), an invasive pathogen of red oak trees, is within reach of the southern Appalachians. The pathogen is not currently in the area, but managers should monitor oak forests for its appearance.

Forest Conversion (4)

Bogs, beech gaps, and early successional community types, as well as several species, are threatened by forest conversion. These communities and species should be monitored under the systematic forest monitoring protocol.

Pinus pungens communities. On Nolichucky Cliffs, Fagall-Birch Branch, Horse Hitch Gap, Whetstone Branch, and Cliff-Temple Ridge, *Pinus pungens* is not successfully replacing itself. If prescribed burns can be conducted without jeopardizing populations of *Tsuga*, burns of med-high intensity would spur regeneration of *Pinus pungens.* Similar burns may also benefit *Buckleya distichophylla.*

Abies fraseri communities. Populations of the spruce–fir forest's codominant, *Abies fraseri*, are threatened by the balsam woolly adelgid (*Adelges piceae*)(see **Parasites and Pathogens**). If *A. fraseri* should decline severely, numerous elements of concern on the site will suffer habitat loss and decline. Monitor *A. fraseri* so population declines are recognized and documented. If methods to control the adelgid are found, the state of the *A. fraseri* population can be followed through decline and improvement. The plots chosen for monitoring the fir can also be used to monitor the Red Spruce – Fraser Fir Forest (Evergreen Shrub Type) Forest CEGL007130, G1.

Tsuga communities. Infestations of *Tsuga* populations by the hemlock woolly adelgid (*Adelges tsugae*) are severe in the 9.F sites (see **Parasites and Pathogens**). This threat will probably result in forest conversion at Cliff-Temple Ridge, Devil's Kitchen Branch Bog, Fagall-Birch Branch, Griffith Branch, Iron Mountain South, Lindy Camp Bog, and Moffett Laurel Botanical Area. Introduction of a natural adelgid predator, the lady beetle *Pseudoscymnus tsugae*, can help suppress adelgid population growth in forest settings.

Fagus grandifolia communities. *Fagus grandifolia* on the Cherokee National Forest is facing the potential threat of beech bark disease (fungi *Nectria coccinea* var. *faginata* or *N. galligena*). The disease is already or soon to be present in the Cherokee National Forest. It was identified in the Great Smoky Mountains National Park, adjacent to the CNF, in 1993 (Houston

1994). Beech bark disease may inflict substantial mortality (≥80%) in dense stands of *Fagus* (Houston 1994). As the disease spreads, *Fagus grandifolia* may give way to the intolerant *Betula* species. Currently, the only recommended action for this threat is monitoring *Fagus* and *Streptopus roseus* (and other TES species that may occur in beech stands). Systematic forest plot data collected on site can be used for monitoring *Fagus*. Use the protocol described for monitoring discrete plant populations to monitor *Streptopus* and other TES species.

Other communities. *Pinus strobus* is not replacing itself on Griffith Branch. A prescribed fire of low intensity that is excluded from *Tsuga* stands may help regeneration of this species. If the fire occurs in late summer it may also help suppress populations of *Microstegium vimenium*. Pine slopes and knobs and xeric oak slopes of Bullet Creek Botanical Area, Little Toqua Creek, and French Broad Shale Slopes also should undergo low intensity burns.

The herbaceous wetland at Cutshall Bog is slowly being encroached upon by woody species. This conversion is not suitable for the TES species on the site that require full sunlight and threatens persistence of the community. Action protocols for removing or suppressing woody vegetation should be followed.

Forestry Roads (5)

Forest Service roads bisect several of the 9.F sites and are used by hunters, OHV users, campers, and horseback riders, as well as Forest Service personnel. The roads have become threats on some sites because they facilitate access for unauthorized OHV use, are invasive species corridors, or impact wetlands and streams. Thus, forestry roads may be contributing agents to the **recreation**, **invasive species**, **erosion**, **sedimentation**, **channel modification**, and **species overexploitation** threats discussed elsewhere.

Roads that facilitate access for OHVs should have signage to reduce or restrict this access (e.g., “Fragile ecosystem / Tread carefully,” “No off road vehicular traffic, please,” “Recovering ecosystem / Please stay on roads”). Signage may help alleviate some damage done by OHVs, but it will not be as effective as establishing access barriers to motor vehicle activities. At Devil’s Kitchen Branch Bog, numerous erosion and sedimentation points along the road are washing down slope toward headwaters of the branch, and direct access from the road has contributed to severe degradation of one area of the bog (Tables 2.5.7, 2.5.8). Limiting vehicular traffic on the road may help prevent further sedimentation. Other sites that contain unsanctioned OHV trails and that require gating of access roads include Dry Branch, Moffett Laurel Botanical Area, Ripshin Ridge, Sugar Cove, and Whetstone Branch. On Haw Knob’s Whigg Meadow, boulders have been successfully placed to prevent OHVs from entering the meadow. Boulder placement may not be efficacious at the Roger’s Ridge meadows of Whetstone Branch, where meadows are extensive and access by authorized vehicles is justifiable. Several fingers of user-created access roads enter the meadows, and more may be created if current ones are blocked. We recommend that signs be posted at the access points, instead, and gates installed. If recreational motor vehicles still enter the ridgeline areas, sensitive areas of the meadows should be individually fenced off (Table 2.26.3).

Roads adjacent to or through bogs and streams are also threats to some sites. Direct sedimentation input into bogs from roads may be occuring at North River / Queen Cove and Sheeds Creek, and has been documented at Cutshall Bog (Table 2.4.6). Ruts created on this road have become erosion channels to the west of the bog, depositing sediment from these channels into the bog. The concrete roadbed through the bog provides access to the forest for managers, and pulling up the roadbed would potentially add more sedimentation to the bog community or

alter established bog hydrology. Gating the road across the bog may be a better option for limiting access. This gate should be placed to prevent vehicles from being driven around it and entering the downstream side of the bog. Installing water bars on the road would divert the direction of sediment flow away from the bog area. These options are less feasible at North River / Queen Cove and Sheeds Creek. However, bank support at road edges adjacent to streams and bogs would help reduce sedimentation input into the waters.

Woody Encroachment (6)

Encroachment by woody species in bogs, meadows and balds, and in fire-adapted forest communities leads to **forest conversion** and loss of these communities. Monitoring at sites subject to this threat should include collection of canopy cover data both before and after management actions, coordinated with monitoring of the species or community of interest.

Two management options that can slow or stop woody encroachment on grassy balds, meadows, or ridges are prescribed burns or the bush-hogging (mowing) of woody species. However, some targeted species may sprout back thickly, therefore, follow-up treatments may be necessary, including selective application of herbicides in non-sensitive areas (i.e., areas not adjacent to streams or susceptible TES species), or annual manual removal of sprouts. If fire is used, only one third of each grassy area should be burned at a time to provide refugia within the habitats for desired species. Care should also be taken to insure that species especially susceptible to fire are protected. Under bush-hogging, herbaceous species are not as susceptible to decline.

Increased sapling and shrub cover in bogs reduces light reaching the ground, negatively impacting TES species and *Sphagnum*. At Bullet Creek Botanical Area, canopy cover readings should be collected along the orchid population monitoring transects, and canopy cover should be monitored along with TES populations at other bogs. If increased canopy cover appears to be detrimentally affecting TES species, measures should be taken to remove woody growth. However, prescribed fire may damage desired species in the bogs, and herbicide application is not recommended in wetlands. Therefore, girdling hardwoods in the immediate vicinity of TES species may be the best option. *Acer rubrum,* a common bog hardwood, sprouts prolifically. After girdling sprouting species it may be necessary to annually chop sprouts until the rootstock dies.

Some of the cliffs, ledges, outcrops, and open areas of Colten's Cliff contain the Southern Appalachian High Elevation Rocky Summit (High Peak Type) Community (CEGL004277), *Anastrophyllum saxicola, Gymnoderma lineare, Prenanthes roanensis, Solidago spithamaea, Arenaria groenlandica, Menziesia pilosa, Geum radiatum, Hedyotis purpureum* var. *montana,* and other elements of concern. The Appalachian Trail Conservancy maintains data on the status of the vegetative populations. Manual removal of woody species will lessen the canopy cover and potentially improve habitat for populations that appear to be diminishing or losing vigor. Girdling is impractical as canopy species are often shrubs, and herbicide application may jeopardize species of concern.

At Nolichucky Cliffs, *Pinus pungens* occurs on outcrops subject to encroachment by shrubs, *Pinus virginiana,* and *Quercus* species. These outcrops should be burned to reduce encroaching species and spur regeneration of *Pinus pungens*. *Pinus pungens* communities at this and other sites should be monitored every five years to determine the need for prescribed burning.

TES species at Pine Knob occur on a steep wet grade that becomes almost vertical as the site enters Lake Watauga. Monitoring here is somewhat dangerous, and activity on the slope disturbs the soils. Therefore, species should be monitored when site visits are warranted for other reasons rather than annually. TVA powerline maintenance protocols should be continued. However, encroachment of woody species on TES species in the powerline right-of-way may necessitate bush-hogging down slope as far as safety allows.

Altered Fire Regime (7)

Alterations to the natural fire regime may result in the introduction of **invasive species**, undesired **encroachment by woody species**, or **forest conversion**. For any management action taken, assess the community composition before and after the action. Plot data collected in 2004 and 2005 may be used for initial monitoring, and the plots may be resampled to determine effects of management actions.

In some sites prescribed fire may not be viable. Trees may be girdled, or trees and shrubs may be injected with herbicide. These actions would enable sunlight to penetrate more deeply into forests, allowing desirable shade-intolerant species to germinate or recruit into larger size classes.

Due to fire suppression and control, *Pinus pungens* populations are experiencing decreased germination and recruitment, with age structure skewed toward mature age classes (Zobel 1969, Harmon 1982). The increased relative abundance of hardwood species is indicative of the absence of fire, as is the fact that litter layers at some sites have accumulated to a point at which *P. pungens* seedlings can no longer successfully establish (Williams and Carter 1990). Hardwood encroachment has closed in the canopies and effectively halted successful *P. pungens* seedling establishment. On cliff sites, lack of fire has also led to the absence of germination and recruitment. Here, hardwoods are less able to encroach, but *Pinus virginiana* is capable. The lack of fire has led to a Global Heritage Status Rank (G rank) of G3 for *P. pungens* communities (NatureServe 2007). *Pinus pungens* communities would benefit from medium to high intensity burns that would open the serotinous cones and clear litter off the soil. Such burns would also kill the above ground biomass of *Pinus virginiana,* and encroaching hardwood trees and shrubs.

Other desired pine communities also need fire disturbance to be maintained. These areas should be burned on a rotation that allows the regeneration of pines, as well as recruitment into larger size classes.

Grassy balds and ridgelines are threatened by woody encroachment and may benefit from application of fire. However, fire in these grassy areas may be harmful to TES species. Therefore, assess population conditions before a management action is undertaken and continue monitoring afterwards. Avoid burning over any entire occurrence of a TES species on site.

Bogs that do not undergo periodic fire may be encroached by woody species. Important herbaceous species occur in some of these bogs that need full to partial sunlight. One of these is *Sphagnum* moss, a highly flammable, but desired species. Therefore, introduction of fire into these systems may not be advisable, especially if conditions are dry. Girdling trees within these communities serves two purposes. First, the herbaceous species and *Sphagnum* receive needed sunlight. Second, the girdled trees will provide downed woody debris and snags in the habitats, both of which increase habitat complexity. Salamanders use the woody debris microhabitats, and snags provide structure for desired avian species. Monitor the *Sphagnum* and TES species populations before any action is undertaken and continue the monitoring afterwards. If burning

in any part of the bog is needed, burns during the wet season should reduce the likelihood of scorching or escape.

Sedimentation (8)

Sedimentation alters bog and stream habitats and **impairs water quality** for many organisms. Sedimentation inputs should be monitored annually. If trails adjacent to streams are sources of sedimentation, move them upslope. Do not build any more trail crossings on 9.F sites. If sedimentation is coming from roads, gate them and install water bars that redirect water flow away from wetlands and streams. Best management practices should be put in place on sites that are undergoing any types of soil disturbance. Such practices include manual removal of invasives, installation of water bars, additions of support banks, and stabilization of sedimentation disturbances such as landslides. Sedimentation inputs that are burying vegetation, altering channels, or damming streams should be dug out.

Streams draining into bogs should be protected from any type of alteration or disturbance that may alter the hydrology of the bog. Cations contained in runoff and sedimentation could potentially raise the pH of the bog (Clymo 1963). All upstream waterways should have sufficient buffers to protect them from any anthropogenic or *Sus scrofa* impacts. Bullet Creek is an example of a site that could benefit from implementation of various buffering strategies. Here, the entire upper watershed could be brought into the site boundary and all area on the bog side of the road could be fenced. If sedimentation should begin to occur from upslope, silt fences and straw bales (following Best Management Practices) should be utilized to contain the flow. The trail into the bog area of Bullet Creek should be moved so that no stream crossing is required to reach the bog. Erosion and collapse of stream banks is possible as visitors jump across the stream.

Incompatible Forestry Practices and Management (9)

Forestry practices that are incompatible with conservation objectives on 9.F sites include the **alteration of the natural fire regime** and harvest of timber species. These practices, in turn, contribute to **invasive species**, **forest conversion**, **woody encroachment**, and **species overexploitation** threats, described elsewhere.

On sites that contain early or mid successional communities, management actions should promote recruitment of pines. Little Toqua Creek's knobs and ridgelines should be burned. The *Pinus taeda* occurrence on this site is represented by a few mature individuals (many have died from a southern pine bark beetle infestation that occurred several years ago). The barrens are being enclosed by woody species and overrun by invasives. Fire would open the barrens, promote pine regeneration, and possibly help curb the spread of invasives on the site. Snags on the site should be protected, as they are part of the critical habitat of *Myotis sodalis*. At Devil's Kitchen Branch Bog, a late summer low intensity prescribed fire may help control the extensive *Microstegium vimenium* invasion and should spur regeneration of *Pinus strobus.* French Broad Shale Slopes needs fire to aid in regeneration of oak species. Sheeds Creek may benefit from a late summer prescribed burn to open the canopy and hinder invasive species expansion. If a burn during that time of year carries high risk of escape or tree mortality, small group cuts would also open the canopy and encourage herbaceous species regeneration.

The *Pinus pungens* communities of Fagall-Birch Branch, Whetstone Branch, and Horse Hitch Gap also need prescribed burns. These burns should be of medium high intensity to kill off woody species and effectively open the canopy and expose mineral soils. These conditions

would help germination and limit competition so the new seedlings can establish and grow into larger size classes. Currently on Fagall-Birch Branch and Whetstone Branch there are only a few mature individuals that appear to be of the same cohort. *Pinus pungens* will disappear in the near term if regeneration by management action or natural disturbance does not occur soon. The *Pinus pungens* at Nolichucky Cliffs occurs on outcrops. These populations should be monitored and, if regeneration is not occurring, or if other species encroach and compete with the pines, the outcrops should also be burned.

At John's Bog, North River / Queen Cove, Bullet Creek, and Cutshall Bog, encroaching woody species may be capturing sunlight before it can reach the herbaceous layer species. Monitor *Sphagnum* mats, other TES species, and canopy coverage in these bogs. If individuals or mats under more dense canopies show less expansion or vigor, girdle trees to open the canopy.

At other sites, the potential of timber harvest puts habitat integrity and TES species at risk. Do not harvest *Prunus serotina* at Sugar Cove and Haw Knob. There are scattered occurrences of TES species that could be negatively impacted by harvesting activities. Dry Branch should not undergo a timber harvest either, as the disturbance could impact the *Myotis* populations that use the site's habitats.

Pine Knob's TES species occur within a powerline right-of-way. Management to keep the right-of-way cleared is conducted by TVA. Species of concern should be monitored as powerline maintenance continues (using monitoring protocols for discrete plant populations), and any future maintenance should not be conducted over any complete occurrences of a TES species. Before the maintenance is scheduled, at least 1/3 of each population of concern should be delineated to NOT be included in the management polygon. Monitoring of the species should be conducted before and continue after the management action has been carried out. Future management actions should be tailored around the resulting evidence of impacts to the populations.

Development of Roads / Utilities (10)

The development of roads and utilities create a more fragmented landscape, increased risk of invasive species, and increased visitation to sites. Like the **forestry roads** threat, development of roads and utilities contributes to other threats, including **invasive species**, **overexploitation of species**, impacts from **recreation**, **channel modification**, **erosion**, and **sedimentation**. Monitoring for invasions and OHV use should occur on all the sites threatened by this development.

Some sites have well developed road systems used primarily for site access and recreactional use on sites. Sites with high visitation rates are in need of signage that directs users to adopt habitats to help protect sensitive species and ecosystems. For example, the upgraded road and parking areas on Roan Mountain has enhanced access for greater numbers of users. In turn, Colten's Cliff / Wolf Ridge is at greater risk of recreational impacts such as degradation of cliff habitats, over-exploitation of species, compaction, and pollution. At this and other sites, signage that informs the public about the fragility of the ecosystems they enjoy would help reduce impacts due to neglect or ignorance. Otherwise, sites may continue to degrade over time. Signs placed at entries from parking areas or adjacent forest areas could generally inform visitors about the sensitive nature of the site ("Fragile ecosystem / Please tread carefully"), whereas others could be targeted to specific situations, such as between trails and TES species ("Sensitive species / Please stay on trail"). Where trampling occurs, low fencing between trails and populations would reduce its intensity.

Some road systems have grown beyond sanctioned use as recreational users have developed their own shortcuts and access trails. In these sites, unsanctioned OHV trails and access points should be closed. Signage ("No vehicular traffic, please / Foot travel is welcome," "Recovering community / Please stay on roads," "Fragile ecosystem / Please stay on sanctioned trails") may be effective if the unsanctioned trails are not yet well established. The sanctioned roads and trails should then be well maintained and clearly marked. If use of unsanctioned roads and trails persist, gate or boulder additions may help dissuade users. Well-established unsanctioned roads should be gated immediately.

Other sites are adjacent to communities or neighborhoods, and public roads and utilities are in place or being added as the area is developed. Here, signage is also important, as people that live adjacent to the sites are likely to use them for recreational opportunities. In the way described above, signs can be placed both at site entry points and at specific protection targets. Dry Branch is such a site. OHV operators use the forestry roads and venture off trail, potentially negatively affecting water quality. The site's proximity to development also puts the limestone caves at a higher risk of being entered. Any disturbance of roosting bats could disrupt productivity lead to cave abandonment. Caves should never be entered. For these reasons, Dry Branch should not be accessible to recreational vehicles, motorized or nonmotorized. If possible, gates or boulders should be placed on current roads and trails at the entrances to this site. Appropriate signage ("Do not disturb stream area / Sensitive species depend on its integrity") should be placed before stream areas adjacent to trails and roads. Cave entrances should be barred or posted with appropriate signage.

Finally, some sites are threatened by past development of roads or utilities. At Pine Knob, TES species occur in a TVA-managed powerline right-of-way. The maintained state of the right-of-way provides suitable habitat for those species, but maintenance actions themselves are potentially harmful to the populations. Plant species of concern should be monitored as powerline maintenance continues, and any future maintenance should not be conducted over any complete occurrences of a TES species. During maintenance planning, assure that at least 1/3 of each population of concern does not occur within the delineated management polygon. Monitoring of the species should be conducted before and continue after the management action has been carried out. Future management actions should be tailored around the resulting evidence of impacts to the populations.

Cutshall Bog is also threatened by past development. Road or utility work that disturbs the bog should not be conducted, except for actions intended to improve water quality, such as the installation of water bars. Removing the roadbed through the bog could potentially increase sedimentation or alter water levels too greatly. Roadwork at Cutshall Bog should not be conducted without pre and post-monitoring of TES species and water levels.

Erosion (11)

Erosion contributes to **sedimentation** and **impaired water quality** threats. At sites where erosion or sedimentation are threats, monitoring for both should occur annually. Those portions of trails, roadways and slopes that are adjacent to streams and bogs are important places to assess. Monitoring is particularly critical at sites that contain extremely steep shale slopes, such as those at French Broad Shale Slopes and Nolichucky Cliffs, or slopes that have recently experienced vegetation removal disturbances, such as the large gap created in 2004 at Lost Cove of Nolichucky Cliffs.

Erosion is evident at sites subjected to *Sus scrofa* trampling and rooting. The upland area of Bullet Creek Botanical Area should be fenced to prevent erosion into the bog area. For the same reasons, fencing of uplands may also be necessary at North River / Queen Cove and Sugar Cove sites.

Roads at some sites are eroding and releasing sediment into adjacent areas. Gating the roads and installing water bars (North Carolina Division of Forest Resources 2006) would allow ruts to heal and would ameliorate effects of erosion.

Channel Modification (12)

Channel modification results from a variety of causes on the Cherokee National Forest: trampling by hikers or animals, waters funneled through culverts or blocked by roads and embankments, road and trail crossings, and OHV usage in or adjacent to streams. Channel modification may facilitate **erosion**, **sedimentation**, and **impaired water quality**.

Where channel modification is a threat, TES species and *Sphagnum* that occur in or adjacent to the impacted area should be monitored annually. OHV effects should be monitored if vehicles are contributing to the problem. Annual photomonitoring can show if damage is spreading or if revegetation is occurring.

Roads that are adjacent to or cross streams should be gated and used only for management access. Redesignation of these roads to nonvehicular travel and identification of such on user maps would enable regulation. Due to unknown effects of removing the road through Cutshall Bog, the road should probably remain undisturbed and addition of culverts avoided. If roads are eroding into the streams, water bar additions set to slow and divert runoff would help keep sedimentation out of the waterways and would reduce vehicular traffic. Road banks that are collapsing into the stream or wetland should receive additional support, such as braced mesh, in the problem area.

Hikers may trample water channels at stream crossings or along sections of trails adjacent to channels. Signage may discourage hikers from straying from the established trail or from using a particular dispersed campsite ("Do not disturb stream / Sensitive species depend on its integrity"). Trails could also be relocated upslope from the stream being impacted. If trampling damage is caused by *Sus scrofa*, then fence the area so it can not enter.

Overexploitation of Species (13)

Species overexploitation can occur as a result of direct harvesting/collection activities or indirectly through conversion or destruction of habitat. TES populations should be annually monitored. Education about elements of concern and how they are impacted by recreational activities would help provide a sense of public ownership and responsibility. Signage may be the most effective way to communicate these messages. Signs to dissuade users from trampling through or collecting species of concern ("Sensitive species / Do not disturb") could be placed where recreation occurs near TES populations. This signage, placed between trails and populations, should not point out particular species. Simple small signs placed at trailheads ("Fragile species / Please stay on trail") may be helpful in heavily visited areas that have many scattered TES occurrences.

Where recreation usage is not easily managed through signage alone, the construction of low fences between trails and TES species may be required. Such measures may be necessary especially at heavily visited sites like Colten's Cliff / Wolf Ridge and Haw Knob.

If vehicle operation, either sanctioned or unsanctioned, is the cause of damage to TES species or habitats, then trails and roads into the affected sites should be closed. Any disturbance of *Myotis* species may impair reproductive success and cause roost cave abandonment, therefore, entrances to possible roosting caves should be gated.

Urban / Suburban Development (14); Second Home / Vacation Development (16)

Some 9.F sites receive high human use because of their adjacency to development, thus proximity to development increases impacts associated with **recreation** and increases risk of **species overexploitation**. Signage is important, as people that live adjacent to the sites are likely to use them for recreational opportunities. Signs placed at site entrances could generally describe the sensitive nature of the site ("Fragile ecosystem / Tread carefully"),whereas other signs placed between trails and elements of concern could provide more targeted protection ("Sensitive species / Please stay on trail"). At some sites, gating access roads would help keep motor vehicles from entering sites. Trails created by OHVs criss-cross several 9.F sites adjacent to development.

Airborne Pollutants / Nutrients (15)

Pollutants deposited by rain and wind are detrimental to some species and could lead to greater risk of **forest conversions**. Some tree species are known to be susceptible to ozone, such as *Prunus serotina* and *Pinus pungens* (Porter 2003). Forest monitoring can provide early warning of pollution effects. However, because insects, drought, and disease are just a few other causes of foliar damage to leaves, experts caution that only trained observers conduct the monitoring.

Incompatible Water Quality (17)

A variety of agents may impair water quality of streams and bogs: livestock trampling, waste inputs, erosion and sedimentation. An annual monitoring program of chemical, physical, and biological aspects of water quality would provide baseline data to which changes could be compared and indicate what follow up actions are appropriate. Monitoring should be conducted at all sites on which water quality may be an issue: North River / Queen Cove, Whetstone Branch, Dry Branch, Cutshall Bog, John's Bog, and Sheeds Creek.

At Dry Branch, high water quality is important, as the streams on site provide forage area for *Myotis* species. Conduct water quality monitoring annually, and place informative signs adjacent to the streams ("Do not disturb stream / Sensitive species depend on its integrity"). North River / Queen Cove's campsite number 4 is too close to the bog and has been used as a restroom area for campers, therefore, it should be closed. At Whetstone Branch, the seeps and bogs on Roger's Ridge may need to be fenced off if signage can not keep OHVs from running through them.

Operation of Dams / Impoundments (18); Water Withdrawal (22)

Dynamics of impounded water at or adjacent to 9.F sites may contribute to **forest conversion** threats. At Sheeds Creek, beaver activity could flood the forest and convert it to an open-canopy, snag-filled pond. Should beaver dams become established, managers should install a control device that allows regulation of water level. Beavers can then remain in the habitat while managers retain some control over extent of forest flooding. We recommend the Clemson Beaver Pond Leveler (Clemson University Cooperative Extension Service 1994).

Operation of large reservoirs at Pine Knob, Griffith Branch, and Little Toqua Creek may cause localized flooding affecting plant communities. Status of these communities and TES species should be tracked by periodic monitoring at these sites.

Seasonal monitoring of water level, and annual monitoring of TES species should be conducted at John's Bog and Jones Branch Bog. The ditches at John's Bog may release valuable water from the bog, and the installation of a water flow regulator at the culvert would allow water to be held in the bog as needed.

Agricultural Conversion (19)

Some 9.F areas previously used in agriculture have become valuable habitats, and the cessation of agricultural practices has contributed to the threat of **woody encroachment** (described elsewhere). Introduction of practices that maintain early successional states (even including the resumption of the former practices) should be implemented. Grassy balds and meadows and herbaceous bogs may be shrinking as *Rubus* spp., *Crateagus* spp., *Acer rubrum, Fagus grandifolia,* and other woody species encroach. This encroachment should be monitored biannually. If treatment actions are undertaken, monitor the affected area both before and after treatment.

The balds and meadows of Haw Knob (Haw Knob, Laurel Top, John's Knob, Whigg Meadow) are shrinking as woody species encroach. These areas were historically used as pastureland, but they now lack the management needed to keep them open. Burning and/or bush-hogging these areas would help suppress the encroaching growth. However, fire in these grassy areas may be harmful to TES species. Therefore, assess population conditions before a management action is undertaken and continue monitoring afterwards. Avoid burning over any entire occurrence of a TES species on site and burn only 30% of an area in a single burn. Care should also be taken to ensure that species especially susceptible to fire, such as *Menziesia pilosa,* are protected. Under bush-hogging, herbaceous species are not as susceptible to decline. With both methods, check and remove sprouts.

Incompatible Resource Extraction (20)

Resource extractions disturb soils, leading to **channel modification**, **erosion**, or **sedimentation** and increasing risk of **invasive species** establishments. Resource extraction is not compatible with conservation objectives of 9.F sites, therefore, no resources should be removed from these sites.

Incompatible Agricultural Practices (23)

Livestock operations, applications of fertilizers or pesticides, or other agricultural practices occurring on or adjacent to 9.F sites may introduce **invasive species**, or they may induce **erosion**, **channel modification**, or **impaired water quality** (threats described elsewhere). Where agricultural practices threaten site integrity, remove or mitigate the source of the threat to the degree possible, and monitor closely for invasive species, evidence of hydrological alteration, and reduced water quality.

1.6. Literature Cited (all URL information confirmed as of October 2007)

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Table 1.1. Ranking of conservation need for CNF rare community sites (ordered by composite score[1] of the Sutter and Szell (2006) conservation ranking approach).

			Threat and Irreplaceability Scores		
Rank	Site		RTS	log(IRR)	Composite
1	Colten's Cliff / Wolf Ridge	CCWR	102.345	1.254	4.033
2	Haw Knob	HK	117.738	1.134	4.021
3	Nolichucky Cliffs	NC	9.752	1.050	4.012
4	Fagall – Birch Branch	FBB	10.847	1.042	4.011
5	Moffett-Laurel	ML	93.185	1.002	4.007
6	Whetstone Branch	WB	98.675	0.974	4.004
7	Cliff – Temple Ridge	CTR	140.112	0.835	2.594
8	Ripshin Ridge	RR	9.764	0.799	2.474
9	Little Toqua Creek	LTC	155.128	0.602	2.449
10	Devil's Kitchen Branch Bog	DKBB	147.646	0.398	2.411
11	Pine Knob	PK	5.323	0.778	2.406
12	Iron Mountain South	IMS	142.762	0.522	2.387
13	John's Bog	JB	49.434	0.769	2.377
14	Sheeds Creek	SCK	139.290	0.336	2.370
15	Bullet Creek	BC	123.217	0.495	2.295
16	Horse Hitch Gap	HHG	107.423	0.097	2.224
17	Griffith Branch	GB	13.020	0.676	2.116
18	North River / Queen Cove	NRQC	80.186	0.628	2.111
19	Sugar Cove	SCV	51.532	0.426	2.005
20	Cutshall Bog	CB	47.848	0.615	1.964
21	Lindy Camp Bog	LCB	6.498	0.514	1.673
22	Dry Branch	DB	10.457	0.477	1.579
23	East Fork Higgins Creek	EFHC	26.264	0.125	1.276
24	Stony Creek Bog	SCB	3.661	0.290	1.214
25	Jones Branch Bog	JBB	12.173	0.200	1.101
26	French Broad Shale Slopes	FBSS	11.062	0.176	1.079

[1] Ranking classifications: NOW – RIGHT NOW (composite score ≥ 4.0, shaded red), NOW (3.0 ≤ score < 4.0), SOON (2.0 ≤ score < 3.0, shaded green), LATER (score < 2.0, shaded blue).

Table 1.2. Composite scores[1] and rankings provided for each CNF rare community site under the Sutter and Szell (2006) conservation ranking approach (shaded columns; RTS and IRR scores also provided) and under eight alternative approaches.

	IRR exponent = -0.5						IRR exponent = -1								IRR exponent = -2					
	RTS weight factor = 2		RTS weight factor = 5		RTS weight factor = 7		RTS weight factor = 2		RTS weight factor = 5				RTS weight factor = 7		RTS weight factor = 2		RTS weight factor = 5		RTS weight factor = 7	
Site	score	Rank	Score	Rank	score	rank	score	rank	RTS	log(IRR)	score	rank	score	rank	score	rank	score	rank	score	rank
BC	2.799	9	2.295	15	2.294	15	2.799	8	123.217	0.495	2.295	15	2.294	15	2.799	7	2.295	14	2.294	14
CB	2.163	19	2.071	19	2.071	19	2.163	18	47.848	0.615	1.964	20	2.014	20	2.163	17	1.916	20	2.014	20
CCWR	4.033	1	4.033	1	4.033	1	4.033	1	102.345	1.254	4.033	1	4.033	1	4.033	1	4.033	1	4.033	1
CTR	2.752	10	2.742	8	2.741	8	2.607	11	140.112	0.835	2.594	7	2.592	7	2.495	13	2.410	10	2.408	9
DB	1.871	22	1.545	22	1.545	22	1.871	21	10.457	0.477	1.579	22	1.579	22	1.871	21	1.612	21	1.612	21
DKBB	2.700	12	2.411	11	2.406	11	2.700	10	147.646	0.398	2.411	10	2.406	10	2.700	9	2.411	9	2.406	10
EFHC	1.396	25	1.276	24	1.266	24	1.396	24	26.264	0.125	1.276	23	1.266	23	1.396	23	1.276	23	1.266	23
FBB	4.021	3	4.021	3	4.021	3	4.011	4	10.847	1.042	4.011	4	4.011	4	2.893	6	2.888	5	2.888	5
FBSS	1.665	23	1.129	26	1.129	26	1.665	23	11.062	0.176	1.079	26	1.079	26	1.665	22	1.049	25	1.025	26
GB	2.285	18	2.272	16	2.270	16	2.124	19	13.020	0.676	2.116	17	2.115	17	2.019	19	2.017	18	2.017	19
HHG	2.572	14	2.224	17	2.234	17	2.572	13	107.423	0.097	2.224	16	2.234	16	2.572	12	2.224	15	2.234	15
HK	4.026	2	4.026	2	4.026	2	4.021	2	117.738	1.134	4.021	2	4.021	2	4.013	2	4.013	2	4.013	2
IMS	2.359	16	2.387	12	2.397	12	2.359	17	142.762	0.522	2.387	12	2.397	12	2.359	16	2.387	11	2.397	11
JB	2.465	15	2.451	9	2.449	9	2.392	16	49.434	0.769	2.377	13	2.375	14	2.364	15	2.309	13	2.307	13
JBB	1.252	26	1.241	25	1.241	25	1.252	25	12.173	0.200	1.101	25	1.101	25	1.252	25	1.059	24	1.046	25
LCB	2.072	20	2.068	20	2.067	20	1.673	22	6.498	0.514	1.673	21	1.673	21	1.342	24	1.342	22	1.342	22
LTC	2.977	7	2.449	10	2.428	10	2.977	7	155.128	0.602	2.449	9	2.428	9	2.977	4	2.449	8	2.428	8
ML	4.016	5	4.016	5	4.016	5	4.007	5	93.185	1.002	4.007	5	4.007	5	2.908	5	2.904	4	2.904	4
NC	4.014	6	4.014	6	4.014	6	4.012	3	9.752	1.050	4.012	3	4.012	3	4.008	3	4.008	3	4.008	3
NRQC	2.591	13	2.111	18	2.113	18	2.591	12	80.186	0.628	2.111	18	2.113	18	2.591	11	2.111	16	2.113	16
PK	2.347	17	2.333	14	2.331	14	2.420	15	5.323	0.778	2.406	11	2.404	11	2.489	14	2.475	6	2.473	6
RR	2.922	8	2.919	7	2.918	7	2.489	14	9.764	0.799	2.474	8	2.472	8	2.026	18	2.024	17	2.024	18
SCB	1.430	24	1.430	23	1.430	23	1.214	26	3.661	0.290	1.214	24	1.214	24	1.111	26	1.046	26	1.046	24
SCK	2.751	11	2.370	13	2.377	13	2.751	9	139.290	0.336	2.370	14	2.377	13	2.751	8	2.370	12	2.377	12
SCV	1.949	21	2.005	21	2.028	21	1.949	20	51.532	0.426	2.005	19	2.028	19	1.949	20	2.005	19	2.028	17
WB	4.016	4	4.016	4	4.016	4	4.004	6	98.675	0.974	4.004	6	4.004	6	2.628	10	2.471	7	2.469	7

[1] Ranking classifications: NOW – RIGHT NOW (composite score ≥ 4.0), NOW (3.0 ≤ score < 4.0), SOON (2.0 ≤ score < 3.0), LATER (score < 2.0).

Table 1.3. Overall threat rankings on Cherokee National Forest, based on threat scores averaged across 9.F rare community sites. Numerical scores (0-4) correspond to severity ranks of Sutter and Szell (2006) and were provided by respondents to a threats assessment survey.

		Threat Scores			
Rank	Threat[1]	Mean	SE	Range	Median
1	Invasive Species	1.475	0.210	0.333 - 4.000	1.250
2	Recreation	0.880	0.099	0.333 - 2.000	0.750
3	Parasites / Pathogens	0.777	0.204	0 - 3.667	0.333
4	Forest Conversion	0.603	0.125	0 - 2.333	0.450
5	Forestry Roads	0.553	0.100	0 - 1.750	0.550
6	Woody encroachment	0.482	0.106	0 - 1.800	0.333
7	Altered Fire Regime	0.476	0.113	0 - 2.250	0.333
8	Sedimentation	0.358	0.076	0 - 1.200	0.292
9	Incompatible Forestry Practices and Management	0.330	0.066	0 - 1.400	0.292
10	Development of Roads / Utilities	0.287	0.101	0 - 2.333	0
11	Erosion	0.265	0.045	0 - 0.667	0.292
12	Channel Modification	0.262	0.069	0 - 1.333	0.100
13	Overexploitation of Species	0.166	0.036	0 - 0.667	0.200
14	Urban / Suburban Development	0.162	0.067	0 - 1.500	0
15	Airborne Pollutants / Nutrients	0.123	0.079	0 - 2.000	0
16	Second Home / Vacation Development	0.111	0.060	0 - 1.500	0
17	Incompatible Water Quality	0.090	0.036	0 - 0.800	0
18	Operation of Dams / Impoundments	0.080	0.040	0 - 0.750	0
19	Agriculture Conversion	0.078	0.052	0 - 1.333	0
20	Incompatible Resource Extraction	0.031	0.018	0 - 0.400	0
21	Hydrologic Threats (unspecified)[2]	0.026	0.026	0 - 0.667	0
22	Water Withdrawal	0.022	0.016	0 - 0.333	0
23	Incompatible Agricultural Practices	0.015	0.011	0 - 0.200	0
23	Incompatible Grazing Practices	0.015	0.015	0 - 0.400	0
25	Conversion to Pasture	0.008	0.008	0 - 0.200	0
25	Livestock Feedlots / Production Practices	0.008	0.008	0 - 0.200	0
25	Proposed / Potential Mineral Resource Extraction	0.008	0.008	0 - 0.200	0
25	Industrial Development	0.008	0.008	0 - 0.200	0

[1] Excludes threats not identified by any survey respondent for any site: Proposed Dams / Impoundments, Proposed Water Withdrawal, Excessive Groundwater Withdrawal.
[2] Not all respondents distinguished a specific hydrological threat (Sedimentation, Erosion, Channel Modification, Incompatible Water Quality, Operation of Dams / Impoundments or Water Withdrawal).

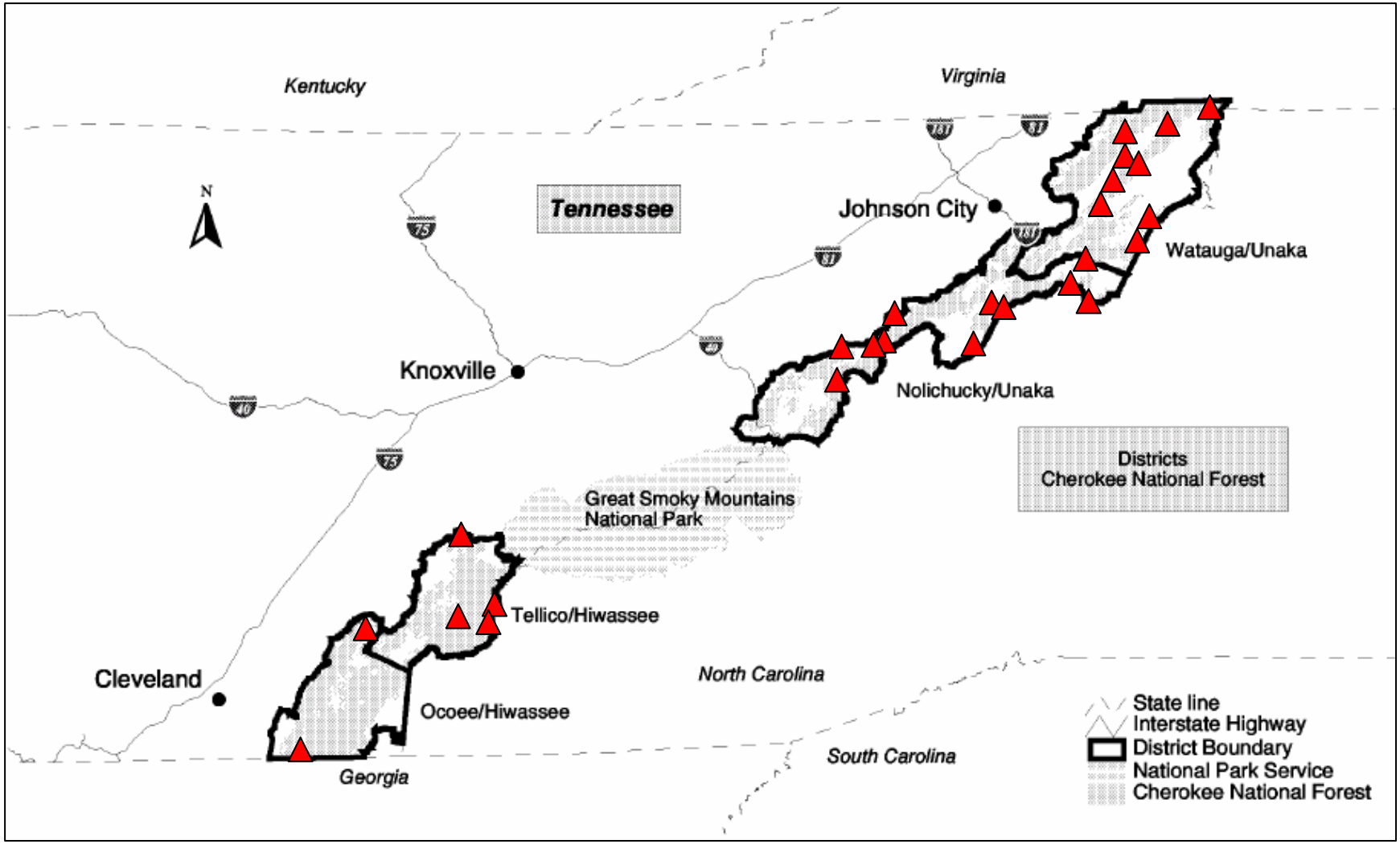

Figure 1.1. Locations of 26 9.F rare community site in Cherokee National Forest.

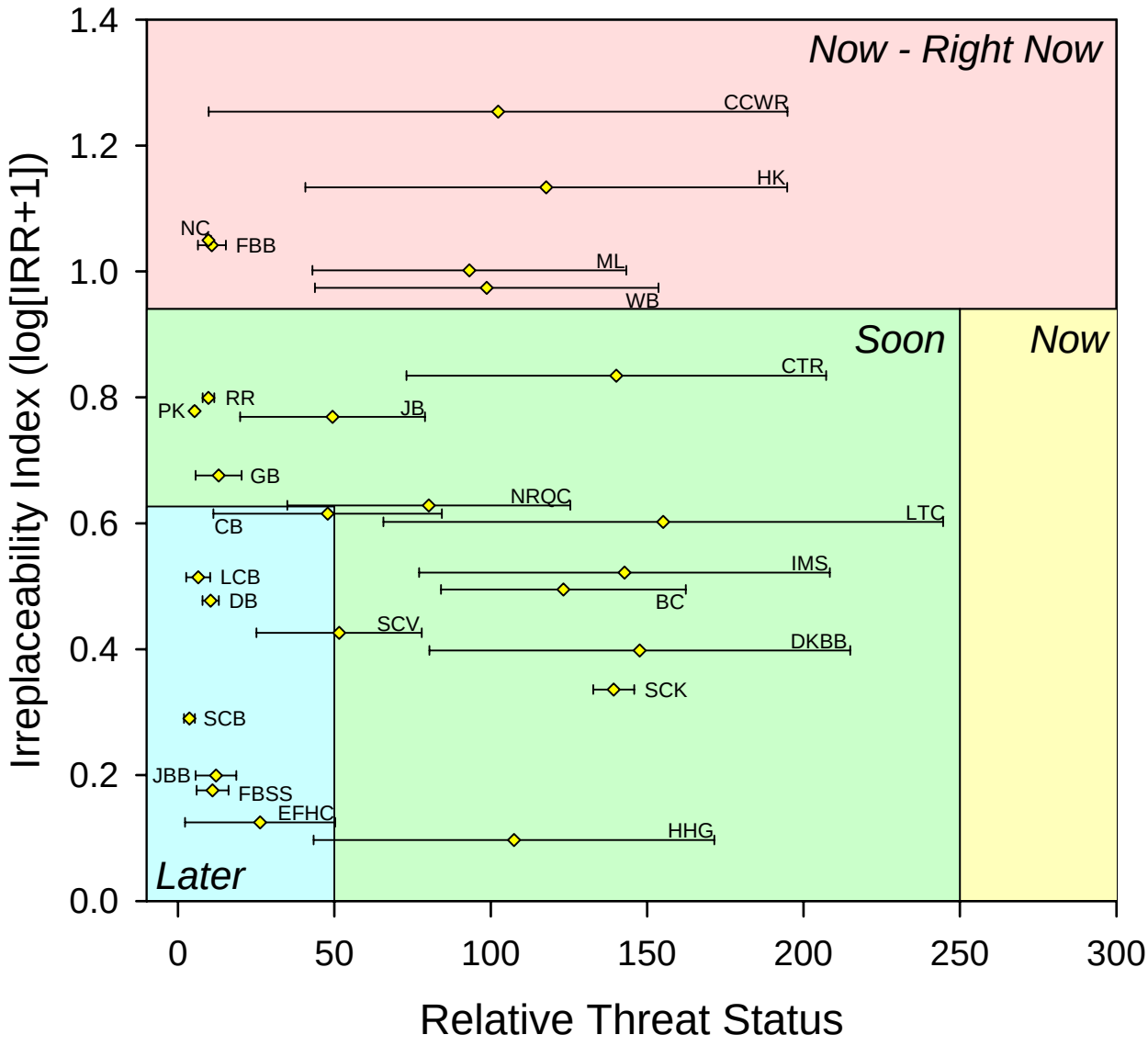

Figure 1.2. Conservation ranking classification of CNF rare community sites by methods of Sutter and Szell (2006). Standard errors for the Relative Threat Status means are indicated by the horizontal whiskers.

Section 2: INDIVIDUAL SITE ASSESSMENTS

Chapter 1
Bullet Creek Botanical Area – Mecca Quad, 35.32507º N, 84.43634º W
Prioritization Rank – Soon, 15th out of 26
Site Photos - Bullet Creek

Summary

This forested acid seep (Table 2.1.1) is found on a perched water table. *Acer rubrum, Nyssa Sylvatica, Liriodendron tulipifera,* and *Liquidambar styraciflua* occur in the overstory of this community type and common ground flora includes several ferns and orchids and *Sphagnum* spp. The most serious threats facing this community include invasive species (*Microstegium*), recreation, and overexploitation of species. This site received a **prioritization category of SOON (ranked 15 of 26)**. Increasing canopy openness and removing the invasive species from the bog are recommended management goals (Table 2.1.2).

Table 2.1.1. Community Types Listed (Major *et al*. 2000)

Classification	Name	G rank
CEGL007443	**Acer rubrum* var. *trilobum - Nyssa sylvatica / Osmunda cinnamomea - Chasmanthium laxum – Carex intumescens / Sphagnum lescurii* Forest	G3?

*** not sampled**

TES Elements

***Cypripedium acaule* (G5/S4) (Table 2.1.3) -** This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). Management practices that benefit *Platanthera integrilabia* should also benefit this orchid.

***Hemidactylium scutatum* (G5/S3) (Table 2.1.3) -** Females nest in mosses and under woody debris, so it is important to maintain these in the habitat (Wisconsin Department of Natural Resources 2006). Burning would remove these important habitat components, so that management action is strongly discouraged within the bog area. Uplands may be burned if precautions are taken to preserve the salamander nesting habitat.

***Platanthera integrilabia* (G2G3/S2S3) (Table 2.1.3) -** The orchid occurs in permanently saturated soils that may flood for periods of time (Robinson 1982). Trees upslope from the bog should be maintained in place to prevent increased runoff that could potentially bury the orchid and its habitat in sediment. Also, any drainage of the habitat could negatively impact the population. *Microstegium vimenium* (Table 2.1.5) should be removed from the habitat to keep competition minimized. This orchid species is monitored yearly by CNF, coordinated by Mark Pistrang (mpistrang@fs.fed.us) (Table 2.1.4). Currently the population is doing well but can be negatively affected by decreased amounts of sunlight. Recommended forestry practice to preserve *Platanthera integrilabia* populations include burning or single or small group removals of canopy trees (Hammond and Sweeney 1997) as the canopy closes. Care should be taken to adhere to Best Management Practices and to not disturb the soil, so a best way to achieve this goal is to kill and leave in place standing trees. The most safe and inexpensive method is to girdle trees. This will leave beneficial snags in the bog. Burning is not a good technique for increasing canopy openness for *Platanthera integrilabia* in this site.

Knowledgeable People

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Table 2.1.2. Threats and management actions for Bullet Creek. These threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Significance	Confi-dence	Elements / Communities that should benefit
Invasive Species	1	Burn bog areas infested with *Microstegium*	0	1	annually in winter	2B:1H	bad	med	*Platanthera* and *Cypripedium*
Invasive Species	1	Fence uplands	2	5	once	4B:0H	very good	med	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Invasive Species	1	Herbicide *M. vimenium*	0	0.5	annually	2B:2H	fair	low	*Platanthera* and *Cypripedium*
Invasive Species	1	Manually remove *M. vimenium* from bog	2	2	annually in late summer, early fall	4B:0H	very good	med	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Recreation	2	Fence uplands	3	5	once	4B:0H	very good	med	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Overexploitation of Species	3	Signage - Sensitive Species. Do not disturb.	4	1	once	4B:0H	good	med	*Platanthera* and *Cypripedium*
Woody Encroachment	4	Chop sprouts of girdled trees	6	0.5	as needed	3B:0H	very good	high	CEGL007443, *Platanthera* and *Cypripedium*
Woody Encroachment	4	Girdle trees	6	1	as needed	3B:0H	very good	high	CEGL007443, *Platanthera* and *Cypripedium*
Woody Encroachment	4	Monitor canopy cover over transects	5	0.5	annually	3B:0H	good	high	CEGL007443, *Platanthera* and *Cypripedium*
Woody Encroachment	4	Monitor TES species	1	0.5	annually	3B:0H	good	med	*Platanthera, Cypripedium, Hemidactylium scutatum*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Significance	Confi-dence	Elements / Communities that should benefit
Incompatible Forestry Practices and Management	5	Girdle trees	12	0	no action	4B:0H	good	med	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Invasive Species	5	Monitor TES species	1	0.5	annually	3B:0H	good	med	*Platanthera, Cypripedium, Hemidactylium scutatum*
Woody Encroachment	5	Monitor TES species	1	0.5	annually	3B:0H	good	med	*Platanthera, Cypripedium, Hemidactylium scutatum*
Forest Conversion	6	Add pine straw to litter layer	14	0.5	annually, once needed	2B:0H	good	med	*Platanthera* and *Cypripedium*
Forest Conversion	6	Burn uplands	8	1	decadally	2B:2H	good	low	*Platanthera* and *Cypripedium*
Incompatible Resource Extraction	7	Do not harvest timber	12	0	no action	4B:0H	good	med	CEGL007443, Platanthera, Cypripedium, Hemidactylium
Forestry Roads	7	Nothing	13	0	continued	0B:0H	good	med	none
Sedimentation	8	Extend site buffer	10	1	once	4B:0H	very good	med	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Channel Modification	8	Fence uplands	3	5	once	4B:0H	good	med	
Channel Modification	8	Move trail	9	0.5	once	4B:0H	very good	med	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Altered Fire Regime	9	Burn uplands	8	1	decadally	2B:2H	good	med	*Platanthera* and *Cypripedium*
Parasites / Pathogens	9	Burn uplands	8	1	decadally	2B:2H	good	low	*Platanthera* and *Cypripedium*
Sedimentation	9	Install and maintain BMPs if needed	11	1	as needed	4B:0H	very good	high	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Sedimentation	9	Move trail	9	0.5	once	4B:0H	very good	med	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Erosion	10	Fence uplands	3	5	once	4B:0H	very good	high	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Significance	Confi-dence	Elements / Communities that should benefit
Erosion	10	Install and maintain BMPs if needed	11	1	as needed	4B:0H	good	med	CEGL007443, *Platanthera, Cypripedium, Hemidactylium*
Airborne Pollutants	10	Monitor TES species	1	0.5	annually	3B:0H	good	med	*Platanthera, Cypripedium, Hemidactylium scutatum*

Table 2.1.3. GPS coordinates of TES species at Bullet Creek Botanical Area

Point Name	GPS Coordinates			
BC *Cypripedium acaule*	35.32000	°N	84.44861	°W
BC *Hemidactylium scutatum*	35.32000	°N	84.44861	°W
BC *Platanthera integrilabi*a	35.32639	°N	84.43528	°W

Table 2.1.4: *Platanthera integrilabia* monitoring at Bullet Creek Botanical Area. Yearly monitoring is conducted by Mark Pistrang, of the Cherokee National Forest, mpistrang@fed.fs.us.

Year	# Flowering	# Vegetative	Total	% flowering	% vegetative
1996	486	112	598	81	19
1997	868	111	979	89	11
2000	854	258	1112	77	23
2001	140	131	271	52	48
2002	176	119	295	60	40
2003	104	134	238	44	56
2004	862	169	1031	84	16
2005	768	126	894	86	14

Table 2.1.5: *Microstegium vimenium* monitoring information at Bullet Creek Botanical Area.

Species	Population length (m)	Population width (m)
Microstegium vimenium	along stream	along stream

Chapter 2
Cliff – Temple Ridge – Chestoa Quad, 36.087111º N, 82.458389º W
Prioritization Rank – Soon, 7th out of 26
Site Photos - Cliff Temple Ridge

Summary

Cliff – Temple Ridge is a xeric ridge line that contains a broken band of *Tsuga caroliniana (Pinus puingens/Pinus rigida)* Forest (CEGL006178-G2) (Table 2.2.1), surrounded by *Quercus alba – Carya (ovata, alba, glabra) – Pinus virginiana* Forest (CEGL007231- G4G5) and *Quercus (prinus, coccinea) / Kalmia latifolia /(Galax urceolata, Gaultheria procumbens)* Forest (CEGL006299 – G5) (Table 2.2.2). The cove contains a *Pinus strobus* community. The largest threats facing this site are parasites and pathogens (Hemlock Woolly Adelgid, *Adelges tsugae*) and an altered fire regime. These serious threats and the rarity of the *Tsuga – Pinus* community on the landscape call for a **high management prioritization of SOON and an overall prioritization ranking of 7 of 26**. Recommended actions include releasing the adelgid predator, *Psuedoscymnus tsugae,* and a med-high intensity burn (Table 2.2.3).

In the *Quercus prinus, Quercus coccinea* Forest (Sorenson's Similarity = 0.80), *Pinus strobus* appears to be likely to increase in dominance in coming decades. Conversely, the current dominants, *Acer rubrum*, *Quercus coccinea,* and *Quercus prinus,* show no indication of substantial change since their size distributions suggest neither increase nor decrease. Thus these species could maintain their dominance, but increasingly share it with *Pinus strobus.*

In the *Quercus alba – Carya (ovata, alba, glabra) – Pinus virginiana* Forest (Sorenson's Similarity = .5), *Pinus strobus*'s abundance level is likely to increase in the future. *Quercus alba, Quercus coccinea,* and *Quercus prinus* should remain at steady population levels, while size distributions suggest that *Acer rubrum* and *Oxydendron arboreum* will decrease in abundance.

Unsampled ridgeline areas contained *Tsuga caroliniana, Pinus virginiana,* and *Pinus pungens.* In the nutrient poor shallow soils it is likely that the pines will increase in dominance as hemlock dies.

Table 2.2.1. Community Types Listed at Cliff Temple Ridge (Major *et al*. 2000).

Classification	Name	G rank
CEGL006178	**Tsuga caroliniana - Pinus (rigida, pungens)* Forest	G2

*** Not sampled**

Table 2.2.2. Communities Found at Cliff Temple Ridge (Major *et al*. 2000; monitoring points listed in Table 2.2.4).

Classification	Community	G rank
CEGL006178	**Tsuga caroliniana (Pinus puingens/Pinus rigida)* Forest	G2
CEGL006299	*Quercus (prinus, coccinea) / Kalmia latifolia /(Galax urceolata, Gaultheria procumbens)* Forest	G5
CEGL007231	*Quercus alba – Carya (ovata, alba, glabra) – Pinus virginiana* Forest	G4G5

*** Not sampled**

TES Elements

***Aster ericoides (dumosa, pilosus)* (G5/S1) --** White Heath Aster blooms August through October in fields and meadows and on roadsides.

***Buckleya distichophylla* (G2/S2) (Table 2.2.5) --** The healthiest populations are associated with periodic wildfires (Virginia Natural Heritage Program 2000), and there is some type of dependence on host plants but the degree of dependence and life stage at which it is important are unknown. Threats to populations of *Buckleya* include lack of fire, collection, roads, development, falling branches, and erosion (Center for Plant Conservation 2007, NatureServe 2007). A renewed fire regime on Cliff Temple Ridge may facilitate regeneration of this species, but care should be taken to insure *Tsuga caroliniana* is not injured by prescribed burns.

***Diervilla sessilifolia* var. *rivularis* (G3/S2) –** This shrub likes full sun and can be found on rocky banks and in disturbed areas. It spreads by rhizomes to form colonies (Center for Plant Conservation 2007). Threats include roadside construction, right of way maintenance, hydrologic alteration, erosion, invasive species, thinning harvests near populations, succession leading to habitat degradation, and canopy closure.

***Helianthus glaucophyllus* (G3/S1) –** This sunflower occurs in moist areas under partial to full shade (Robinson 1982). Clearing the canopy would remove necessary shade and increase occurrence of woody vines and shrubs that could outcompete the sunflower. Fire may damage the plant.

***Lilium canadense* (G5/S3) –** The Canada lily prefers moist meadows, wood edges and streamsides. It blooms April through July and is pollinated mostly by the ruby throated hummingbird.

***Scutellaria saxatilis* (G3/S3) –** Rock skullcap is an herbaceous perennial that requires moist shaded habitat and blooms June through August (Radford *et al.* 1964, Dolan 2004). The biggest threats to *Scutellaria saxatilis* are exotic species like *Microstegium vimenium* and *Lonicera japonica* and loss of canopy (Dolan 2004, NatureServe 2007). Other threats include burning, grazing, woody encroachment, and trampling. Management actions should include protection of enough habitats for population growth and monitoring of those populations. Invasive species and encroaching woody shrubs should be removed and canopy trees preserved. In Great Smoky Mountains National Park, removal of shrubs and saplings in 2001 temporarily boosted population numbers, but in 2003 numbers again fell. Posting signs at populations near trailsides may help prevent trampling.

***Tsuga caroliniana* (G3/S3) –** This hemlock is a southern Appalachian endemic that grows on xeric ridgelines, cliffs, and rocky slopes and in gorges in nutrient poor soils. Viable populations should contain at least 35 trees on high quality habitat that contains dense stands of ericaceous shrubs and oak and pine species. The hemlock woolly adelgid can quickly degrade or even wipe out whole stands, though. If adelgid population levels are high enough to support predators, the *Psuedoscymnus tsugae* should be released on this site to try to stem the damage caused by the adelgid.

***Woodsia scopulina* ssp *appalachiana (appalachiana)* (G4/S1S2) -** Appalachian Woodsia can be found in shaded areas of sandstone or shale cliffs and ledges. It is moderatly threatened by its limited distribution (NatureServe 2007).

ATC monitoring info

NC-51 (Table 2.2.6). *Buckleya distichophylla* has been monitored on site since 1994 and appears to be stable. *Tsuga caroliniana* was monitored first in 2002. Contact Kent Schwarzkopf (304)-535-6767, Kent_Schwarzkopf@nps.gov for updates on this monitoring effort.

Knowledgeable People

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Roger McCoy, TDEC - Natural Heritage Division, 14th Floor, L&C Tower, 401 Church Street, Nashville, TN 37243-0447

Leigh Griggs Nedlo, 3953 Garnet Road, Pollock Pines, CA 95726

Table 2.2.3. Threats and management actions for Cliff-Temple Ridge. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Parasites / Pathogens	1	Monitor Buckleya distichophylla - ATC	1	0.5	biannually	1B:0H	very good	med	*Buckleya*
Parasites / Pathogens	1	Monitor *Tsuga* - ATC	1	0	biannually	3B:0H	good	med	CEGL006178, *Tsuga, Buckleya*
Forest Conversion	2	Monitor *Buckleya distichophylla* - ATC	1	0.5	biannually	1B:0H	very good	med	*Buckleya*
Forest Conversion	2	Monitor *Pinus pungens*	1	0.5	every five years	1B:0H	good	high	CEGL006178
Forest Conversion	2	Monitor *Tsuga* - ATC	1	0	biannually	3B:0H	good	med	CEGL006178, *Tsuga, Buckleya*
Forest Conversion	2	Prescribed burn - ridge and upper slope, protecting *Tsuga*	2	1	decadally	2B:1H	good	med	*Pinus*, *Buckleya*
Forest Conversion	2	Release adelgid predator	3	1	as needed	3B:0H	good	med	CEGL006178, *Tsuga, Buckleya*
Invasive Species	3	Monitor invasives	4	0.5	annually	9B:0H	good	high	CEGL006178, *Aster, Helianthius, Diervilla, Scutellaria, Buckleya, Tsuga, Lilium, Woodsia*
Erosion	4	Monitor trail and cliffs	5	0.5	annually	9B:0H	good	high	CEGL006178, *Aster, Helianthius, Diervilla, Scutellaria, Buckleya, Tsuga, Lilium, Woodsia*
Recreation	5	Signage - Fragile ecosystem! Tread carefully.	6	1	once	4B:0H	good	med	*Buckleya, Tsuga, Lilium, Woodsia*

Table 2.2.4: GPS coordinates of plots and species at Cliff Temple Ridge.

Point Name	GPS Coordinates			
ctra1	36.084500	°N	82.458500	°W
ctra2	36.084417	°N	82.459333	°W
ctrb1	36.087111	°N	82.458389	°W
ctrb2	36.087139	°N	82.458361	°W
ctrb3	36.087000	°N	82.459861	°W
ctrc1	36.087861	°N	82.457667	°W
ctrc2	36.087667	°N	82.458639	°W
ctrd1	36.089611	°N	82.457528	°W
crd2	36.089389	°N	82.458750	°W
ctre1	36.091306	°N	82.454806	°W
ctre2	36.091361	°N	82.453917	°W
ctre3	36.090500	°N	82.455889	°W
CTR *Buckleya distichophylla* 1	36.101972	°N	82.453556	°W
CTR *Buckleya distichophylla* 2	36.101972	°N	82.452111	°W
CTR *Buckleya distichophylla* 3	36.101861	°N	82.450722	°W
CTR *Buckleya distichophylla* 4	36.101972	°N	82.450361	°W
CTR *Buckleya distichophylla* 5	36.101889	°N	82.450611	°W
CTR *Buckleya distichophylla* 6	36.101778	°N	82.450833	°W
CTR *Buckleya distichophylla* 7	36.100833	°N	82.450972	°W
CTR *Buckleya distichophylla* 8	36.101667	°N	82.450583	°W
CTR *Aster ericoides (pilosus)*	36.083333	°N	82.433333	°W
CTR *Buckleya distichophylla*	36.101389	°N	82.450556	°W
CTR *Diervilla sessilifolia* var. *rivularis*	36.101111	°N	82.449444	°W
CTR *Helianthus glaucophyllus*	36.139278	°N	82.449444	°W
CTR *Lilium canadense*	36.104167	°N	82.450000	°W
CTR *Scutellaria saxatilis*	36.083333	°N	82.433333	°W
CTR *Tsuga caroliniana*	36.101389	°N	82.450556	°W
CTR *Woodsia scopulina* ssp. *appalachiana*	36.105556	°N	82.448889	°W

Table 2.2.5: *Buckleya distichophylla* monitoring information at Cliff Temple Ridge.

	GPS coordinates		
Plant #	**N**	**W**	**Notes**
1	36.102139	82.453556	10 stems - the 1st seen along ridge as AT climbs, up higher than 1900
2	36.101972	82.452111	running up slope to south from 1st
3	36.101861	82.450722	up slope, south
4	36.101972	82.450361	up slope, south
5	36.101889	82.450611	down slope to west from plant 3, 2 stems - 1 is a resprout
6	36.101778	82.450833	down slope from last 2
7	36.100833	82.450972	Clump drops down and to N and S from this *Buckleya*
8	36.101667	82.450583	other side of trail, to east

Table 2.2.6: Appalachian Trail Conservancy monitoring information at Cliff Temple Ridge.

NC-51	**Temple Ridge**	**Monitor Date**	**Vigor**	**Vigor Change**	**Cinema**
		17-May-94			*Buckleya distichophylla*
		27-May-95			*Buckleya distichophylla*
		18-May-96			*Buckleya distichophylla*
		28-May-97			*Buckleya distichophylla*
		24-May-99	(no response)	(no response)	*Buckleya distichophylla*
		11-Jul-01	Good	stable	*Buckleya distichophylla*
		18-Sep-02			*Tsuga caroliniana*
		18-Sep-02	Good	stable	*Buckleya distichophylla*

Chapter 3
Colten's Cliff / Wolf Ridge – Carver's Gap & Bakersville Quads, 36.104622º N, 82.127088º W
Prioritization Rank – Now – Right Now, 1st out of 26
Site Photos – none

Summary

Colten's Cliff / Wolf Ridge consists of a high elevation *Picea rubens* - (*Abies fraseri*) / (*Rhododendron catwbiense, Rhododendron maximum*) Forest (CEGL007130, G1) within a *Betula alleghaniensis* - *Fagus grandifolia* - *Aesculus flava* / *Viburnum lantanoides* / *Aster chlorolepis* - *Dryopteris intermedia* Forest (G3G4) (Table 2.3.1). This site received an overall **priority category of NOW - RIGHT NOW, and a ranking of 1 of 26**, with invasive species, forest parasites and pathogens, and recreational use determined to be primary site threats (Table 2.3.2).

Table 2.3.1. Community Types Listed at Colten's Cliff / Wolf Ridge (Major *et al*. 2000; monitoring points listed in Table 2.3.3)

Classification	Name	G rank
CEGL007130	*Picea rubens - (Abies fraseri) / (Rhododendron catawbiense, Rhododendron maximum)* Forest	G1
CEGL007285	*Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Aster chlorolepis - Dryopteris intermedia* Forest	G3G4
CEGL004277	**Saxifraga michauxii - Carex misera - Aster acuminatas - Solidago glomerata* Herbaceous Vegetation	G1

*** Not sampled**

Dominant Species Found

CCWR-A and CCWR-B matched the overstory of the Southern Appalachian Northern Hardwood (*Betula alleghaniensis – Fagus grandifolia – Aesculus flava*) Forest.

Group A is currently dominated in the lower strata by *Abies fraseri* and because of an increasing size distribution, it should remain a dominant of the site-group. The species may not become dominant in the overstory stratum, however, because the balsam wooly adelgid kills individuals of this species when they reach maturity (Burns and Honkala 1990). All current overstory dominants - *Acer saccharum, Aesculus flava, Betula alleghaniensis,* and *Fagus grandifolia* – have decreasing size distributions and are therefore expected to become lesser components of the future forest canopy at CCWR-A. This site-group will either become more similar to the

Red Spruce – Fraser Fir Forest over the next several decades or it may be part of a transition zone between the two community types. The community type does occur within the elevational range of *Picea*.

At CCWR-B current size distributions suggest that *Acer saccharum* and *Aesculus flava* will decrease in abundance. *Fagus grandifolia* has a neutral distribution, but the spread of beech bark disease will likely reduce the abundance of this species (Wiggins *et al*. 2004).

CCWR-C matched the overstory of the Red Spruce – Fraser Fir Evergreen Shrub (*Picea rubens*-(*Abies fraseri*) / (*R. catawbiense, R. maximum*) Forest. *Abies fraseri* and *Picea rubens* should maintain their dominances, while another current dominant, *Betula alleghaniensis*, is expected to decrease. The desired composition of this G1 community is self-replicating within CCWR-C.

TES Elements

Abies fraseri (G2/S3) - Main threat facing the species is the balsam woolly adelgid. Mature trees die from secondary diseases and pests after the adelgid attacks, but young recruits are more able to withstand infestations (Burns and Honkala 1990). Sometimes fir recruitment increases after infestations. One study found the densities of fir and spruce saplings increased in plots where overstory fir trees had succumbed to the balsam wooly adelgid (Busing *et al.* 1988). Fir mortality also increased birch dominance. Increasing nitrogen in the soil will enhance cone production of Fraser firs (Arnold *et al.* 1992).

Alnus viridis spp. crispa **(G5T5/S1)** - American green alder is semi-shade tolerant and does not burn easily (Rowe and Scotter 1973). Green alder is abundant in areas with a history of frequent fires and reestablishes by seed dispersed from adjacent, unburned areas. Even though establishment and persistence of Alnus viridis ssp. crispa are favored by fire, total recovery is slow (Furlow 1979).

Anastrophyllum saxicola **(G5G4/S1)** - This species of liverwort occurs in disjunct populations at high elevations of the mountains of the southern Appalachians (USDA Natural Resources Conservation Service 2007). It occurs in crevices and on rock fragments.

Arenaria (Minuartia) groenlandica **(G5/S1) –** This annual herb is found on rocky slopes and ledges at high elevation alpine forests and it flowers from late spring to summer (Anonymous, Undated). A similar species, *Arenaria fontinalis*, grows best in sunlight and partial shade and needs permanent moisture for preservation (Robinson 1982). Dr. Robert Kral (Botanical Research Institute of Texas) estimates that harvest or thinning of deep overstories may help increase populations that are in decline.

***Cardamine clematis* (G3/S2) -** This perennial herb is a southern Appalachian endemic that is found on rocky streamsides at high elevations above 1000 m (3280 ft) (NatureServe 2007). It blooms from April to May. Survey data collected in Tennessee and North Carolina suggest that populations are currently stable. Threats include land-use conversion, habitat fragmentation, forest management practices, invasive species, atmospheric pollutant deposition, and trampling (NatureServe 2007). Populations that suffer declines in abundance may be slow to recover because of low dispersal capabilities and low fecundity. Preferred habitat is wet areas near or in edges of streams that have little competition from other herbaceous plants, an overhead canopy that allows light to reach the population, and a lack of litter accumulation. It roots in moss, rock crevices, or occasionally in soil. Viable populations in high quality habitats should have more than 500 stems; fair populations should contain 51-100 stems (NatureServe 2007).

***Carex misera* (G3/S2) –** This sedge is found in moist acidic seeps at or near the summit of high mountains (Robinson 1982). It prefers cool moist habitats so cutting overstories may be detrimental to populations. Burning will also destroy populations. Trampling and over-collection should be discouraged (NatureServe 2007). For rare endemic species, preserving the genetic diversity within populations is important. Seeds can be collected from populations, germinated, and replanted in the habitat to help keep populations viable (Godt *et al*. 1996). It blooms June through July.

***Clintonia borealis* (G5/S2S3) (Table 2.3.4) -** *Clintonia* is usually found in homogeneous colonies (Anonymous 2007*b*). It is native to the boreal forest but is also found coniferous, mixed and cool, temperate *Acer* forests. *Clintonia* only grows in shade. It takes over twelve years to establish a clone and produce flowers. It blooms from late May through June and sets fruit in August and September (Radford *et al*. 1964). *Clintonia* is very sensitive to deer browsing due to its slow growth rate.

***Gentiana austromontana* (G3/S3) –** This herbaceous plant is found in full to partial shade at high elevations. Threats include trampling and timber harvest (NatureServe 2007). It is vulnerable to land use alteration due to limited distribution (Carter 2004).

***Geum radiatum* (G1/S1) -** This species grows in clearings at the summits of high elevation mountains, usually over 5000 ft. It grows in full sun. One study has found that several parameters are useful for prediction of occurrence of *Geum*; solar radiation, percent bedrock, and height of vegetation are important at small scales. Shrubs that occur on these summits can shade out the *Geum* (Robinson 1982). Therefore, shrubs and trees surrounding populations of *Geum* should be removed.

***Gymnoderma lineare* (G2/S1) –** This lichen grows on Colten's Cliff.

***Hedyotis purpurea* var. *montana* (G5T2/S1)** – This perennial herb occurs on the highest peaks of the southern Appalachians in gravel pockets and crevices of metamorphic rock outcrops above 1350 meters. It will also form mats on talus slopes. There are only ten known populations and they are threatened by recreational use (trampling, over collection, climbing) (NatureServe 2007).

***Huperzia appalachiana* (G4/S3)** – This club moss is found in meadows on high peaks (NatureServe 2007).

***Hydrophyllum virginianum* (G5/S3) (Table 2.3.4) –** This perennial herb can be found on moist slopes of rich woods. Threats include land-use alteration and habitat fragmentation.

***Menziesia pilosa* (G4G5/S2)** - The minniebush is found on sunny rock outcrops at high altitudes. Since the minniebush is found in rocky, rugged habitats, anthropogenic disturbance is rare. The generation and regeneration of boulderfields through landslides and avalanches are common erosional processes in *Menziesia* habitats (Hack and Goodlett 1960). It is not fire adapted, so may be sensitive.

***Microhexura montivaga* (G1/S1)** - The spruce-fir moss spider inhabits an endangered community type with only two known reproducing populations. The spider lives in high elevation spruce-fir forests on moist, well-drained moss mats growing on rocks and boulders. The main threat facing this species is the loss of suitable moss habitat due to the decline of Frasier fir from the balsam wooly adelgid. Less obvious threats are acid rain from air pollution, past logging and burning in the Appalachians, extirpation from a single event such as wildfire, drought or timber harvesting and human disturbance of the moss mats and the vegetation that shades them. The spiders' habitat and food supply are negatively affected by moss desiccation caused by canopy thinning. NatureServe (2007) suggests protecting the existing populations and their habitats. Also, the threats posed by the balsam wooly adelgid should be assessed.

***Phlox subulata* (G5/S1)** - Main threats faced by this herbaceous perennial are land-use conversion, habitat fragmentation, forest management practices, and succession (NatureServe 2007). This species prefers full sun to partial shade (Rhodus 2002). It flowers from March to May (Tenaglia 2007).

***Potentilla (Sibbaldiopsis) tridentata* (G5/S1S2) –** This member of the Rosaceae family is perennial and prefers acidic soils (Evans 2004). It requires open habitat and typically occurs at high elevation rock outcrops and grassy balds (USDA Natural Resources Conservation Service 2007). Populations in recreation areas may be at risk of being trampled; shading by encroaching shrubs or saplings may negatively affect population, also (NatureServe 2007).

***Prenanthes roanensis* (G3/S3) -** This perennial herb is found at forest edges, in upper slope or ridgetop clearings, and around *Prunus pennsylvanica* in areas that have been burned (Robinson 1982). It is not found under deep canopies. Opening the canopy may increase regeneration of populations of this species (Robinson 1982). Fire may help maintain this species through decreasing competition and shade. This endemic of the southern Appalachians is restricted to elevations above 1200m and is often associated with mixed spruce/hardwood forests (NatureServe 2007). This species faces low level threats from land-use conversion and habitat fragmentation.

***Solidago spithamaea* (G1/S1) –** A perennial herbaceous species, Blue Ridge goldenrod is found in full sunlight on rock outcrops and balds at high elevations (>1400m) (NatureServe 2007). The goldenrod blooms from July to September and also spreads by rhizomes. It can be found in association with *Geum radiatum* and *Liatris helleri*. Trampling is a major concern, as high elevation balds are highly visited. Acid deposition is another potential threat (Center for Plant Conservation 2007, accessed 2007).

***Stellaria alsine* (G5/S1) -** The Trailing Stitchwort, can be found along streamsides, in seepages, wet tracks and ditches. It flowers from June to September. It is declining, but reasons are currently unknown (NatureServe 2007).

ATC monitoring info

Sites NC-62 & NC-63 (Table 2.3.5), contact Kent Schwarzkopf (304)-535-6767, Kent_Schwarzkopf@nps.gov for updates on this monitoring effort.

Knowledgeable People

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Leigh Griggs Nedlo, 3953 Garnet Road, Pollock Pines, CA 95726

Table 2.3.2. Threats and management actions for Colten's Cliff / Wolf Ridge. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Invasive Species	1	Search for invasives	1	0.5	biannually	22B:0H	very good	high	All
Parasites / Pathogens	2	Add fertilizer to increase soil Nitrogen	10	1	annually	2B:0H	good	med	*Microhexura*, *Abies fraseri*, CEGL007130
Parasites / Pathogens	2	Monitor *Abies fraseri*	2	1	every five years	3B:0H	good	high	CEGL00713
Recreation	3	Monitor rock climbing effects	6	1	every other year	4B:0H	good	low	CEGL004277
Recreation	3	Monitor TES species	4	0.5	annually	22B:0H	good	med	all
Recreation	3	Signage - Fragile species! Please stay on trail.	3	1	once	20B:0H	good	high	all TES species, CEGL004277
Recreation	3	Signage - Restoration area. Keep out.	5	1	once	9B:0H	good	high	CEGL004277, *Carex*, *Clintonia*, *Gymnoderma, Hedyotis*, *Huperzia*, *Menziasia*, *Prenanthes*, *Solidago*
Forest Conversion	4	Monitor *Abies fraseri*	2	1	every five years	1B:0H	med	low	CEGL00713
Airborne Pollutants	5	Monitor TES species	4	0.5	annually	22B:0H	good	med	all
Woody Encroachment	6	Herbicide hardwoods and shrubs	11	0.5	selectively, as needed	9B:0H	bad	low	CEGL004277, *Anastrophyllum*, *Gymnoderma*, *Prenanthes*, *Solidago*, *Alnus*, *Arenaria*, *Gentiana*, *Geum*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Woody Encroachment	6	Manually remove woody species from cliffs	7	1	as needed	9B:0H	good	high	CEGL004277, *Anastrophyllum*, *Gymnoderma*, *Prenanthes*, *Solidago*, *Alnus*, *Arenaria*, *Gentiana*, *Geum*
Woody Encroachment	6	Monitor woody encroachment	5	0.5	every five years	9B:0H	good	high	CEGL004277, *Anastrophyllum*, *Gymnoderma*, *Prenanthes*, *Solidago*, *Alnus*, *Arenaria*, *Gentiana*, *Geum*
Overexploitation of Species	7	Build low fences between trails and TES species	12	5	once	20B:0H	good	high	all species, CEGL004277, CEGL00713
Development of Roads / Utilities	7	Signage - Fragile ecosystem! Tread carefully.	8	1	once	22:B:0H	very good	med	all species, CEGL004277, CEGL00713
Overexploitation of Species	7	Signage - Sensitive Species. Do not disturb.	9	1	once	20B:0H	good	high	all species, CEGL004277, CEGL00713

Table 2.3.3. GPS coordinates of plots and TES elements at Coltens' Cliff / Wolf Ridge.

Point Name	GPS Coordinates			
ccwra1	36.114190	°N	82.134630	°W
ccwra2	36.115090	°N	82.133540	°W
ccwrb1	36.112800	°N	82.133150	°W
ccwrc1	36.107300	°N	82.130860	°W
ccwrc2	36.107900	°N	82.130040	°W
ccwrc3	36.108700	°N	82.128970	°W
ccwrc4	36.108780	°N	82.128390	°W
ccwrd1	36.104750	°N	82.125860	°W
ccwre1	36.108180	°N	82.122110	°W
ccwre2	36.108140	°N	82.122880	°W
ccwre3	36.109580	°N	82.125320	°W

Point Name	GPS Coordinates			
ccwre4	36.110080	°N	82.125230	°W
CCWR *Abies fraseri*	36.104722	°N	82.126389	°W
CCWR *Alnus viridis* spp. *Crispa*	36.104722	°N	82.129444	°W
CCWR *Anastrophyllum saxicola*	36.104444	°N	82.126389	°W
CCWR *Arenaria groenlandica*	36.104444	°N	82.126389	°W
CCWR *Cardamine clematis*	36.114167	°N	82.119167	°W
CCWR *Carex misera*	36.104444	°N	82.126389	°W
CCWR *Clintonia borealis* 1	36.104444	°N	82.126389	°W
CCWR *Clintonia borealis* 2	36.108780	°N	82.128390	°W
CCWR *Geum radiatum* 1	36.104444	°N	82.126389	°W
CCWR *Geum radiatum* 2	36.114167	°N	82.119167	°W
CCWR *Gymnoderma lineare*	36.104444	°N	82.126389	°W
CCWR *Hedyotis purpurea* var. *montana*	36.104444	°N	82.126389	°W
CCWR *Huperzia appalachiana*	36.104444	°N	82.126389	°W
CCWR *Hydrophyllum virginianum*	36.115330	°N	82.133610	°W
CCWR *Menziesia pilosa*	36.104444	°N	82.126389	°W
CCWR *Microhexura montivaga*	36.106944	°N	82.122222	°W
CCWR *Potentilla (Sibbaldiopsis) tridentata*	36.104444	°N	82.126389	°W
CCWR *Prenanthes roanensis*	36.104444	°N	82.126389	°W
CCWR *Solidago spithamaea*	36.104444	°N	82.126389	°W
CCWR *Stellaria alsine*	36.104444	°N	82.126389	°W

Table 2.3.4: Vegetative species of concern found in the Summer of 2005 at Colten's Cliff / Wolf Ridge. Raw counts of individuals and percentages of individuals' reproductive statuses are shown.

Species	GPS coordinates N	W	Population (#/(%)) Repro	Nonrepro	Area (m^2)	Status	Concerns	Notes
Clintonia borealis			33 (60%)	21 (40%)	$3m^2$	vigorous	trailside	slight slope; aspect 10º; ridge top beside trail; monitored by ATC; several large populations on AT heading to Carver's Gap
Allium tricoccum	36.11533º	82.1336º	325 (100%)	0 (0%)	$3750m^2$	vigorous		assoc w/ open areas; staked at *Hydrophyllum* population
Hydrophyllum virginanum	36.11533º	82.1336º	5 (38%)	8 (62%)	$1m^2$	good		*Allium* upslope, to L and R from stake.
Clintonia borealis	36.10878º	82.1284º				good		in plot ccwrc4 & on slope

Table 2.3.5: ATC species monitoring at Colten's Cliff / Wolf Ridge.

NC-62	Roan Mountain section 2	Monitor Date	Vigor	Vigor Change	Cinema
	CCWR	20-Jul-95			*Corvus corax*
	CCWR	20-Jul-95			*Carex misera*
	CCWR	20-Jul-95			*Glaucomys sabrinus coloratus*
	CCWR	20-Jul-95			*Alnus viridis* ssp. *Crispa*
	CCWR	24-Aug-95			*Alnus viridis* ssp. *Crispa*
	CCWR	7-Jul-96			*Alnus viridis* ssp. *Crispa*
	CCWR	7-Jul-96			*Carex misera* **
	CCWR	7-Jul-96			*Geum radiatum* **
	CCWR	7-Jul-96			*Corvus corax* **
	CCWR	28-May-99	(no response)	(no response)	*Regulus satrapa*
	CCWR	18-Jun-99	(no response)	(no response)	*Regulus satrapa*
	CCWR	18-Jun-99	(no response)	(no response)	*Catharus guttatus*
	CCWR	6-Jul-99	(no response)	stable	*Carex misera*
	CCWR	6-Jul-99	fair	stable	*Alnus viridis* ssp. *Crispa*
	CCWR	14-Sep-99	(no response)	stable	*Carex misera*
	CCWR	14-Sep-99	(no response)	(no response)	*Gentiana austromontana*
	CCWR	7-May-00	good	stable	*Alnus viridis* ssp. *Crispa*
	CCWR	28-Jun-00	(no response)	(no response)	*Alnus viridis* ssp. *Crispa*
	CCWR	28-Jun-00	good	first visit	*Geum radiatum*
	CCWR	28-Jun-00	good	first visit	*Carex misera*
	CCWR	15-Jun-01	good	(no response)	*Alnus viridis* ssp. *Crispa*
	CCWR	15-Jun-01	fair	declining	*Geum radiatum*
	CCWR	15-Jun-01	struggling	(no response)	Red Spruce-Fraser Fir Forest
	CCWR	15-Jun-01	good	stable	*Carex misera*
	CCWR	15-Jun-01	(no response)	(no response)	*Corvus corax*
	CCWR	15-Jun-01	(no response)	(no response)	*Regulus satrapa*
	CCWR	15-Jun-01	(no response)	(no response)	*Empidonax alnorum*
	CCWR	21-Jun-02	fair	declining	*Geum geniculatum*
	CCWR	21-Jun-02	struggling	declining	*Huperzia appalachiana*
	CCWR	21-Jun-02	good	declining	*Huperzia appalachiana*

NC-62	Roan Mountain section 2	Monitor Date	Vigor	Vigor Change	Cinema
	CCWR	21-Jun-02	good	stable	*Minuartia groenlandica*
	CCWR	22-Aug-02	excellent	stable	*Prenanthes roanensis*
	CCWR	12-Sep-02	good	stable	*Carex misera*
	CCWR	12-Sep-02	fair		*Geum radiatum*
	CCWR	12-Sep-02	good	stable	*Alnus viridis* ssp. *Crispa*
	CCWR	12-Sep-02	good		*Gentiana astromontana*

NC-63	Roan Mountain section 3	Monitor Date	Vigor	Vigor Change	Cinema
	CCWR	18-Jun-99	(no response)	(no response)	*Empidonax alnorum*
	CCWR	4-Jul-99	good	(no response)	*Minuartia groenlandica*
	CCWR	4-Jul-99	excellent	(no response)	*Senecio schweinitzianus*
	CCWR	4-Jul-99	excellent	(no response)	*Senecio schweinitzianus*
	CCWR	4-Jul-99	excellent	first visit	*Huperzia appalachiana*
	CCWR	4-Jul-99	excellent	first visit	*Carex aenea*
	CCWR	4-Jul-99	excellent	(no response)	*Prenanthes roanensis*
	CCWR	4-Jul-99			*Lillium grayi*
	CCWR	4-Jul-99	fair	declining	*Huperzia appalachiana*
	CCWR	4-Jul-99	excellent	first visit	*Geum geniculatum*
	CCWR	22-Jun-02	excellent	stable	*Senecio schweinitzianus*
	CCWR	22-Jun-02	excellent	stable	*Senecio schweinitzianus*
	CCWR	22-Jun-02	fair	declining	*Carex aenea*

Table 2.3.6: Tallies of species of the monitoring plots at Colten's Cliff / Wolf Ridge. Saplings were individuals that were < 2m tall. Understory species were 2m+ tall and had Diameters at Breast Height (DBHs) <5cm. Subcanopy trees were >2m tall and had DBHs 5-20cm. Overstory species were >2m tall and had DBHs of 20cm+.

Species	ccwrc1 saplings	ccwrc1 understory	ccwrc1 subcan	ccwrc1 overstory	ccwre1 saplings	ccwre1 understory	ccwre1 subcan	ccwre1 Overstory
Abies fraseri	22	31	7	7	19	242	48	1
Acer spicatum	0	0	0	0	0	2	0	0
Betula alleghaniensis	0	9	7	5	0	6	8	0
Picea rubens	0	3	0	0	3	41	35	2
Prunus pensylvanica	0	0	0	0	0	0	1	0
Rhus glabra	4	13	0	0	0	0	0	0
Sorbus americana	0	0	0	0	0	4	1	0

Chapter 4
Cutshall Bog – Davy Crockett Lake Quad, 36.01062º N, 82.78487º W
Prioritization Rank – Later, 20th out of 26
Site Photos- Cutshall Bog

Summary

Cutshall Bog is an *Acer rubrum* var. *trilobum – Nyssa sylvatica / Osmunda cinnamomea – Chasmanthium laxum – Carex intumescens / Sphagnum lescurii* Forest (CEGL00743, G3?) (Table 2.4.1). This site has been **prioritized as LATER and ranked 20 out of 26 for need of management actions** (Table 2.4.2). A roadbed crossing the bog may be decreasing water levels (Table 2.4.5) on the lower side so that woody species (Table 2.4.8) are establishing, but the main threats on this site are invasive species (Table 2.4.7) and sedimentation (Table 2.4.6). *Lonicera japonica* occurs along the roadbed and *Microstegium vimenium* (Table 2.4.7) is extensive throughout the bog on the downstream side of the road bed and along bog edges. Burning or herbicide application may decrease the occurrence of invasives, but may also harm TES species so manual removal is recommended. The road that runs through the bog is rutted into erosion channels to the west and uphill of the bog. These channels funnel sedimentation into the bog. Adding waterbars to the road way may help divert the sedimentation and closing the road to recreational traffic may stem the erosion.

Table 2.4.1. Community Types Listed at Cutshall Bog (Major *et al*. 2000)

Classification	Name	G rank
CEGL007443	**Acer rubrum var. trilobum - Nyssa sylvatica / Osmunda cinnamomea - Chasmanthium laxum - Carex intumescens / Sphagnum lescurii* Forest	G3?

* Not sampled

TES Elements

***Caltha palustris* (G5/S1) (Table 2.4.4)** - Habitat requirements for this perennial herb include moist soil that may be covered with 6 or less inches of water, pH between 5.0 and 7.0, and full sun to partial shade (Rook 2002). Grazing and sedimentation are the major threats facing this species, but forestry practices may also negatively impact populations (NatureServe 2007). The species flowers from April to June. The plants may be divided and replanted during early spring before flowering or when plants go dormant in mid summer. The population at Cutshall Bog has one year's worth of monitoring information that should be maintained (Table 2.4.4).

***Campanula aparinoides* (G5/S2) (Table 2.4.3) –** This perennial herb is found in wet, slightly acidic (Wherry 1927) fens, bogs, wet meadows, and marshes in association with grasses and sedges. It blooms June through August. Threats include land-use conversion and habitat fragmentation (NatureServe 2007).

***Cypripedium acaule* (G5/S4*)* -** This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007).

***Pedicularis lanceolata* (G5/S1) (Table 2.4.3) –** A plant of the Scrophulariaceae family that is parasitic on the roots or other plants, this species is found in wet meadows and along streambanks (Allard 2001). Individuals are short-lived, but perennial. It flowers from August to September and is pollinated by bumblebees. Seeds mature in September and October. Deer have been known to browse this species. This wood-betony may benefit from disturbances and management activities that maintain open habitats. It prefers calcareous soils, but will grow in slightly acid substrates, also. The main negative influences to *Pedicularis* populations are altered water levels of wetlands and woody encroachment. Invasive species may be able to outcompete *Pedicularis. Microstegium vimenium, Lytrum salicaria,* and *Phragmites australis* could threaten populations, but no studies to determine their effects have been conducted. Mowing after seedset may aid in dispersal but it could also harm host plants or increase available habitat for invasives so managers should monitor the effects of this action on populations. In New England management actions include constructing deer exclosures, removing woody encroachment, and removing invasive species, as well and monitoring known populations. The New England Wildflower Society collects seeds and maintains seedbanks. Based on the monitoring information that has been collected in New England, 200 plants per population, with management in place, should be adequate for stability.

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Table 2.4.2. Threats and management actions for Cutshall Bog. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Forestry Roads	1	Gate road	1	1	once	4B:0H	good	med	*Campanula, Caltha, Pedicularis, Cypripedium*
Forestry Roads	1	Install waterbars in roadway W of bog	9	5	once	5B:0H	very good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Forestry Roads	1	Remove roadbed through bog	16	30	once	?	?	?	?
Development of Roads / Utilities	2	Monitor invasives	3	0.5	annually	5B:0H	good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Development of Roads / Utilities	2	Monitor TES species	2	0.5	annually	4B:0H	very good	high	*Campanula, Caltha, Pedicularis, Cypripedium*
Development of Roads / Utilities	2	Monitor water levels	6	0.5	seasonally	5B:0H	good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Development of Roads / Utilities	2	Remove roadbed through bog	16	30	once	?	?	?	?
Development of Roads / Utilities	2	Remove roadbed through bog	16	30	once	?	?	?	
Recreation	3	Gate road	1	1	once	4B:0H	good	med	*Campanula, Caltha, Pedicularis, Cypripedium*
Woody Encroachment	3	Remove roadbed through bog	16	30	once	?	?	?	
Recreation	3	Signage -- No vehicular traffic, please.	4	1	once	5B:0H	very good	med	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Invasive Species	4	Herbicide *Microstegium vimenium* outside	15	0.5	annually	1B:4H?	fair	low	CEGL007443

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
		of bog area							
Invasive Species	4	Manually remove *M. vimenium* and *Lonicera japonica* from bog	5	2	annually in late summer, early fall	5B:0H	very good	med	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Invasive Species	4	Monitor invasives	3	0.5	annually	5B:0H	good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Invasive Species	4	Prescribed fire low intensity on bog edges	13	1	as needed	5B:0H	good	med	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Channel Modification	5	Add culverts under roadbed	14	?	once	?B:?H	?	?	CEGL007443
Forest Conversion	5	Girdle trees	8	1	as needed	5B:0H	very good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Channel Modification	5	Monitor sediment inputs	7	0.5	annually	4B:0H	very good	high	*Campanula, Caltha, Pedicularis, Cypripedium*
Channel Modification	5	Monitor TES species	2	0.5	annually	4B:0H	good	high	*Campanula, Caltha, Pedicularis, Cypripedium*
Channel Modification	5	Monitor water levels	6	0.5	seasonally	5B:0H	good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Forest Conversion	5	Prescribed fire	13	1	decadally	5B:0H	good	med	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Channel Modification	5	Remove roadbed through bog	16	30	once	?	?	?	?
Incompatible Forestry Practices and Management	6	Girdle trees	8	1	as needed	5B:0H	very good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Altered Fire Regime	7	Chop sprouts of girdled trees	10	0.5	as needed	5B:0H	very good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Erosion	7	Gate road	1	1	once	4B:0H	good	med	*Campanula, Caltha, Pedicularis, Cypripedium*
Sedimentation	7	Gate road	1	1	once	4B:0H	good	med	*Campanula, Caltha, Pedicularis, Cypripedium*
Altered Fire Regime	7	Girdle trees	8	1	as needed	5B:0H	very good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Sedimentation	7	Instal BMPs if	9	1	as needed	5B:0H	very	high	CEGL007443, *Campanula, Caltha,*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
		needed					good		*Pedicularis, Cypripedium*
Erosion	7	Install waterbars in roadway W of bog	9	5	once	5B:0H	very good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Sedimentation	7	Install waterbars in roadway W of bog	9	5	once	5B:0H	very good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Sedimentation	7	Monitor sedimentation inputs	7		annually	4B:0H	very good	high	*Campanula, Caltha, Pedicularis, Cypripedium*
Sedimentation	7	Monitor TES species	2	0.5	annually	4B:0H	good	high	*Campanula, Caltha, Pedicularis, Cypripedium*
Agricultural Conversion	7	Monitor water quality	12	0.5	annually	5B:0H	good	med	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Incompatible Water Quality	7	Monitor water quality	11	0.5	annually	5B:0H	very good	high	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Altered Fire Regime	7	Prescribed fire - low intensity on bog edges	13	1	decadally	5B:0H	good	med	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*
Agricultural Conversion	8	Monitor invasives	3	1	annually	5B:0H	good	med	CEGL007443, *Campanula, Caltha, Pedicularis, Cypripedium*

Table 2.4.3: GPS Coordinates of points of interest in Cutshall Bog.

Point Name	GPS Coordinates			
CB Caltha palustris	36.011230	°N	82.785110	°W
CB photomonitor point	36.010620	°N	82.784870	°W
CB *Campanula aparinoides*	36.010556	°N	82.785278	°W
CB *Pedicularius lanceolata*	36.010556	°N	82.785278	°W

Table 2.4.4. Cutshall Bog *Caltha palustris* photomonitoring information. Photos taken 5/20/2005. GPS coordinates of site are 36.01123º N, 82.78511º W.

Photos	Notes	# of Plants	% reproductive	% non repro
CB Clatha palustris 1	size of clump 1	2	100	0
CB Caltha palustris 2	size of clump 2			
CB Caltha palustris 3	leaves and fruit close-up			
CB Caltha palustris 4	leaves close-up			
CB Caltha palustris 5	fruit close-up			
CB Leigh marking Clatha palustris 1				
CB Leigh marking Clatha palustris 2				
CB Leigh Marking Caltha palustris 3				

Table 2.4.5. Hydrology monitoring at Cutshall Bog. Depth measurements were taken every 10 meters in the directions indicated from the starting points indicated, for the length of the transect. Monitoring on 5/20/2005.

Transect	Distance (m)	Depth (cm)	Notes	Photos
1 start point - on S side of road in front of maple group into high water side				
1 - 16 degrees	10	37	rushes, golden club	CB5 - Mark and Oreo
1 - 16 degrees	20	35		CB6 - Dan running transect
1 - 16 degrees	30	44		
1 - 16 degrees	40	30		
1 - 16 degrees	50	14		
1 - 16 degrees	60	30	crossed stream channel	
1 - 16 degrees	70	20		
1 - 16 degrees	80	0		
1 - 16 degrees	90	20		
1 - 16 degrees	100	20		
2 start point- on S side of road behind maple clump into shrubby side				
2- 196 degrees	10	10	finger of deep water	
2- 196 degrees	20	40		
2- 196 degrees	30	10		
2- 196 degrees	40	0	shallow clear area	
2- 196 degrees	50	40		
2- 196 degrees	60	20		
2- 196 degrees	70	0	channel	
2- 196 degrees	80	40		
2- 196 degrees	90	150		
2- 196 degrees	100	0		

Table 2.4.6. Sedimentation monitoring at Cutshall Bog. Photos are all from the west end of the concrete roadbed through the bog.

Sedimentation photos	Notes
CB sedimentation from road 1	view from bog
CB sedimentation from road 2	closeup
CB sedimentation from road 3	view from bog
CB sedimentation from road 4	view from bog
CB sedimentation from road 5	view from road
CB sedimentation from road 6	shows waterflow down road and entrance point into bog right before road bed changes to concrete
CB sedimentation from road 7	

Table 2.4.7. *Microstegium vimenium* monitoring at Cutshall Bog. The length and width refer to the longest axes of the population clump of *Microstegium vimenium*.

Species	Popululation length (m)	Population width (m)	Photos	Notes
Microstegium vimenium	100m+	100m+	CB Microstegium	covers ground layer of lower bog and roadbed

Table 2.4.8. Woody species encroachment photomonitoring at Cutshall Bog.

		GPS coordinates	
Vegetation Photos	Notes	N	W
CB1	general road effects	taken from road	
CB2	general road effects	taken from road	
CB3	general road effects	taken from road	
CB4	general road effects	taken from road	
CB photomonitor at 212º	PVC pipe marker	36.01062º	82.78487º
CB photomonitor at 310º	PVC pipe marker	36.01062º	82.78487º
CB photomonitor at 360º	PVC pipe marker	36.01062º	82.78487º

Chapter 5
Devil's Kitchen Branch Bog – Davy Crockett Quad, 36.0127º N, 82.79054º W
Prioritization Rank – Soon, 10th out of 26
Site photos - Devil's Kitchen Branch Bog

Summary

Devil's Kitchen Branch Bog contains a streamside bog within a *Pinus strobus - Tsuga canadensis / Rhododendron maximum – Leucothoe fontanesiana* Forest (CEGL007102, G4) (Table 2.5.1). **Its management prioritization is SOON and it is ranked 10th out of 26 sites** for need of management (Table 2.5.3). The largest threat this site faces is recreation (Tables 2.5.8 - 2.5.10). OHV vehicles have severely damaged a large area of the bog and facilitated the spread of *Microstegium* (Table 2.5.7). The most important thing to do to save the biological integrity of this site is to close it to recreation.

Table 2.5.1. Community types listed at Devil's Kitchen Bog (Major *et al*. 2000; monitoring points listed in Table 2.5.4)

Classification	Name	G rank
CEGL007102	*Pinus strobus - Tsuga canadensis / Rhododendron maximum - (Leucothoe fontanesiana)* Forest	G4

Dominant Species Found

The single Devil's Kitchen Branch Bog (DKBB) site-group matched the expected association, Southern Appalachian Eastern Hemlock (White Pine Type) (*Pinus strobus – Tsuga canadensis / Rhododendron maximum – (Leucothoe fontanesiana)* Forest. Current composition and size structure at Devil's Kitchen Branch Bog suggest that it is likely to become increasingly dominated by *Liriodendron tulipifera, Acer rubrum, Oxydendron arboreum, and Quercus rubra* in future decades (Table 2.5.2). *Pinus strobus* is likely to become less dominant, on the basis of its decreasing size distribution. Prescribed fire (Table 2.5.6) would spur regeneration of *Pinus strobus* but should not be allowed to burn *Tsuga canadensis* stands. The *Tsuga* is in a possibly irreversible decline. If supplies of the adelgid predator are available, releasing it on this site could slow or stem the adelgid enough so that some individual trees could survive.

Table 2.5.2. Species dominances and population trends found at Devil's Kitchen Branch Bog. Letters included in the table indicate the strata in which each species is dominant(a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Group
Species	dkbb-h
Acer rubrum	**A,B,C**
Liriodendron tulipifera	**A,B,C,D**
Oxydendron arboreum	**A,B,C**
Pinus strobus	**c,d**
Quercus rubra	**A**
Tsuga canadensis	*d*

TES Elements

***Cypripedium acaule* (G5/S4) (Table 2.5.5) -** This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). *Microstegium vimenium* is present at Devil's Kitchen Branch Bog and should be removed. Two individuals of *C. acaule* were found and initially monitored in 2005.

***Pedicularis lanceolata* (G5/S1) –**A plant of the Scrophulariaceae family that is parasitic on the roots or other plants, this species is found in wet meadows and along streambanks (Allard 2001). Individuals are short-lived, but perennial. It flowers from August to September and is pollinated by bumblebees. Seeds mature in September and October. Deer have been known to browse this species. This wood-betony may benefit from disturbances and management activities that maintain open habitats. It prefers calcareous soils, but will grow in slightly acid substrates, also. The main negative influences on *Pedicularis* populations are altered water levels of wetlands and woody encroachment. Invasive species may be able to outcompete *Pedicularis. Microstegium vimenium, Lytrum salicaria,* and *Phragmites australis* could threaten populations, but no studies to determine their effects have been conducted. Mowing after seedset may aid in dispersal but it could also harm host plants or increase available habitat for invasives so managers should monitor the effects of this action on populations. *Microstegium* is present at Devil's Kitchen Branch Bog and should be removed. Herbicide application, manual removal, and prescribed fire (Table 2.5.6) may be used singularly or in combination, but care

should be taken to prevent these methods from having their own negative impacts to the site. See the Invasive Species threat write-up for additional details. In New England management actions include constructing deer exclosures, removing woody encroachment, and removing invasive species, as well and monitoring known populations. The New England Wildflower Society collects seeds and maintains seedbanks. Based on the monitoring information that has been collected in New England, 200 plants per population, with management in place, should be adequate for stability. No monitoring effort was initiated for this species at this site, but it should be located and monitored on a yearly basis. As management actions are conducted it will be important to know any effects on this species.

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Table 2.5.3. Threats and management actions for Devil's Kitchen Branch Bog. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Forestry Roads	1	Gate road around site	1	1	once	3B:0H	good	high	CEGL007102
Development of Roads / Utilities	2	Gate road around site	1	1	once	3B:0H	very good	high	CEGL007102
Development of Roads / Utilities	2	Monitor OHV impact	8	1	annually	3B:0H	very good	high	CEGL007102, *Pedicularis, Cypripiedium*
Development of Roads / Utilities	2	Monitor TES species	4	0.5	annually	3B:0H	very good	high	CEGL007102, *Pedicularis, Cypripiedium*
Development of Roads / Utilities	2	Signage - Fragile ecosystem! Tread carefully.	2	1	once	3B:0H	very good	med	CEGL007102, *Pedicularis, Cypripiedium*
Development of Roads / Utilities	2	Signage - No vehicular traffic, please. Foot travel is welcome.	3	1	once	3B:0H	very good	med	CEGL007102, *Pedicularis, Cypripiedium*
Channel Modification	3	Add water bars to bare areas with signs of erosion	9	5	once	3B:0H	very good	high	CEGL007102, *Pedicularis, Cypripiedium*
Recreation	3	Gate road around site	1	1	once	3B:0H	very good	high	CEGL007102
Channel Modification	3	Monitor OHV impact	3	1	annually	3B:0H	very good	high	CEGL007102, *Pedicularis, Cypripiedium*
Channel Modification	3	Monitor TES species	4	0.5	annually	3B:0H	very good	high	*Pedicularis, Cypripiedium*
Channel Modification	3	Gate road around site	1	1	once	3B:0H	very good	high	CEGL007102
Erosion	4	Gate road around site	1	1	once	3B:0H	very good	high	CEGL007102

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Sedimentation	4	Gate road around site	1	1	once	3B:0H	very good	high	CEGL007102
Sedimentation	4	Install BMPs if needed	9	1	as needed	3B:0H	very good	high	CEGL007102, *Pedicularis, Cypripiedium*
Erosion	4	Monitor sedimentation	5	0.5	annually	3B:0H	good	high	CEGL007102, *Pedicularis, Cypripiedium*
Sedimentation	4	Monitor sedimentation areas along road	5	1	annually	3B:0H	very good	high	CEGL007102, *Pedicularis, Cypripiedium*
Erosion	4	Monitor TES species	4	0.5	annually	3B:0H	very good	high	CEGL007102, *Pedicularis*, *Cypripiedium*
Invasive Species	5	Herbicide *Microstegium vimenium* outside of bog area	13	0.5	annually	1B:1H	fair	low	CEGL007102
Invasive Species	5	Manually remove *M. vimenium* from bog	7	2	annually in late summer, early fall	3B:0H	very good	med	CEGL007102, *Pedicularis, Cypripedium*
Invasive Species	5	Monitor spread of *Microstegium vimenium*	6	0.5	annually	3B:0H	good	high	CEGL007102, *Pedicularis, Cypripiedium*
Invasive Species	5	Prescribed fire - late summer	14	1	as needed	2B:1H	fair	med	*Pedicularis, Cypripedium*
Forest Conversion	6	Prescribed fire - late summer	14	1	decadally	3B:1H	fair	med	CEGL007102, *Pedicularis, Cypripedium*
Forest Conversion	6	Release adelgid predator	12	1	as needed	1B:0H	good	med	CEGL007102
Woody Encroachment	7	Girdle trees/shrubs	10	1	as needed	2B:0H	very good	med	CEGL007102, *Pedicularis*
Incompatible Forestry Practices and Management	7	Prescribed fire - late summer	14	1	decadally	3B:1H	fair	med	CEGL007102, *Pedicularis, Cypripedium*
Parasites / Pathogens	8	Monitor *Tsuga*	11	0.5	annually	1B:0H	good	med	CEGL007102
Parasites / Pathogens	8	Release adelgid predator	12	1	as needed	1B:0H	good	med	CEGL007102

Table 2.5.4. GPS coordinates of plots and monitoring points at Devil's Kitchen Branch Bog.

Point Name	GPS Coordinates			
dkbba1	36.01200	°N	82.79000	°W
dkbba2	36.01270	°N	82.79054	°W
dkbba3	36.01354	°N	82.79192	°W
dkbbb1	36.01238	°N	82.78953	°W
dkbbb2	36.01215	°N	82.79090	°W
dkbbb3	36.01184	°N	82.79184	°W
DKBB Sedimentation point 1	36.01141	°N	82.78917	°W
DKBB Sedimentation point 2	36.01178	°N	82.78888	°W
DKBB Sedimentation point 3	36.01195	°N	82.78891	°W
DKBB Sedimentation point 4	36.01219	°N	82.78917	°W
DKBB Sedimentation point 5	36.01266	°N	82.78924	°W
DKBB Sedimentation point 6	36.01342	°N	82.78921	°W
DKBB Sedimentation point 7	36.01329	°N	82.78984	°W
DKBB Sedimentation point 8	36.01423	°N	82.79121	°W
DKBB Sedimentation point 9	36.01483	°N	82.79132	°W
DKBB Sedimentation point 10	36.01491	°N	82.79110	°W
DKBB Sedimentation point 11	36.01442	°N	82.79211	°W
DKBB Sedimentation point 12	36.01413	°N	82.79258	°W
DKBB Sedimentation point 13	36.01503	°N	82.79341	°W
DKBB Sedimentation point 14	36.01512	°N	82.79419	°W
DKBB Sedimentation point 15	36.01399	°N	82.79435	°W
DKBB Sedimentation point 16	36.01341	°N	82.79568	°W
DKBB Sedimentation point 17	36.01317	°N	82.79650	°W
DKBB Sedimentation point 18	36.01229	°N	82.794.67	°W
DKBB Sedimentation point 19	36.01176	°N	82.79460	°W
DKBB Sedimentation point 20	36.00164	°N	82.79424	°W
DKBB Sedimentation point 21	36.01139	°N	82.79407	°W
DKBB Sedimentation point 22	36.01109	°N	82.79425	°W
DKBB Sedimentation point 23	36.01051	°N	82.79441	°W
DKBB Sedimentation point 24	36.01041	°N	82.79458	°W
DKBB Sedimentation point 25	36.01019	°N	82.79457	°W

Point Name	GPS Coordinates			
DKBB Sedimentation point 26	36.00995	°N	82.79502	°W
DKBB Sedimentation point 27	36.00957	°N	82.79520	°W
DKBB Sedimentation point 28	36.00945	°N	82.79544	°W
DKBB OHV effects 1 - P strobus	36.01209	°N	82.79405	°W
DKBB OHV effects 1 - P strobus	36.01209	°N	82.79405	°W
DKBB OHV effects 1 - P strobus	36.01209	°N	82.79405	°W
DKBB OHV effects 1 - P strobus	36.01209	°N	82.79405	°W
DKBB OHV effects 1 - P strobus	36.01209	°N	82.79405	°W
DKBB OHV effects 2 - Open area	36.01229	°N	82.79467	°W
DKBB OHV effects 2 - Open area	36.01229	°N	82.79467	°W
DKBB OHV effects 3 - General shots of OHV damage	36.01229	°N	82.79467	°W
DKBB OHV effects 3 - General shots of OHV damage	36.01229	°N	82.79467	°W
DKBB OHV effects 3 - General shots of OHV damage	36.01229	°N	82.79467	°W
DKBB OHV effects 3 - General shots of OHV damage	36.01229	°N	82.79467	°W
DKBB OHV effects 3 - General shots of OHV damage	36.01229	°N	82.79467	°W
DKBB OHV effects 3 - General shots of OHV damage	36.01229	°N	82.79467	°W
DKBB OHV effects 3 - General shots of OHV damage	36.01229	°N	82.79467	°W
DKBB *Cypripedium acaule*	36.01215	°N	82.79090	°W

Table 2.5.5. *Cypripedium acaule* monitoring at Devil's Kitchen Branch Bog. Sampled 8/4/2005.

Species	N	W	% Reproductive	% Nonreprod.	Area (m2)	Status	Concerns
Cypripedium acaule	36.01215º	82.7909º	2 (100%)	0 (0%)	1	good	

Table 2.5.6. Fire effects monitoring at Devil's Kitchen Branch Bog

	GPS coordinates		
Plot	N	W	Picture
DKBB a3	36.01354	82.79192	DKBB a3
DKBB b2	36.01215	82.7909	N

Table 2.5.7. Sedimentation and Invasion Monitoring at Devils' Kitchen Branch Bog. Under "Photos" below, photo names are all prefixed with "DKBB sed" (indicated by "--").

Site #	N	W	Length (m)	Angle	Width (m)	Angle	*Micro-stegium* ?	Length (m)	Angle	Width (m)	Angle	Photos
1	36.0114	82.78917	6.6	310	3.7	226	N					--1a, --1b, --1c
2	36.0118	82.78888	5.8	284	0.7	200	N					--2a, --2b, --2c
3	36.012	82.78891	15.4	252	4.78	158	Y	10.5	246	4.1	158	--3a, --3b, --3c, --3d, -- 3e
4	36.0122	82.78917	5.3	290	1.7	154	Y	5.3	266	3.1	180	--4a, --4b, --4c
5	36.0127	82.78924	45	284	5	192	Y	21.8	280	7.6	184	--5a, --5b, --5c, --5d, --5e
6	36.0134	82.78921	21.8	280	7.6	184	Y	11.3	242	9.6	344	--6a, --6b, --6c, --6d, --6e
7	36.0133	82.78984	1	168	9.4	96	Y	4.9	70	5.5	160	--7a
8	36.0142	82.79121	16	283	7.2	28	Y	9.8	283	7.2	28	--8a, --8b, --8c
9	36.0148	82.79132	14.6	308	5.9	210	Y	9.4	308	5.9	210	--9a, --9b, --9c, --9d
10	36.0149	82.7911	11.1	222	3.8	312	Y	26.6	210	18.9	304	--10a, --10b
11	36.0144	82.79211	25.6	140	6.3	61	Y	21.8	140	13.9	61	--11a, --11b
12	36.0141	82.79258	21.5	200	7.9	105	Y	21.5	200	6.5	288	--12a, --12b, --12c
13	36.015	82.79341	24.4	275	3	24	Y	9.6	290	1	180	--13a, --13b, --13c
14	36.0151	82.79419	7	273	3	351	Y	13.3	273	2.4	339	--14a, --14b, --14c
15	36.014	82.79435	6.5	103	3	30	Y	6.6	103	3.1	30	--15a, --15b
16	36.0134	82.79568	4.9	186	2.6	83	Y	10.5	186	11.5	83	--16a
17	36.0132	82.7965	10.7	120	2.9	192	Y	12	184	9	120	--17a, --17b, --17c, --17d
18	36.0123	82.79467	see OHV effects below									
19	36.0118	82.7946	4.1	274	3.5	4	Y	3.7	4	3.6	274	--19a, --19b
20	36.0016	82.79424	17.7	71	32.3	354	Y	small occurrences along edges				--20a, --20e
					lower road width							--20b
					5.3	320						--20c

Site #	N	W	Length (m)	Angle	Width (m)	Angle	*Micro-stegium*?	Length (m)	Angle	Width (m)	Angle	Photos
					upper road width							--20d
21	36.0114	82.79407	7.1	12	4	82	N					--21a, --21b, --21c
22	36.0111	82.79425	5.1	210	4.6	145	N					--22a, --22b, --22c, --22d
23	36.0105	82.79441	5.6	24	4.4	297	Y	5.5	24	5	297	--23a, --23b, --23c
24	36.0104	82.79458	8.2	309	5.3	54	Y	2.7	132	2.4	37	--24a, --24b, --24c
25	36.0102	82.79457	8.2	232	2.5	320	N					--25a
					channel 1							--25b
					2.3	318						-- 25c
					channel 2							--25d
26	36.01	82.79502	29.7	65	5.2	10	Y	25.8	360	3.6	289	--26a, --26d, --26e
			channel 1									--26b
			23.3	360								--26c
27	36.0096	82.7952	9.4	222	8	321	Y	6.3	230	4.5	321	-- 27a, --27b, --27c, --27d
28	36.0095	82.79544	9.8	237	8.7	321	Y	11.6		8.24		--28a, --28b, --28c, --28d

Table 2.5.8. OHV effects, such as compaction, trenching, plant loss, and gasoline smell at Devil's Kitchen Branch Bog, GPS coordinates 36.01229º N, 82.79467º W.

Measurement #	Site	Length (m)	Angle	Photo	Notes
1	3 *Acers*	39.5	120		
2	3 *Acers*	49.1	66		*Microstegium vimenium* starts at 36.5m
3	3 *Acers*	39.4	33		*Microstegium vimenium* starts at 19.9m
4	3 *Acers*	57	96		*Microstegium vimenium* starts at 16.7m and 45.9m
5	3 *Acers*	22.8	164		
	Turned	59.1	180		

Table 2.5.9. Photomonitoring of OHV effects at Devil's Kitchen Branch Bog

Site	GPS coordinates N	GPS coordinates W	Photos
P strobus	36.0121	82.7940	OHV P strobus photomonitor 1
P strobus	36.0121	82.7940	OHV P strobus photomonitor 2
P strobus	36.0121	82.7940	OHV P strobus photomonitor 3
P strobus	36.0121	82.7940	OHV P strobus photomonitor 4
P strobus	36.0121	82.7940	OHV P strobus photomonitor 5
Open herbaceous bog area	36.0123	82.7947	OHV trail through bog 1
Open herbaceous bog area	36.0123	82.7947	OHV trail through bog 2
General shots of OHV damage	36.0123	82.7947	OHV 1
General shots of OHV damage	36.0123	82.7947	OHV 2
General shots of OHV damage	36.0123	82.7947	OHV 3
General shots of OHV damage	36.0123	82.7947	OHV 4
General shots of OHV damage	36.0123	82.7947	OHV 5
General shots of OHV damage	36.0123	82.7947	OHV 6
General shots of OHV damage	36.0123	82.7947	OHV 7

Table 2.5.10. Photomonitoring of trash inputs at Devil's Kitchen Branch Bog

Site	GPS coordinates N	W	Photos
DKBB sed 8	36.0123º	82.79467º	DKBB recreation 1
			DKBB recreation 2
			DKBB recreation 3
			DKBB recreation 4
			DKBB recreation 5
			DKBB recreation 6

Chapter 6
Dry Branch – Cedar Creek Quad, 36.009156º N, 82.886133º W
Prioritization Rank – Later, 22nd out of 26
Site photos – none

Summary

Dry Branch is a *Quercus alba – Quercus rubra / Cercis canadensis)* Forest (CEGL007233, G4) (Table 2.6.1) and is designated as a 9F site on the Cherokee National Forest because it is used by endangered bats as a foraging area. **Management prioritization is LATER and the site ranks 22 out of 26** for action. The caves on site may also act as roosting sites. The occurrences of *Myotis grisescens* and *Myotis sodalis* are the most important aspects of this site and management actions should enhance and maintain habitat quality (Table 2.6.2). Water quality should be monitored, stream disturbance minimized, invasive species removed (Table 2.6.3), and caves protected.

Table 2.6.1. Community Types Listed at Dry Branch (Major *et al*. 2000)

Classification	Name	G rank
CEGL007233	**Quercus alba - Quercus (rubra, Carya* spp.) Forest Alliance	G4

* Not sampled

TES Elements

***Myotis grisescens* (G3/S2) -** Grey myotis populations are currently stable, but are vulnerable because hibernation is concentrated into only nine caves (NatureServe 2007). It is imperative that caves used by the bat be conserved. Buffers of undisturbed areas should surround cave openings and flight paths between foraging and roosting areas. Use of pesticides and insecticides near foraging areas may reduce prey item abundances and potentially kill the bats. Main prey foods are mayflies, and other flying insects and beetles. The bats forage along streams, 2-3 meters above the water. Cleared forests will not be utilized for foraging. Even periodic light in the caves could be too much disturbance for the grey bats. Separate hibernation caves are used for females that have mated. These females begin hibernation in late September and October after mating; males and juveniles begin by early November. Females emerge from hibernation caves in late March and early April, followed by males and juveniles a few weeks later.

***Myotis sodalis* (G2/S1) -** Indiana bat migrates between summer and winter habitat (NatureServe 2007). From August to September, the bats roost in limestone caves, leaving each night to forage so fat reserves will be sufficient during hibernation. The bats hibernate through the winter, awakening about every 10 days to fly about for an hour or more. The large, tight, compact clusters move

northward in the spring. During summer, females establish maternity colonies beneath the loose bark of dead trees, while males roost in caves. Cave management should prevent human disturbance and maintain intact forested habitat. Even mild human disturbance causes the bats to use up energy so visitation and handling is to be avoided. Signs at cave entrances or fences/gates at cave entrances should be considered. The bats' summer roosts need to be identified and winter roosts need to be protected.

Knowledgeable People

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Table 2.6.2. Threats and management actions for Dry Branch. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Recreation	1	Gate roads into site	1	1	once	3B:0H	good	med	CEGL007233, *Myotis* spp.
Incompatible Forestry Practices and Management	2	Do not harvest	2	0	no action	2B:0H	very good	med	*Myotis* spp.
Invasive Species	3	Herbicide *M. vimenium*	11	0.5	annually	1B:2H	fair	low	CEGL007233
Invasive Species	3	Manually remove *Microstegium vimenium*	3	1	annually	1B:0H	good	med	CEGL007233
Invasive Species	3	Monitor invasives	4	0.5	annually	1B:0H	good	high	CEGL007233
Invasive Species	3	Prescribed fire	8	1	annually	1B:2H	fair	med	CEGL007233
Forestry Roads	4	Gate roads into site	1	1	once	3B:0H	good	med	CEGL007233, *Myotis* spp.
Altered Fire Regime	5	Prescribed fire - ridgelines	5	1	decadally	1B:2H	good	med	CEGL007233
Overexploitation of Species	6	Bar cave entrances	10	1	once	2B:0H	good	high	*Myotis* spp.
Sedimentation	6	Gate roads into site	1	1	once	3B:0H	good	med	CEGL007233, *Myotis* spp.
Urban / Suburban Development	6	Gate roads into site	1	1	once	3B:0H	good	med	CEGL007233, *Myotis* spp.
Sedimentation	6	Monitor water quality	6	0.5	annually	3B:0H	good	med	CEGL007233, *Myotis* spp.
Sedimentation	6	Signage - Do not disturb stream, Sensitive species depend on its integrity	9	1	once	2B:0H	good	med	*Myotis* spp.
Overexploitation of Species	6	Signage - Sensitive Species. Do not disturb.	7	1	once	2B:0H	good	med	*Myotis* spp.
Incompatible Water Quality	7	Gate roads into site	1	1	once	3B:0H	good	med	CEGL007233, *Myotis* spp.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Erosion	7	Monitor sedimentation	6	0.5	annually	3B:0H	good	high	CEGL007233, *Myotis* spp.
Incompatible Water Quality	7	Monitor water quality	6	0.5	annually	3B:0H	good	med	CEGL007233, *Myotis* spp.
Forest Conversion	7	Prescribed burn	8	1	decadally	1B:2H	good	med	CEGL007233
Woody Encroachment	7	Prescribed burn	8	1	decadally	1B:0H	good	med	CEGL007233
Channel Modification	7	Signage - Do not disturb stream, Sensitive species depend on its integrity	9	1	once	2B:0H	good	med	*Myotis* spp.
Second Home / Vacation Development	7	Signage - Sensitive species. Please stay on trail.	7	1	once	2B:0H	good	med	*Myotis* spp.

Table 2.6.3. GPS coordinates of points at Dry Branch

Point Name	GPS Coordinates	
DB *Microstegium vimenium*	36.00969º N	82.88363º W

Chapter 7
East Fork of Higgins Creek – Bald Creek and Sam's Gap Quads, 35.98286º N, 82.50274º W
Prioritization Rank – Later, 23th out of 26
Site Photos - East Fork Higgins Creek

Summary

This site is a *Betula alleghaniensis* / *Acer spicatum* / *Hydrangea arborescens - Ribes cynosbati* / *Dryopteris marginalis* Forest (CEGL004982, G3) (Table 2.7.1). **Management prioritization is LATER and the site is ranked 23 out of 26** for action. There are not very many pressing threats at East Fork of Higgins Creek. Invasive species may become an issue if recreation increases. Development of second homes and vacation homes could lead to increased visitation. Monitoring for invasive species should occur on a regular basis and signage installed to protect the TES on this site (Table 2.7.3).

Table 2.7.1. Community types listed at East Fork of Higgins Creek (Major *et al*. 2000; monitoring points listed in Table 2.7.4).

Classification	Name	G rank
CEGL004982	*Betula alleghaniensis / Acer spicatum / Hydrangea arborescens - Ribes cynosbati / Dryopteris marginalis* Forest	G3

Table 2.7.2. Species dominances and population trends found at East Fork Higgins Creek. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups	
Species	efhc-a	efhc-g
Acer rubrum		**A,B,C,D**
Acer saccharum	**b,d**	**A,B,C,D**
Fagus grandifolia	**a,b,c,d**	**A,B,C**
Quercus rubra		*d*
Tilia americana var. *heterophylla*		**c,d**

Communities Found

Though large *Betula* did occur within the plots sampled at EFHC, EFHC-A contained only one dominant overstory species, *Fagus grandifolia,* so it better matched the Southern Appalachian Beech Gap (North Slope Tall HerbType) (*Fagus grandifolia / Agertina altissima* var.*roanensis*) Forest (S = 1). Group A at East Fork of Higgins Creek may follow an unknown compositional trajectory, since none of the tree species there exhibit an increasing size distribution (Table 2.7.2). However, both *Acer saccharum* and *Fagus grandifolia* have decreasing size distributions, so despite their current canopy dominance, they are likely to become less abundant in the next several decades. In addition, the spread of beech bark disease is likely to greatly reduce the abundance of *Fagus*.

EFHC-G did not match any NatureServe (2007) associations, but did most closely match the *Acer saccharum – Tilia americana – (Quercus rubra)* Alliance (S = .86). Site-group G at East Fork of Higgin's Creek appears to be headed towards increased dominance by *Acer rubrum* and *Acer saccharum*, which are current overstory dominants with increasing size distributions. Again, despite an increasing size distribution for *Fagus grandifolia*, that species is likely to actually decrease in abundance as a result of beech bark disease.

TES Elements

***Allium tricoccum* (G5/S1S2) (Table 2.7.5) –** This perennial herb grows in rich mesic soils. Collections may have severe implications on the sustainability of the species in the southern Appalachians (Rock *et al*. 2004). Researchers ran simulated collections and found that sustainable levels of harvest for the species in the southern limit of its range may be as low as 10% of individuals of populations once every 10 years. Their simulation removed plants of all sizes, but they admit that this varies from real harvest methods, which probably preferentially remove larger plants. This method decreases vegetative reproduction within populations. Personal collections of *Allium tricoccum* should be permitted and restricted to extremely low levels of harvest. Sustainable levels are still unknown, but are sure to be at or below 10% once every 10 years. I recommend that permits be for specific sites known to contain vigorous populations and that collections on any given site be limited to 5-10% harvest every 10 years. In other words, if a population has 100 individuals in year 1 five to10 individuals could be harvested within a 10 year period. The next 10 year harvest period should begin after a population has been re-evaluated.

***Hydrophyllum virginianum* (G5/S3) (Table 2.7.5) –** This perennial herb can be found on moist slopes of rich woods. Threats include land-use alteration and habitat fragmentation.

***Polygonum cilinode* (G5/S1S2) (Table 2.7.5) -** This annual smartweed is found in openings and clearing at higher elevations of the southern Appalachians and reproduces from June through September (Radford *et al.* 1964). It is top-killed by fire (Rook 2002),

after which it is capable of reproduction by seed and perhaps from root rhizomes. Reproduction is greater after severe fire than after milder fires.

Knowledgeable People

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Table 2.7.3. Threats and management actions for East Fork of Higgins Creek. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Second Home / Vacation Development	1	Signage - Fragile ecosystem! Tread carefully.	2	1	once	3B:0H	good	med	*Hydrophyllum, Allium, Polygonum*
Urban / Suburban Development	1	Signage - Fragile ecosystem! Tread carefully.	2	1	once	3B:0H	good	med	*Hydrophyllum, Allium, Polygonum*
Invasive Species	2	Search for invasives	1	0.5	biannually	4B:0H	very good	high	CEGL004982, *Hydrophyllum, Allium, Polygonum*
Recreation	2	Signage - Fragile ecosystem! Tread carefully.	2	1	once	3B:0H	good	med	*Hydrophyllum, Allium, Polygonum*

Table 2.7.4. GPS coordinates of plots and elements at East Fork of Higgins Creek

Point Name	GPS Coordinates			
efhca2	35.985530	°N	82.498730	°W
efhca3	35.986090	°N	82.498940	°W
efhca4	35.987470	°N	82.499270	°W
efhca5	35.988070	°N	82.499200	°W
efcb1	35.982860	°N	82.502740	°W
efcb2	35.983440	°N	82.502730	°W
efcb3	35.984390	°N	82.502960	°W
efcb4	35.985630	°N	82.502600	°W
efcb5	35.986470	°N	82.502860	°W
EFHC *Allium tricoccum* 1	35.984050	°N	82.499080	°W
EFHC *Allium tricoccum* 2	35.983440	°N	82.502730	°W
EFHC *Hydrophyllum virginianum*	35.983440	°N	82.502730	°W
EFHC *Polygonum cilinode*	35.984900	°N	82.497370	°W

Table 2.7.5. TES species monitoring at East Fork of Higgins Creek

Species	GPS coordinates		Repro	Non-repro	Area (m^2)	status	concerns	
	N	W						
Polygonum cilinode	35.9849º	82.4974º			500	good	road	At trailhead on NC side of ridge
Allium tricoccum	35.9840º	82.4991º	100%	0%	10	good	close to trail	At edge of AT
Hydrophyllum virginianum	35.9834º	82.5027º	12 (1%)	1000s (99%)	630	good	repro	Along seep for about 63 m; thins out after Betula with 1 trunk broken; some along high edges
Allium tricoccum	35.9834º	82.5027º	100%	0%	630	good		Scattered with Hydrophyllum

Chapter 8
Fagall – Birch Branch – Laurel Bloomery Quad, 36.30811º N, 82.13008º W
Prioritization Rank – Now – Right Now, 4th out of 26
Site Photos - Fagall – Birch Branch

Summary

Fagall-Birch Branch is a mosaic of communities (Table 2.8.1). The site has a management priority of NOW-RIGHT NOW and has a rank of 4 out of 26. There are many threats facing Fagall-Birch Branch. The main ones are forestry roads, the development of roads and utilities, and invasive species. Gating the roads and monitoring for invasives are the most important actions for the site (Table 2.8.3). Monitoring the TES species is also important for management of the site (Table 2.8.3).

Table 2.8.1. Community types listed at Fagall-Birch Branch (Major *et al*. 2000; monitoring points listed in Table 2.8.4).

Classification	Name	G rank
CEGL004982	*Betula alleghaniensis / Acer spicatum / Hydrangea arborescens - Ribes cynosbati / Dryopteris marginalis* Forest	G3
CEGL007710	*Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana var. heterophylla) / Cimicifuga racemosa - Laportea canadensis* Forest	G4
CEGL007097	*Pinus pungens - Pinus rigida -(Quercus prinus) / Kalmia latifolia- Vaccinium pallidum* Woodland	G3
CEGL007285	*Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Aster chlorolepis - Dryopteris intermedia* Forest	G3G4
CEGL007136	*Tsuga canadensis / Rhododendron maximum - Leucothoe fontanesiana* Forest	G3G4
CEGL003814	**Kalmia latifolia - Rhododendron catawbiense - (Gaylussacia baccata, Pieris floribunda, Vaccimium corymbosum* Shrubland	G2G3

*** Not sampled**

Communities Found

Fagall – Birch Branch (FBB) was contained within two adjacent watersheds. On this most highly sampled site only two of the site-groups matched the overstories of any of the five expected associations.

FBB-B fit the *Quercus rubra (Acer saccharum)* Forest Alliance (S = .67), but did not match any NatureServe (2007) associations. Group B on Fagall-Birch Branch has no species that appear to be increasing in abundance, but the *Quercus rubra* population should remain steady. The two overstory dominants, *Acer saccharum* and *Betula lenta*, may remain important components of the overstory , based on their size distributions (Table 2.8.2).

FBB-D fit the overstory of the Southern Appalachian Acid Cove (Typic Type) (*Liriodendron tulipifera – Betula lenta – Tsuga canadensis / Rhododendron maximum*) Forest (S = 0.75). At FBB-D size distributions of *Betula lenta*, *Liriodendron tulipifera*, *Quercus prinus*, and *Tsuga canadensis* indicate that they all are likely to decrease in abundance. However, *Quercus rubra* and *Acer rubrum* will likely remain steady (Table 2.8.2).

FBB-E matched the overstory of the Southern Appalachian Eastern Hemlock (Typic Type) (*Tsuga canadensis / Rhododendron maximum – Leucothoe fontanesiana*) Forest. At FBB-E, *Liriodendron tulipifera*, *Magnolia fraseri*, and *Tsuga canadensis* are all overstory dominants that are expected to decrease, based on their size distributions (Table 2.8.2). No species appear to be likely to increase in abundance in this site-group.

FBB-F matched the expected overstory of the Blue Ridge Table Mountain Pine – Pitch Pine (*Pinus pungens, Pinus rigida – (Quercus prinus) / Kalmia latifolia – Vaccinium pallidum*) Woodland. The other site-groups did not fit expected associations. FBB-F contains one species that may increase in abundance, *Pinus strobus*. *Acer rubrum* is likely to be a lesser component of the site-group in future decades, based on its size distribution, while *Quercus prinus* will probably not experience a substantial change in its abundance (Table 2.8.2).

FBB-G most closely matched the Chestnut Oak (Mesic Slope Heath Type) (*Quercus prinus – Quercus rubra / Rhododendron maximum / Galax urceolata*) Forest (S = .80). On FBB-G, both overstory dominants - *Acer rubrum* and *Quercus rubra* – are likely to remain important (Table 2.8.2).

Table 2.8.2. Species dominances and population trends at Fagall-Birch Branch. Letters included in the table indicate the strata in which each species is dominant(a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups				
Species	**Fbb-b**	**fbb-d**	**fbb-e**	**fbb-f**	**fbb-g**
Acer rubrum		*a*	*a*	**c,d**	*a,b,c,d*
Acer saccharum	**b,c,d**				
Betula alleghaniensis	**B,c**				
Betula lenta	**C,d**	**d**			
Liriodendron tulipifera	**c**	**d**	**d**		
Magnolia fraseri	**c**		**d**		**b**
Oxydendron arboreum				**b,c**	**b**
Pinus strobus				**A,B**	**a,b**
Quercus prinus		**d**		*d*	
Quercus rubra	*A,d*	*a,d*	*a*	*a*	*a,d*
Tsuga canadensis		**a,b,c,d**	**a,b,c,d**		**b**

TES Elements

***Carex argyrantha* (G5/S1) –** This sedge is threatened by land-use conversion, habitat fragmentation, and forest management practices.

***Carex ruthii* (G3/S2)** - This southern Appalachian endemic, perennial sedge is associated with the Southern Blue Ridge High Elevation Seep (Sedge Type) (Discover Life in America 2006). The seeps are dominated by sedges and are scattered throughout the high elevations (>5000 ft) on seepage slopes of the Southern Blue Ridge. It may also occur in other high elevation open areas. It blooms in June. *Carex ruthii* is considered underreported, therefore it is considered widespread throughout its range. Wetland alteration and habitat loss appear to be the greatest threats (NatureServe 2007).

***Cymophyllus fraserianus* (G4/S3)** - This perennial sedge is found in rocky, humid, acidic areas, often around streams (Robinson 1982). It prefers semi- to heavy shade and populations react negatively to increased light levels and the pioneer species that establish after disturbance. It blooms from March to May (Radford *et al*. 1964). The sedge has poor dispersal ability

(NatureServe 2007), but nevertheless has higher than expected diversity for a rare plant (Godt *et al*. 2004). Degradation of mature streamside habitats may lead to decreased diversity. Dr. Robert Kral (Botanical Research Institute of Texas) expected that both thinning and grazing would destroy populations (Robinson 1982).

***Cypripedium acaule* (G5/S4) -** This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). Management practices that benefit *Platanthera integrilabia* should also benefit this orchid.

***Dryopteris cristata* (G5/S2) –** This fern grows in moist woods, sphagnum bogs, wet thickets, and other low elevation wet areas. Habitat and hydrology alteration are the main threats to this species in the southern Appalachians (NatureServe 2007).

***Eupatorium steelei* (G4/S3) –** This perennial can be found in openings and on roadsides at higher elevations of the Southern Appalachians.

***Gentiana austromontana* (G3/S3) –** This herbaceous plant is found in full to partial shade at high elevations. Threats include trampling and timber harvest (NatureServe 2007). It is vulnerable to land use alteration due to limited distribution (Carter 2004).

***Hydrophyllum virginianum* (G5/S3) –** This perennial herb can be found on moist slopes of rich woods. Threats include land-use alteration and habitat fragmentation.

***Listera smallii* (G4/S3) -** The kidneyleaf twayblade occurs in uncleared forests on steep slopes. This orchid prefers to grow in the humus of damp woods, thickets, and bogs or below rhododendron on mountain slopes. The wetland habitat is vulnerable to drainage and logging, especially in wet hemlock forests (NatureServe 2007). It blooms from June through July.

***Neotoma magister* (G3/S3) -** The Alleghany woodrat is solitary except when breeding and raising young (NatureServe 2007). They nest in crevices of rock outcrops, talus and cave habitats and these suitable brood areas are often the limiting factor of their habitats. Predators include owls, skunks, weasels, foxes, raccoons, bobcats and large snakes. They are mostly nocturnal and vegetarian. Occupied habitat should be mapped and a low-impact monitoring program maintained. Pennsylvania Game Commission has formulated provisional protection guidelines, pending more specific guidance that should come out of current research

(NatureServe 2007). These guidelines are:

1. All caves and limestone mines on public land having either *Neotoma* and/or bats in residence (seasonally or all year) should be designated as "no admittance: restricted areas." Caves with a history of public use or easy accessibility should be gated or fenced to reinforce the "restricted area" concept.

2. Contiguous woodrat habitat, with *Neotoma* occupying any portion thereof, should be protected from any surface disturbance or other form of fragmentation.

3. No surface disturbance should occur within 200 meters [660 ft] (the primary foraging zone) of active colonies.

4. A diversity of mature, mast-producing trees (and all evergreens) should be reserved overtopping and within 50 meters [165 ft] of contiguous woodrat habitat with *Neotoma* occupying any portion thereof.

5. No tree cutting should occur within 200 meters [660 ft] of the "center" of active colonies. Logging roads should be excluded from this zone.

6. If a streambottom occurs within 400 meters [1320 ft] of an active colony, a minimum disturbance corridor (no surface mining, no clearcutting...) of 100 meters [330 ft] in width or wider should connect the colony site to the stream corridor.

7. Blasting - attendant mining - should never be so close as to shift rocks within the colony site.

Crevices and openings in rock or among boulders must be present for den sites, and in some areas this will be the limiting factor. Where oaks have been hit hard by gypsy moth, it may be important to assure alternative winter food sources. Food supplies can be enhanced by planting or managing for native species that provide fruits, seeds, and nuts. Gypsy moth defoliation can be prevented and in some contexts with minimal nontarget impacts. Specifically, managers should consider BTK if there is not a potential to eradicate rare Lepidoptera, and "Gypchek" if rare Lepidoptera are present (Schweitzer 2004, NatureServe 2007). Human intrusion in nesting areas should be discouraged because human contact may be detrimental: "Although it would be difficult to document a direct cause and effect relationship between the decline of the woodrat and its intolerance of human contact, any management efforts to preserve the eastern woodrat should at least consider this possibility and incorporate into recovery plans safeguards to minimize contact

between humans and woodrats" (Kirkland 1986). Restoration efforts should include well-designed experiments that will yield information on possible causes of the decline.

***Panax quinquefolius* (G3/S3) –** Populations of this perennial herb are declining because of overharvest of the roots, overbrowsing by deer, and timber harvesting. Currently, few populations are of a viable size; in the Great Smoky Mountain National Park that size is 510 individuals. Plants can be marked with dye and magnetic chips to help reduce illegal harvest of plants. Also harvests are supposed to be coordinated with planting efforts by the harvester of seeds from the harvested plants, but sometimes those seeds are not yet mature or are planted ineffectively. Education of legal harvesters and greater enforcement against illegal harvests are needed to ensure future viability of ginseng populations. Distributing pamphlets or even requiring that harvesters take a class covering proper techniques before they can be licensed may help protect the species. Harvesters should dig only mature plants after seeds have reached maturity. All regulations surrounding ginseng harvests should be strictly enforced. Plants begin to reproduce between the ages of 4 and 7 (Nantel *et al*. 1996).

***Platanthera psycodes* (G5/S2) –** This orchid prefers open, moist habitats of streamsides and ditches and wet meadows (Hapeman 1996). Flowers are fertilized by butterflies and hawkmoths.

***Polygonum cilinode* (G5/S1S2) -** This annual smartweed is found in openings and clearing at higher elevations of the southern Appalachians and reproduces from June through September (Radford *et al.* 1964). It is top-killed by fire (Rook 2002), after which it is capable of reproduction by seed and perhaps from rhizomes. Reproduction is greater after severe fire.

***Prenanthes roanensis* (G3/S3) -** This perennial herb is found at forest edges, in upper slope or ridgetop clearings, and around *Prunus pennsylvanica* in areas that have been burned (Robinson 1982). It is not found under deep canopies. Opening the canopy may increase regeneration of populations of this species (Robinson 1982). Fire may help maintain this species through decreasing competition and shade. This endemic of the southern Appalachians is restricted to elevations above 1200m, and is often associated with mixed spruce/hardwood forests (NatureServe 2007). This species faces low level threats from land-use conversion and habitat fragmentation.

***Scutellaria saxatilis* (G3/S3) –** Rock skullcap is an herbaceous perennial that requires moist shaded habitat and blooms June through August (Radford *et al.* 1964, Dolan 2004). The biggest threats to *Scutellaria saxatilis* are exotic species like *Microstegium vimenium* and *Lonicera japonica* and loss of canopy (Dolan 2004, NatureServe 2007). Other threats include burning, grazing, woody encroachment, and trampling. Management actions should include protection of enough habitats for population growth and

monitoring of those populations. Invasive species and encroaching woody shrubs should be removed and canopy trees preserved. In Great Smoky Mountains National Park, removal of shrubs and saplings in 2001 temporarily boosted population numbers, but in 2003 numbers again fell. Posting signs at populations near trailsides may help prevent trampling.

***Sorex cinereus* (G5/S4)** – This shrew breeds from March to September and those individuals born in early spring may themselves reproduce later in the same breeding season (Stewart *et al*. 1989). One to twelve shrews may be found per acre and home ranges are approximately 0.10 acres (Buckner 1966). Preferred habitats of the shrew are herbaceous and wooded wetlands (NatureServe 2007). Fallen logs, woody debris, deep leaf litter and standing dead trees are characteristic elements of habitats. The shrew nests in shallow burrows or in logs and stumps. It is most active in early morning hours between 1:00 and 2:00am and on cloudy rainy nights, but is active throughout the day (NatureServe 2007).

***Synaptomys cooperi* (G5/S4) -** The southern bog lemming is a small rodent with a ¼-1 acre range (NatureServe 2007). Densities vary from 5 to 35 per ha, reaching 89/ha in peak years (Banfield 1974), and colonies are scarce and scattered. This lemming prefers boggy habitat and is common in marshes, meadows and upland forests with a deep humus layer. It utilizes a 6-12 in deep burrow system. After a 21-23 day gestation period, 1-8 (avg 2-5) young are born underground. The breeding season is year round with a peak in April-Sept. This lemming's diet consists primarily of herbaceous plants; leaves, stems, seeds, and rootstocks, especially of grasses and sedges; as well as small fruits (Connor 1959). It is active, foraging day and night throughout the year. Expanding meadow vole populations may displace populations of the lemming. Fire may also drive it out of areas.

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Table 2.8.3 Threats and management actions for Fagall-Birch Branch. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Development of Roads / Utilities	1	Gate access roads above Birch Branch	12	1	once	6B:0H	very good	high	CEGL004982, CEGL007710, CEGL007285, CEGL007136, *Eupatorium, Prenanthes, Panax, Polygonum, Cypripedium,*
Forestry Roads	1	Gate access roads above Birch Branch	12	1	once	6B:0H	good	med	CEGL004982, CEGL007710, CEGL007285, CEGL007136, *Eupatorium, Prenanthes, Panax, Polygonum, Cypripedium,*
Development of Roads / Utilities	1	Gate roads along Fagall & Birch Branch channels	1	1	once	9B:0H	very good	high	CEGL007710, *Scutellaria, Hydrophyllum, Cymophyllus, Eupatorium, Gentiana, Platanthera Synaptomys, Sorex*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Invasive Species	2	Manually remove invasive species	9	1		19B:0H	good	med	CEGL004982, CEGL007710, CEGL007285, CEGL007136, CEGL003814, *Eupatorium, Prenanthes, Panax, Polygonum, Cypripedium, Scutellaria, Hydrophyllum, Listera, Cymophyllus, Drypoteris, Carex spp., Panax, Gentiana*
Invasive Species	2	Monitor stream and road sides for invasives	2	0.5	annually in early fall	19B:0H	good	high	CEGL004982, CEGL007710, CEGL007285, CEGL007136, CEGL003814, *Eupatorium, Prenanthes, Panax, Polygonum, Cypripedium, Scutellaria, Hydrophyllum, Listera, Cymophyllus, Drypoteris, Carex spp., Panax, Gentiana*
Altered Fire Regime	3	Burn *Pinus pungens* ridge, med-high intensity	4	1	decadally	1B:0H	very good	high	CEGL007097
Altered Fire Regime	3	Monitor *Pinus pungens* regeneration	3	0.5	every five years	1B:0H	good	high	CEGL007097
Incompatible Forestry Practices and Management	4	Burn *Pinus pungens* ridge - med high intensity	4	1	decadally	2B:0H	very good	high	CEGL007097, *C. argyrantha*
Incompatible Forestry Practices and Management	4	Manually remove shrubs from ridge populations	10	5	once	4B:0H	good	med	CEGL007097, *Carex spp., Prenanthes,*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Incompatible Forestry Practices and Management	4	Monitor *Pinus pungens* regeneration	3	0.5	every five years	1B:0H	good	high	CEGL007097
Recreation	5	Gate roads along Fagall & Birch Branch channels	1	1	once	9B:0H	very good	high	CEGL007710, *Scutellaria, Hydrophyllum, Cymophyllus, Eupatorium, Gentiana, Platanthera, Synaptomys, Sorex*
Sedimentation	5	Monitor *Dryopteris cristata*	6	0.5	annually	1B:0H	good	med	*Dryopteris*
Erosion	5	Monitor erosion and sedimentation	5	0.5	annually	8B:0H	good	high	*Cymophyllus, Dryopteris, Gentiana, Listera, Platanthera, Scutellaria, Sorex, Synaptomys*
Incompatible Water Quality	6	?	?	?	?	?	?	?	?
Woody Encroachment	6	Burn bald area	9	1	decadally	1B:0H	good	high	CEGL003814
Woody Encroachment	6	Burn *Pinus pungens* ridge - med high intensity	4	1	every decade	1B:0H	very good	high	CEGL007097
Forest Conversion	6	Burn *Pinus pungens* ridge, med-high intensity	4	1	decadally	1B:0H	very good	high	CEGL007097
Channel Modification	6	Gate roads along Fagall & Birch Branch channels	1	1	once	9B:0H	very good	high	CEGL007710, *Scutellaria, Hydrophyllum, Cymophyllus, Eupatorium, Gentiana, Platanthera Synaptomys, Sorex*
Overexploitation of Species	6	Monitor showy TES species	7	0.5	annually in early fall	12B:0H	good	med	*Eupatorium, Prenanthes, Scutellaria, Hydrophyllum, Listera, Polygonum, Cymophyllus, Dryopteris, Carex spp., Panax, Cypripedium*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Forest Conversion	6	Release adelgid predator	11	1	ass needed	2b:0H	good	med	CEGL007316
Overexploitation of Species	6	Signage - Sensitive Species. Do not disturb.	8	1	once	12B:0H	good	med	*Eupatorium, Prenanthes, Scutellaria, Hydrophyllum, Listera, Polygonum, Cymophyllus, Dryopteris, Carex spp., Panax, Cypripedium*

Table 2.8.4. GPS coordinates of Fagall-Birch Branch plots

Point Name	GPS Coordinates			
fbba1	36.308111	°N	82.130083	°W
fbba2	36.569306	°N	81.855778	°W
fbba3	36.569028	°N	81.856639	°W
fbbb1	36.568500	°N	81.859917	°W
fbbb2	36.568472	°N	81.859917	°W
fbbc1	36.567000	°N	81.859000	°W
fbbc2	36.565556	°N	81.861194	°W
fbbc3	36.566806	°N	81.860611	°W
fbbc4	36.566750	°N	81.861472	°W
fbbd1	36.566750	°N	81.861472	°W
fbbd2	36.561222	°N	81.861333	°W
fbbd3	36.559528	°N	81.858472	°W
fbbd4	36.559694	°N	81.858889	°W
fbbe1	36.555944	°N	81.857444	°W
fbbe2	36.556056	°N	81.856056	°W
fbbe3	36.556917	°N	81.855000	°W
fbbe4	36.557000	°N	81.854056	°W
fbbe5	36.557056	°N	81.854083	°W
fbbf1	36.569417	°N	81.857333	°W
fbbf2	36.567972	°N	81.856639	°W
fbbf3	36.567583	°N	81.856333	°W
fbbg1	36.567694	°N	81.856389	°W
fbbg2	36.565500	°N	81.856861	°W
fbbg3	36.565500	°N	81.856861	°W
fbbh1	36.561722	°N	81.853083	°W
fbbh2	36.562417	°N	81.853056	°W
fbbh3	36.562278	°N	81.854389	°W
fbbh4	36.563278	°N	81.854500	°W
fbbh5	36.563250	°N	81.855389	°W
fbbh6	36.564139	°N	81.855944	°W
fbbh7	36.564722	°N	81.855944	°W

Point Name	GPS Coordinates			
fbbh8	36.566278	°N	81.855750	°W
fbbi1	36.555000	°N	81.858583	°W
fbbi2	36.553000	°N	81.859694	°W
fbbi3	36.552222	°N	81.026667	°W
fbbi4	36.551806	°N	81.861000	°W
fbbi5	36.551000	°N	81.861417	°W
fbbi6	36.550000	°N	81.862722	°W
fbbi7	36.549500	°N	81.863056	°W
fbbi8	36.547889	°N	81.863333	°W
fbbi9	36.548389	°N	81.864361	°W
fbbj1	36.548306	°N	81.862750	°W
fbbj2	36.548500	°N	81.862444	°W
fbbk1	36.542917	°N	81.862194	°W
fbbk2	36.543083	°N	81.862167	°W
fbbk3	36.543583	°N	81.860194	°W
fbbk4	36.544056	°N	81.859333	°W
fbbk5	36.543861	°N	81.858306	°W
fbbk6	36.544333	°N	81.857167	°W
fbbl1	36.547194	°N	81.857833	°W
fbbl2	36.547611	°N	81.857556	°W
fbbl3	36.548750	°N	81.855944	°W
fbbl4	36.548667	°N	81.855944	°W
fbbl5	36.549917	°N	81.854722	°W
fbbl6	36.550889	°N	81.853639	°W
fbbl7	36.551194	°N	81.853333	°W
fbbl8	36.552028	°N	81.852556	°W
fbbl9	36.552667	°N	81.852056	°W
fbbl10	36.552333	°N	81.851722	°W
fbbl11	36.553500	°N	81.850444	°W
fbbm1	36.531444	°N	81.850417	°W
fbbm2	36.532806	°N	81.849806	°W
fbbm3	36.532472	°N	81.848472	°W

Point Name	GPS Coordinates			
fbbm4	36.532278	°N	81.848333	°W
fbbm5	36.531833	°N	81.847000	°W
fbbm6	36.531389	°N	81.846306	°W
fbbm7	36.530833	°N	81.844639	°W
fbbm8	36.531333	°N	81.843028	°W
fbbn1	36.379056	°N	81.852472	°W
fbbn2	36.546278	°N	81.851417	°W
fbbn3	36.546222	°N	81.850667	°W
fbbn4	36.547417	°N	81.850389	°W
fbbn5	36.547389	°N	81.849583	°W
fbbn6	36.548806	°N	81.849444	°W
fbbn7	36.552444	°N	81.849028	°W
fbbn8	36.549944	°N	81.864806	°W
fbbn9	36.550472	°N	81.847361	°W
fbbn10	36.550861	°N	81.847083	°W
fbbn11	36.551833	°N	81.846306	°W
fbbn12	36.552389	°N	81.845667	°W
fbbn13	36.552861	°N	81.844556	°W
fbbo1	36.538361	°N	81.837389	°W
fbbo2	36.538889	°N	81.838361	°W
fbbo3	36.539139	°N	81.839000	°W
fbbo4	36.538889	°N	81.840083	°W
fbbo5	36.539944	°N	81.840528	°W
fbbo6	36.540528	°N	81.841000	°W
fbbp1	36.542694	°N	81.838139	°W
fbbp2	36.542222	°N	81.836778	°W
fbbp3	36.541111	°N	81.835333	°W
fbbp4	36.539889	°N	81.834639	°W
fbbp5	36.541083	°N	81.834028	°W
fbbq1	36.549722	°N	81.832361	°W
fbbq2	36.549028	°N	81.831444	°W
fbbq3	36.548806	°N	81.830750	°W

Point Name	GPS Coordinates			
fbbq4	36.548167	°N	81.829250	°W
fbbq5	36.547444	°N	81.829583	°W
fbbq6	36.547111	°N	81.827417	°W
fbbq7	36.546694	°N	81.826889	°W
fbbr1	36.543000	°N	81.837917	°W
fbbr2	36.542306	°N	81.837083	°W
fbbr3	36.541667	°N	81.836306	°W
fbbr4	36.541444	°N	81.835667	°W
fbbr5	36.540944	°N	81.834861	°W
fbbr6	36.540611	°N	81.834611	°W
fbbr7	36.540139	°N	81.833917	°W
fbbs1	36.558889	°N	81.848583	°W
fbbs2	36.559222	°N	81.849861	°W
fbbs3	36.557861	°N	81.849556	°W
fbbs4	36.557444	°N	81.850417	°W
fbbs5	36.556722	°N	81.851944	°W
fbbs6	36.556389	°N	81.852194	°W
fbbt1	36.540694	°N	81.855167	°W
fbbt2	36.541639	°N	81.853139	°W
fbbt3	36.541556	°N	81.853083	°W
fbbu1	36.537222	°N	81.845639	°W
fbbu2	36.536722	°N	81.845056	°W
fbbu3	36.536361	°N	81.844361	°W
fbbu4	36.535611	°N	81.842583	°W
fbbu5	36.535389	°N	81.842167	°W
fbbu6	36.535167	°N	81.840944	°W
fbbu7	36.534806	°N	81.840472	°W
fbbv1	36.546944	°N	81.835139	°W
fbbv2	36.546806	°N	81.833444	°W
fbbv3	36.546000	°N	81.832167	°W
fbbv4	36.545889	°N	81.831806	°W
fbbv5	36.544972	°N	81.830694	°W

Point Name	GPS Coordinates			
fbbv6	36.544639	°N	81.829583	°W
fbbv7	36.544528	°N	81.829000	°W
FBB *Cymophyllus fraserianus*	36.560000	°N	81.856389	°W
FBB *Dryopteris cristata*	36.571667	°N	81.856667	°W
FBB *Eupatorium steelei*	36.538333	°N	81.836111	°W
FBB *Hydrophyllum virginianum*	36.560000	°N	81.856389	°W
FBB *Polygonum cilinode*	36.538333	°N	81.836111	°W
FBB *Prenanthes roanensis*	36.538333	°N	81.836111	°W
FBB *Scutellaria saxitilis*	36.560000	°N	81.856389	°W

Chapter 9
French Broad Shale Slopes – Paint Rock Quad, 35.923276º N, 82.959283º W
Prioritization Rank – Later, 26th out of 26
Site Photos - French Broad Shale Slopes

Summary

French Broad Shale Slopes has a *Quercus prinus - Juniperus viginiana* - (*Pinus virginiana*) / *Philadelphus hirsutus - Celtis occidentalis* Woodland (CEGL007720, G3?) (table 2.9.1). The site has a **management priority of LATER and is ranked 26 of the 26 sites**. The main threats facing the site are invasive species and an altered fire regime (Table 2.9.3). Annual searches for and removal of invasives should be conducted (Table 2.9.4). The regeneration of the community of interest should be monitored by revisiting sample plots, and prescribed fire should be administered on the site.

Table 2.9.1. Community types listed at French Broad Shale Slopes (Major *et al*. 2000).

Classification	Name	G rank
CEGL007720	*Quercus prinus - Juniperus virginiana - (Pinus virginiana) / Philadelphus hirsutus - Celtis occidentalis* Woodland	G3?

Communities Found

The only site-group at FBSS best fit an alliance, the Northern Red Oak – Chestnut Oak (*Quercus rubra – Quercus prinus*) Woodland Alliance (S = .67). Group H at French Broad Shale Slopes contains overstory dominants that appear to be sustainable parts of the composition, based on their size distributions (Table 2.9.2): *Quercus alba, Quercus coccinea*, and *Quercus rubra*. *Pinus strobus* is the only overstory dominant that is likely to decrease in abundance. Size distributions of *Magnolia fraseri* and *Prunus serotina* suggest increased abundance in future decades.

Table 2.9.2. Species dominances and population trends within French Broad Shale Slopes. Letters included in the table indicate the strata in which each species is dominant(a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Group
Species	**fbss-h**
Acer rubrum	*a,b,c*
Fagus grandifolia	**b**
Fraxinus americana	**b**
Magnolia fraseri	**A**
Nyssa sylvatica	*a,b,c*
Pinus strobus	**d**
Pinus virginiana	*a*
Prunus serotina	**A,B**
Quercus alba	*a,d*
Quercus prinus	*a,b,c,d*
Quercus rubra	*a,d*

TES Elements
None

Knowledgeable People

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Leigh Griggs Nedlo, 3953 Garnet Road, Pollock Pines, CA 95726

Table 2.9.3 Threats and management actions for French Broad Shale Slopes. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Incompatible Forestry Practices and Management	1	Prescribed burn - ridge and upper slope	4	1	Decadally	1B:0H	good	high	CEGL007720
Invasive Species	1	Manually remove invasive species	2	1		1B:oH	good	med	CEGL007720
Invasive Species	1	Search for invasives	1	0.5	Biannually	1B:0H	very good	high	CEGL007720
Altered Fire Regime	2	Monitor community regeneration	3	1	every five years	1B:0H	good	high	CEGL007720
Altered Fire Regime	2	Prescribed fire - ridge and upper slope	4	1	Decadally	1B:0H	good	high	CEGL007720
Woody encroachment	3	Prescribed burn - ridge and upper slope	4	1	Decadally	1B:0H	good	high	CEGL007720
Recreation	3	Signage - Fragile ecosystem! Tread carefully.	5	1	Once	1B:0H	very good	med	CEGL007720
Development of Roads / Utilities	4	?	?	?	?	?	?	?	?
Forestry Roads	4	?	?	?	?	?	?	?	?
Incompatible Forestry Practices and Management	4	Monitor community regeneration	3	1	every five years	1B:0H	good	high	CEGL007720
Erosion	4	Monitor shale slope slippage	6	0.5	Annually	1B:0H	good	high	CEGL007720
Overexploitation of Species	5	?	?	?	?	?	?	?	?

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Forest Conversion	5	Monitor community regeneration	3	1	every five years	1B:0H	good	high	CEGL007720
Forest Conversion	5	prescribed burn - ridge and upper slope	4	1	decadally	1B:0H	good	high	CEGL007720

Table 2.9.4. Invasive species at French Broad Shale Slopes

Species	Popululation length (m)	Population width (m)	Photos	Notes
Ailianthus altissima	scattered		N	along shale slope down to French Broad River

Chapter 10
Griffith Branch – Elizabethton Quad, 36.31339º N, 82.130611º W
Prioritization Rank – Soon, 17th out of 26
Site Photos – none

Summary

Griffith Branch consists of several communities (Table 2.10.1): *Tilia americana* var. *heterophylla* - *Fraxinus americana* - (*Ulmus rubra*) / *Sanguinaria canadensis* - (*Aquilegia canadensis*, *Asplenium rhizophyllum*) Forest (CEGL007711, G2G3); *Pinus strobus* - *Quercus* (*coccinea, prinus*) / (*Gaylussacia ursine, Vaccinium stamineum*) Forest (CEGL007519, G3), and (*Quercus prinus, Quercus coccinea*) / *Kalmia latifolia* / *Galax urceolata* Forest (CEGL006271, G5). **The management prioritization is SOON and it is ranked 17 out of the 26 sites for management action**. Main threats include invasives, recreation, and forest conversion (Table 2.10.3). The most important actions to undertake on Griffith Branch are to monitor invasives and manually remove *Microstegium vimenium* (Table 2.10.5).

Table 2.10.1. Community types listed at Griffith Branch (Major *et al*. 2000; monitoring points listed in Table 2.10.4)

Classification	Name	G rank
CEGL007711	**Tilia americana var. heterophylla - Fraxinus americana - (Ulmus rubra) / Sanguinaria canadensis - (Aquilegia canadensis, Asplenium rhizophyllum)* Forest	G2G3
CEGL007519	*Pinus strobus - Quercus (coccinea, prinus) / (Gaylussacia ursina, Vaccinium stamineum)* Forest	G3
CEGL006271	*(Quercus prinus, Quercus coccinea) / Kalmia latifolia / Galax urceolata* Forest	G5

*** Not sampled**

Communities Found

GB-D did not match any of the expected associations of this site but its overstory did match a NatureServe (2007) association: the Central Appalachian Hemlock – Chestnut Oak (*Tsuga canadensis – Quercus prinus – Betula lenta*) Forest association (S = .67). However, this association has only been documented in the central Appalachians (NatureServe 2007). The overstory of group D at Griffith Branch is currently dominated by species likely to decrease in abundance - *Acer rubrum* and *Acer saccharum* - or to experience little or no change in occurrence - *Betula lenta*. However, *Fagus grandifolia, Magnolia fraseri*, and *Oxydendron arboreum* all are expected to increase in abundance, based on their size distributions (Table 2.10.2).

GB-F matched the Chestnut Oak (Xeric Ridge Type) ((*Quercus prinus, Quercus coccinea) / Kalmia latifolia / Galax urceolata)* Forest overstory. GB-F also matched the overstory of the Appalachian White Pine – Xeric Oak (*Pinus strobus – Quercus (coccinea, prinus) / (Gaylussacia ursina, Vaccinium stamineum*) Forest. On GB-F *Acer rubrum* and *Quercus alba* are likely to decrease in abundance and *Quercus coccinea* and *Quercus prinus* may have sustainable populations. *Oxydendron arboreum* is the only species that appears to be increasing in abundance in the site-group (Table 2.10.2).

GB-G matched the Chestnut Oak (Xeric Ridge Type). GB-G contained three overstory dominants that all have size distributions that suggest neither increasing nor decreasing populations on the site-group: *Acer rubrum, Quercus prinus,* and *Quercus rubra*. *Fagus grandifolia* and *Magnolia fraseri* are likely to increase in abundance, according to their size distributions. Here again, though, beech bark disease may, in reality, cause *Fagus* to decrease in abundance (Table 2.10.2).

GB-H matched the overstory of the Appalachian White Pine – Xeric Oak (*Pinus strobus – Quercus (coccinea, prinus) / (Gaylussacia ursina, Vaccinium stamineum*) Forest. GB-H has several species that exhibit increasing size distributions: *Acer rubrum*, which is dominant in every strata, *Fagus grandifolia*, *Nyssa sylvatica*, *Oxydendron arboreum*, and *Tsuga canadensis*. *Pinus strobus* may not undergo substantial change in the site-group (Table 2.10.2).

Table 2.10.2. Species dominances and population trends within Griffith Branch. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups			
Species	**gb-d**	**Gb-f**	**gb-g**	**gb-h**
Acer rubrum	*a,d*	**C,d**	*a,b,c,d*	**A,B,C,D**
Acer saccharum	*a,d*			
Betula lenta	**c,d**			
Fagus grandifolia	**A,B**		**B**	**B**
Magnolia fraseri	**A,B**		**A,B**	
Nyssa sylvatica				**B**
Oxydendron arboreum	**A**	**B,C**	*c*	**B,C**
Pinus strobus		*a*		*a,d*
Quercus alba		**d**		

	Site Groups			
Species	**gb-d**	**Gb-f**	**gb-g**	**gb-h**
Quercus coccinea		*c,d*		
Quercus prinus		*d*	*a,d*	
Quercus rubra			*a,b,c,d*	
Tsuga canadensis				**B,C**

TES Elements

***Cypripedium acaule* (G5/S4) -** This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). Management practices that benefit *Platanthera integrilabia* should also benefit this orchid.

***Gentiana austromontana* (G3/S3) –** This herbaceous plant is found in full to partial shade at high elevations. Threats include trampling and timber harvest (NatureServe 2007). It is vulnerable to land use alteration due to limited distribution (Carter 2004).

***Panax quinquefolius* (G3/S3) –** Populations of this perennial herb are declining because of overharvest of the roots, overbrowsing by deer, and timber harvesting. Currently, few populations are of a viable size; in the Great Smoky Mountain National Park that size is 510 individuals. Plants can be marked with dye and magnetic chips to help reduce illegal harvest of plants. Also harvests are supposed to be coordinated with planting efforts by the harvester of seeds from the harvested plants, but sometimes those seeds are not yet mature or are planted ineffectively. Education of legal harvesters and increased enforcement against illegal harvests are needed to ensure future viability of ginseng populations. Distributing pamphlets or even requiring that harvesters take a class covering proper techniques before they can be licensed may help protect the species. Harvesters should dig only mature plants after seeds have reached maturity. All regulations surrounding ginseng harvests should be strictly enforced. Plants begin to reproduce between the ages of 4 and 7 (Nantel *et al*. 1996).

***Tsuga caroliniana* (G3/S3) –** This hemlock is a southern Appalachian endemic that grows on xeric ridgelines, cliffs, and rocky slopes and in gorges in nutrient poor soils. Viable populations should contain at least 35 trees on high quality habitat that contains dense stands of ericaceous shrubs and oak and pine species. The hemlock woolly adelgid can quickly degrade or even wipe out whole stands, though.

Knowledgeable People

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Table 2.10.3. Threats and management actions for Griffith Branch. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Invasive Species	1	Herbicide *M. vimenium*	9	0.5	annually	3B:4H	fair	low	CEGL007711, CEGL007519, CEGL006271
Invasive Species	1	Manually remove *Microstegium vimenium*	2	2	annually in late summer, early fall	7B:0H	very good	med	CEGL007711, CEGL007519, CEGL006271, *Panax, Cypripedium, Gentiana, Tsuga*
Invasive Species	1	Monitor spread of *Microstegium vimenium*	1	0.5	annually	7B:0H	good	high	CEGL007711, CEGL007519, CEGL006271, *Panax, Cypripedium, Gentiana, Tsuga*
Erosion	2	Monitor erosion channels	6	0.5	annually	7B:0H	good	high	CEGL007711, CEGL007519, CEGL006271, *Panax, Cypripedium, Gentiana, Tsuga*
Operation of Dams / Impoundments	2	Monitor TES species	10	0.5	annually				*Panax, Tsuga, Gentiana*
Forest Conversion	2	Monitor *Tsuga*	5	0.5	biannually	1B:0H	very good	low	*Tsuga*
Parasites / Pathogens	2	Monitor *Tsuga*	5	0.5	biannually	1B:0H	very good	low	*Tsuga*
Forest Conversion	2	Prescribed fire - low intensity	8	1	every other decade	2B:4H?	fair	low	CEGL006271, CEGL007519
Altered Fire Regime	2	Prescribed fire - low intensity, protect *Tsuga*	8	1	every other decade	2B:4H?	fair	low	CEGL006271, CEGL007519
Forest Conversion	2	Release adelgid predator	7	1	as needed	1B:0H	good	med	*Tsuga*
Forest Conversion	2	Release adelgid predator	7	0.5	as needed	1B:0H	good	med	*Tsuga*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Recreation	2	Close dispersed campsites	4	0.5	Once	3B:0H	very good	med	CEGL007519, Tsuga, Gentiana
Recreation	2	Run annual clean-ups	3	1	annually	7B:0H	very good	med	CEGL007711, CEGL007519, CEGL006271, Panax, Cypripedium, Gentiana, Tsuga

Table 2.10.4. GPS coordinates of plots and elements at Griffith Branch.

Point Name	GPS Coordinates			
Gba2	36.313389	°N	82.130611	°W
Gbb1	36.314667	°N	82.129306	°W
Gbc1	36.312222	°N	82.130639	°W
Gbc2	36.311889	°N	82.250000	°W
Gbd1	36.312778	°N	82.133028	°W
Gbd2	36.312722	°N	82.133111	°W
Gbd3	36.310722	°N	82.130778	°W
Gbe1	36.310639	°N	82.130639	°W
Gbe2	36.310361	°N	82.132722	°W
Gbe3	36.310750	°N	82.133028	°W
Gbe4	36.309389	°N	82.130750	°W
Gbe5	36.308750	°N	82.130056	°W
Gbf1	36.307583	°N	82.129528	°W
GB *Microstegium vimenium* 1	36.312780	°N	82.133028	°W
GB *Microstegium vimenium* 2	36.312720	°N	82.133111	°W
GB *Ligustrum sinense*	36.312720	°N	82.133111	°W
GB *Lonicera japonica*	36.312720	°N	82.133111	°W
GB *Cypripedium acaule*	36.306667	°N	82.130278	°W
GB *Gentiana austromontana*	36.306667	°N	82.130278	°W
GB *Panax quinquefolius*	36.312222	°N	82.128889	°W
GB T*suga caroliniana*	36.309444	°N	82.129722	°W

Table 2.10.5. Invasive species monitoring information at Griffith Branch.

Species	GPS N	W	Photos	Notes
Microstegium vimenium			GB Microstegium	along Griffith Branch beside trail heading S from Griffith Branch
	36.31278º	82.13303º		on trail/road leading into site covers road bed in plot D1
	36.31272º	82.13311º		old homesite and road bed in D2
Ligustrum sinense	36.31272º	82.13311º		old homesite and road bed in D2
Lonicera japonica	36.31272º	82.13311º		old homesite and road bed in D2

Chapter 11
Haw Knob – Big Junction Quad, 35.30971º N, 84.02645º W
Prioritization Rank – Now-Right Now, 2nd out of 26.
Site Photos - Haw Knob

Summary

Haw Knob consists of high elevation meadows surrounded by a *Betula alleghaniensis – Fagus grandifolia – Aesculus flava / Viburnum lantanoides / Aster chlorolepis – Dryopteris intermedia* Forest (CEGL007285, G3G4) (Table 2.11.1). It is **prioritized as NOW-RIGHT NOW and ranks number 2 of 26 sites** for management need. There are many TES species at Haw Knob, with varying habitat requirements and threats. Major threats on the site are woody encroachment (Table 2.11.6), forest conversion, incompatible forestry management and practices, and parasites and pathogens. TES species should be monitored to ascertain the effects of these threats and management actions should focus on alleviating those effects (Table 2.11.3). The meadows and some forest areas of Haw Knob should undergo prescribed fire, the *Fagus* community should be monitored for signs of beech bark disease and compositional changes, and old growth characteristics should be maintained in other parts of the site (Table 2.11.3).

Table 2.11.1. Community types listed at Haw Knob (Major *et al*. 2000; monitoring points listed in Table 2.11.4).

Classification	Name	G rank
CEGL007285	*Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Aster chlorolepis - Dryopteris intermedia Forest*	G3G4

Communities Found

Haw Knob (HK) also contained only one site-group (HK-A) that also matched the overstory of the one expected association on the site, southern Appalachian Northern Hardwood (*Betula alleghaniensis – Fagus grandifolia – Aesculus flava / Viburnum lantanoides / Aster chlorolepis)* Forest. Haw Knob also has only one site-group, HK-A, in which the only dominant tree species, *Fagus grandifolia* appears likely to remain a steady component (Table 2.11.2). However, because of the possibility of this species being impacted by beech bark disease in the near future, the compositional trajectory of this site-group is difficult to assess. It is possible that *Betula alleghaniensis* will increase occurrence in the short term, but the future remains to be seen.

Table 2.11.2 Species dominances and population trends within Haw Knob. Letters included in the table indicate the strata in which each species is dominant(a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Group
Species	hk-a
Fagus grandifolia	*a,b,c,d*

TES Elements

***Abies fraseri* (G2/S3) (Table 2.11.5) -** The main threat facing the species is the balsam wooly adelgid. Mature trees die from secondary diseases and pests after the adelgid attacks, but young recruits are more able to withstand infestations (Burns and Honkala 1990). Sometimes fir recruitment increases after infestations. One study found the densities of fir and spruce saplings increased in plots where overstory fir trees had succumbed to the balsam woolly adelgid (Busing *et al.* 1988). Fir mortality also increased birch dominance. Increasing nitrogen in the soil will enhance cone production of Fraser firs (Arnold *et al.* 1992).

***Aegolius acadicus* (G5/S1) (Table 2.11.5) -** The Northern Saw-whet Owl is a secondary cavity nester (Hausman 1948). Ideal habitat for the owls is old growth forest with large snags and cavity trees (Illinois Natural History Survey 2006). Dense undergrowth and large woody debris are also favorable habitat charactersitics. The owls roost on low branches during the day and they breed in riparian zones, using large cavity trees. The number of cavity trees maintained in an area should be greater than the number of owls within that area. In Maryland, home ranges were about 104 ha (Churchill *et al*. 2002). If cavity trees are lacking in expected habitats, nest boxes about the size of woodduck boxes can be placed 14 – 60 feet off the ground (Alsop 2001). Surveys for the owl should be conducted in early spring on clear calm nights. Several years of surveys are needed because the owls are often not very vocal (Palmer 1987).

***Cardamine clematis* (G3/S2) (Table 2.11.5) -** This perennial herb is a southern Appalachian endemic that is found on rocky streamsides at high elevations above 1000 m (3280 ft) (NatureServe 2007). It blooms from April to May. Survey data collected in Tennessee and North Carolina suggest that populations are currently stable. Threats include land-use conversion, habitat fragmentation, forest management practices, invasive species, atmospheric pollutant deposition, and trampling (NatureServe 2007). Populations that suffer declines in abundance may be slow to recover because of low dispersal capabilities and low fecundity. Preferred habitat is wet areas near or in edges of streams that have little competition from other herbaceous plants, an overhead canopy

that allows light to reach the population, and a lack of litter accumulation. It roots in moss, rock crevices, or occasionally in soil. Viable populations in high quality habitats should have more than 500 stems; fair populations should contain 51-100 stems (NatureServe 2007).

***Carex ruthii* (G3/S2) (Table 2.11.5)** - This southern Appalachian endemic, perennial sedge is associated with the Southern Blue Ridge High Elevation Seep (Sedge Type) (Discover Life in America 2006). The seeps are dominated by sedges and are scattered throughout the high elevations (>5000 ft) on seepage slopes of the Southern Blue Ridge. It may also occur in other high elevation open areas. It blooms in June. *Carex ruthii* is considered underreported, therefore it is considered widespread throughout its range. Wetland alteration and habitat loss appear to be the greatest threats (NatureServe 2007).

***Clintonia borealis* (G5/S2S3) (Table 2.11.5)** - *Clintonia* is usually found in homogeneous colonies (Anonymous 2007*b*). It is native to the boreal forest but is also found in coniferous, mixed and cool, temperate *Acer* forests. *Clintonia* only grows in shade. It takes over twelve years to establish a clone and produce flowers. It blooms from late May through June and sets fruit in August and September (Radford *et al*. 1964). *Clintonia* is very sensitive to deer browsing due to its slow growth rate.

***Euonymus obovatus* (G5/S2) -** This plant grows best in partial shade to full sun in moist environments of coves and streambanks and under hardwoods (Radford *et al*. 1964). It flowers from May to June and sets fruit in September and October.

***Glaucomys sabrinus coloratus* (G5T1/S1) (Table 2.11.5).** This squirrel is found in areas dominated by conifers, but is also abundant in deciduous and mixed coniferous/deciduous forests (University of Michigan Museum of Zoology 2006). It has been found in areas dominated by spruce, fir, and mixed hemlocks, and in beech maple forests. Optimal habitats are cool and moist mature forests with many snags (NatureServe 2007). It often nests in conifers 1 to 18 meters above the ground (University of Michigan Museum of Zoology 2006). The most preferred nests are cavities, but the squirrel will use burrows or built nests made of twigs and bark softened with feathers, fur, leaves, and conifer needles (NatureServe 2007). It will use nest boxes, also. In winter, squirrels will share their nests. Favorable habitats can contain up to 10 squirrels per hectare, though females are territorial. The squirrels feed mainly on lichen and fungi but it also may aid in conifer seed dispersal.

***Glyceria grandis* (G5T5/SH) (Table 2.11.5) –** This perennial grass likes moist to wet habitats (Cholewa 2002).

***Hydrophyllum virginianum* (G5/S3) (Table 2.11.5) –** This perennial herb can be found on moist slopes of rich woods. Threats include land-use alteration and habitat fragmentation.

***Hypericum mitchellianum* (G3/S2) (Table 2.11.5) -** This bluet's habitat is grassy balds, seeps, and forest openings at higher elevations (Radford *et al.* 1964, NatureServe 2007). It blooms in July (Horn and Cathcart 2005). It has a limited distribution and is especially vulnerable to habitat fragmentation and land-use conversion (NatureServe 2007).

***Juncus gymnocarpus (G4/S3)* (Table 2.11.5) -** This species is found in shady margins of sphagnum bogs. To keep populations healthy, water levels must be maintained at low levels and the overstory trees should be kept in place (Robinson 1982).

***Napaeozapus insignis* (G5/S4) (Table 2.11.5)** - The woodland jumping mouse is characterized by an extremely long tail. It prefers deciduous and coniferous forests with an herbaceous ground cover and nests in underground burrows or under a log or stump in winter. It eats subterranean fungi, seeds, caterpillars, beetle larvae and berries. This nocturnal mammal hibernates from September/October to April/ May (NatureServe 2007).

***Platanthera psycodes* (G5/S2) (Table 2.11.5) –** This orchid prefers open, moist habitats of streamsides and ditches and wet meadows (Hapeman 1996). Flowers are fertilized by butterflies and hawkmoths.

***Poa palustris* (G5/S1) (Table 2.11.5) –** This perennial grass grows well in wet areas and can be found on streambanks and in meadows (Radford *et al*. 1964). Minor threats include land use conversion, habitat fragmentation, and forestry practices (NatureServe 2007). The grass is found near a roadside at Haw Knob; therefore other threats include invasive species and damage from vehicular traffic.

***Potentilla (Sibbaldiopsis) tridentata* (G5/S1S2) –** This member of the Rosaceae family is perennial and prefers acidic soils (Evans 2004). It requires open habitat and typically occurs at high elevation rock outcrops and grassy balds (USDA Natural Resources Conservation Service 2007). Populations in recreation areas may be at risk of being trampled; also, shading by encroaching shrubs or saplings may negatively affect population (NatureServe 2007).

***Prenanthes roanensis* (G3/S3) (Table 2.11.5) -** This perennial herb is found at forest edges, in upper slope or ridgetop clearings, and around *Prunus pennsylvanica* in areas that have been burned (Robinson 1982). It is not found under deep canopies. Opening the canopy may increase regeneration of populations of this species (Robinson 1982). Fire may help maintain this species through decreasing competition and shade. This endemic of the southern Appalachians is restricted to elevations above 1200m and is often associated with mixed spruce/hardwood forests (NatureServe 2007). This species faces low level threats from land-use conversion and habitat fragmentation.

***Sorex cinereus* (G5/S4) (Table 2.11.5)** – This shrew breeds from March to September and those individuals born in early spring may themselves reproduce later in the same breeding season (Stewart *et al*. 1989). One to twelve shrews may be found per acre and home ranges are approximately 0.10 acres (Buckner 1966). Preferred habitats of the shrew are herbaceous and wooded wetlands (NatureServe 2007). Fallen logs, woody debris, deep leaf litter and standing dead trees are characteristic elements of habitats. The shrew nests in shallow burrows or in logs and stumps. It is most active in early morning hours between 1:00 and 2:00am and on cloudy rainy nights, but is active throughout the day (NatureServe 2007).

***Sorex fumeus* (G5/S4) (Table 2.11.5) –** This shrew breeds from March to August. Sexual maturity is reached only after the first winter, so young of the year do not reproduce. Populations' densities could be as high as 25-50 shrews per acre at the end of a successful breeding season, but may decline by up to 75% over winter (Hamilton 1940). The shrew is found in damp woodlands with fallen logs, woody debris and standing dead trees (NatureServe 2007). It nests under logs, rocks, and stumps and it is active at all hours.

***Speyeria diana* (G3/S3) (Table 2.11.5) -** The species is found throughout the southern Appalachians in forested areas. In the fall, after larvae emerge from eggs laid on the ground, they feed on violets. First instars overwinter and pupate in late spring in the leaf litter, emerging as adults beginning in late June. Males are first to appear, but females become common in late July as they search for oviposition sites. *Aclepias* spp., *Echinacea* spp., *Silphium laciniatum, and Pycanthemum incanum* are some of their nectar sources. They may feed on roadsides, but do not venture far from woodland habitats. *Bacillus thuringiensis* (BT) sprays used to control gypsy moths may be contributing to declining populations of this species. One study has shown that larvae are susceptible to the insecticide (Peacock *et al*. 1998). Dimilin may pose a similar or greater threat than BT. Timber harvesting is a minor threat as populations do return to cut-over areas once forest cover reestablishes. Invasive species and over-browsing of violets by deer could also pose threats to the fritillary. Violet densities should be monitored along with the fritillary populations. Fritillary populations in given areas do fluctuate from year to year, so accurate assessments of numbers is difficult. Overall, this species requires a large and diverse habitat. Larvae feed on woodland violets and adults gather nectar from more flowers that occur on edges, shrublands, or in open fields and grasslands.

***Sphyrapicus varius* (G5/S1) (Table 2.11.5) -** The Yellow-bellied Sapsucker can be found in forests and woodlands throughout much of North America (NatureServe 2007). The southern Appalachians of Tennessee and North Carolina represent its southernmost breeding areas. Standing dead trees are an important part of this bird's habitat. Sapsuckers excavate cavities which other avian species also use and create sapwells that lead to greater abundance and diversities of insects. Cavities are found 3-14 meters above the

ground. Food items consist of inner bark and sap of drilled trees, ants, wasps, mayflies, moths, spruce budworms, beetles, fruit, aspen buds, and suet (Terres 1980).

***Streptopus roseus* (G5/S1S2) (Table 2.11.5) -** The rosy twisted-stalk requires moist soil in full or partial shade. It is primarily found in beech gaps and under birch trees at high elevations, and it prefers cool, acidic soils. No threats are immediately evident for this species, though beech bark disease could potentially have a negative impact on populations that occur in association with *Fagus grandifolia*.

***Synaptomys cooperi* (G5/S4) (Table 2.11.5) -** The southern bog lemming is a small rodent with a ¼-1 acre range (NatureServe 2007). Densities vary from 5 to 35 per ha, reaching 89/ha in peak years (Banfield 1974) and colonies are scarce and scattered. This lemming prefers boggy habitat and is common in marshes, meadows and upland forests with a deep humus layer. It utilizes a 6-12 in deep burrow system. After a 21-23 day gestation period, 1-8 (avg 2-5) young are born underground. The breeding season is year round with a peak in April-Sept. This lemming's diet consists primarily of herbaceous plants; leaves, stems, seeds, and rootstocks, especially of grasses and sedges; as well as small fruits (Connor 1959). It is active, foraging day and night throughout the year. Expanding meadow vole populations may displace populations of the lemming. Fire may also drive it out of areas.

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Table 2.11.3. Threats and management actions for Haw Knob. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit : Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Incompatible Forestry Practices	1	Do not harvest timber	16	0	no action	11B:3H	very good	med	CEGL007285, *Abies, Aegolius, Cardamine, Clintonia, Glaucomys, Hydrophyllum. Napaeozapus, Sorex spp., Speyeria, Streptopus*
Invasive Species	1	Burn invaded areas	14	1	as needed	21B:5H	good	med	CEGL007285, CEGL004242, CEGL007298, CEGL007861, *Aegolius, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Invasive Species	1	Herbicide invasives	18	1	as needed	?B:?H	fair	low	?
Invasive Species	1	Manually remove invasives	2	1	annually	26B:0H	very good	high	CEGL007285, CEGL004242, CEGL007298, CEGL007861, *Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit : Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Invasive Species	1	Monitor invasives	3	0.5	biannually	26B:0H	very good	high	CEGL007285, CEGL004242, CEGL007298, CEGL007861, *Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Invasive Species	1	Search for invasives	1	0.5	biannually	26B:0H	very good	high	CEGL007285, CEGL004242, CEGL007298, CEGL007861, *Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Invasive Species	1	Signage - Please keep horses on roads		1	once	26B:0H	very good	med	CEGL007285, CEGL004242, CEGL007298, CEGL007861, *Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Forest Conversion	2	Monitor *Fagus grandifolia*	4	0.5	every five years	4B:0H	good	med	CEGL007285, *Hypericum, Streptopus, Clintonia,*
Forest Conversion	2	Monitor *Streptopus roseus*	5	0.5	biannually	1B:0H	good	med	*Streptopus*
Woody Encroachment	3	Burn Whigg Meadow, Haw Knob, Laurel Top, and other grassy ridges	13	1	decadally	9B:1H	very good	med	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, hypericum. Glyceria, Poa*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit : Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Woody Encroachment	3	Bushhog Whigg Meadow, Haw Knob, Laurel Top, John's Knob, and other grassy balds	6	1	as needed	10B:0H	very good	high	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Recreation	4	Signage - Fragile ecosystem! Tread carefully.	7	1	once	12B:0H	very good	med	*Cardamine, Carex, Clintonia, Euonymus,Glyceria, Hydrophyllum, Hypericum, Juncus, Poa, Platanthera, Potentilla, Prenanthes*
Parasites / Pathogens	5	Monitor *Fagus grandifolia*	4	0.5	every five years	4B:0H	good	med	CEGL007285, *Hypericum, Streptopus, Clintonia,*
Incompatible Agricultural Practices	6	Burn Whigg Meadow, Haw Knob, Laurel Top, John's Knob, and other grassy ridges	13	1	decadally	9B:1H	very good	med	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, hypericum. Glyceria, Poa*
Incompatible Forestry Practices and Management	6	Burn Whigg Meadow, Haw Knob, Laurel Top, John's Knob, and other grassy ridges	13	1	decadally	9B:1H	very good	med	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, hypericum. Glyceria, Poa*
Incompatible Agricultural Practices	6	Bushhog Whigg Meadow, Haw Knob, Laurel Top, John's Knob, and other grassy balds	6	1	as needed	10B:0H	very good	high	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Incompatible Forestry Practices and Management	6	Bushhog Whigg Meadow, Haw Knob, Laurel Top, John's Knob, and other grassy balds	6	1	as needed	10B:0H	very good	high	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit : Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Altered Fire Regime	7	Burn Whigg Meadow, Haw Knob, Laurel Top, John's Knob and other grassy ridges	13	1	decadally	9B:1H	very good	med	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, hypericum. Glyceria, Poa*
Altered Fire Regime	7	Bushhog Whigg Meadow, Haw Knob, Laurel Top, John's Knob, and other grassy balds	6	1	as needed	10B:0H	very good	high	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Altered Fire Regime	7	Monitor TES species	8	0.5	annually	22B:0H	good	med	*Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Altered Fire Regime	7	Monitor woody encroachment	9	0.5	every five years	10B:0H	very good	high	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Forestry Roads	8	Signage - Fragile ecosystem! Tread carefully.	9	1	once	12B:0H	very good	med	*Cardamine, Carex, Clintonia, Euonymus,Glyceria, Hydrophyllum, Hypericum, Juncus, Poa, Platanthera, Potentilla, Prenanthes*
Forestry Roads	8	Signage - No off road vehicular traffic, please.	7	1	once	10B:0H	very good	med	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Incompatible Resource Extraction	9	Do not harvest timber	16	0	no action	11B:3H	very good	med	CEGL007285, *Abies, Aegolius, Cardamine, Clintonia, Glaucomys, Hydrophyllum. Napaeozapus, Sorex spp., Speyeria, Streptopus*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit : Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Airborne Pollutants	9	Monitor TES species	10	0.5	annually	22B:0H	good	med	*Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Incompatible Grazing Practices	9	Signage - Please keep horses on roads	11	1	once	10B:0H	very good	med	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Overexploitation of Species	10	Build low fences between trails and TES species		5	once	22B:0H	very good	high	*Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Agricultural Conversion	10	Burn Whigg Meadow, Haw Knob, Laurel Top, John's Knob and other grassy ridges	13	1	decadally	9B:1H	very good	med	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, hypericum. Glyceria, Poa*
Agricultural Conversion	10	Bushhog Whigg Meadow, Haw Knob, Laurel Top, John's Knob, and other grassy balds	6	1	as needed	10B:0H	very good	high	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Proposed / Potential Mineral Resource Extraction	10	Do not allow	17	1	once	23B:0H	good	high	CEGL007285, *Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit : Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Industrial Development	10	Monitor TES species	10	0.5	biannually	22B:0H	very good	high	*Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Overexploitation of Species	10	Monitor TES species	10	0.5	biannually	22B:0H	very good	high	*Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*
Agricultural Conversion	10	Monitor woody encroachment	9	0.5	biannually	10B:0H	very good	high	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Urban / Suburban Development	10	Signage - Fragile ecosystem! Tread carefully.	9	1	once	12B:0H	very good	med	*Cardamine, Carex, Clintonia, Euonymus,Glyceria, Hydrophyllum, Hypericum, Juncus, Poa, Platanthera, Potentilla, Prenanthes*
Development of Roads / Utilities	10	Signage - No vehicular traffic, please. Foot travel is welcome.	7	1	once	10B:0H	very good	med	CEGL004242, CEGL007298, *Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Livestock Feedlots / Production Practices	10	Signage - Please keep horses on roads	11	1	once	10B:0H	very good	med	*CEGL004242, CEGL007298, Speyeria, Potentilla, Prenanthes, Carex, Hypericum, Glyceria, Poa, Synaptomys*
Overexploitation of Species	10	Signage - Sensitive species. Please stay on trail.	12	1	once	11B:0H	very good	med	*Cardamine, Euonymus, Hypericum, Hydrophyllum, Juncus,Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit : Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Second Home / Vacation Development	10	Signage - Sensitive species. Please stay on trail.	14	1	once	22B:0H	good	high	*Aegolius, Sphyrapius, Sorex spp., Glaucomys, Synaptomys, Napaeozapus, Potentilla, Speyeria, Prenanthes, Cardamine, Euonymus, Hypericum, Hydrophyllum, Abies, Carex, Clintonia, Streptopus, Platanthera, Glyceria, Poa, Juncus*

Table 2.12.4. GPS coordinates of plots and elements at Haw Knob

Point Name	GPS Coordinates			
hka1	35.309710	°N	84.025310	°W
hka2	35.303350	°N	84.027360	°W
hkb1	35.297130	°N	84.023740	°W
hkb2	35.293930	°N	84.024110	°W
hkb3	35.296470	°N	84.025820	°W
hkc1	35.300290	°N	84.022980	°W
hkd1	35.329390	°N	84.031690	°W
hkd2	35.330160	°N	84.033190	°W
HK *Abies fraseri*	35.314722	°N	84.035556	°W
HK *Aegolius acadicus*	35.314722	°N	84.036667	°W
HK *Cardamine clematis*	35.324444	°N	84.032778	°W
HK *Carex ruthii 1*	35.324444	°N	84.032778	°W
HK *Carex ruthii 2*	35.316944	°N	84.047500	°W
HK *Clintonia borealis* 1	35.309444	°N	84.027500	°W
HK *Clintonia borealis* 2	35.324444	°N	84.032778	°W
HK *Euonymus obovatus* 1	35.316667	°N	84.033333	°W
HK *Euonymus obovatus* 2	35.183056	°N	84.033611	°W
HK *Glaucomys sabrinus* var . *coloratus*	35.314722	°N	84.036944	°W
HK *Glyceria grandis*	35.324444	°N	84.032778	°W
HK *Hydrophyllum virginianum*	35.326944	°N	84.041944	°W
HK *Hypericum mitchellianum*	35.308889	°N	84.026944	°W

Point Name	GPS Coordinates			
HK *Juncus gymnocarpus*	35.311944	°N	84.044167	°W
HK *Napaeozapus insignis* 1	35.309167	°N	84.038889	°W
HK *Napaeozapus insignis* 2	35.300000	°N	84.033333	°W
HK *Napaeozapus insignis* 3	35.337222	°N	84.071944	°W
HK *Platanthera psycodes*	35.333333	°N	84.033333	°W
HK *Poa palustris*	35.324444	°N	84.032778	°W
HK *Prenanthes roanensis*	35.328056	°N	84.033056	°W
HK *Sorex cinereus* 1	35.309722	°N	84.038889	°W
HK *Sorex cinereus* 2	35.300000	°N	84.038889	°W
HK *Sorex cinereus* 3	35.326389	°N	84.041667	°W
HK *Sorex fumeus*	35.309722	°N	84.038889	°W
HK *Speyeria Diana*	35.309167	°N	84.038056	°W
HK *Sphyrapicus varius* 1	35.314722	°N	84.051389	°W
HK *Sphyrapicus varius* 2	35.307500	°N	84.059722	°W
HK *Streptopus roseus* 1	35.329390	°N	84.031690	°W
HK *Streptopus roseus* 2	35.324444	°N	84.032778	°W
HK *Streptopus roseus* 3	35.329390	°N	84.031690	°W
HK *Synaptomys cooperi* 1	35.309722	°N	84.038889	°W
HK *Synaptomys cooperi* 2	35.312222	°N	84.045833	°W
HK Woody Encroachment Photomonitoring	35.309710	°N	84.026450	°W

Table 2.11.5. Haw Knob Species Monitoring

Species	GPS N	GPS W	Repro-ductive	Nonrepro-ductive	Area (m2)	Status	Concerns	Notes
Streptopus roseus	35.32939º	84.03169º	100 (71%)	41 (29%)	100m^2+	vigorous	none	at plot C1
Abies fraseri	35.31472º	84.03556º						Little Haw Knob
Aegolius acadicus	35.31472º	84.03667º						Little Haw Knob, Whigg Meadow
Cardamine clematis	35.32444º	84.03278º						mossy rock in small stream
Carex ruthii	35.32444º	84.03278º						Mud Gap
Carex ruthii	35.31694º	84.04750º						along brook edge and roadside ditch
Clintonia borealis	35.30944º	84.02750º						SW slope near top of Haw Knob
Clintonia borealis	35.32444º	84.03278º						Mud Gap
Euonymus obovatus	35.31667º	84.03333º						Boulder filled coves along FS road 17
Euonymus obovatus	35.18306º	84.03361º						Along FS road 61, W of John's Knob
Glaucomys sabrinus var . coloratus	35.31472º	84.03694º						Whigg Meadow
Glyceria grandis	35.32444º	84.03278º						Mud Gap
Hydrophyllum virginianum	35.32694º	84.04194º						

Species	GPS N	GPS W	Repro-ductive	Nonrepro-ductive	Area (m2)	Status	Concerns	Notes
Hypericum mitchellianum	35.30889º	84.02694º						Haw Knob 0.6 miles below Little Haw Knob
Juncus gymnocarpus	35.31194º	84.04417º						Meadow Whigg
Napaeozapus insignis	35.30917º	84.03889º						Meadow 0.5 miles S of Whigg
Napaeozapus insignis	35.3000º	84.03333º						Meadow Round Mt. Branch, N
Napaeozapus insignis	35.33722º	84.07194º						River Road
Platanthera psycodes	35.33333º	84.03333º						N River Road
Poa palustris	35.32444º	84.03278º						Mud Gap 50 yds behind gate of old logging road
Prenanthes roanensis	35.32806º	84.03306º						0.25 miles N of Mud Gap Whigg
Sorex cinereus	35.30972º	84.03889º						Meadow 0.5 miles S of Whigg
Sorex cinereus	35.30000º	84.03889º						Meadow

Species	GPS N	GPS W	Repro-ductive	Nonrepro-ductive	Area (m2)	Status	Concerns	Notes
Sorex cinereus	35.32639º	84.04167º						1.0 miles W of Stratton Meadows on unimproved road
Sorex fumeus	35.30972º	84.03889º						Whigg Meadow
Speyeria diana	35.30917º	84.03806º						Whigg Meadow, below Little Haw Knob, be
Sphyrapicus varius	35.31472º	84.05139º						Whigg Meadow
Sphyrapicus varius	35.30750º	84.05972º						Intersection of FS road 61 and Trail 86
Streptopus roseus	35.32444º	84.03278º						Mud Gap
Streptopus roseus	35.32939º	84.03169º						Big Junction trail
Synaptomys cooperi	35.30972º	84.03889º						Whigg Meadow
Synaptomys cooperi	35.31222º	84.04583º						0.5 miles S of Whigg Meadow

Table 2.11.6. Woody encroachment monitoring at Haw Knob. Staked at N edge of Haw Knob.

GPS coordinates			
N	**W**	**Photos**	**Angle**
35.30971º	84.02645º	HK Photomonitor 280	280º
		HK Photomonitor 220	220º
		HK Photomonitor 160	160º
		HK Whigg Meadow from Haw Knob	

Chapter 12
Horse Hitch Gap – Davy Crockett Lake Quad, 36.034480° N, 82.770041° W
Prioritization Rank – Soon, 16th out of 26.
Site Photos – Horse Hitch Gap

Summary

Horse Hitch Gap is a *Pinus pungens - Pinus rigida* - (*Quercus prinus*) / *Kalmia latifolia - Vaccineum pallidum* woodland (CEGL007097, G3) (Table 2.12.1). The site was **prioritized as SOON and ranked 16 out of 26 sites**. There are no TES elements on the site, but the community is in jeopardy of converting into a different community type. Forest conversion and altered fire regime are the main threats facing Horse Hitch gap. The slopes that contain the desired community type should be burned on a rotation that allows regeneration of the pines (Table 2.12.2).

Table 2.12.1. Community types listed at Horse Hitch Gap (Major *et al*. 2000; monitoring points listed in Table 2.12.4)

Classification	Name	G rank
CEGL007097	*Pinus pungens - Pinus rigida -(Quercus prinus) / Kalmia latifolia- Vaccinium pallidum* Woodland	G3

Communities Found

Horse Hitch Gap (HHG) contained only one site-group (HHG-I) and it matched the overstory of the expected association of the site, the Blue Ridge Table Mountain Pine – Pitch Pine Woodland. However, none of the expected *Pinus* species occurred in the overstory, though *Pinus pungens* did occur in all three lower strata and was a dominant in the sapling layer. *Pinus pungens* and *Pinus virginiana* have increasing population size distributions and may replace *Quercus prinus* if the oak has not created too much shade for the pines to mature.

Quercus prinus, along with other *Quercus* species such as *Q. coccinea, Q. rubra, and Q. marilandica* dominate Horse Hitch Gap's southern slope. *Q. prinus* is more dominant in the subcanopy and other *Quercus* species occur in the sapling and understory layers. The *Pinus pungens* and *P. virginiana* overstory has been removed by the southern pine bark beetle. Standing dead *Pinus* species make up 15 to 30% of the trees on the A transect plots. No living *Pinus pungens* occur along the lower plots on this slope, but there are a few living on the upper slope. Plot A3 contains some 5<20cm DBH *P. pungens* and A4 contains a sapling. Instead of regeneration of the preferred species on this slope, *Pinus virginiana* represents 20% of the sapling layer of the A transect plots. On

Horse Hitch Gap the most common shrubs are *Vaccinium* spp, including *Vaccinium vacillans*, and *V. stamineum*. *Kalmia latifolia* increases in abundance as elevation increases.

The top of the B transect is open and contains *P. pungens* regeneration. Lower on the slope other species, such as *Nyssa sylvatica* and *Quercus prinus*, increase in abundance and form a low canopy.

Important Environmental Characteristics. Exposure of *P. pungens* stands is usually to the south and/or west (NatureServe 2007). Aspect and presence of *P. pungens* are correlated – probability of occurrence is higher at more southwesterly aspects (Whittaker 1956) - but as elevation increases, aspect matters less. On Horse Hitch Gap, occurrences of *P. pungens* reach around to the southeastern aspect directly above FS 98 at about 730 m. Aspect affects the climate of slopes, and therefore also affects species distributions (Geiger 1965, in Zobel 1969). For instance, solar irradiation (the amount of solar radiation, diffuse and direct, received at a location) of *P. pungens* sites varies predictably with aspect and season (Geiger 1965, in Zobel 1969). Southern aspects receive up to 13 times more radiation in winter months than do northern slopes. Soil moisture and air temperature are also influenced by aspect; the southwestern mid-slope of a conical mountain is the warmest of montane positions. There are pockets of dense sapling regeneration of *P. pungens* along the southwestern aspect of Horse Hitch Gap, but the coves along that slope house the oaks, gums, and hickories. *Pinus pungens* prefers acidic microsites and does not occur on limestone.

Knowledgeable People

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Table 2.12.2. Threats and management actions for Horse Hitch Gap. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi -cance	Confi- dence	Elements / Communities that should benefit
Forest Conversion	1	Burn *Pinus pungens* slope - med high intensity	1	1	decadally	1B:0H	very good	high	CEGL007097
Parasites / Pathogens	1	Monitor *Pinus pungens* regrowth	2	0.5	every five years	1B:0H	good	med	CEGL007097
Forest Conversion	1	Monitor *Pinus* sp. *regeneration*	2	0.5	every five years	1B:0H	good	medium	CEGL007097
Altered Fire Regime	2	Burn *Pinus pungens* slope - med high intensity	1	1	decadally	1B:0H	very good	high	CEGL007097
Incompatible Forestry Practices and Management	3	Burn *Pinus pungens* slope - med high intensity	1	1	decadally	1B:0H	very good	high	CEGL007097
Invasive Species	4	Search for invasives	3	0.5	biannually	1B:0H	very good	high	CEGL007097
Woody Encroachment	5	Burn *Pinus pungens* slope - med high intensity	1	1	decadally	1B:0H	good	high	CEGL007097
Woody Encroachment	5	Herbicide hardwoods and shrubs	6	0.5	after fire	1B:0H	good	medium	CEGL007097
Woody Encroachment	5	Manually remove shrubs/saplings	5	2	once	1B:0H	good	medium	CEGL007097
Forestry Roads	5	Signage - Recovering community . . . please stay on roads	4	1	once	1B:0H	very good	med	CEGL007097

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi -cance	Confi- dence	Elements / Communities that should benefit
Recreation	5	Signage - Recovering community . . . please stay on roads	4	1	once	1B:0H	good	medium	CEGL007097
Overexploitation of Species	5	Signage - Sensitive Species. Do not disturb.	7	1	once	1B:0H	good	medium	CEGL007097

Table 2.12.3. GPS coordinates of plots at Horse Hitch Gap.

Point Name	GPS Coordinates			
hhga1	36.035460	°N	82.770330	°W
hhga2	36.035930	°N	82.771430	°W
hhga3	36.036170	°N	82.771480	°W
hhga4	36.036420	°N	82.772950	°W
hhgb1	36.037930	°N	82.776510	°W
hhgb2	36.037000	°N	82.777000	°W
hhgb3	36.036000	°N	82.776000	°W
hhgb4	36.035000	°N	82.776000	°W
hhgb5	36.034000	°N	82.776000	°W

Table 2.12.4: Tallies of species on monitoring plots at HHG. Saplings were individuals that were < 2m tall. Understory species were 2m+ tall and had Diameters at Breast Height (DBHs) <5cm. Subcanopy trees were >2m tall and had DBHs 5-20cm. Overstory species were >2m tall and had DBHs of 20cm+.

Species	HHGa2 saplings	HHGa2 understory	HHGa2 subcanopy	HHGa2 overstory	HHGb2 saplings	HHGb2 understory	HHGb2 subcanopy	HHGb2 overstory
Nyssa sylvatica	0	0	0	0	10	9	0	0
Pinus pungens	0	0	0	0	0	31	3	0
Pinus virginiana	17	2	0	0	0	0	0	0
Quercus coccinea	1	20	0	0	0	0	0	0
Quercus marilandica	5	4	0	0	6	12	0	0
Quercus prinus	3	19	2	0	1	1	0	0

Chapter 13
Iron Mountain South – Watauga Dam Quad, 36.33933º N, 82.09146º W
Prioritization Rank – Soon, 12th out of 26
Site Photos - none

Summary

Iron Mountain South contains an example of *Tsuga caroliniana* / *Kalmia latifolia - Rhododendron catawbiense* Forest (CEGL007139, G2) (Table 2.13.1). **Management prioritization for the site is SOON and it ranks 12 out of 26** for management action. Forest conversion, parasites & pathogens, and invasive species are the main threats facing this site (Table 2.13.3), as the hemlock woolly adelgid is present and killing the TES species *Tsuga caroliniana* and may threaten another TES species, *Buckleya distichophylla*. A low intensity burn of the site may improve habitat for the *Buckleya* and release of the *Pseudoscymnus* adelgid predator may provide some more time for the *Tsuga*.

Table 2.13.1 Community Types Listed at Iron Mountain South (Major *et al*. 2000; monitoring points listed in Table 2.13.4)

Classification	Name	G rank
CEGL007139	*Tsuga caroliniana / Kalmia latifolia - Rhododendron catawbiense* Forest	G2

Communities Found

Of the two site-groups at IMS one, IMS-G fit an alliance, the White Oak – (Northern Red Oak, Hickory species) (*Quercus alba – (Quercus rubra, Carya* spp.)) Forest Alliance (S = .5). Group G at Iron Mountain South has four overstory dominants, one of which may increase in abundance (table 2.13.2): *Quercus prinus*. *Acer rubrum* and *Nyssa sylvatica* appear likely to become lesser components and *Quercus rubra*'s size distribution does not indicate substantial change in either direction. *Liriodendron tulipifera* may increase in abundance in the future, as indicated by its size distribution.

The overstory of IMS-J best matched the Central Appalachian / Northern Piedmont Low - Elevation Chestnut Oak (*Quercus prinus – (Quercus coccinea, Quercus rubra) / Kalmia latifolia / Vaccinium pallidum*) Forest. At IMS-J, both overstory dominant species, *Quercus prinus* and *Quercus rubra*, appear likely to remain important components (Table 2.13.2). Both *Acer rubrum* and *Quercus coccinea* are likely to increase in abundance, based on their size distributions.

Table 2.13.2 Species dominances and population trends within Iron Mountain South. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups	
Species	**ims-g**	**ims-j**
Acer rubrum	**b,c,d**	**A,B**
Liriodendron tulipifera	**B**	
Nyssa sylvatica	**b,d**	**b,c**
Oxydendron arboreum	**b,c**	**b,c**
Pinus strobus		**b**
Quercus coccinea		**A,B,C**
Quercus prinus	**D**	**A,B,C,D**
Quercus rubra	*a,d*	**A,B,C,D**

TES Elements

***Buckleya distichophylla* (G2/S2) -** The healthiest populations are associated with periodic wildfires (Virginia Natural Heritage Program 2000), and there is some type of dependence on host plants but the degree of dependence and life stage at which it is important are unknown. Threats to populations of *Buckleya* include lack of fire, collection, roads, development, falling branches, and erosion (Center for Plant Conservation 2007, NatureServe 2007).

***Corvus corax* (G5/S2) -** This sedentary, non migratory bird can nest in large flocks of several hundred individuals (NatureServe 2007). In the southern Appalachians, it repeatedly uses the same nests, which are found on rocky cliffs and in conifers between 45 and 80 feet above the ground (Alsop 2001). It prefers scrubby woodland habitat of mixed hardwoods and conifers (University of Michigan Museum of Zoology 2006) and has no serious predators. Home ranges vary between 0.2 and 40 square kilometers (NatureServe 2007).

***Cypripedium acaule* (G5/S4)** - This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over-collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). Management practices that benefit *Platanthera integrilabia* should also benefit this orchid.

***Hydrophyllum virginianum* (G5/S3) –** This perennial herb can be found on moist slopes of rich woods. Threats include land-use alteration and habitat fragmentation.

***Tsuga caroliniana* (G3/S3) –** This hemlock is a southern Appalachian endemic that grows on xeric ridgelines, cliffs, and rocky slopes and in gorges in nutrient poor soils. Viable populations should contain at least 35 trees on high quality habitat that contains dense stands of ericaceous shrubs and oak and pine species. The hemlock woolly adelgid can quickly degrade or even wipe out whole stands, though.

Knowledgeable People

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Table 2.13.3. Threats and management actions for Iron Mountain South. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Forest Conversion	1	Burn - low intensity, protecting *Tsuga caroliniana*	1	1	decadally	1B:2H	good	good	*Buckleya*
Forest Conversion	1	Release adelgid predator	3	0.5	as needed	2B:0H	good	med	CEGL007139, *Tsuga, Buckleya*
Parasites / Pathogens	2	Release adelgid predator	3	0.5	as needed	2B:0H	very good	low	CEGL007139, *Tsuga, Buckleya*
Parasites / Pathogens	2	Search for/monitor *Buckleya distichophylla*	2	0.5	biannually	1B:0H	very good	med	*Buckleya*
Invasive Species	3	Release adelgid predator	3	0.5	as needed	2B:0H	good	med	CEGL007139, *Tsuga, Buckleya*
Invasive Species	3	Search for invasives	4	0.5	biannually	5B:0H	very good	high	CEGL007139, *Tsuga, Buckleya, Cypripedium, Hydrophyllum*
Recreation	3	Signage - Fragile ecosystem! Tread carefully.	5	1	once	4B:0H	very good	med	*Buckleya, Cypripedium, Hydrophyllum, Tsuga*

Table 2.13.4. GPS coordinates of plots and TES elements at Iron Mountain South

Point Name	GPS Coordinates			
imsa1	36.339330	°N	82.091460	°W
imsb1	36.338600	°N	82.091580	°W
imsb2	36.339480	°N	82.091960	°W
imsb3	36.339970	°N	82.092450	°W
imsc1	36.338050	°N	82.092960	°W
imsc2	36.339080	°N	82.098760	°W
imsc3	36.339610	°N	82.094110	°W
imsd1	36.335910	°N	82.095300	°W
imse1	36.331740	°N	82.101520	°W
imse2	36.331670	°N	82.101300	°W
imsf1	36.332610	°N	82.103270	°W
IMS *Buckleya distichophylla*	36.330000	°N	82.107778	°W
IMS *Tsuga caroliniana*	36.341667	°N	82.088889	°W

Chapter 14
John's Bog – Shady Valley Quad, 36.528781º N, 81.965029º W
Prioritization Rank – Soon, 13th out of 26.
Site Photos – John's Bog

Summary

John's Bog contains *Rhynchospora alba - Parnassia asarifolia* / *Sphagnum warnstorfii* herbaceous vegetation (CEGL004157, G1) (Table 2.14.1) and is a far southern example of a *Vaccineum macrocarpon* bog. **The site is prioritized as needing management action SOON and it ranks 13 out of 26 for that action**. Important actions include monitoring of invasives, TES species, and woody encroachment, as well as monitoring erosion and sedimentation in and around the bog (Table 2.14.2).

Table 2.14.1. Community types listed at John's Bog (Major *et al*. 2000).

Classification	Name	G rank
CEGL004157	**Rhynchospora alba - Parnassia asarifolia / Sphagum warnstorfii* Herbaceous Vegetation	G1

* Not sampled

TES Elements

***Corvus corax* (G5/S2) (Table 2.14.3)** -- This sedentary, non migratory bird can nest in large flocks of several hundred individuals (NatureServe 2007). In the southern Appalachians, it repeatedly uses the same nests, which are found on rocky cliffs and in conifers between 45 and 80 feet above the ground (Alsop 2001). It prefers scrubby woodland habitat of mixed hardwoods and conifers (University of Michigan Museum of Zoology 2006) and has no serious predators. Home ranges vary between 0.2 and 40 square kilometers (NatureServe 2007).

***Cypripedium acaule* (G5/S4)** - This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over-collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). Management practices that benefit *Platanthera integrilabia* should also benefit this orchid.

***Dryopteris cristata* (G5/S2) (Table 2.14.3) –** This fern grows in moist woods, sphagnum bogs, wet thickets, and other low elevation wet areas. Habitat alteration and alteration of hydrology are the main threats to this species in the southern Appalachians (NatureServe 2007).

***Glyceria laxa* (G5/S1) –** This perennial grass is threatened by land-use alteration, habitat fragmentation, and forest management (NatureServe 2007).

***Hypericum ellipiticum* (G5/S1) (Table 2.14.3) -** This perennial herb is found in bogs and wet meadows. Fragmentation and land conversion are main threats (NatureServe 2007).

***Vaccinium macrocarpon* (G4/S2) (Table 2.14.3) -** The bog cranberry is found in the acidic soils and peatlands of bogs, fens and swamps (Vander Kloet 1988, Weakley 2000). Because this cranberry occurs in these very sensitive habitats, it is especially vulnerable to land conversion and fragmentation, including bog and wetland conversion. In the southern Appalachians, bog conversion is a low level threat (NatureServe 2007).

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Table 2.14.2. Threats and management actions for John's Bog. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Woody Encroachment	1	Burn bog edges	10	1	decadally	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Woody Encroachment	1	Monitor woody encroachment	1	0.5	every five years	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Altered Fire Regime	2	Burn bog edges	10	1	decadally	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Sedimentation	2	Dig out sedimentation inputs	7	1	as needed	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Sedimentation	2	Monitor channels and edges for sedimentation	4	0.5	annually	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Invasive Species	2	Monitor invasives	3	0.5	annually	6B:0H	good	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Altered Fire Regime	2	Monitor TES species	2	0.5	annually	6B:0H	good	high	*Dryopteris, Glyceria, Hypericum, Vaccinium, Corax, Cypripiedium*
Channel Modification	3	Add water bars to bare areas with signs of erosion	8	5	once	6B:0H	good	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Forest Conversion	3	Burn bog edges	10	1	decadally	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Channel Modification	3	Dig out sedimentation inputs	7	1	as needed	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Channel Modification	3	Monitor channels and edges for sedimentation	5	0.5	annually	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Channel Modification	3	Monitor erosion channels	6	0.5	annually	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Channel Modification	3	Monitor TES species	2	0.5	annually	6B:0H	good	high	*Dryopteris, Glyceria, Hypericum, Vaccinium, Corax, Cypripiedium*
Forestry Roads	4	Signage - Recovering community . . . please stay on roads.	15	1	once	6B:0H	very good	med	CEGL004157, *Dryopteris, Hypericum, Glyceria, Vaccinium, Cypripedium*
Erosion	5	Add water bars to areas with signs of erosion	8	5	once	6B:0H	good	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Erosion	5	Monitor erosion channels	6	0.5	annually	6B:0H	good	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Recreation	5	Signage - Fragile ecosystem! Please stay on road.	9	1	once	6B:0H	good	med	CEGL004157, *Dryopteris, Hypericum, Glyceria, Vaccinium, Cypripedium*
Recreation	5	Signage - Fragile ecosystem! Please stay on road.	9	1	once	6B:0H	good	med	CEGL004157, *Dryopteris, Hypericum, Glyceria, Vaccinium, Cypripedium*
Water Withdrawal	6	Add flow regulation devices to ditches	11	1	once	5B:0H	very good	med	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium*
Incompatible Forestry Practices and Management	6	Burn bog edges	10	1	decadally	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Water Withdrawal	6	Monitor water levels	12	0.5	seasonally	5B:0H	very good	med	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Incompatible Water Quality	6	Monitor water quality	12	0.5	annually	6B:0H	good	med	CEGL004157, *Dryopteris, Hypericum, Glyceria, Vaccinium, Cypripedium*
Overexploitation of Species	6	Signage - Sensitive Species. Do not disturb.	14	1	once	6B:0H	good	med	CEGL004157, *Dryopteris, Hypericum, Glyceria, Vaccinium, Cypripedium*
Agricultural Conversion	7	Burn bog edges	10	1	decadally	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*
Agricultural Conversion	7	Bushhog bog edges	13	1	as needed	6B:0H	fair	high	CEGL004157, *Dryopteris, Glyceria, Hypericum, Vaccinium, Cypripedium*

Table 2.14.3. GPS coordinates of Plots and Elements at John's Bog.

Point Name	GPS Coordinates			
JB Photomonitor Point	36.529100	°N	81.964010	°W
JB *Corvus corax*	36.528333	°N	81.965278	°W
JB *Dryopteris cristata*	36.528611	°N	81.963333	°W
JB *Hypericum ellipticum*	36.528611	°N	81.964167	°W
JB *Vaccinium macrocarpon*	36.529167	°N	81.963333	°W

Chapter 15
Jones Branch Bog – Elk Park Quad, 36.20188º N, 81.98443º W
Prioritization Rank – Later, 25th out of 26.
Site Photos - Jones Branch Bog

Summary

Jones Branch Bog is a *Tsuga canadensis - Acer rubrum* - (*Liriodendron tulipifera, Nyssa sylvatica*) / *Rhododendron maximum* / *Sphagnum* spp. Forest (CEGL007565, G2) (Table 2.15.1). The site's **management prioritization category is LATER and it is ranked 25 out of the 26 sites**. Parasites and pathogens, urban and suburban development, recreation, sedimentation, and invasives are the most pressing threats. Important actions include monitoring *Tsuga*, gating the roads into the sites, monitoring the TES species, and searching for invasives (Table 2.15.3).

Table 2.15.1 Community Types Listed at Jones Branch Bog (Major *et al.* 2000; monitoring points listed in Table 2.15.4)

Classification	Name	G rank
CEGL007565	*Tsuga canadensis - Acer rubrum - (Liriodendron tulipifera, Nyssa sylvatica) / Rhododendron maximum / Sphagnum spp.* Forest	G2

Communities Found

JBB contained one site-group that did not match the site's expected association or any NatureServe (2007) associations or alliances. At SCB, the three site-groups all contained *Acer rubrum* and *Quercus rubra* within their overstories. Neither SCB-B nor SCB-G had any good matches in the association or alliance level. SCB-J most closely fits the overstory of the Chestnut Oak – Northern Red Oak (*Quercus prinus – Quercus rubra*) Forest Alliance (S = .80). Jones Branch Bog's one site-group, JBB-D, contains one species that is likely to increase in abundance, *Tsuga canadensis* (Table 2.15.2). *Betula alleghaniensis* may decrease in occurrence in future decades, based on its size distribution. *Betula lenta*, though, may have a continued presence on the site-group, as it appears to be neither increasing nor decreasing in abundance.

Table 2.15.2. Species dominances and population trends within Jones Branch Bog. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Group
Species	**jbb-d**
Betula alleghaniensis	**c,d**
Betula lenta	*c,d*
Liriodendron tulipifera	*c*
Tsuga canadensis	**A,B,C**

TES Elements

***Helianthus glaucophyllus* (G3/S1) –** This sunflower occurs in moist areas under partial to full shade (Robinson 1982). Clearing the canopy would remove necessary shade and increase occurrence of woody vines and shrubs that could outcompete the sunflower. Fire may damage the plant.

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Table 2.15.3. Threats and management actions for Jones Branch Bog. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Parasites / Pathogens	1	Monitor *Tsuga*	1	0.5	biannually	2B:0H	good	med	
Parasites / Pathogens	1	Release adelgid predator	12	0.5	as needed	1B:0H	good	high	CEGL007565
Urban / Suburban Development	2	Gate roads into site	2	1	once	2B:0H	good	high	CEGL007565, *Helianthus*
Urban / Suburban Development	2	Signage - Fragile ecosystem! Tread carefully.	6	1	once	2B:0H	good	med	CEGL007565, *Helianthus*
Woody Encroachment	3	Burn bog edges	12	1	as needed	0B:2H	bad	low	none
Sedimentation	3	Dig out sedimentation inputs	10	1	as needed	1B:0H	good	high	CEGL007565
Recreation	3	Gate roads into site	2	1	once	2B:0H	good	med	CEGL007565, *Helianthus*
Woody Encroachment	3	Girdle trees/shrubs	9	1	as needed	2B:0H	good	med	CEGL007565, *Helianthus*
Invasive Species	3	Herbicide *M. vimenium*	15	0.5	annually	2B:0H?	fair	low	CEGL007565, *Helianthus*
Invasive Species	3	Manually remove invasives	5	0.5	annually	2B:0H	good	med	
Sedimentation	3	Monitor channel below roads and trails for sedimentation	7	0.5	annually	1B:0H	good	med	CEGL007565
Invasive Species	3	Monitor TES species	3	1	biannually	1B:0H	very good	high	*Helianthus*
Woody Encroachment	3	Monitor TES species	3	1	biannually	1B:0H	good	high	*Helianthus*
Water Withdrawal	3	Monitor water levels	8	0.5	seasonally	2B:0H	good	med	
Recreation	3	Run annual clean-ups	11	0.5	annually	2B:0H	good	high	CEGL007565, *Helianthus*
Invasive Species	3	Search for invasives	4	0.5	biannually	2B:0H	very good	high	CEGL007565

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Recreation	3	Signage - Fragile ecosystem! Tread carefully.	6	1	once	2B:0H	good	med	CEGL007565, *Helianthus*
Second Home / Vacation Development	3	Signage - Fragile ecosystem! Tread carefully.	6	1	once	2B:0H	good	med	CEGL007565, *Helianthus*

Table 2.15.4. GPS coordinates of plots and elements at Jones Branch Bog

Point Name	GPS Coordinates			
jbba1	36.201880	°N	81.984430	°W
jbbb1	36.201462	°N	81.985490	°W
jbbc1	36.201880	°N	81.988070	°W
jbbd1	36.202190	°N	81.989000	°W
JBB *Helianthus glaucophyllus*	36.203611	°N	81.987222	°W

Chapter 16
Lindy Camp Bog – Doe Quad, 36.47503º N, 81.95746ºW
Prioritization Rank – Later, 21st out of 26.
Site Photos - Lindy Camp Bog

Summary

Lindy Camp Bog is a forest mosaic that contains *Tsuga canadensis - Acer rubrum* - (*Liriodendron tulipifera*, *Nyssa sylvatica*) / *Rhododendron maximum* / *Sphagnum* spp. Forest (CEGL007565, G2) (Table 2.16.1). **Management prioritization for the site is LATER and it is ranked 21 of 26 sites**. Forest conversion, forestry roads, invasive species, erosion (Table 2.16.7) and sedimentation are important threats. Actions needed to help alleviate the threats (Table 2.16.3) include signage that encourages users to stay on roads and trails, releasing the hemlock woolly adelgid predator, and monitoring *Sphagnum* mats (Table 2.16.6) and invasive species.

Table 2.16.1. Community types listed at Lindy Camp Bog (Major *et al.* 2000; monitoring points listed in Table 2.16.4).

Classification	Name	G rank
CEGL007565	*Tsuga canadensis - Acer rubrum - (Liriodendron tulipifera, Nyssa sylvatica) / Rhododendron maximum / Sphagnum* spp. Forest	G2

Communities Found

In group B of Lindy Camp Bog, *Prunus serotina* is the only species likely to increase in abundance (Table 2.16.2). In LCB-D *Acer saccharum* is dominant in the overstory, but its importance is likely to decrease over the next few decades, based on its size distribution (Table 2.16.2). *Quercus rubra*, however, may be sustained on the site-group. In LCB-F, *Acer rubrum* appears likely to decrease in the future (Table 2.16.2). However, *Oxydendron arboreum* is likely to persist in the site-group. LCB-G has one dominant species in the overstory, *Acer rubrum*, which displays a size distribution that suggests the species will decrease in importance in the future (Table 2.16.2). *Liriodendron tulipifera* and *Magnolia acuminata* appear to be sustainable in the community. The only species likely to increase in abundance is *Prunus serotina*.

Table 2.16.2. Species dominances and population trends within Lindy Camp Bog. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups			
Species	**lcb-b**	**lcb-d**	**lcb-f**	**lcb-g**
Acer rubrum		*c*	**b,c,d**	**b,c,d**
Acer saccharum		**b,c,d**		**a,b,c**
Betula alleghaniensis		*a*		
Betula lenta			**c**	
Liriodendron tulipifera		*b*		*a,b*
Magnolia acuminata				*a*
Magnolia fraseri		**b**	**b**	**a,b**
Nyssa sylvatica		**b**	**A,b**	
Oxydendron arboreum			*a*	**b**
Prunus serotina	**A**			**A**
Quercus prinus		**c**		
Quercus rubra	*a*	*a,d*		
Tsuga canadensis	**c**			

TES Elements

***Allium tricoccum* (G5/S1S2) (Table 2.16.5) –** This perennial herb grows in rich mesic soils. Collections may have severe implications on the sustainability of the species in the southern Appalachians (Rock *et al*. 2004). Researchers ran simulated collections and found that sustainable levels of harvest for the species in the southern limit of its range may be as low as 10% of individuals of populations once every 10 years. Their simulation removed plants of all sizes, but they admit that this varies from real harvest methods, which probably preferentially remove larger plants. This method decreases vegetative reproduction within populations. Personal collections of *Allium tricoccum* should be permitted and restricted to extremely low levels of harvest. Sustainable levels are still unknown, but are sure to be at or below 10% once every ten years. We recommend that collection permits be restricted only to specific sites known to contain vigorous populations and that collections on any given site be limited to 5-10% harvest every ten years. In other words, if a population has 100 individuals in year one, 5 to10 individuals could be harvested within a ten-year period. The next ten-year harvest period should begin after a population has been re-evaluated.

***Gentiana austromontana* (G3/S3) –** This herbaceous plant is found in full to partial shade at high elevations. Threats include trampling and timber harvest (NatureServe 2007). It is vulnerable to land use alteration due to limited distribution (Carter 2004).

***Listera smallii* (G4/S3)** – The kidneyleaf twayblade occurs in uncleared forests on steep slopes. This orchid prefers to grow in the humus of damp woods, thickets, and bogs or below rhododendron on mountain slopes. The wetland habitat is vulnerable to drainage and logging, especially in wet hemlock forests (NatureServe 2007). It blooms from June through July.

***Panax quiquefolius* (G3/S3) (Table 2.16.5)** – Populations of this perennial herb are declining because of overharvest of the roots, overbrowsing by deer, and timber harvesting. Currently, few populations are of a viable size; in the Great Smoky Mountains National Park that size is 510 individuals. Plants can be marked with dye and magnetic chips to help reduce illegal harvest of plants. Also harvests are supposed to be coordinated with planting efforts by the harvester of seeds from the harvested plants, but sometimes those seeds are not yet mature or are planted ineffectively. Education of legal harvesters and enforcement against illegal harvests are needed to ensure future viability of ginseng populations. Distributing pamphlets or even requiring that harvesters take a class covering proper techniques before they can be licensed may help protect the species. Harvesters should dig only mature plants after seeds have reached maturity. All regulations surrounding ginseng harvests should be strictly enforced. Plants begin to reproduce between the ages of 4 and 7 (Nantel *et al*. 1996).

***Platanthera orbiculata* (G5/S3) (Table 2.16.5) –** This orchid is capable of extended dormancies possibly because the lack of sunlight in its habitat (NatureServe 2007, Hapeman 1996) and occurs within small populations. Ideal habitats are shaded areas of

forests, where germination requires mycorrhizal associations (Hapeman 1996). It is found most often in acidic mesic areas (Whiteaker *et al.* 1998). The species' main threats are land conversion, habitat fragmentation, and forestry practices (NatureServe 2007). Other threats include reduction of organic matter, indiscriminate pesticide applications, climate change, increased herbivory by invertebrates such as slugs and snails, and heat or drought stress.

***Pooecetes gramineus* (G5/S1) -** The Vesper Sparrow requires open habitat, primarily of low vegetation (less than 8 inches tall) with patches of bare ground and scattered saplings or shrubs (New Jersey Dept. Environmental Protection 2005). The sparrow nests in dense herbaceous cover at ground level. Territories range from 0.5 to3.2 hectares. Populations have declined dramatically in the eastern United States as a result of altered agricultural practices. Tennessee is in the non-breeding range (NatureServe 2007); forage areas are most critical in the Cherokee National Forest. The bird feeds on the ground near fence rows and edges, eating grains, seeds, and insects (NatureServe 2007). Management recommendations include planting native warm season grasses with undisturbed edges and scrub areas (NatureServe 2007). No burning or mowing nesting areas should occur during the breeding season (early spring to early fall), but mown areas are preferred for foraging and recently burned areas may be preferred for nesting. However, not more than 50% of a grassland habitat should be burned in a given year (NatureServe 2007).

***Scutellaria saxatilis* (G3/S3) –** Rock skullcap is an herbaceous perennial that requires moist shaded habitat and blooms June through August (Radford *et al.* 1964, Dolan 2004). The biggest threats to *Scutellaria saxatilis* are exotic species like *Microstegium vimenium* and *Lonicera japonica* and loss of canopy (Dolan 2004, NatureServe 2007). Other threats include burning, grazing, woody encroachment, and trampling. Management actions should include protection of enough habitats for population growth and monitoring of those populations. Invasive species and encroaching woody shrubs should be removed and canopy trees preserved. In Great Smoky Mountains National Park, removal of shrubs and saplings in 2001 temporarily boosted population numbers, but in 2003 numbers again fell. Posting signs at populations near trailsides may help prevent trampling.

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Table 2.16.3. Threats and management actions for Lindy Camp Bog. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Forest Conversion	1	Release adelgid predator	1	0.5	as needed	1B:0H	good	Med	CEGL007565
Forestry Roads	1	Signage - Recovering community . . . please stay on roads	2	1	Once	8B:0H	very good	Med	CEGL007565, *Allium, Gentiana, Listera, Panax, Platanthera, Pooecetes, Scutellaria*
Channel Modification	2	Monitor *Sphagnum* mats	3	0.5	Annually	3B:0H	good	Med	CEGL007565, *Listera, Scutellaria*
Sedimentation	2	Monitor *Sphagnum* mats	3	0.5	Annually	3B:0H	very good	Med	CEGL007565, *Listera, Scutellaria*
Invasive Species	3	Burn open areas infested with *Microstegium*	5	1	annually in winter	2B:?H	very good	High	CEGL007565, *Poocetes*
Invasive Species	3	Herbicide *M. vimenium*	8	0.5	Annually	5B:3H	fair	Low	CEGL007565, *Allium, Listera, Panax, Platanthera*
Invasive Species	3	Manually remove *Microstegium vimenium*	6	2	annually in late summer, early fall	8B:0H	very good	Med	CEGL007565, *Allium, Listera, Panax, Platanthera, Pooecetes, Scutellaria*
Erosion	3	Monitor *Sphagnum* mats	3	0.5	Annually	3B:0H	good	Med	CEGL007565, *Listera, Scutellaria*
Invasive Species	3	Monitor spread of *Microstegium vimenium*	4	0.5	annually, in summer	8B:0H	good	High	CEGL007565, *Allium, Gentiana, Listera, Panax, Platanthera, Pooecetes, Scutellaria*
Recreation	3	Signage - Fragile ecosystem! Tread carefully.	7	1	once	8B:0H	good	Med	CEGL007565, *Allium, Gentiana, Listera, Panax, Platanthera, Pooecetes, Scutellaria*

Table 2.16.4. GPS coordinates of plots and elements at Lindy Camp Bog

Point Name	GPS Coordinates			
lcba1	36.468100	°N	81.955410	°W
lcba2	36.469590	°N	81.955570	°W
lcba3	36.469800	°N	81.955740	°W
lcba4	36.471130	°N	81.956010	°W
lcba5	36.471660	°N	81.956070	°W
lcbb1	36.473700	°N	81.957080	°W
lcbb2	36.471260	°N	81.957320	°W
lcbb3	36.469470	°N	81.955140	°W
lcbc1	36.470910	°N	81.954200	°W
lcbc2	36.475030	°N	81.957460	°W
LCB *Sphagnum* mat 1	36.473790	°N	81.954240	°W
LCB *Sphagnum* mat 2	36.473700	°N	81.954460	°W
LCB *Sphagnum* mat 3	36.473780	°N	81.954450	°W
LCB *Sphagnum* mat 4	36.473750	°N	81.954780	°W
LCB *Sphagnum* mats 5-9	36.474770	°N	81.955790	°W
LCB *Allium tricoccum*	36.468300	°N	81.955390	°W
LCB *Listera smallii* 1	36.473611	°N	81.954722	°W
LCB *Listera smallii* 2	36.474722	°N	81.955556	°W
LCB *Panax quinquefolius*	36.468150	°N	81.955410	°W
LCB *Platanthera orbiculata* 1	36.470833	°N	81.954444	°W
LCB *Platanthera orbiculata* 2	36.471260	°N	81.957320	°W
LCB *Platanthera orbiculata* 3	36.468610	°N	81.955160	°W
LCB Erosion Site 1	36.472800	°N	81.957430	°W
LCB Erosion Site 2	36.474440	°N	81.957240	°W

Table 2.16.5. TES species 2005 monitoring information.

Species	GPS coordinates N	GPS coordinates W	Reproductive	Nonreproductive	Area (m2)	Status	Concerns	Notes
Panax quinquefolius	36.46815º	81.95541º	2 (50%)	2 (50%)	10	good		
Plantanthera orbiculata	36.47126º	81.95732º	1 (100%)	0 (0%)	1	good		
Plantanthera orbiculata	36.46861º	81.95516º	1 (14%)	6 (86%)	150	good		
Allium tricoccum	36.4683º	81.95539º	5 (100%)	0 (0%)	1	good		

Table 2.16.6. *Sphagnum* spp. mat monitoring 2005 at Lindy Camp Bog.

		GPS coordinates		Size		
Bridge	Mat	N	W	Direction	Length (m)	Comments
1	0					bridge does not block waterflow, people cross over stream on SE side of bridge, signage
2	0					
3	1	36.47379	81.95424	67 degrees	2	adjacent to *Sphagnum* mat 1
3	1			343 degrees	2.45	
3	1			305 degrees	2.8	
4	2	36.4737	81.95446	322	6.42	surrounding are in good condition, no evidence of off trail trampling
4	2			36	5.33	
4	2			78	4	
4	3	36.47378	81.95445	270	2.52	mat at spring
4	3			258	2.95	mixed with non *Sphagnum* bryophytes
4	3			162	0.85	
5	4	36.47375	81.95478	120	0.16	mat off E side of bridge
5	4			23	0.19	bridge in good shape, no off trail trampling evident
6	5	36.47477	81.95579	282	9.54	Several *Sphagnum* patches
6	5			307	6.12	
6	5			223	9.65	
6	5			209	3.91	
6	6			316	2.85	
6	6			210	2.8	
6	7			0	0.72	
6	7			248	0.72	
6	8			100	1.45	
6	8			32	0.22	
6	9			90	0.68	

Bridge	Mat	GPS coordinates N	GPS coordinates W	Size Direction	Size Length (m)	Comments
6	9			346	0.26	
7	0					good conditions
8	10			260	0.7	good conditions, lots of little *Sphagnum* patches
8	10			165	0.43	canopy to dense for GPS reading
8	11				0.1	very small
8	12				0.1	very small

Table 2.16.7. Erosion monitoring at Lindy Camp Bog

Site #	GPS coordinates	Length (m)	Angle	Width (m)	Angle	*Microstegium*?	Notes
1	36.47280º N, 81.95743º W	4.5	270	2.83	0	Yes	
2	36.47444º N, 81.95724º W	9.9	70	5.47	352	Yes	Culvert addition would be good

Chapter 17
Little Toqua Creek – Vonore Quad, 35.516361º N, 84.164944º W
Prioritization Rank – Soon, 9th out of 26.
Site Photos - Little Toqua Creek

Summary

Little Toqua Creek contains *Quercus stellata - Pinus virginiana* (*Schizachyrium scoparium - Piptohaetium avenaceum*) woodland (CEGL008406, G2?) on red knobs of the site (Table 2.17.1). **Management prioritization is SOON and the site is ranked 9 of 26 for need of management action**. Invasive species, altered fire regime, and parasites & pathogens are the main threats on the site. The barrens, ridges and knobs of the site should be burned, invasives should be monitored and removed, and the pine species should be monitored for parasites and pathogens (Table 2.17.3).

Table 2.17.1. Community types listed at Little Toqua Creek (Major *et al*. 2000; monitoring points listed in Table 2.17.4).

Classification	Name	G rank
CEGL008406	*Quercus stellata - Pinus virginiana (Schizachyrium scoparium - Piptohaetium avenaceum)* Woodland	G2?

Communities Found

Little Toqua Creek (LTC) was made up of one site-group, LTC-H. It matched the expected overstory association for the site, Red Knobs Post Oak – Virginia Pine (*Quercus stellata – Pinus virginiana (Schizachyrium scoparium – Piptohaetium avenaceum) Woodland*. Little Toqua Creek has only one group, H, and within it Oxydendron arboreum is the only species that is likely to increase in abundance (Table 2.17.2). *Pinus virginiana*, the only overstory dominant species, may be on the decline, based on its size distribution.

Table 2.17.2. Species dominances and population trends within Little Toqua Creek (LTC). Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

Species	Site Group ltc-h
Acer rubrum	**b**
Nyssa sylvatica	**b**
Oxydendron arboreum	**B,C**
Pinus virginiana	**b,c,d**
Prunus serotina	**b**

TES Elements

***Acer saccharum* ssp. *leucoderme* (G5/S3) -** This small, slowly growing shade tolerant tree (Gilman and Watson 2006) does well in sun to shade and tolerates drought well (Anonymous 2005). The thin bark of maples is easily injured by fire.

***Myotis sodalis* (G2/S1) -** The Indiana bat migrates between summer and winter habitat (NatureServe 2007). From August to September, the bats roost in limestone caves, leaving each night to forage so fat reserves will be sufficient during hibernation. The bats hibernate through the winter, awakening about every 10 days to fly about for an hour or more. The large, tight, compact clusters move northward in the spring. During summer, females establish maternity colonies beneath the loose bark of dead trees, while males roost in caves. Cave management should prevent human disturbance and maintain intact forested habitat. Even mild human disturbance causes the bats to use up energy, so visitation and handling is to be avoided. Signs at cave entrances or fences/gates at cave entrances should be considered. The bats' summer roosts need to be identified and winter roosts need to be protected.

Knowledgeable People

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Table 2.17.3. Threats and management actions for Little Toqua Creek. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Altered Fire Regime	1	Burn barrens	1	1	decadally	1B:0H	very good	high	CEGL008406
Altered Fire Regime	1	Burn ridge and knobs	7	1	decadally	1B:2H	fair	high	CEGL008406
Invasive Species	2	Herbicide invasives	9	1	annually	0B:2H	bad	med	none
Invasive Species	2	Manually remove invasives	3	2	annually, summer	1B:0H	very good	med	CEGL008406
Invasive Species	2	Monitor invasions from road corridor	2	0.5	annually	2B:0H	good	high	CEGL008406, *Acer*
Parasites / Pathogens	3	Monitor *Pinus* spp.	4	0.5	every five years	1B:0H	good	med	CEGL008406. *Myotis*
Forest Conversion	4	Burn barrens	1	1	decadally	1B:0H	very good	high	CEGL008406
Forest Conversion	4	Burn ridge and knobs	7	1	decadally	1B:2H	fair	high	CEGL008406
Operation of Dams / Impoundments	5	Nothing	10	0	continued	0B:0H	fair	med	none
Recreation	6	Signage - Recovering community . . . please stay on roads	5	1	once	2B:0H	very good	med	CEGL008406, *Myotis*
Recreation	6	Signage - Sensitive species. Do not disturb	5	1	once	2B:0H	very good	med	CEGL008406, *Myotis*
Forestry Roads	7	Signage - Recovering community . . . please stay on roads	5	1	once	2B:0H	very good	med	CEGL008406, *Myotis*
Woody Encroachment	8	Burn barrens	1	1	decadally	1B:0H	very good	high	CEGL008406
Woody Encroachment	8	Burn ridge and knobs	7	1	decadally	1B:2H	fair	high	CEGL008406

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Incompatible Forestry Practices and Management	9	Burn barrens	1	1	decadally	1B:0H	very good	high	CEGL008406
Incompatible Forestry Practices and Management	9	Burn ridges and knobs	7	1	decadally	1B:2H	fair	high	CEGL008406
Incompatible Forestry Practices and Management	9	Leave snags in place	6	0	continued	1B:0H	very good	high	*Myotis*
Urban / Suburban Development	10	Gate roads into site	5	1	once	2B:0H	good	med	CEGL008406, *Myotis*
Development of Roads / Utilities	10	Signage - Recovering community . . . please stay on roads	5	1	once	2B:0H	very good	med	CEGL008406, *Myotis*

Table 2.17.4. GPS coordinates of plots and elements at Little Toqua Creek.

Point Name	GPS Coordinates			
ltca1	35.514472	°N	84.166889	°W
ltca2	35.514889	°N	84.166722	°W
ltca3	35.516361	°N	84.164944	°W
ltca4	35.517250	°N	84.163306	°W
ltcb1	35.514250	°N	84.161139	°W
ltcb2	35.514333	°N	84.163278	°W
ltcc1	35.514806	°N	84.162917	°W
ltcd1	35.518639	°N	84.166639	°W
ltcd2	35.519361	°N	84.165917	°W
ltcd3	31.520139	°N	84.165639	°W
ltce1	35.521389	°N	84.166972	°W
LTC *Myotis sodalis*	35.520833	°N	84.182500	°W

Chapter 18
Moffet – Laurel Botanical Area – Iron Mountain Gap Quad, 36.15328º N, 82.17205º W
Prioritization Rank – Now –Right Now, 5th out of 26.
Site Photos - Moffett – Laurel

Summary

Moffett-Laurel Botanical Area contains a mosaic of three important communities (Table 2.18.1): *Tsuga canadensis - Acer rubrum* - (*Liriodendron tulipifera, Nyssa sylvatica*) / *Rhododendron maximum* / *Sphagnum* spp. forest (CEGL007565, G2), *Tsuga canadensis - Betula alleghaniensis - Prunus serotina* / *Rhododendron maximum* forest (CEGL006206, G?), and *Diphylleia cymosa - Saxifraga micranthidifolia - Laportea canadensis* herbaceous vegetation (CEGL004296, G3). **The site has a management prioritization of NOW - RIGHT NOW, and it is ranked 5 out of 26 sites**. Invasive species, parasites & pathogens, and recreation are the main threats Moffett-Laurel faces. Monitoring and removal of invasives, monitoring *Tsuga*, and gating roads are the most important actions to implement on the site (Table 2.18.3).

Table 2.18.1. Community types listed at Moffett-Laurel Botanical Area (Major *et al*. 2000; monitoring points listed in Table 2.18.4).

Classification	Name	G rank
CEGL007565	*Tsuga canadensis - Acer rubrum - (Liriodendron tulipifera, Nyssa sylvatica) / Rhododendron maximum / Sphagnum* spp. Forest	G2
CEGL006206	*Tsuga canadensis - Betula alleghaniensis - Prunus serotina / Rhododendron maximum* Forest	G?
CEGL004296	**Diphylleia cymosa - Saxifraga micranthidifolia - Laportea canadensis* Herbaceous Vegetation	G3

Communities Found

Moffet Laurel (ML) broke up into three site-groups and had three expected associations. ML-D and ML-E matched the overstory of the central Appalachian Hemlock – Northern Hardwood *(Tsuga canadensis – Betula alleghaniensis – Prunus serotina / Rhododendron maximum)* Forest. The overstory dominants of ML-D, *Betula alleghaniensis* and *Tsuga canadensis*, are likely to decrease in abundance and Acer saccharum shows no indication of substantial change (Table 2.18.2). In ML-E two overstory dominants are likely to increase: *Acer saccharum* and *Betula lenta* (Table 2.18.2). The other overstory dominants, *Betula alleghaniensis*, *Magnolia acuminata*, and *Prunus serotina* all appear likely to decrease in abundance in future decades.

ML-B, matched the overstory of the Tuliptree – Beech – Maple (*Fagus grandifolia – Liriodendron tulipifera – Betula lenta – Acer saccharum)* Forest (S = .75*).* This association has only been documented in the mid-Atlantic region (NatureServe 2007). Group B at Moffett-Laurel contains one current overstory dominant that seems to be increasing in abundance: *Fagus grandifolia* (Table 2.18.2). Two others, *Acer saccharum* and *Betula lenta*, are likely to decrease. Another overstory dominant, *Betula alleghaniensis*, may be sustainable on the site-group.

Table 2.18.2. Species dominances and population trends within Moffett-Laurel Botanical Area. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups		
Species	**ml-b**	**ml-d**	**ml-e**
Acer saccharum	**a,b,c,d**	*a*	**B,C,D**
Betula alleghaniensis	*d*	**b,c,d**	**d**
Betula lenta	**d**		**A,B,C,D**
Fagus grandifolia	**A,B,D**		
Magnolia acuminata			**d**
Magnolia fraseri		**a,b,c**	
Nyssa sylvatica		**a,b**	
Prunus serotina			**d**
Quercus prinus		**c**	
Robinea pseudoacia		**B**	
Tsuga canadensis		**a,b,c,d**	**b,c**

TES Elements

***Allium tricoccum* (G5/S1S2) (Table 2.18.5) –** This perennial herb grows in rich mesic soils. Collections may have severe implications on the sustainability of the species in the southern Appalachians (Rock *et al*. 2004). Researchers ran simulated collections and found that sustainable levels of harvest for the species in the southern limit of its range may be as low as 10% of individuals of populations once every 10 years. Their simulation removed plants of all sizes, but they admit that this varies from real harvest methods, which probably preferentially remove larger plants. This method decreases vegetative reproduction within

populations. Personal collections of *Allium tricoccum* should be permitted and restricted to extremely low levels of harvest. Sustainable levels are still unknown, but are sure to be at or below 10% once every ten years. We recommend that collection permits be restricted only to specific sites known to contain vigorous populations and that collections on any given site be limited to 5-10% harvest every ten years. In other words, if a population has 100 individuals in year one, 5 to10 individuals could be harvested within a ten-year period. The next ten-year harvest period should begin after a population has been re-evaluated.

***Cardamine clematis* (G3/S2)** - This perennial herb is a southern Appalachian endemic that is found on rocky streamsides at high elevations above 1000 m (3280 ft) (NatureServe 2007). It blooms from April to May. Survey data collected in Tennessee and North Carolina suggest that populations are currently stable. Threats include land-use conversion, habitat fragmentation, forest management practices, invasive species, atmospheric pollutant deposition, and trampling (NatureServe 2007). Populations that suffer declines in abundance may be slow to recover because of low dispersal capabilities and low fecundity. Preferred habitat is wet areas near or in edges of streams that have little competition from other herbaceous plants, an overhead canopy that allows light to reach the population, and a lack of litter accumulation. It roots in moss, rock crevices, or occasionally in soil. Viable populations in high quality habitats should have more than 500 stems; fair populations should contain 51-100 stems (NatureServe 2007).

***Cardamine rotundifolia* (G4/S2S3)** – This perennial herb is found in seeps and streams. It blooms from April to May. The biggest threat it faces is forest management practices; it is more mildly threatened by habitat loss and fragmentation (NatureServe 2007).

***Carex bromoides* var. *montana* (G5/S1) –** This perennial sedge is found in other woodland seeps and low wet areas and is threatened by drainage of those wetlands.

***Carex roanensis* (G3/S2) –** This sedge is found in boulder fields and on exposed granite ledges in mesic forests containing rich soils at approximately 4700 ft. (Herman 1947). It is associated with birch and beech trees. South of Virginia, there are six known populations remaining: four in Tennessee (one in Unicoi Co., two in Carter Co. and one on Roan Mountain), one in North Carolina and one in Georgia. It is more common in Virginia (Chester *et al*. 1993, NatureServe 2007). The N.C. arboretum is trying to develop cultivation techniques but *Fusarium* crown rot has prevented the arboretum from maintaining plants for more than two years (Center for Plant Conservation 2007).

***Clintonia borealis* (G5/S2S3)** - *Clintonia* is usually found in homogeneous colonies (Anonymous 2007*b*). It is native to the boreal forest but is also found coniferous, mixed and cool, temperate *Acer* forests. *Clintonia* only grows in shade. It takes over twelve

years to establish a clone and produce flowers. It blooms from late May through June and sets fruit in August and September (Radford *et al*. 1964). *Clintonia* is very sensitive to deer browsing due to its slow growth rate.

***Corvus corax* (G5/S2**) - This sedentary, non migratory bird can nest in large flocks of several hundred individuals (NatureServe 2007). In the southern Appalachians, it repeatedly uses the same nests, which are found on rocky cliffs and in conifers between 45 and 80 feet above the ground (Alsop 2001). It prefers scrubby woodland habitat of mixed hardwoods and conifers (University of Michigan Museum of Zoology 2006) and has no serious predators. Home ranges vary between 0.2 and 40 square kilometers (NatureServe 2007).

***Cymophyllus fraserianus* (G4/S3)** - This perennial sedge is found in rocky, humid, acidic areas, often around streams (Robinson 1982). It prefers semi- to heavy shade, and populations react negatively to increased light levels and the pioneer species that establish after disturbance. It blooms from March to May (Radford *et al*. 1964). The sedge has poor dispersal ability (NatureServe 2007), but nevertheless has higher than expected diversity for a rare plant (Godt *et al*. 2004). Degradation of mature streamside habitats may lead to decreased diversity. Dr. Robert Kral (Botanical Research Institute of Texas) expected that both thinning and grazing would destroy populations (Robinson 1982).

***Cypripedium acaule* (G5/S4)** - This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over-collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). Management practices that benefit *Platanthera integrilabia* should also benefit this orchid.

***Desmognanthus quadramaculatus* (G5/S2) -** This lungless salamander is found in rocky streams, near waterfalls, and in other areas where cold water drips or flows (Conant and Collins 1998). It seeks shelter under rocks during the day.

***Eupatorium steelei* (G4/S3) – T**his perennial can be found in openings and on roadsides at higher elevations of the Southern Appalachians.

***Gentiana austromontana* (G3/S3) –** This herbaceous plant is found in full to partial shade at high elevations. Threats include trampling and timber harvest (NatureServe 2007). It is vulnerable to land use alteration due to limited distribution (Carter 2004).

***Hydrophyllum virginianum* (G5/S3) –** This perennial herb can be found on moist slopes of rich woods. Threats include land-use alteration and habitat fragmentation.

***Listera smallii* (G4/S3)** - The kidneyleaf twayblade occurs in uncleared forests on steep slopes. This orchid prefers to grow in the humus of damp woods, thickets, and bogs or below rhododendron on mountain slopes. The wetland habitat is vulnerable to drainage and logging, especially in wet hemlock forests (NatureServe 2007). It blooms from June through July.

***Panax quiquefolius (*G3/S3)** – Populations of this perennial herb are declining because of overharvest of the roots, overbrowsing by deer, and timber harvesting. Currently, few populations are of a viable size; in Great Smoky Mountains National Park that size is 510 individuals. Plants can be marked with dye and magnetic chips to help reduce illegal harvest of plants. Also harvests are supposed to be coordinated with planting efforts by the harvester of seeds from the harvested plants, but sometimes those seeds are not yet mature or are planted ineffectively. Education of legal harvesters and increased enforcement against illegal harvests are needed to ensure future viability of ginseng populations. Distributing pamphlets or even requiring that harvesters take a class covering proper techniques before they can be licensed may help protect the species. Harvesters should dig only mature plants after seeds have reached maturity. All regulations surrounding ginseng harvests should be strictly enforced. Plants begin to reproduce between the ages of 4 and 7 (Nantel *et al*. 1996).

***Platanthera orbiculata* (G5/S3) –** This orchid is capable of extended dormancies possibly because the lack of sunlight in its habitat (NatureServe 2007, Hapeman 1996) and occurs within small populations. Ideal habitats are shaded areas of forests, where germination requires mycorrhizal associations (Hapeman 1996). It is found most often in acidic mesic areas (Whiteaker *et al.* 1998). The species' main threats are land conversion, habitat fragmentation, and forestry practices (NatureServe 2007). Other threats include reduction of organic matter, indiscriminate pesticide applications, climate change, increased herbivory by invertebrates such as slugs and snails, and heat or drought stress.

***Platanthera psycodes* (G5/S2) –** This orchid prefers open, moist habitats of streamsides and ditches and wet meadows (Hapeman 1996). Flowers are fertilized by butterflies and hawkmoths.

***Prenanthes roanensis* (G3/S3) -** This perennial herb is found at forest edges, in upper slope or ridgetop clearings, and around *Prunus pensylvanica* in areas that have been burned (Robinson 1982). It is not found under deep canopies. Opening the canopy may increase regeneration of populations of this species (Robinson 1982). Fire may help maintain this species through decreasing competition and shade. This endemic of the southern Appalachians is restricted to elevations above 1200m and is often associated

with mixed spruce/hardwood forests (NatureServe 2007). This species faces low level threats from land-use conversion and habitat fragmentation.

Knowledgeable People

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Table 2.18.3. Threats and management actions for Moffett-Laurel. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Invasive Species	1	Herbicide *invasives*	11	0.5	annually	0B:11H	fair	low	None
Invasive Species	1	Manually remove invasives	1	2	annually in late summer, early fall	11B:0H	very good	med	CEGL004296, *Cardamine spp., Carex spp., Gentiana, Hydrophyllum, Listera, P. psycodes, Cymophyllus, Desmognanthus*
Invasive Species	1	Monitor spread of *Microstegium vimenium*	2	0.5	annually	11B:0H	good	high	CEGL004296, *Cardamine spp., Carex spp., Gentiana, Hydrophyllum, Listera, P. psycodes, Cymophyllus, Desmognanthus*
Parasites / Pathogens	2	Monitor *Tsuga*	3	0.5	biannually	2B:0H	good	med	CEGL007565, CEGL006206
Recreation	3	Gate roads	4	1	once	20B:0H	very good	high	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Forestry Roads	4	Gate roads	4	1	once	20B:0H	good	med	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*
Forest Conversion	5	Release adelgid predator	5	0.5	as needed	2B:0H	good	med	CEGL007565, CEGL006206
Sedimentation	6	Dig out sedimentation inputs	7	1	as needed	11B:0H	good	med	CEGL004296, *Cardamine spp., Carex spp., Gentiana, Hydrophyllum, Listera, P. psycodes, Cymophyllus, Desmognanthus*
Sedimentation	6	Monitor channels below roads for sedimentation	6	0.5	annually	11B:0H	very good	med	CEGL004296, *Cardamine spp., Carex spp., Gentiana, Hydrophyllum, Listera, P. psycodes, Cymophyllus, Desmognanthus*
Erosion	6	Monitor sedimentation	6	0.5	annually	11B:0H	good	high	CEGL004296, *Cardamine spp., Carex spp., Gentiana, Hydrophyllum, Listera, P. psycodes, Cymophyllus, Desmognanthus*
Incompatible Forestry Practices and Management	7	?	?	?	?	?	?	?	?
Altered Fire Regime	8	Burn ridgeline	8	1	as needed	2B:0H	fair	med	*Prenanthes, Cypripedium*
Altered Fire Regime	8	Do not burn	12	0	no action	17B:2H	very good	med	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Panax, Desmognanthus*
Woody Encroachment	9	?	?	?	?	?	?	?	?

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Channel Modification	9	Gate road	4	1	once	11B:0H	very good	high	CEGL004296, *Cardamine spp., Carex spp., Gentiana, Hydrophyllum, Listera, P. psycodes, Cymophyllus, Desmognanthus*
Development of Roads / Utilities	9	Gate roads	4	1	once	20B:0H	very good	high	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*
Overexploitation of Species	9	Gate roads	4	1	once	20B:0H	very good	high	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*
Second Home / Vacation Development	9	Gate roads	4	1	once	20B:0H	very good	high	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*
Second Home / Vacation Development	9	Gate roads	4	1	once	20B:0H	very good	high	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Development of Roads / Utilities	9	Signage - Fragile ecosystem! Tread carefully.	10	1	once	21B:0H	very good	med	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Corax, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*
Development of Roads / Utilities	9	Signage - No vehicular traffic, please. Foot travel is welcome.	9	1	once	21B:0H	very good	med	CEGL007565, CEGL006206, CEGL004296, *Allium, Cardamine spp., Carex spp., Clintonia, Corax, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*
Overexploitation of Species	9	Signage - Sensitive Species. Do not disturb.		1	once	17B:0H	good	med	*Allium, Cardamine spp., Carex spp., Clintonia, Eupatorium, Gentiana, Hydrophyllum, Listera, Platanthera spp., Cymophyllus, Cypripedium, Panax, Prenanthes, Desmognanthus*

Table 2.18.4. GPS coordinates of plots and elements at Moffett Laurel Botanical Area

Point Name	GPS Coordinates			
mla1	36.153280	°N	82.172050	°W
mla2	36.152560	°N	82.171940	°W
mla3	36.152020	°N	82.171850	°W
mla4	36.150830	°N	82.171850	°W
mla5	36.150400	°N	82.171890	°W
mlb1	36.149960	°N	82.169510	°W
mlb2	36.149280	°N	82.169270	°W
mlb3	36.148870	°N	82.169450	°W
mlb4	36.147550	°N	82.169080	°W
mlc1	36.147270	°N	82.172800	°W
mlc2	36.147720	°N	82.172820	°W
mlc3	36.148670	°N	82.172830	°W
mld1	36.148720	°N	82.175720	°W
mld2	36.150160	°N	82.176010	°W
mle1	36.157650	°N	82.170870	°W
mle2	36.156870	°N	82.170950	°W
mle3	36.156350	°N	82.170600	°W
mle4	36.155930	°N	82.170650	°W
ML *Allium tricoccum 1*	36.151000	°N	82.169450	°W
ML *Allium tricoccum 2*	36.154520	°N	82.169910	°W
ML *Cardamine rotundifolia*	36.149167	°N	82.180556	°W
ML *Carex roanensis*	36.153611	°N	82.180556	°W
ML *Clintonia borealis 1*	36.153333	°N	82.181389	°W
ML *Clintonia borealis 2*	36.148333	°N	82.176389	°W
ML *Corvus corax*	36.149722	°N	82.171944	°W
ML *Desmognanthus quadramaculatus*	36.150000	°N	82.176389	°W
ML *Eupatorium steelei 1*	36.154444	°N	82.180000	°W
ML *Eupatorium steelei 2*	36.154167	°N	82.181944	°W
ML *Gentiana austromontana*	36.158333	°N	82.175000	°W
ML *Hydrophyllum virginianum 1*	36.154167	°N	82.181944	°W

Point Name	GPS Coordinates			
ML *Hydrophyllum virginianum 2*	36.146667	°N	82.176944	°W
ML *Listera smallii*	36.149167	°N	82.180556	°W
ML *Platanthera orbiculata 1*	36.151389	°N	82.180556	°W
ML *Platanthera orbiculata 2*	36.153611	°N	82.180556	°W
ML *Platanthera psycodes*	36.154167	°N	82.181944	°W
ML *Prenanthes roanensis 1*	36.154444	°N	82.180000	°W
ML *Prenanthes roanensis 2*	36.154167	°N	82.181944	°W
ML *Prenanthes roanensis 3*	36.158333	°N	82.175000	°W
ML *Prenanthes roanensis 4*	36.148333	°N	82.176389	°W

Table 2.18.5. TES element 2005 monitoring at Moffett Laurel Botanical Area

Species	Collec-tion #	GPS coordinates	Repro-ductive	Non-reprod-ductive	Area (m2)	Status	Concerns	Notes
Allium tricoccum	432	36.15452º N, 82.16991º W	7 (100%)	0 (0%)	24	good	Adjacent trail	On trail 53311 heading NE across stream; North of rock jutting out of slope (20 ft high); 4 plants on road bank, 3 on road
Allium tricoccum		36.15002º N, 82.16945º W	107 (100%)	0 (0%)	> 1000	vigorous		Up toe slope form sharp curve in stream; 50 m S of feeder stream

Chapter 19
Nolichucky Cliffs – Chestoa Quad, 36.09358º N, 82.42696º W
Prioritization Rank – Now –Right Now, 3rd out of 26.
Site Photos - Nolichucky Cliffs

Summary

Nolichucky Cliffs contains several communities including *Pinus pungens - Pinus rigida -*(*Quercus prinus*) / *Kalmia latifolia- Vaccinium pallidum* woodland (CEGL007097, G3), *Pinus virginiana - Quercus prinus - Juniperus virginiana* / *Philadelphus hirsutus - Celtis occidentalis* woodland (CEGL007720, G2?), *Pinus virginiana - Quercus prinus - Quercus rubra* / *Vaccinium pallidum* - Kalmia latifolia Forest (CEGL007539, G2?), *Justicia americana* herbaceous vegetation (CEGL004286, G4G5), and *Vittaria appalachiana - Heuchera parviflora - Houstonia serpyllifolia* / *Plagiochila* spp. Herbaceous Vegetation (CEGL004302, G3) (Table 2.19.1). **The management prioritization for Nolichucky Cliffs is NOW-RIGHT NOW and it is ranked 3 out of 26 for management action**. Forest conversion, parasites and pathogens, and invasive species are the threats of the most concern. Suggested actions to alleviate these threats include monitoring *Pinus pungens* and *P. virginiana*, monitoring *Tsuga* spp., monitoring woody encroachment, burning *Pinus pungens* ridges and bluffs, and manually removing invasives (Table 2.19.3).

Table 2.19.1 Community Types Listed for Nolichucky Cliffs (Major *et al*. 2000; monitoring points listed in Table 2.19.4).

Classification	Name	G rank
CEGL007097	*Pinus pungens - Pinus rigida -(Quercus prinus) / Kalmia latifolia- Vaccinium pallidum* Woodland	G3
CEGL007720	*Pinus virginiana - Quercus prinus - Juniperus virginiana / Philadelphus hirsutus - Celtis occidentalis* Woodland	G2?
CEGL007539	*Pinus virginiana - Quercus prinus - Quercus rubra / Vaccinium pallidum - Kalmia latifolia* Forest	G2?
CEGL004286	* *Justicia americana* Herbaceous Vegetation	G4G5
CEGL004302	**Vittaria appalachiana - Heuchera parviflora - Houstonia serpyllifolia / Plagiochila* spp. Herbaceous Vegetaton	G3

*** Not sampled**

Communities Found

Nolichucky Cliffs (NC) consisted of four site groups that all matched one or more of the three expected associations. All four, NC-G, NC-H, NC-I, and NC-J, matched the overstory of the Blue Ridge Acid Shale (*Pinus virginiana – Quercus prinus – Quercus rubra / Vaccinium pallidum*) Forest. Two, NC-H and NC-I, matched the overstory of the Blue Ridge Calcareous Shale Slope (*Pinus*

virginiana – Quercus prinus – Juniperus virginiana / Philadelphus hirsutus – Celtis occidentalis) Woodland. Compositions of the understory and shrub vegetations are needed to break these two associations apart. When we look at the lower strata of these site-groups we see that NC-G and NC-I contain ericaceous shrubs, which are indicative of acidic soils; these site-groups are matches for the Blue Ridge Acid Shale (*Pinus virginiana – Quercus prinus – Quercus rubra / Vaccinium pallidum*) Forest. Group G of Nolichucky Cliffs contains three overstory dominants, *Quercus prinus, Quercus rubra*, and *Tilia americana var. heterophylla*, which all appear likely to decrease in abundance in future decades (Table 2.19.2). *Oxydendron arboreum* and *Pinus virginiana* may increase, based on their size distributions. At NC-I, the only overstory dominant, *Quercus prinus*, appears to be stable, as it exhibits a random size distribution (Table 2.19.2). *Acer rubrum*, *Pinus virginiana,* and *Quercus rubra* are all likely to have increased abundances in future decades.

NC-H is more likely calcareous, as it has no ericaceous shrubs in the lower strata, so it matches the Blue Ridge Calcareous Shale Slope (*Pinus virginiana – Quercus prinus – Juniperus virginiana / Philadelphus hirsutus – Celtis occidentalis*) Woodland. In NC-H, *Pinus virginiana* is dominant in the overstory, but its size distribution indicates that it is likely to lose dominance in the future (Table 2.19.2). *Acer rubrum* is the only species in the site-group that should increase in abundance in the future.

NC-J also fits the Blue Ridge Table Mountain Pine – Pitch Pine (*Pinus pungens, Pinus rigida – (Quercus prinus) / Kalmia latifolia – Vaccinium pallidum*) Woodland overstory. The overstory dominants in NC-J, *Quercus prinus* and *Quercus rubra,* both have random size distributions, so appear to be persistent (Table 2.19.2). *Acer rubrum*, *Pinus strobus*, and *Pinus virginiana*, appear likely to increase in abundance in future decades, based on their size distributions.

Table 2.19.2. Species dominances and population trends within Nolichucky Cliffs. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups			
Species	**nc-g**	**nc-h**	**nc-I**	**nc-j**
Acer rubrum	**c**	**A,B**	**A,B**	**A,B,C**
Oxydendron arboreum	**A**			**b**
Pinus strobus		**b,c**		**A,B**
Pinus virginiana	**A**	**b,c,d**	**B,C**	**A,B,C**
Quercus prinus	**c,d**		*a,b,c,d*	*a,b,c,d*
Quercus rubra	**d**	**c**	**A,B**	*a,b,c,d*
Tilia americana var. heterophylla	**c,d**			

TES Elements

***Adlumia fungosa* (G4/S2) –** This vine grows on wooded or rocky slopes in rich woods. It blooms from June to September and remains in the seedbank until a disturbance, such as fire, opens the canopy (Judziewicz 2001).

***Buckleya distichophylla* (G2/S2) (Table 2.19.5) -** The healthiest populations are associated with periodic wildfires (Virginia Natural Heritage Program 2000), and there is some type of dependence on host plants, but the degree of dependence and life stage at which it is important are unknown. Threats to populations of *Buckleya* include lack of fire, collection, roads, development, falling branches, and erosion (Center for Plant Conservation 2007, NatureServe 2007).

***Cymophyllus fraserianus* (G4/S3) (Table 2.19.5)** - This perennial sedge is found in rocky, humid, acidic areas, often around streams (Robinson 1982). It prefers semi- to heavy shade, and populations react negatively to increased light levels and the pioneer species that establish after disturbance. It blooms from March to May (Radford *et al*. 1964). The sedge has poor dispersal ability (NatureServe 2007), but nevertheless has higher than expected diversity for a rare plant (Godt *et al*. 2004).

***Cypripedium acaule* (G5/S4)** - This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over-collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). Management practices that benefit *Platanthera integrilabia* should also benefit this orchid.

***Diervilla sessilifolia* var. *rivularis* (G3/S2)** – This shrub likes full sun and can be found on rocky banks and in disturbed areas. It spreads by rhizomes to form colonies (Center for Plant Conservation 2007). Threats include roadside construction, right-of-way maintenance, hydrologic alteration, erosion, invasive species, thinning harvests near populations, succession leading to habitat degradation, and canopy closure.

***Falco peregrinus* (G4/S1)** – The Peregrine Falcon's habitat includes open forest, rock outcrops, meadows, and wetlands (Nature of New England 2007). It nests under cliff overhangs and possibly in hollow trees in undisturbed areas and prefers extended views from its nest locations (NatureServe 2007). Artificial nesting platforms have been successfully used, and there has been at least one case of successful use of nest boxes (Anonymous 2007*b*). The falcon hunts mostly in the morning, but may hunt at anytime. It is susceptible to pesticide contamination, and continued increases in abundance hinge on keeping contamination levels at low levels (NatureServe 2007). Other threats include loss of prey species' wetland habitats, poaching of nests, and shooting. Human use of nesting habitats may also threaten the species. The Great-horned Owl may be a nest predator.

***Helianthus glaucophyllus* (G3/S1) –** This sunflower occurs in moist areas under partial to full shade (Robinson 1982). Clearing the canopy would remove necessary shade and increase occurrence of woody vines and shrubs that could outcompete the sunflower. Fire may damage the plant.

***Lysimachia terrestris* (G5/S1)** – This loosestrife is found in marshes, moist thickets and grassy shores (Gleason and Cronquist 1991). Bog drainage is the biggest threat it faces (NatureServe 2007). Water degradation and changes in stream flow should be avoided. Exotic pest plants are hazardous to the species, as is site access through trail or road construction.

***Speyeria diana* (G3/S3) -** The species is found throughout the southern Appalachians in forested areas. In the fall, after larvae emerge from eggs laid on the ground, they feed on violets. First instars overwinter and pupate in late spring in the leaf litter, emerging as adults beginning in late June. Males are first to appear, but females become common in late July as they search for oviposition sites. *Aclepias* spp., *Echinacea* spp., *Silphium laciniatum*, and *Pycanthemum incanum* are some of their nectar sources. They may feed on roadsides, but do not venture far from woodland habitats. *Bacillus thuringiensis* (BT) sprays used to control gypsy moths may

be contributing to declining populations. One study has shown that larvae are susceptible to the insecticide (Peacock *et al*. 1998). Dimilin may pose a similar or greater threat than BT. Timber harvesting is a minor threat as populations do return to cut-over areas once forest cover reestablishes. Invasive species and over-browsing of violets by deer could also pose threats to the fritillary. Violet densities should be monitored along with the fritillary populations. Fritillary populations in given areas do fluctuate from year to year, so accurate assessments of numbers is difficult. Overall, this species requires a large and diverse habitat. Larvae feed on woodland violets, and adults gather nectar from more flowers that occur on edges, shrublands, or in open fields and grasslands.

***Tsuga caroliniana* (G3/S3) –** This hemlock is a southern Appalachian endemic that grows on xeric ridgelines, cliffs, and rocky slopes and in gorges in nutrient poor soils. Viable populations should contain at least 35 trees on high quality habitat that contains dense stands of ericaceous shrubs and oak and pine species. The hemlock woolly adelgid can quickly degrade or even wipe out whole stands, though.

***Woodsia scopulina* ssp *appalachiana (appalachiana)* (G4/S1S2) -** Appalachian Woodsia can be found in shaded areas of sandstone or shale cliffs and ledges. It is moderately threatened by its limited distribution (NatureServe 2007).

Knowledgeable People

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Table 2.19.3. Threats and management actions for Nolichucky Cliffs. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Parasites / Pathogens	1	Monitor *Pinus pungens, virginiana*	1	0.5	every five years	3B:0H	good	med	CEGL007097, CEGL007720, CEGL007539
Parasites / Pathogens	1	Monitor *Tsuga* spp.	2						
Parasites / Pathogens	1	Release adelgid predator	9	0.5	as needed	1B:0H	very good	med	*Tsuga*
Forest Conversion	2	Burn *Pinus pungens* ridges and bluffs, med-high intensity	4	1	decadally	4B:1H	good	high	CEGL007097, *Cypripedium, Buckleya, Adlumia*
Forest Conversion	2	Monitor woody encroachment	8			4B:0H	good	med	CEGL007097, CEGL007720, *Cypripedium, Buckleya, Adlumia, Falco*
Invasive Species	3	Manually remove invasives	5						
Invasive Species	3	Monitor invasives - *Microstegium vimenium, Lythrum salicaria, Populus lombardi, Polygonum japonicum*	4	0.5	annually	8B:0H	good	high	CEGL004286, CEGL004302, *Lysimachia, Helianthus, Diervilla, Cymophyllus, Adlumia, Spirea*
Altered Fire Regime	4	Burn *Pinus pungens* ridges and bluffs, med-high intensity	4	1	decadally	4B:1H	good	high	CEGL007097, *Cypripedium, Buckleya, Adlumia*
Woody Encroachment	4	Burn *Pinus pungens* ridges and bluffs, med-high intensity	4	1	decadally	4B:1H	good	high	CEGL007097, *Cypripedium, Buckleya, Adlumia*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Recreation	4	Monitor rock climbing effects	7	0.5	periodically	3B:0H	good	med	CEGL004302, *Falco, Woodsia*
Altered Fire Regime	4	Monitor woody encroachment	3	0.5	every five years	4B:0H	good	med	CEGL007097, CEGL007720, *Cypripedium, Buckleya, Adlumia, Falco*
Woody Encroachment	4	Monitor woody encroachment	3	0.5	every five years	4B:0H	good	med	CEGL007097, CEGL007720, *Cypripedium, Buckleya, Adlumia, Falco*
Erosion	5	Monitor erosion channels	7	0.5	annually	5B:0H	good	high	CEGL004286, *Spiraea, Lysimachia, Adlumia, Cymophyllus*
Erosion	5	Monitor shale slope slippage	9	0.5	annually	1B.0H	good	high	CEGL007720
Development of Roads / Utilities	5	Signage - Fragile ecosystem! Tread carefully.	8	1	once	12B:0H	very good	med	CEGL004302, CEGL004286, *Diervilla, Adlumia, Cypripiedium, Lysimachia, Spirea, Cymophyllus, Helianthus, Woodsia, Buckleya, Tsuga*
Overexploitation of Species	5	Signage - Sensitive Species. Do not disturb.	10	1	once	11B:0H	good	med	CEGL004302, *Buckleya, Diervilla, Adlumia, Lysimachia, Spiraea, Cymophyllus, Cypripedium, Helianthus, Tsuga, Woodsia*
Forestry Roads	6	Gate roads	11	1	once	0B:0H	fair	low	none?
Sedimentation	6	Monitor Lost Cove Branch and river islands for sedimentation	6	0.5	annually	1B:0H	good	med	Cymophyllus
Incompatible Forestry Practices	6	Monitor woody encroachment	3	0.5	every five years	4B:0H	good	med	CEGL007097, CEGL007720, *Cypripedium, Buckleya, Adlumia, Falco*

Table 2.19.4. GPS coordinates of plots and elements at Nolichucky Cliffs

Point Name	GPS Coordinates			
nca1	36.088220	°N	82.423210	°W
nca2	36.088350	°N	82.422590	°W
nca3	36.088610	°N	82.421990	°W
ncb1	36.089990	°N	82.422640	°W
ncb2	36.089160	°N	82.423950	°W
ncc1	36.093580	°N	82.426960	°W
ncc2	36.093480	°N	82.425755	°W
ncc3	36.093100	°N	82.425270	°W
ncc4	36.092980	°N	82.424990	°W
ncd1	36.094100	°N	82.426480	°W
ncd2	36.094050	°N	82.427010	°W
ncd3	36.094410	°N	82.426470	°W
nce1	36.086270	°N	82.431120	°W
nce2	36.865300	°N	82.430930	°W
ncf1	36.036820	°N	82.425470	°W
ncf2	36.086310	°N	82.425670	°W
NC *Adlumia fungosa*	36.071667	°N	82.418333	°W
NC *Buckleya distichophylla*	36.088610	°N	82.421990	°W
NC *Cymophyllus fraserianus* 1	36.090278	°N	82.427222	°W
NC *Cymophyllus fraserianus* 2	36.092778	°N	82.438333	°W
NC *Cymophyllus fraserianus* 3	36.086280	°N	82.430680	°W
NC *Cymophyllus fraserianus* 4	36.085556	°N	82.431111	°W
NC *Cymophyllus fraserianus* 5	36.089270	°N	82.428050	°W
NC *Diervilla sessilifolia v rivularis* 1	36.084167	°N	82.425000	°W
NC *Diervilla sessilifolia v rivularis* 2	36.150833	°N	82.443333	°W
NC *Falco peregrinus*	36.082778	°N	82.420000	°W
NC *Lysimachia terrestris*	36.097222	°N	82.433333	°W
NC *Spirea virginiana*	36.081944	°N	82.424167	°W

Table 2.19.5. TES element 2005 monitoring information at Nolichucky Cliffs

Species	Collec -tion #	GPS coordinates	Repro- ductive	Non- reprod- ductive	Area (m2)	Status	Concerns	Notes
Buckleya distichophylla		36.08861º N, 82.42199º W	0%	100%	1	fair	Little reproduction	Nca3
Cymophyllus fraseri	395	36.08628º N, 82.43068º W	0 (0%)	10 (100%)		fair	Blowdown	In Long Branch Cove past huge blowdown on west side
Cymophyllus fraseri	396	36.08927º N, 82.42805º W	20 (71%)	8 (29%)	1000	vigorous	None	Veg reprod, above and below trail bed

Chapter 20
North River / Queen Cove – Big Junction Quad, 35.32043º N, 84.11482º W
Prioritization Rank – Soon, 18th out of 26.
Site Photos – North River / Queen Cove

Summary

North River / Queen Cove contains a woodland bog within a *Tsuga canadensis - Liriodendron tulipifera / Rhododendron maximum / Tiarella cordifolia* Forest (CEGL007543, G5) (Table 2.20.1). **Management action for this site is prioritized as SOON, and ranked 18 of 26 sites**. The greatest threats facing this site are invasive species, recreation, and sedimentation. Management actions should include monitoring the invasives (Table 2.20.4), manually removing invasives that are currently present on the site, closing campsite 4 to stop degradation of the bog, and monitoring TES species (Table 2.20.2).

Table 2.20.1. Community types listed at North River / Queen Cove (Major *et al*. 2000).

Classification	Name	G rank
CEGL007543	**Tsuga canadensis - Liriodendron tulipifera / Rhododendron maximum / Tiarella cordifolia* Forest	G5

* Not sampled

TES Elements

***Cymophyllus fraserianus* (G4/S3) (Table 2.20.3)** - This perennial sedge is found in rocky, humid, acidic areas, often around streams (Robinson 1982). It prefers semi- to heavy shade, and populations react negatively to increased light levels and the pioneer species that establish after disturbance. It blooms from March to May (Radford *et al*. 1964). The sedge has poor dispersal ability (NatureServe 2007), but nevertheless has higher than expected diversity for a rare plant (Godt *et al*. 2004). Degradation of mature streamside habitats may lead to decreased diversity. Dr. Robert Kral (Botanical Research Institute of Texas) expected that both thinning and grazing would destroy populations (Robinson 1982).

***Hemidactylium scutatum* (G5/S3) (Table 2.20.3) -** Females nest in mosses and under woody debris, so it is important to maintain these in the habitat (Wisconsin Department of Natural Resources 2006). Burning would remove these important habitat components, so that management action is strongly discouraged within the bog area. Uplands may be burned if precautions are taken to insure the salamander's nesting habitat is preserved.

***Juglans cinerea* (G4/S3) (Table 2.20.3) –** This hickory prefers moist, rich woods (NatureServe 2007). It has a severely decreased occurrence due to butternut canker. Replanting programs are being tested, currently and global population levels appear to be stable after a 77% decline since 1967. There are no known methods of protecting the tree from butternut canker, so conserving the remaining healthy trees is the most important management action currently feasible. Seedlings do not successfully establish under closed canopies, so if seedlings are discovered, canopy removal may help spur recruitment into larger stem classes. Optimal growth occurs on bottomlands and floodplains with well drained soils. It grows best in full sun.

***Juncus gymnocarpus* (G4/S3) (Table 2.20.3) -** This species is found in shady margins of sphagnum bogs. To keep populations healthy, water levels must be maintained at low levels and the overstory trees should be kept in place (Robinson 1982).

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Table 2.20.2. Threats and management actions for North River/Queen Cove. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / communities that should benefit
Invasive Species	1	Fence off bog		5	once	0B:2H	fair	low	
Invasive Species	1	Herbicide *Microstegium* and *Elaeagnus*	11	0.5	once	0B:2H	fair	low	
Invasive Species	1	Manually remove *Elaeagnus umbellata* and *Microstegium vimenium*	2	1	every five years	3B:0H	very good	high	*Juncus, Hemidactylium, Cymophyllus*
Invasive Species	1	Monitor invasive species	1			3B:0H	good	med	*Juncus, Hemidactylium, Cymophyllus*
Invasive Species	1	Monitor TES species	7	0.5	annually	4B:0H	good	med	*Juncus, Hemidactylium, Cympophyllus, Juglans*
Recreation	2	Close campsite #4	3	0.5	once	2B:0H	very good	high	*Juncus, Hemidactylium*
Sedimentation	3	Dig out sedimentation inputs	8	1	as needed	3B:0H	good	med	*Juncus, Hemidactylium, Cymophyllus*
Sedimentation	3	Monitor sedimentation inputs	6			3B:0H	good	med	*Juncus, Hemidactylium, Cymophyllus*
Sedimentation	3	Monitor *Sphagnum* mats	4	0.5	annually	1B:0H	good	med	*Hemidactylium*
Woody Encroachment	4	Girdle trees/shrubs	5	1	as needed	2B:0H	very good	med	*Juncus, Hemidactylium*
Woody Encroachment	4	Monitor *Sphagnum* mats	4	0.5	annually	1B:0H	good	med	*Hemidactylium*
Channel Modification	5	Install bank support in bog at road edge	9	10	once	2B:0H	good	high	*Juncus, Hemidactylium*
Channel Modification	5	Monitor TES species	7	0.5	annually	4B:0H	good	med	*Juncus, Hemidactylium, Cympophyllus, Juglans*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / communities that should benefit
Incompatible Agricultural Practices	6	?	?	?	?	?	?	?	?
Incompatible Water Quality	7	Close campsite #4	3	0.5	once	2B:0H	very good	high	*Juncus, Hemidactylium*
Incompatible Water Quality	7	Monitor water quality		0.5	once	2B:0H	very good	high	*Juncus, Hemidactylium*
Incompatible Forestry Practices and Management	8	Girdle trees	?	0	no action	2B:0H	good	med	*Juncus, Hemidactylium*
Forestry Roads	8	Install bank support in bog at road edge	9	10	once	2B:0H	good	high	*Juncus, Hemidactylium*
Altered Fire Regime	8	Monitor *Sphagnum* mats	4	0.5	annually	1B:0H	good	med	*Hemidactylium*
Overexploitation of Species	8	Monitor TES species	4	0.5	annually	3B:0H	good	med	*Hemidactylium, Juncus, Cypripedium*
Forestry Roads	8	Nothing	12	0	continued	0B:0H	fair	low	none
Erosion	9	Install bank support in bog at road edge	9	10	once	2B:0H	good	high	*Juncus, Hemidactylium*
Erosion	9	Monitor sedimentation inputs	6	0.5	annually	3B:0H	good	med	*Juncus, Hemidactylium, Cymophyllus*
Erosion	9	Monitor *Sphagnum* mats	4	0.5	annually	1B:0H	good	med	*Hemidactylium*
Incompatible Resource Extraction	9	Monitor *Sphagnum* mats	4	0.5	annually	1B:0H	good	med	*Hemidactylium*
Airborne Pollutants	9	Monitor TES species	7	0.5	annually	4B:0H	good	med	*Juncus, Hemidactylium, Cympophyllus, Juglans*
Parasites / Pathogens	9	Release adelgid predator	10	0.5	as needed	1B:0H	very good	med	*Tsuga*

Table 2.20.3. GPS coordinates of TES elements and invasives at North River / Queen Cove.

Point Name	GPS Coordinates			
NRQC *Microstegium vimenium*	35.315328	°N	84.109466	°W
NRQC *Eleagnus umbellata*	35.319598	°N	84.114749	°W
NRQC *Cymophyllus fraserianus*	35.315556	°N	84.111389	°W
NRQC *Hemidactylium scutatum*	35.322500	°N	84.115833	°W
NRQC *Juglans cinerea*	35.321667	°N	84.116944	°W
NRQC *Juncus gymnocarpus*	35.320556	°N	84.114167	°W

Table 2.20.4. Invasive species 2004 monitoring at North River / Queen Cove

	GPS coordinates			
Species	**N**	**W**	**Photos**	**Notes**
Microstegium vimenium	35.3153º	84.10947º	NRQC Queen Cove beaver pond 7 *Microstegium*	covers back portion of bog at beaver pond
Eleagnus umbellate	35.3196º	84.11475º	NRQC campsite - *Eleagnus umbellate*	along edges

Chapter 21
Pine Knob – Elk Mills Quad, 36.299420º N, 81.93450º W
Prioritization Rank – Soon, 11th out of 26.
Site Photos - Pine Knob

Summary

Pine Knob contains an extremely southern example of a *Thuja occidentalis* Saturated Woodland (CEGL003675, G?) (Table 2.21.1). Several TES species are found within the TVA powerline right-of-way that cuts through the site. **This site has a management priority of SOON and it is ranked 11 of 26 for management action**. Primary threats include woody encroachment, incompatible forestry practices and management, invasive species, and development of roads and utilities (Table 2.21.2). Recommended actions include continuing the current powerline maintenance and monitoring the TES species, collaborating with TVA to lessen any possible impacts to the community or TES species, and searching for invasive species (Table 2.21.6).

Table 2.21.1. Community types listed at Pine Knob (Major *et al*. 2000).

Classification	Name	G rank
CEGL003675	**Thuja occidentalis* Saturated Woodland	G?

***Not sampled**

TES Elements

***Cypripedium reginae* (G4/S1) -** This orchid is found in semi-wet areas and likes calcareous substrates, but will grow in slightly acidic environments (NatureServe 2007). It grows well in full sun to semi-shade. It does not survive well in deep shade or in dry conditions. Threats to this species include harvesting, habitat alteration, hydrologic alteration, water contamination through run-off, soil compaction, canopy closure, logging, deer browsing, trampling, and over-collecting. Globally, the species is stable, but at the periphery of its range it is in decline. Management areas that house this species should be large enough for natural or prescribed disturbances to occur (NatureServe 2007). Major tasks include the prevention of over-harvesting and maintenance of hydrologic integrity of *C. reginae* habitat.

***Spiranthes lucida* (G5/S1S2) (Table 2.21.3) –** Shining ladies' tresses, an herbaceous perennial, is found in calcareous soils of moist banks, wet meadows, lakeshores, damp woods, and marshes (Andreas 1983). Threats include trampling, soil compaction, over-collection and habitat desiccation, as well as land-use conversion, habitat fragmentation, and forestry practices (Andreas 1983, NatureServe 2007).

***Thuja occidentalis* (G5/S3) (Table 2.21.4)** - The northern white cedar prefers wet forests so it is abundant in swamps where fast-growing trees cannot compete (NatureServe 2007). It is also known to invade openings caused by cutting, windfall or recently burned swamps to create even-aged stands. This very long lived tree can exceed 800 years old. *Thuja* is threatened by over browsing from deer. It is very susceptible to fire due to thin bark, shallow roots and high oil content. White cedar slash can be a fire hazard for 20-30 years due to its decay resistance. Land fragmentation and land-use conversion are moderate risks. It can also be negatively impacted by surrounding land use.

***Zigadenus glaucus (elegans* ssp. *glaucus)* (G4/S1) (Table 2.21.3, Table 2.21.5) –** This camas can be found on calcareous cliffs, bluffs, slopes, and shores, as well as in marshes, fens, and mesic-hydric meadows. It does not tolerate heavy disturbances and declines have occurred from habitat degradation. Succession and woody encroachment, alteration of hydrology, invasive species, and trampling are all threats that face this species.

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Table 2.21.2. Threats and management actions for Pine Knob. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Woody Encroachment	1	Bushhog powerline right-of-way a safe distance downslope	7	1	decadally	3B:3H?	good	med	*Zigadenus, Cypripedium, Spiranthes*
Woody Encroachment	1	Continue powerline maintenance	1	0.5	as needed - TVA	5B:5H?	?	?	CEGL003675, *Cypripedium, Zigadenus, Spiranthes, Thuja*
Incompatible Forestry Practices and Management	2	Monitor TES species	2	0.5	annually		very good	high	CEGL003675, *Cypripedium, Zigadenus, Spiranthes, Thuja*
Development of Roads / Utilities	3	Collaborate with TVA to lessen impacts	3	1	as needed	5B:0H	good	med	CEGL003675, *Cypripedium, Zigadenus, Spiranthes, Thuja*
Invasive Species	3	Search for invasives	4	1	biannually	5B:0H	very good	high	CEGL003675, *Cypripedium, Zigadenus, Spiranthes, Thuja*
Parasites / Pathogens	4	?	?	?	?	?	?	?	?
Sedimentation	4	Monitor powerline slope into lake	5	0.5	biannually	5B:0H	good	med	CEGL003675, *Cypripedium, Zigadenus, Spiranthes, Thuja*
Operation of Dams / Impoundments	4	Monitor TES species	8	0	continued	5B:0H	very good	high	CEGL003675, *Cypripedium, Zigadenus, Spiranthes, Thuja*
Recreation	4	Signage - Fragile ecosystem! Tread carefully.	6	1	once	3B:0H	good	high	*Zigadenus, Cypripedium, Spiranthes*

Table 2.21.3. GPS coordinates of TES elements at Pine Knob.

Point Name	GPS Coordinates			
PK *Spiranthes lucida*	36.299167	°N	81.935278	°W
PK *Zigadenus glaucus*	36.299420	°N	81.934850	°W

Table 2.21.4. *Thuja occidentalis* monitoring at Pine Knob.

Thuja #	Size class	Canopy cover (%)	Comment
1	understory	93.5	
2	subcanopy	88.82	
3	understory	92.5	
4	understory	85	
5	understory	10	
6	understory	25	
7	overstory	30	sickly - dead branches
8	understory	50	
9	overstory	10	sickly
10	overstory	10	sickly
11	subcanopy	30	sickly
12	understory	90	85% leaves gone
13	overstory	70	
14	subcanopy	70	
15	overstory	15	
16	overstory	5	
17	clump	30	3 saplings, 1 understory, 4 subcanopy, 2 overstory sizes = 10 stems
18	sapling	95	
19	subcanopy	5	
20	subcanopy	30	
21	subcanopy	30	
22	subcanopy	30	

Table 2.21.5. *Zigadenus glaucus* 2005 monitoring at Pine Knob.

Species	GPS coordinates	Repro	Nonrepro	area	status	concerns	notes
Zigadenus glaucus	36.29942º N, 81.93485º W	11 (100%)	0 (0%)	100m2	vigorous	none	on steep slope directly above water and below powerline; not all plants counted because of difficulty of movement here

Table 2.21.6. Invasive species at Pine Knob.

Species	Population length (m)	Population width (m)	GPS coordinates N	W	Photos	Notes
Microstegium vimenium						all over ridgetop and powerline row
Ailanthus altissima						scattered

Chapter 22
Ripshin Ridge – Iron Mountain Gap Quad, 36.18726º N, 82.16642º W
Prioritization Rank – Soon, 8th out of 26.
Site Photos - Ripshin Ridge

Summary

Ripshin Ridge is a high elevation site that contains examples of the *Quercus rubra / (Kalmia latifolia, Rhododendron maximum) / Galax urceolata* Forest (CEGL007299, G4), *Aesculus flava - Betula alleghaniensis - Acer saccharum / Acer spicatum / Caulophyllum thalictroides - Laportea canadensis* Forest (CEGL004973, G3), *Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Aster chlorolepis - Dryopteris intermedia* Forest (CEGL004982, G3), and *Saxifraga michauxii Herbaceous* Vegetation (CEGL004524, G3?) (Table 2.22.1). **Ripshin Ridge is prioritized as SOON, and it is ranked 8 out of 26 for management action**. Threats include overexploitation of species, recreation, and forestry roads. Recommended management actions include gating roads and placing signage at entrances to the site that remind users to stay on trails and prohibit vehicular traffic (Table 2.22.3).

Table 2.22.1. Community types listed at Ripshin Ridge (Major *et al*. 2000; monitoring points listed in Table 2.22.4).

Classification	Name	G rank
CEGL007299	*Quercus rubra / (Kalmia latifolia, Rhododendron maximum) / Galax urceolata* Forest	G4
CEGL004524	**Saxifraga michauxii Herbaceous* Vegetation	G3?
CEGL004973	*Aesculus flava - Betula alleghaniensis - Acer saccharum / Acer spicatum / Caulophyllum thalictroides - Laportea canadensis* Forest	G3
CEGL004982	*Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Aster chlorolepis - Dryopteris intermedia* Forest	G3

*** Not sampled**

Communities Found

On Ripshin Ridge (RR), four out of the five site-groups matched the overstory of the same expected association, the High Elevation Red Oak (*Quercus rubra / (Kalmia latifolia, Rhododendron maximum) / Galax urceolata)* Forest. Group B at Ripshin Ridge contains two species that appear likely to increase in abundance in future decades, *Acer saccharum* and *Quercus prinus* (Table 2.22.2). *Fraxinus americana* and *Quercus rubra* are current overstory dominants that may actually decrease in occurrence. On RR-D, though, *Quercus rubra* appears to be persistent (Table 2.22.2). The only species that may increase in abundance is *Acer saccharum*. On RR-

G, overstory dominants *Acer rubrum*, and *Acer saccharum* show no indication of substantial change (Table 2.22.2). No species appear to be increasing in abundance on the site. On RR-J the only species that may increase in abundance is *Prunus serotina* (Table 2.22.2). Both overstory dominants, *Acer rubrum* and *Quercus rubra*, have random size distributions so are perhaps persistent on the site-group.

RR-F did not match either of the expected associations but it did match the Chestnut Oak (Xeric Ridge Type) (*Quercus prinus, Quercus coccinea) / Kalmia latifolia / Galax urceolata*) Forest (S = .50). On RR-F, *Acer rubrum*, has a random size distribution, so may be sustainable in the site-group (Table 2.22.2). The other two current overstory dominants, *Nyssa sylvatica* and *Quercus prinus*, may actually decrease in abundance in the next several decades. *Quercus rubra* is likely to increase in abundance, based on its size distribution.

Table 2.22.2. Species dominances and population trends within Ripshin Ridge. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups				
Species	**rr-b**	**rr-d**	**rr-f**	**rr-g**	**rr-j**
Acer rubrum			*a,b,c,d*	*c,d*	*a,b,c,d*
Acer saccharum	**A,B,C,D**	**A,B,C**		*a,b,c*	
Betula allegheniensis		**c**			
Betula lenta			**b**		*a,b*
Fraxinus americana	**d**				
Magnolia fraseri		*b,c*			
Nyssa sylvatica			**b,d**		
Oxydendron arboreum			**b,c**		
Prunus serotina					**B**
Quercus prinus	**A**		**d**		**a,b**
Quercus rubra	**d**	*a,b,c,d*	**A**	*d*	*c,d*
Tsuga canadensis			**b**		

TES Elements

***Clintonia borealis (*G5/S2S3) (Table 2.22.5)** - *Clintonia* is usually found in homogeneous colonies (Anonymous 2007*b*). It is native to the boreal forest but is also found coniferous, mixed and cool, temperate *Acer* forests. *Clintonia* only grows in shade. It takes over twelve years to establish a clone and produce flowers. It blooms from late May through June and sets fruit in August and September (Radford *et al*. 1964). *Clintonia* is very sensitive to deer browsing due to its slow growth rate.

***Corvus corax* (G5/S2) -** This sedentary, non migratory bird can nest in large flocks of several hundred individuals (NatureServe 2007). In the southern Appalachians, it repeatedly uses the same nests, which are found on rocky cliffs and in conifers between 45 and 80 feet above the ground (Alsop 2001). It prefers scrubby woodland habitat of mixed hardwoods and conifers (University of Michigan Museum of Zoology 2006) and has no serious predators. Home ranges vary between 0.2 and 40 square kilometers (NatureServe 2007).

***Corydalis sempervirens* (G4/S1S2) (Table 2.22.5) -** This herbaceous plant grows on dry soils and in disturbed sites, particulularly rock cliffs and outcrops (Radford *et al*. 1964). It also germinates well after fire (Cushwa *et al*. 1968). It is vulnerable to human encroachment and altered disturbance regimes because it has an uncommon habitat and limited distribution (NatureServe 2007). It blooms from April to June (Radford *et al*. 1964).

***Cypripedium acaule* (G5/S4) (Table 2.22.5) -** This orchid needs partial canopy cover and soil with a pH around 4.5 (Anonymous 2007*a*). Threats include habitat destruction, disturbance, invasive plant competition, over-collection for sales and medicinal purposes, and fire suppression. It survives well in the face of forestry practices, however (NatureServe 2007). Management practices that benefit *Platanthera integrilabia* should also benefit this orchid.

***Eupatorium steelei* (G4/S3) –** This perennial can be found in openings and on roadsides at higher elevations of the Southern Appalachians.

***Listera smallii* (G4/S3)** – The kidneyleaf twayblade occurs in uncleared forests on steep slopes. This orchid prefers to grow in the humus of damp woods, thickets, and bogs or below rhododendron on mountain slopes. The wetland habitat is vulnerable to drainage and logging, especially in wet hemlock forests (NatureServe 2007). It blooms from June through July.

***Panax quinquefolius* (G3/S3)** – Populations of this perennial herb are declining because of overharvest of the roots, overbrowsing by deer, and timber harvesting. Currently, few populations are of a viable size; in the Great Smoky Mountain National

Park that size is 510 individuals. Plants can be marked with dye and magnetic chips to help reduce illegal harvest of plants. Also harvests are supposed to be coordinated with planting efforts by the harvester of seeds from the harvested plants, but sometimes those seeds are not yet mature or are planted ineffectively. Education of legal harvesters and increased enforcement against illegal harvests are needed to ensure future viability of ginseng populations. Distributing pamphlets or even requiring that harvesters take a class covering proper techniques before they can be licensed may help protect the species. Harvesters should dig only mature plants after seeds have reached maturity. All regulations surrounding ginseng harvests should be strictly enforced. Plants begin to reproduce between the ages of 4 and 7 (Nantel *et al*. 1996).

Platanthera orbiculata **(G5/S3) –** This orchid is capable of extended dormancies possibly because the lack of sunlight in its habitat (NatureServe 2007, Hapeman 1996) and occurs within small populations. Ideal habitats are shaded areas of forests, where germination requires mycorrhizal associations (Hapeman 1996). It is found most often in acidic mesic areas (Whiteaker *et al.* 1998). The species' main threats are land conversion, habitat fragmentation, and forestry practices (NatureServe 2007). Other threats include reduction of organic matter, indiscriminate pesticide applications, climate change, increased herbivory by invertebrates such as slugs and snails, and heat or drought stress.

Polygonum cilinode **(G5/S1S2) (Table 2.22.5) -** This annual smartweed is found in openings and clearings at higher elevations of the southern Appalachians and reproduces from June through September (Radford *et al.* 1964). It is top-killed by fire (Rook 2002), after which, it is capable of reproduction by seed and perhaps from root rhizomes. Reproduction is greater after severe fire than after milder fires.

Prenanthes roanensis **(G3/S3) -** This perennial herb is found at forest edges, in upper slope or ridgetop clearings, and around *Prunus pennsylvanica* in areas that have been burned (Robinson 1982). It is not found under deep canopies. Opening the canopy may increase regeneration of populations of this species (Robinson 1982). Fire may help maintain this species through decreasing competition and shade. This endemic of the southern Appalachians is restricted to elevations above 1200m and is often associated with mixed spruce/hardwood forests (NatureServe 2007). This species faces low level threats from land-use conversion and habitat fragmentation.

Saxifraga michauxii – **(G4G5/ SNR) –** This perennial herb grows on moist rocks and in seepage slopes (NatureServe 2007). It blooms from June through August. It is threatened by land-use conversion, habitat fragmentation, and forest management. Changes to the microclimate of habitats can be detrimental.

Knowledgeable People

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Table 2.22.3. Threats and management actions for Ripshin Ridge. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / communities that should benefit
Overexploitation of Species	1	Gate roads	1	1	Once	15B:0H	very good	high	CEGL007299, CEGL004524, CEGL004973, CEGL004982, *Corydalis, Clintonia, Platanthera, Prenanthes, Eupatorium, Panax, Listera, Polygonum, Saxifraga*
Recreation	2	Gate roads	1	1	Once	15B:0H	very good	high	CEGL007299, CEGL004524, CEGL004973, CEGL004982, *Corydalis, Clintonia, Platanthera, Prenanthes, Eupatorium, Panax, Listera, Polygonum, Saxifraga*
Recreation	2	Signage - Fragile ecosystem! Tread carefully.	2		Once	5B:0H	good	med	CEGL004524, *Corydalis, Clintonia, Platanthera, Listera*
Forestry Roads	3	Gate roads	1	1	Once	15B:0H	good	med	CEGL007299, CEGL004524, CEGL004973, CEGL004982, *Corydalis, Clintonia, Platanthera, Prenanthes, Eupatorium, Panax, Listera, Polygonum, Saxifraga*
Forestry Roads	3	Signage - Fragile ecosystem! No vehicular traffic.	2	1	Once	5B:0H	very good	med	CEGL004524, *Corydalis, Clintonia, Platanthera, Listera*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / communities that should benefit
Development of Roads / Utilities	4	Gate roads	1	1	Once	15B:0H	very good	high	CEGL007299, CEGL004524, CEGL004973, CEGL004982, *Coydalis, Clintonia, Platanthera, Prenanthes, Eupatorium, Panax, Listera, Polygonum, Saxifraga*
Development of Roads / Utilities	4	Signage - Fragile ecosystem! Tread carefully.	2	1	once	5B:0H	very good	med	CEGL004524, *Corydalis, Clintonia, Platanthera, Listera*
Development of Roads / Utilities	4	Signage - No vehicular traffic, please. Foot travel is welcome.	3	1	once	15B:0H	very good	med	CEGL007299, CEGL004524, CEGL004973, CEGL004982, *Corydalis, Clintonia, Platanthera, Prenanthes, Eupatorium, Panax, Listera, Polygonum, Saxifraga*
Forest Conversion	5	burn ridge	6	1	every twenty years	5B:3H	fair	med	CEGL007299, *Corydalis, Cypripedium, Eupatorium, Prenanthes*
Erosion	5	Monitor erosion channels	5	0.5	annually	2B:0H	good	high	*Clintonia, Eupatorium*
Parasites / Pathogens	5	monitor for sudden oak death as it approaches	7	1	as needed	1B:0H	good	med	CEGL007299
Invasive Species	5	Search for invasives	4	1	biannually	15B:0H	very good	high	CEGL007299, CEGL004524, CEGL004973, CEGL004982, *Corydalis, Clintonia, Platanthera, Prenanthes, Eupatorium, Panax, Listera, Polygonum, Saxifraga*
Urban / Suburban Development	5	Signage - Fragile ecosystem! Tread carefully.	2	1	once	5B:0H	good	med	CEGL004524, *Corydalis, Clintonia, Platanthera, Listera*

Table 2.22.4. GPS coordinates of plots and elements at Ripshin Ridge

Point Name	GPS Coordinates			
rra1	36.187260	°N	82.166420	°W
rra2	36.186800	°N	82.167400	°W
rrb1	36.188880	°N	82.167500	°W
rrb2	36.188720	°N	82.167700	°W
rrb3	36.188680	°N	82.168010	°W
rrc1	36.192110	°N	82.165280	°W
rrc2	36.192130	°N	82.160050	°W
rrd1	36.194480	°N	82.162580	°W
rrd2	36.194880	°N	82.163280	°W
rrd3	36.195280	°N	82.163610	°W
rre1	36.202860	°N	82.163330	°W
rre2	36.203390	°N	82.163470	°W
RR *Clintonia borealis* 1	36.195556	°N	82.165000	°W
RR *Clintonia borealis* 2	36.192500	°N	82.164444	°W
RR *Clintonia borealis* 3	36.197222	°N	82.159722	°W
RR *Clintonia borealis* 4	36.189722	°N	82.167222	°W
RR *Clintonia borealis* 5	36.196930	°N	82.159880	°W
RR *Clintonia borealis* 6	36.195500	°N	82.162220	°W
RR *Clintonia borealis* 7	36.193230	°N	82.164080	°W
RR *Clintonia borealis* 8	36.194480	°N	82.162580	°W
RR *Clintonia borealis* 9	36.195150	°N	82.163390	°W
RR *Corvus corax*	36.193611	°N	82.166111	°W
RR *Corydalis sempervirens* 1	36.191389	°N	82.166667	°W
RR *Corydalis sempervirens* 2	36.195278	°N	82.161667	°W
RR *Corydalis sempervirens* 3	36.187510	°N	82.166410	°W
RR *Cypripedium acaule*	36.203390	°N	82.163470	°W
RR *Platanthera orbiculata* 1	36.191111	°N	82.167778	°W
RR *Platanthera orbiculata* 2	36.195278	°N	82.163056	°W
RR *Polygonum cilinode* 1	36.191389	°N	82.166667	°W
RR *Polygonum cilinode* 2	36.195278	°N	82.161667	°W
RR *Polygonum cilinode* 3	36.195890	°N	82.106070	°W

Point Name	GPS Coordinates			
RR *Prenanthes roanensis* 1	36.193056	°N	82.163889	°W
RR *Prenanthes roanensis* 2	36.189722	°N	82.167222	°W
RR *Prenanthes roanensis* 3	36.193889	°N	82.162500	°W
RR *Saxifraga michauxii*	36.182778	°N	82.167500	°W

Table 2.22.5. TES element monitoring at Ripshin Ridge

Species		GPS coordinates	Repro	Nonrepro	area	status	concerns	Notes
Polygonum cilinode	N	36.19589º N, 82.10607º W	250 (25%)	750 (75%)	>1000m2	vigorous	none	
Clintonia borealis	N	36.19693º N, 82.15988º W	1 (100%)	0 (0%)	1m2	poor	pop size	
Clintonia borealis	N	36.19505º N, 82.16222º W	0 (0%)	75 (100%)	34m2	fair	repro	Staked
Clintonia borealis	N	36.19323º N, 82.16408º W	1 (8%)	11 (92%)	<1m2	poor		unsanctioned trail surrounds population
Clintonia borealis				8	>1000m2	fair	repro	scattered just S of High Rock
Corydalis sempervirens	N	36.18751º N, 82.16641º W	68 (48%)	73 (52%)	480m2	vigorous	none	
Cypripedium acaule?	N		38	17		good	none	on big rock between d & e trans
Clintonia borealis	N	36.19448º N, 82.16258º W	0 (0%)	4 (100%)		good	none	
Clintonia borealis	N	36.19515º N, 82.16339º W	1 (0%)	1873 (100%)	>1000m2	vigorous	none	pic 99, 55 d 11 m, 350 d, 29m; populations drops down slope and to NNW, between 2 cliffs
Cypripedium acaule?	N	36.20339º N, 82.16347º W	5 (55%)	4(45%)	1m2	fair		dense *Kalmia*

Chapter 23
Sheeds Creek – Hemp Top & Caney Creek Quads, 34.997433º N, 84.621328º W
Prioritization Rank – Soon, 14th out of 26.
Site Photos - None

Summary

Sheeds Creek is a *Liquidambar styraciflua - Liriodendron tulipifera - (Platanus occidentalis) / Carpinus caroliniana - Halesia tetraptera / Amphicarpaea bracteata* Forest (CEGL007880, G4) (Table 2.23.1). **Its priority for management is SOON and it ranks 14 of the 26 sites for action**. Threats that face Sheeds Creek include invasive species, agricultural conversion, and incompatible forestry practices and management (Table 2.23.2). Invasives should be monitored and manually removed (Tables 2.23.3, and 2.23.4), and a prescribed burn conducted on the site.

Table 2.23.1 Community Types Listed at Sheeds Creek (Major *et al*. 2000)

Classification	Name	G rank
CEGL007880	**Liquidambar styraciflua - Liriodendron tulipifera - (Platanus occidentalis) / Carpinus caroliniana - Halesia tetraptera / Amphicarpaea bracteata* Forest	G4

*** Not sampled**

TES Elements

***Panax quinquefolius* (G3/S3)** – Populations of this perennial herb are declining because of overharvest of the roots, overbrowsing by deer, and timber harvesting. Currently, few populations are of a viable size; in Great Smoky Mountains National Park that size is 510 individuals. Plants can be marked with dye and magnetic chips to help reduce illegal harvest of plants. Also harvests are supposed to be coordinated with planting efforts by the harvester of seeds from the harvested plants, but sometimes those seeds are not yet mature or are planted ineffectively. Education of legal harvesters and increased enforcement against illegal harvests are needed to ensure future viability of ginseng populations. Distributing pamphlets or even requiring that harvesters take a class covering proper techniques before they can be licensed may help protect the species. Harvesters should dig only mature plants after seeds have reached maturity. All regulations surrounding ginseng harvests should be strictly enforced. Plants begin to reproduce between the ages of 4 and 7 (Nantel *et al*. 1996).

Knowledgeable People

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Table 2.23.2. Threats and management actions for Sheeds Creek. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Invasive Species	1	Manually remove *Microstegium vimenium*	2	2	annually in late summer, early fall	2B:0H	very good	med	CEGL007880, *Panax*
Invasive Species	1	Monitor invasives	1	0.5	annually	2B:0H	good	med	CEGL007880, *Panax*
Agricultural Conversion	2	Monitor invasives	1	0.5	annually	2B:0H	good	med	CEGL007880, *Panax*
Agricultural Conversion	2	Monitor water quality	7	0.5	annually	2B:0H	good	med	CEGL007880, *Panax*
Incompatible Forestry Practices and Management	3	prescribed burn	3	1	rarely	1B:0H	good	med	CEGL007880
Recreation	3	Signage - Fragile ecosystem! Tread carefully.	4	1	once	2B:0H	good	med	CEGL007880, *Panax*
Incompatible Forestry Practices and Management	3	Small group cuts	8	5	As needed	1B:0H	good	med	CEGL007880
Sedimentation	4	Monitor sedimentation in creek	5	0.5	annually	2B:0H	good	med	CEGL007880, *Panax*
Forestry Roads	4	Nothing	9	0	continued	0B:0H	fair	high	CEGL007880, *Panax*
Channel Modification	5	Install water control device in future beaver dams	6	1	As needed	2B:0H	good	med	CEGL007880, *Panax*
Operation of Dams / Impoundments	5	install water control device in future beaver dams	6	1	As needed	2B:0H	good	med	CEGL007880, *Panax*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Altered Fire Regime	5	Manually remove *Microstegium vimenium*	2	2	once before fires	2B:0H	very good	med	CEGL007880, *Panax*
Incompatible Water Quality	5	Monitor water quality	7	0.5	annually	2B:0H	good	med	CEGL007880, *Panax*
Altered Fire Regime	5	prescribed burn	3	1	rarely	1B:0H	good	med	CEGL007880
Altered Fire Regime	5	Small group cuts	8	5	as needed	1B:0H	good	med	CEGL007880

Table 2.23.3. GPS coordinates of invasive species at Sheeds Creek.

Point Name	GPS Coordinates			
SCK *Microstegium vimenium*	34.998840	°N	84.620620	°W

Table 2.23.4. *Microstegium vimenium* monitoring at Sheeds Creek, 2005.

Species	GPS coordinates N	W	Photos	Notes
Microstegium vimenium	34.99884º	84.62062º	SCK - Microstegium 1 SCK - *Microstegium* 2 SCK - *Microstegium* 3 SCK - *Microstegium* 4 SCK - *Microstegium* 5 SCK *Trillium* and *Microstegium*	scattered all over site, in field, in fire break, along stream and between stream and road

Chapter 24
Stony Creek Bog – Doe & Shady Valley Quads, 36.49967º N, 81.98498º W
Prioritization Rank – Later, 24th out of 26.
Site Photos - Stony Creek Bog

Summary

Stony Creek Bog contains an example of a *Tsuga canadensis - Acer rubrum - (Liriodendron tulipifera, Nyssa sylvatica) / Rhododendron maximum / Sphagnum* spp. Forest (Table 2.24.1). **The site's management priority is LATER and the need for action is ranked 24 out of 26**. Some of the threats that were found at Stony Creek Bog include forest conversion, channel modification, and invasive species (Table 2.24.3). Recommended management actions to consider are monitoring *Tsuga* decline, closing the dispersed campsites (Table 2.24.6), monitoring invasives, and monitoring erosion channels.

Table 2.24.1. Community types listed at Stony Creek Bog (Major *et al*. 2000; monitoring points listed in Table 2.24.4).

Classification	Name	G rank
CEGL007565	*Tsuga canadensis - Acer rubrum - (Liriodendron tulipifera, Nyssa sylvatica) / Rhododendron maximum / Sphagnum* spp. Forest	G2

Communities Found

Stony Creek Bog's group B contains one overstory species, *Fraxinus americana* that may remain a canopy dominant over the next few decades (Table 2.24.2). *Betula lenta* and *Quercus rubra* are likely to decrease in occurrence. *Acer rubrum*'s size distribution suggests neither an increase nor decrease in abundance of the species. SCB-G had three overstory dominants. One of them, *Betula lenta*, is likely to have a decreased importance in the site-group, and the other two, *Acer rubrum* and *Quercus rubra* will probably persist (Table 2.24.2). The only species that appears to be increasing in abundance on SCB-G is *Prunus serotina*. SCB-J contains two species likely to increase in abundance: *Magnolia fraseri* and *Magnolia tripetala* (Table 2.24.2). No other species appear likely to gain or maintain dominance. All overstory dominants, *Acer rubrum*, *Quercus prinus*, and *Quercus rubra*, will likely not undergo substantial changes in their abundances.

Table 2.24.2. Species dominances and population trends within Stony Creek Bog. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups		
Species	**scb-b**	**scb-g**	**scb-j**
Acer rubrum	*b,d*	*a,b,c,d*	*c,d*
Betula lenta	**c,d**	**c,d**	
Fraxinus americana	**A,B,C,D**		
Magnolia fraseri		**b**	**B**
Magnolia tripetala			**B**
Oxydendron arboreum	*a,c*		**b**
Prunus serotina		**A,B**	
Quercus prinus			*d*
Quercus rubra	**d**	*b,d*	*a,d*
Tilia americana var. *heterophylla*	**c**		

TES Elements

***Juncus gymnocarpus* (G4/S3) (Table 2.24.5) -** This species is found in shady margins of sphagnum bogs. To keep populations healthy, water levels must be maintained at low levels and the overstory trees should be kept in place (Robinson 1982).

***Platanthera orbiculata* (G5/S3) –** This orchid is capable of extended dormancies possibly because the lack of sunlight in its habitat (NatureServe 2007, Hapeman 1996) and occurs within small populations. Ideal habitats are shaded areas of forests, where germination requires mycorrhizal associations (Hapeman 1996). It is found most often in acidic mesic areas (Whiteaker *et al.* 1998). The species' main threats are land conversion, habitat fragmentation, and forestry practices (NatureServe 2007). Other threats include reduction of organic matter, indiscriminate pesticide applications, climate change, increased herbivory by invertebrates such as slugs and snails, and heat or drought stress.

Knowledgeable People

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Table 2.24.3. Threats and management actions for Stony Creek Bog. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Forest Conversion	1	Monitor *Tsuga* decline	1	0.5	bianually	1B:0H	good	med	CEGL007565
Forest Conversion	1	Release adelgid predator	5	0.5	bianually	1B:0H	good	med	CEGL007565
Channel Modification	2	Close dispersed campsites	2	0.5	once	3B:0H	good	med	CEGL007565, *Juncus, Panax*
Recreation	3	Close dispersed campsites	2	0.5	once	3B:0H	good	med	CEGL007565, *Juncus, Panax*
Erosion	3	Monitor erosion channels	4	0.5	annually	3B:0H	good	high	CEGL007565, *Juncus, Panax*
Invasive Species	3	Monitor invasives	3	0.5	bianually	3B:0H	good	high	CEGL007565, *Juncus, Panax*

Table 2.24.4. GPS coordinates of plots and elements at Stony Creek Bog

Point Name	GPS Coordinates			
scba1	36.499620	°N	81.987040	°W
scba2	36.499880	°N	81.986480	°W
scba3	36.500020	°N	81.985960	°W
scbb1	36.499900	°N	81.985250	°W
scbb2	36.499680	°N	81.985360	°W
scbc1	36.499670	°N	81.984890	°W
scbc2	36.499520	°N	81.985110	°W
scbc3	36.499180	°N	81.985300	°W
scbc4	36.498970	°N	81.985820	°W
scbc5	36.498200	°N	81.986080	°W
SCB campsite monitoring 1	36.499990	°N	81.984090	°W
SCB campsite monitoring 2	36.500100	°N	81.985950	°W
SCB *Juncus gymnocarpus* 1	36.508889	°N	81.985556	°W
SCB *Juncus gymnocarpus* 2	36.510000	°N	81.985950	°W
SCB *Platanthera orbiculata*	36.499444	°N	81.999722	°W

Table 2.24.5. Element monitoring 2005 at Stony Creek Bog

	GPS coordinates							
Species	**N**	**W**	**Repro-ductive**	**Non-reproductive**	**Area (m2)**	**Status**	**Concerns**	**Notes**
Juncus gymnocarpus	36.5001º	81.9859º	46 (100%)	0 (0%)	1000	vigorous		

Table 2.24.6. Campsite monitoring at Stony Creek Bog, 2005

Campsite 1		**TRANS 1**	**transect start**	**junction of AT and stream (0m)**	
N	36.49999º		direction transect	35º	
W	81.98409º		end	start of upslope on other side of seep (58.5 m)	
pics	28				
	29		**distance (m)**	**species**	**comments**
	30		58.5	*Rhododendron maximum*	at seep
	31		52.8	*Thelyptris*	becomes gradually more sparse
	32			*Prenanthes*	
	33			*Viola*	
	34			*Mitchella repens*	
	35			*Smilax*	
	36			*Acer rubrum*	
				Maianthimum canadense	
			44.5		no veg cover
			43	*Prenanthes*	
				Discorea	
				Thelyptris	
				Amelanchier seedling	
				Acer pennsylvanica	
				Anemone	
				Rhododendron	bare field layer except small Galax
			36	*maximum*	patch
			15	grass	few tufts
			14		bare
			5	*Viola*	patch in wet area near stream
			3		bare soil at AT
			0		bare soil at AT

	-1	bryophytes	below AT at streamside
		Houstonia	
		Viola	
		Kalmia	

TRANS 2	transect start	non degraded area	
	direction	310º	
	transect end	above firepit on slope	

distance (m)	**species**	**comments**
0	*Polygonatum*	
	Thelyptris	
	Vaccinium sp	
	Quercus rubra seedlings	
	Sanicula	
	Osmunda cinnamomea	
	Smilax rotundifolia	
	Conopholis americana	
	Mitchella repens	
	Acer rubrum seedlings	
	Amelanchier seedlings	
	Oxydendron seedlings	
	bryophytes	
	Discorea	
	Galax urceolata	
	Medeola virginiana	
	Clintonia umbellata	
	Convullaria montana	
	Trillium petiolata	

	Arisaema triphyllum	
	Viola	
	Prunus serotina seedlings	
	Ilex montana	
	Rhododendron canescens	
22.5	*Viola*	vacc shrub at 22.5m
	Sanicula	
	Acer seedling	
	Rhododendron maximum	
26		no veg
36.6	*Thelyptris*	
	Acer seedling	
	Tsuga seedling	
37.8		no veg until Tsuga sapling at 42.5m
42.5	*Tsuga canadensis*	other veg is under Tsuga
	Galax urceolata	
	Smilax rotundifolia	
43.8		out from under Tsuga, no veg
48.6	grass	patchy
50.3		no veg
53.1	bryophytes	
	Viola	
	grass	
	Aster	around dried stream bed
55.5	bryophytes	up hill to 75.4m, patchy
	saplings	

		TRANS	transect	
Campsite 2		3	start	base of *Fraxinus* near trail
N	36.5001º		direction	103º
W	81.98595º		transect	other side of large fallen log

Pics	end **distance (m)**	**species**	**comments**
		Osmunda	
37	0	*cinnamomea*	path into site from At
38		*Discorea*	
39		*Arisaema triphyllum*	
40		*Kalmia latifolia*	
		Prunus serotina	
		Rhododendron	
42	2.4	*canescens*	kind of bare
43		*Acer rubrum* seedlings	
44		*Podophyllum peltatum*	
45	6.9	*Arisaema triphyllum*	very sparse
46		*Viola*	
47		*Trautvetteria caroliniensis*	
48		thin wiry grass	
		Rubus sp	
		Houstonia seriphyllum	
		opp red petiolate	
		alt fuzzy serrate	
		fern- thrice cut grooved w/ pale bracts	
		Acer seedlings	
		Prenanthes	
		Polystichum acrostichoides	
		grass - long head	
	13	*Smilax rotundifolia*	bare to log at 20.7m
		Voila	
	20.7	*Viola*	to tsuga at 23 m
		Prenanthes	
		Arisaema triphyllum	
		Polygonatum	

Chapter 25
Sugar Cove – Big Junction Quad, 35.344090º N, 84.040370º W
Prioritization Rank – Soon, 19th out of 26.
Site Photos - Sugar Cove

Summary

Sugar Cove contains an *Aesculus flava - Betula alleghaniensis - Acer saccharum / Acer spicatum / Caulophyllum thalictroides - Laportea canadensis* Forest (CEGL004973, G3) (Table 2.25.1). **The site's management priority is SOON and it is ranked 19 of the 26 sites**. The main threats that face Sugar Cove are invasives, sedimentation, and forestry roads (Table 2.25.3). Recommended management actions include manually removing invasives, searching for other invasives that may be present (Table 2.25.5), monitoring the creek for sedimentation, and gating the access trail.

Table 2.25.1. Community types listed at Sugar Cove (Major *et al*. 2000; monitoring points listed in Table 2.25.4).

Classification	Name	G rank
CEGL004973	*Aesculus flava - Betula alleghaniensis - Acer saccharum / Acer spicatum / Caulophyllum thalictroides - Laportea canadensis* Forest	G3

Communities Found

Sugar Cove (SCV) contained three different site-groups, also. The overstory of SCV-B most closely matched the expected association of the Southern Appalachian Northern Hardwood (*Aesculus flava – Betula alleghaniensis – Acer saccharum / Acer spicatum / Caulophyllum thalictroides – Laportea canadensis*) Forest. Sugar Cove, group B contains three overstory dominant species (Table 2.25.2). Two of those, *Acer saccharum* and *Aesculus flava*, appear likely to remain canopy dominants, based on their size distributions. The other overstory dominant, *Fagus grandifolia*, exhibits a size distribution that indicates it will likely decrease in abundance in the next several decades, especially in the face of the looming beech bark disease epidemic.

SCV-D did not match any association or alliance well. In SCV-D four of the overstory dominants, *Acer rubrum, Betula lenta, Liriodendron tulipifera*, and *Robinea pseudoacacia*, are likely to decrease in abundance in future decades (Table 2.25.2). The other overstory dominant, *Quercus prinus* displays a size distribution that suggests it will likely persist in the site-group, but may lose dominance in future decades. The only species that appears to be increasing in the site-group is *Fagus grandifolia*, though beech bark disease could decrease its occurrence in the site-group.

SCV-F matched the Chestnut Oak (Xeric Ridge Type) (*Quercus prinus*, *Quercus coccinea*) / *Kalmia latifolia* / *Galax urceolata*) Forest (S = 1.0). All the species in SCV-F displayed decreasing size distributions, including the overstory dominants *Quercus coccinea* and *Quercus prinus* (Table 2.25.2).

Table 2.25.2. Species dominances and population trends within Sugar Cove. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups		
Species	**scv-b**	**scv-d**	**scv-f**
Acer rubrum		**c,d**	**b,c**
Acer saccharum	**A,C,D**	**b**	
Aesculus flava	**A,D**		
Betula lenta		**d**	
Fagus grandifolia	**a,b,c,d**	**A,B**	
Liriodendron tulipifera		**d**	
Nyssa sylvatica		**b**	
Oxydendron arboreum			**c**
Quercus coccinea			**d**
Quercus prinus		*b,d*	**c,d**
Robinea pseudoacia		**d**	
Tsuga canadensis		*a,b,c*	

TES Elements

***Euonymus obovatus* (G5/S2) -** This plant grows best in partial shade to full sun in moist environments of coves and streambanks and under hardwoods (Radford *et al*. 1964). It flowers from May to June and sets fruit in September and October.

***Streptopus roseus* (G5/S1S2) -** The rosy twisted-stalk requires moist soil in full or partial shade. It is primarily found in beech gaps and under birch trees at high elevations, and it prefers cool, acidic soils. No threats are immediately evident for this species, though beech bark disease could potentially have a negative impact on populations that occur in association with *Fagus grandifolia*.

***Synaptomys cooperi* (G5/S4) -** The southern bog lemming is a small rodent with a ¼-1 acre range (NatureServe 2007). Densities vary from 5 to 35 per ha, reaching 89/ha in peak years (Banfield 1974), and colonies are scarce and scattered. This lemming prefers boggy habitat and is common in marshes, meadows and upland forests with a deep humus layer. It utilizes a 6-12 in deep burrow system. After a 21-23 day gestation period, 1-8 (avg 2-5) young are born underground. The breeding season is year round with a peak in April-Sept. This lemming's diet consists primarily of herbaceous plants; leaves, stems, seeds, and rootstocks, especially of grasses and sedges, as well as small fruits (Connor 1959). It is active, foraging day and night throughout the year. Expanding meadow vole populations may displace populations of the lemming. Fire may also drive it out of areas.

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Table 2.25.3. Threats and management actions for Sugar Cove. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treatments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Invasive Species	1	Manually remove *Rosa palustris*	1	1	every five years	4B:0H	good	med	CEGL004973, *Streptopus, Euonymus, Synaptomys*
Invasive Species	1	Search for *Microsteguim vimenium*	2	1	anually	4B:0H	very good	high	CEGL004973, *Streptopus, Euonymus, Synaptomys*
Sedimentation	2	Monitor creek for sedimentation	3	0.5	annually	3B:0H	good	med	CEGL004973, *Synaptomys, Euonymus*
Forestry Roads	3	Gate access trail	4	0	continued	4B:0H	very good	high	CEGL004973, *Streptopus, Euonymus, Synaptomys*
Incompatible Forestry Practices and Management	4	Do not harvest	5	0	no action	3B:0H	good	med	CEGL004973, *Synaptomys, Streptopus*
Recreation	5	Signage - Fragile ecosystem. Tread carefully.	6	1	once	4B:0H	good	med	CEGL004973, *Streptopus, Euonymus, Synaptomys*
Recreation	5	Signage - Fragile species! Stay on trail, please.	6	1	once	4B:0H	good	med	CEGL004973, *Streptopus, Euonymus, Synaptomys*
Altered Fire Regime	6	Do not burn	7	0	no action	4B:0H	good	med	CEGL004973, *Streptopus, Euonymus, Synaptomys*
Channel Modification	6	Monitor channels	8	0.5	biannually	2B:0H	good	med	CEGL004973, *Synaptomys*

Table 2.25.4. GPS coordinates of plots and elements at Sugar Cove.

Point Name	GPS Coordinates			
scva1	35.331800	°N	84.057380	°W
scva2	35.335100	°N	84.056620	°W
scvb1	35.344090	°N	84.040370	°W
scvb2	35.342680	°N	84.039780	°W
SCV *Euonymus obovatus*	35.345833	°N	84.038611	°W
SCV *Streptopus roseus*	35.341667	°N	84.170833	°W
SCV *Synaptomys cooperi*	35.339722	°N	84.174722	°W

Table 2.25.5. Invasive species monitoring at Sugar Cove.

Species	Population length (m)	Population width (m)	GPS N	W	Photos	Notes
Rosa multiflora					None	1 patch near FS 217, outside of site boundary

Chapter 26
Whetstone Branch – Grayson Quad, 36.605870º N, 81.681980º W
Prioritization Rank – Now-Right Now 6th out of 26.
Site Photos - Whetstone Branch

Summary

Whetstone Branch contains several communities (Table 2.26.1): *Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Aster chlorolepis - Dryopteris intermedia* Forest (CEGL007710, G4), *Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana var. heterophylla) / Cimicifuga racemosa - Laportea canadensis* Forest (CEGL007097, G3), *Pinus pungens - Pinus rigida -(Quercus prinus) / Kalmia latifolia- Vaccinium pallidum* Woodland (CEGL007285, G3G4), *Quercus rubra / (Kalmia latifolia, Rhododendron maximum) / Galax urceolata* Forest (CEGL007299, G4), and *Danthonia compressa - (Sibaldiopsis tridentata)* Herbaceous Vegetation (CEGL004242, G1). **The site is prioritized as in need of management action NOW-RIGHT NOW and it is ranked 6 of 26 sites**. Threats include invasive species, forest conversion, forestry roads, and second home / vacation home development (Table 2.26.3). Recommendations are that signage is used to keep horses to designated trails (Table 2.26.5), invasives and *Pinus pungens* monitored, the *Pinus pungens* ridges burned, and that roads into the site be gated.

Table 2.26.1. Community types listed at Whetstone Branch (Major *et al*. 2000; monitoring points listed in Table 2.26.4).

Classification	Name	G rank
CEGL007710	*Betula alleghaniensis - Fagus grandifolia - Aesculus flava / Viburnum lantanoides / Aster chlorolepis - Dryopteris intermedia* Forest	G4
CEGL007097	*Liriodendron tulipifera - Aesculus flava - (Fraxinus americana, Tilia americana* var. *heterophylla) / Cimicifuga racemosa - Laportea canadensis* Forest	G3
CEGL007285	*Pinus pungens - Pinus rigida -(Quercus prinus) / Kalmia latifolia- Vaccinium pallidum* Woodland	G3G4
CEGL007299	*Quercus rubra / (Kalmia latifolia, Rhododendron maximum) / Galax urceolata* Forest	G4
CEGL004242	**Danthonia compressa - (Sibaldiopsis tridentata)* Herbaceous Vegetation	G1

Communities Found

At Whetstone Branch (WB), the overstories of all of the expected associations' were matched by site-groups. WB-A's overstory matched the Southern Appalachian Northern Hardwood (*Betula alleghaniensis – Fagus grandifolia – Aesculus flava)* Forest.

At Whetstone Branch's group A, *Fagus grandifolia* is an overstory dominant with a likelihood of continued importance, given its size distribution pattern (Table 2.26.2). The occurrence of beech bark disease would negatively impact the species, though.

WB-B and WB-E both matched the overstory of an Appalachian Cove (Mixed Mesophytic) (*Liriodendron tulipifera – Aesculus flava –* (*Fraxinus americana, Tilia americana* var. *heterophylla*) / *Cimicifuga racemosa – Laportea canadensis*) Forest. On WB-B, two species may increase or maintain importance in future decades: *Acer saccharum* and *Quercus rubra* (Table 2.26.2). *Betula alleghaniensis* and *Tilia americana* var. *heterophylla* exhibit the potential for decreased future abundances in the site-group. *Fraxinus americana* is a current overstory species with a more neutral size distribution pattern that suggests it will continue to persist within the site-group. At WB-E size distributions of *Acer rubrum* and *Quercus rubra* indicate that they may increase in dominance (Table 2.26.2). On the other hand, *Liriodendron tulipifera* will likely become a lesser component of the site-group.

WB-G matched the overstory of the High Elevation Red Oak (*Quercus rubra / (Kalmia latifolia, Rhododendron maximum) / Galax urceolata)* Forest and WB-J matched the overstory of the Blue Ridge Table Mountain Pine – Pitch Pine (*Pinus pungens, Pinus rigida – (Quercus prinus) / Kalmia latifolia – Vaccinium pallidum*) Woodland. Group G at Whetstone Branch has one species that displays a size distribution indicative of increased future abundance, *Fagus grandifolia* (Table 2.26.2). Beech bark disease will likely contribute to the species' decline, however. *Acer rubrum* is a current dominant, but its size distribution suggests that it will decrease in future decades. *Quercus rubra* will likely remain steady on the site-group. WB-J contains one species that may have an increased future abundance: *Magnolia fraseri* (Table 2.26.2). *Quercus prinus* appears to be on the decline, based on its size distribution pattern.

In WB-D, codominants were *Acer rubrum* (IV=61.9) and *Quercus prinus* (IV=38.1). This site-group had neither a good associational nor alliance match. On WB-D *Acer rubrum, Liriodendron tulipifera*, and *Quercus prinus* have the same random size distributions (Table 2.26.2). Species with decreasing size distributions included *Betula alleghaniensis*, *Betula lenta,* and *Oxydendron arboreum*. *Fagus grandifolia, Quercus rubra,* and *Tsuga canadensis* all appear likely to increase dominance within the site-group.

Table 2.26.2. Species dominances and population trends within Whetstone Branch. Letters included in the table indicate the strata in which each species is dominant (a = sapling layer, b = understory, c= subcanopy, and d = overstory). Entries in bold upper case letters indicate inverse-J size distributions, lower case bold indicate decreasing size distributions, and lower case italicized indicate neutral size distributions.

	Site Groups					
Species	**wb-a**	**wb-b**	**wb-d**	**wb-e**	**wb-g**	**wb-j**
Acer rubrum	**b,c**		*a,b,c,d*	**A**	**c,d**	**b,c**

Species	Site Groups wb-a	wb-b	wb-d	wb-e	wb-g	wb-j
Acer saccharum		**A,B,C,D**		**b**		
Betula allegheniensis		**c,d**	**c**			
Betula lenta			**c**			
Fagus grandifolia	**A,B,C,D**		**B**		**A,B**	
Fraxinus americana		*d*				
Liriodendron tulipifera			*d*	**d**		
Magnolia fraseri						**A**
Oxydendron arboreum			**b**			
Quercus prinus			**a,d**			*d*
Quercus rubra		**A**	**A**	**A**	*d*	
Tilia americana var. heterophylla		**d**				
Tsuga canadensis		**c**	**A,B**	**b,c**		

TES Elements

***Abies fraseri* (G2/S3) -** The main threat facing the species is the balsam wooly adelgid. Mature trees die from secondary diseases and pests after the adelgid attacks, but young recruits are more able to withstand infestations (Burns and Honkala 1990). Sometimes fir recruitment increases after infestations. One study found the densities of fir and spruce saplings increased in plots where overstory fir trees had succumbed to the balsam wooly adelgid (Busing *et al.* 1988). Fir mortality also increased birch dominance. Increasing nitrogen in the soil will enhance cone production of Fraser firs (Arnold *et al.* 1992).

***Allium tricoccum* (G5/S1S2) –** This perennial herb grows in rich mesic soils. Collections may have severe implications on the sustainability of the species in the southern Appalachians (Rock *et al*. 2004). Researchers ran simulated collections and found that sustainable levels of harvest for the species in the southern limit of its range may be as low as 10% of individuals of populations once every 10 years. Their simulation removed plants of all sizes, but they admit that this varies from real harvest methods, which probably preferentially remove larger plants. This method decreases vegetative reproduction within populations. Personal collections of *Allium tricoccum* should be permitted and restricted to extremely low levels of harvest. Sustainable levels are still unknown, but are sure to be at or below 10% once every ten years. We recommend that collection permits be restricted only to specific sites known to contain vigorous populations and that collections on any given site be limited to 5-10% harvest every ten years. In other words, if a population has 100 individuals in year one, 5 to10 individuals could be harvested within a ten-year period. The next ten-year harvest period should begin after a population has been re-evaluated.

***Cardamine clematis* (G3/S2)** - This perennial herb is a southern Appalachian endemic that is found on rocky streamsides at high elevations above 1000 m (3280 ft) (NatureServe 2007). It blooms from April to May. Survey data collected in Tennessee and North Carolina suggest that populations are currently stable. Threats include land-use conversion, habitat fragmentation, forest management practices, invasive species, atmospheric pollutant deposition, and trampling (NatureServe 2007). Populations that suffer declines in abundance may be slow to recover because of low dispersal capabilities and low fecundity. Preferred habitat is wet areas near or in edges of streams that have little competition from other herbaceous plants, an overhead canopy that allows light to reach the population, and a lack of litter accumulation. It roots in moss, rock crevices, or occasionally in soil. Viable populations in high quality habitats should have more than 500 stems; fair populations should contain 51-100 stems (NatureServe 2007).

***Clintonia borealis* (G5/S2S3)** - *Clintonia* is usually found in homogeneous colonies (Anonymous 2007*b*). It is native to the boreal forest but is also found coniferous, mixed and cool, temperate *Acer* forests. *Clintonia* only grows in shade. It takes over twelve years to establish a clone and produce flowers. It blooms from late May through June and sets fruit in August and September (Radford *et al*. 1964). *Clintonia* is very sensitive to deer browsing due to its slow growth rate.

***Eupatorium steelei* (G4/S3) –** This perennial can be found in openings and on roadsides at higher elevations of the Southern Appalachians.

***Hydrophyllum virginianum* (G5/S3) –** This perennial herb can be found on moist slopes of rich woods. Threats include land-use alteration and habitat fragmentation.

***Listera smallii* (G4/S3)** – The kidneyleaf twayblade occurs in uncleared forests on steep slopes. This orchid prefers to grow in the humus of damp woods, thickets, and bogs or below rhododendron on mountain slopes. The wetland habitat is vulnerable to drainage and logging, especially in wet hemlock forests (NatureServe 2007). It blooms from June through July.

***Menziesia pilosa* (G4G5/S2)** - The minniebush is found on sunny rock outcrops at high altitudes. Since the minniebush is found in rocky, rugged habitats, anthropogenic disturbance is rare. The generation and regeneration of boulderfields through landslides and avalanches are common erosional processes in *Menziesia* habitats (Hack and Goodlett 1960). It is not fire adapted, and thus may be sensitive to fire.

***Paronychia argyrocoma* (G4/S1S2) –** These perennial herbs may grow individually or in small groups (Schori 2001). Individuals bloom from June to September. The plant may grow best in open areas with full to partial shade and little to no

competition in the root zone. They grow well on cliffs, sandbars and gravel slopes, and populations may regenerate successfully after disturbance. Well established plants can develop woody stems. Damage from rock climbing and wind scour may threaten the species on slopes. No new rock climbing routes should be established over populations. Burial by sediment and competition from invasive species are major concerns in riverine habitats. OHV use may also damage populations. Fire may destroy existing populations of this species, but also open up the habitat for reestablishment. Any use of fire within habitats of *Paronychia aryrocoma* should be accompanied by careful monitoring of population responses. In New England, conservation goals include maintaining populations with at least 75% flowering individuals. This objective is a good place to start for Whetstone Branch populations, too. Monitoring should be conducted on at least a bi-yearly basis to track the health and vigor of populations.

Platanthera orbiculata **(G5/S3) –** This orchid is capable of extended dormancies possibly because the lack of sunlight in its habitat (NatureServe 2007, Hapeman 1996) and occurs within small populations. Ideal habitats are shaded areas of forests, where germination requires mycorrhizal associations (Hapeman 1996). It is found most often in acidic mesic areas (Whiteaker *et al.* 1998). The species' main threats are land conversion, habitat fragmentation, and forestry practices (NatureServe 2007). Other threats include reduction of organic matter, indiscriminate pesticide applications, climate change, increased herbivory by invertebrates such as slugs and snails, and heat or drought stress.

Prenanthes roanensis **(G3/S3) -** This perennial herb is found at forest edges, in upper slope or ridgetop clearings, and around *Prunus pennsylvanica* in areas that have been burned (Robinson 1982). It is not found under deep canopies. Opening the canopy may increase regeneration of populations of this species (Robinson 1982). Fire may help maintain this species through decreasing competition and shade. This endemic of the southern Appalachians is restricted to elevations above 1200m and is often associated with mixed spruce/hardwood forests (NatureServe 2007). This species faces low level threats from land-use conversion and habitat fragmentation.

Scutellaria saxatilis **(G3/S3) –** Rock skullcap is an herbaceous perennial that requires moist shaded habitat and blooms June through August (Radford *et al.* 1964, Dolan 2004). The biggest threats to *Scutellaria saxatilis* are exotic species like *Microstegium vimenium* and *Lonicera japonica* and loss of canopy (Dolan 2004, NatureServe 2007). Other threats include burning, grazing, woody encroachment, and trampling. Management actions should include protection of enough habitats for population growth and monitoring of those populations. Invasive species and encroaching woody shrubs should be removed and canopy trees preserved. In Great Smoky Mountains National Park, removal of shrubs and saplings in 2001 temporarily boosted population numbers, but in 2003 numbers again fell. Posting signs at populations near trailsides may help prevent trampling.

***Sphyrapicus varius* (G5/S1) -** The Yellow-bellied Sapsucker can be found in forests and woodlands throughout much of North America (NatureServe 2007). The southern Appalachians of Tennessee and North Carolina represent its southernmost breeding areas. Standing dead trees are an important part of this bird's habitat. Sapsuckers excavate cavities which other avian species also use and create sapwells that lead to greater abundance and diversities of insects. Cavities are found 3-14 meters above the ground. Food items consist of inner bark and sap of drilled trees, ants, wasps, mayflies, moths, spruce budworms, beetles, fruit, aspen buds, and suet (Terres 1980).

***Streptopus roseus* (G5/S1S2) -** The rosy twisted-stalk requires moist soil in full or partial shade. It is primarily found in beech gaps and under birch trees at high elevations, and it prefers cool, acidic soils. No threats are immediately evident for this species, though beech bark disease could potentially have a negative impact on populations that occur in association with *Fagus grandifolia*.

***Zapus hudsonius* (G5/S4) -** The meadow jumping mouse is generally solitary although it may change habits in response to a drying habitat (NatureServe 2007). Its home range is about 1 ha for males and less for females. Density ranges from 7-48/ha and varies from year to year. It breeds from late April to early September, with peak breeding occuring in July and August. After 17-20 days of gestation, 2-9 pups appear (the average is 4-6), and 2-3 litters are common in a year. Young are independent after 4 weeks of weaning and breed the summer following birth. Life span is short, approximately 2-3 years. The mouse inhabits grassland/herbaceous areas, old fields, and chapparal /shrublands. It burrows in banks or hills or hides under logs when inactive, and prefers thick vegetation of open grassy and bushy areas of marshes, meadows, swamps and streamsides. It is mostly nocturnal but often observed during the day. It hibernates from September-October to April-May.

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Table 2.26.3. Threats and management actions for Whetstone Branch. The threats were ranked from survey response data collected using methods similar to Sutter and Szell (2006). The list of possible actions is at each site is also ranked, using objective opinion and a review of studies and current knowledge. Some monitoring of elements or sites has been initiated (Tables in §2: Individual Site Assessments) and most sites have forest community composition data (§3.1: Plot Data). The Benefit:Harm ratio is a comparison of the results of a successfully implemented action on TES species and on Forest communities where B = # of elements likely to benefit from the action and H = # of elements likely to be harmed as a consequence of the action. The Significance column is a subjective ranking of the possible success of the action and the Confidence column is a subjective ranking of the action's capability of achieving that success.

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Invasive Species	1	Monitor invasives	2	0.5	annually	19B:0H	good	high	CEGL004242, CEGL007710, CEGL007097, CEGL007285, CEGL007299, *Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Invasive Species	1	Signage - Keep horses to designated trails midslopes and xeric areas of ridgelines	1	1	once	15B:0H	very good	med	CEGL004242, *Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Forest Conversion	2	Burn *Pinus pungens* ridge, med-high intensity	4	1	decadally	1B:0H	very good	high	CEGL007097
Forest Conversion	2	Monitor *Pinus pungens*	3	0.5	every five years	1B:0H	very good	high	CEGL007097
Forestry Roads	3	Fence off ridgetop seeps, rock outcrops, and bogs	11	2	once	4B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria, Paronychia*
Forestry Roads	3	Gate access roads near top of ridge	5	1	once	4B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria, Paronychia*
Second Home / Vacation Development	4	Fence off ridgetop seeps, rock outcrops, and bogs	11	2	once	4B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria, Paronychia*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Second Home / Vacation Development	4	Gate access roads near top of ridge	5	1	once	4B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria, Paronychia*
Recreation	5	Clear and maintain trails	10	1	annually in early spring	19B:0H	good	med	CEGL004242, CEGL007710, CEGL007097, CEGL007285, CEGL007299, *Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Recreation	5	Fence off ridgetop seeps, rock outcrops, and bogs	11	2	once	4B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria, Paronychia*
Recreation	5	Gate access roads near top of ridge	5	1	once	4B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria, Paronychia*
Recreation	5	Signage - Keep horses to designated trails midslopes and xeric areas of ridgelines	1	once	once	15B:0H	very good	med	CEGL004242, *Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Recreation	5	Signage - Keep horses to designated trails.	1	once	once	21B:0H	good	med	CEGL004242, CEGL007710, CEGL007097, CEGL007285, CEGL007299, *Sphyrapicus, Zapus, Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Altered Fire Regime	6	Burn *Pinus pungens* ridge, med-high intensity	4	1	decadally	1B:0H	very good	high	CEGL007098
Woody Encroachment	6	Burn *Pinus pungens* ridge, med-high intensity	4	1	decadally	1B:0H	very good	high	CEGL007097

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Airborne Pollutants	7	Monitor TES species	6	0.5	annually	15B:0H	good	med	*Sphyrapicus, Zapus, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Incompatible Forestry Practices and Management	8	Burn *Pinus pungens* ridge, med-high intensity	4	1	decadally	1B:0H	very good	high	CEGL007097
Incompatible Forestry Practices and Management	8	Burn ridgeline balds on a rotation, protecting *Menziesia* population	7	1	annually	1B:0H	very good	high	CEGL004242
Sedimentation	8	Do not build additional creek crossings	13	0	no action	5B:0H	very good	med	*Cardamine, Scutellaria, Hydrophyllum, Allium, Streptopus*
Sedimentation	8	Fence off ridgetop seeps and bogs	11	2	once	3B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria*
Erosion	8	Search for and monitor erosion channels	14	0.5	annually	5B:0H	good	high	*Cardamine, Scutellaria, Hydrophyllum, Allium, Streptopus*
Development of Roads / Utilities	9	Clear and maintain trails	10	1	annually in early spring	19B:0H	good	med	CEGL004242, CEGL007710, CEGL007097, CEGL007285, CEGL007299, *Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Channel Modification	9	Fence off ridgetop seeps and bogs	11	2	once	4B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria*
Incompatible Water Quality	9	Fence off ridgetop seeps and bogs	11	2	once	4B:0H	very good	high	CEGL004242, *Hypericum, Scutellaria*
Parasites / Pathogens	9	Monitor *Pinus pungens*	3	0.5	every five years	1B:0H	very good	high	CEGL007097
Incompatible Water Quality	9	Monitor water quality of streams	15	0.5	once	4B:0H	very good	High	CEGL004242, *Hypericum, Scutellaria*

Threat/Element	Threat Rank	Action	Action Rank	Time (days)	Timing of treat-ments	Benefit: Harm ratio	Signifi-cance	Confi-dence	Elements / Communities that should benefit
Development of Roads / Utilities	9	Signage - No vehicular traffic, please. Foot travel is welcome.	8	1	once	21B:0H	very good	med	CEGL004242, CEGL007710, CEGL007097, CEGL007285, CEGL007299, *Sphyrapicus, Zapus, Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Development of Roads / Utilities	9	Signage - Sensitive Species. Do not disturb.	9	0.5	once	15B:0H	very good	med	CEGL004242, *Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Overexploitation of Species	9	Signage - Sensitive Species. Do not disturb.	9	0.5	once	15B:0H	good	med	CEGL004242, *Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*
Development of Roads / Utilities	9	Signage -Fragile ecosystem. Please stay on sanctioned trails.	12	1	once	21B:0H	very good	med	CEGL004242, CEGL007710, CEGL007097, CEGL007285, CEGL007299, *Sphyrapicus, Zapus, Allium, Prenanthes, Cardamine, Paronychia, Hypericum, Menziesia, Hydrophyllum, Abies, Scutellaria, Clintonia, Streptopus, Eupatorium, Listera, Platanthera*

Table 2.26.4. GPS coordinates of plots and elements at Whetstone Branch

Point Name	GPS Coordinates			
wba1	36.605870	°N	81.681980	°W
wba2	36.606180	°N	81.681660	°W
wba3	36.606290	°N	81.680210	°W
wbb1	36.605600	°N	81.679310	°W
wbb2	36.605030	°N	81.678850	°W
wbc1	36.601380	°N	81.677810	°W
wbc2	36.603220	°N	81.680610	°W
wbd1	36.608740	°N	81.683780	°W
wbd2	36.608630	°N	81.685190	°W
wbd3	36.608560	°N	81.685850	°W
wbe1	36.588611	°N	81.696083	°W
wbe2	36.589028	°N	81.697278	°W
wbe3	36.589556	°N	81.698000	°W
wbf1	36.594194	°N	81.690667	°W
wbf2	36.595611	°N	81.691028	°W
wbf3	36.597417	°N	81.691222	°W
WB *Cardamine clematitis* 1	36.600556	°N	81.685833	°W
WB *Cardamine clematitis* 2	36.599444	°N	81.677778	°W
WB *Cardamine clematitis* 3	36.599810	°N	81.677860	°W
WB *Clintonia borealis*	36.587778	°N	81.696111	°W
WB *Eupatorium steelei*	36.714722	°N	81.683889	°W
WB *Hydrophyllum virginianum* 1	36.600556	°N	81.677778	°W
WB *Hydrophyllum virginianum* 2	36.599444	°N	81.677778	°W
WB *Hydrophyllum virginianum* 3	36.587778	°N	81.696111	°W
WB *Hydrophyllum virginianum* 4	36.590556	°N	81.697222	°W
WB *Hydrophyllum virginianum* 5	36.598100	°N	81.677860	°W
WB *Hypericum mitchellianum* 1	36.587500	°N	81.685000	°W
WB *Hypericum mitchellianum* 2	36.587390	°N	81.685361	°W
WB *Listera smallii* 1	36.608333	°N	81.683333	°W
WB *Listera smallii* 2	36.593611	°N	81.684444	°W
WB *Listera smallii* 3	36.606380	°N	81.683290	°W

Point Name	GPS Coordinates			
WB *Listera smallii* 4	36.606830	°N	81.683430	°W
WB *Menziesia pilosa*	36.587500	°N	81.685000	°W
WB *Paronychia argyrocoma*	36.591667	°N	81.691111	°W
WB *Prenanthes roanensis* 1	36.587500	°N	81.685000	°W
WB *Prenanthes roanensis* 2	36.583889	°N	81.701111	°W
WB *Scutellaria saxatilis* 1	36.600556	°N	81.685833	°W
WB *Scutellaria saxatilis* 2	36.599444	°N	81.677778	°W
WB *Scutellaria saxatilis* 3	36.588056	°N	81.679722	°W
WB *Scutellaria saxatilis* 4	36.587778	°N	81.696111	°W
WB *Scutellaria saxatilis* 5	36.603580	°N	81.692830	°W
WB *Scutellaria saxatilis* 6	36.589280	°N	81.690639	°W
WB *Sphyrapicus varius*	36.606944	°N	81.688611	°W
WB *Streptopus roseus* 1	36.600556	°N	81.677778	°W
WB *Streptopus roseus* 2	36.599444	°N	81.677778	°W
WB *Streptopus roseus* 3	36.590556	°N	81.697222	°W
WB *Streptopus roseus* 4	36.601600	°N	81.679070	°W
WB *Zapus hudsonius*	36.581389	°N	81.695833	°W
WB Woody encroachment monitor start	36.58764	°N	81.68219	°W
WB no horses -Catface Ridge	36.598111	°N	81.690333	°W
WB no horses - Rogers Ridge	36.588222	°N	81.688333	°W
WB no horses - Location 4	36.587388	°N	81.685361	°W
WB no horses - Location 5	36.587861	°N	81.687166	°W
WB no horses - 2nd saddle B4 Roger's Knob 1	36.588416	°N	81.68900	°W
WB no horses - 2nd saddle B4 Roger's Knob 2	36.588472	°N	81.689972	°W
WB no horses - 2nd saddle B4 Roger's Knob 3	36.588583	°N	81.689972	°W
WB no horses - 2nd saddle B4 Roger's Knob 4	36.588638	°N	81.689916	°W
WB no horses - Location 10	36.576138	°N	81.702833	°W
WB no horses - Location 11	36.59981	°N	81.67786	°W
WB no horses - Location 12	36.589277	°N	81.690638	°W
WB no horses - Location 13	36.60882	°N	81.68343	°W
WB no horses - Location 14	36.60638	°N	81.68329	°W
WB no horses - Location 15	36.60106	°N	81.67907	°W

Point Name	GPS Coordinates			
WB no horses - Location 16	36.59981	°N	81.67786	°W
WB no horses - Location 17	36.60055	°N	81.7878	°W
WB no horses - Location 18	36.60358	°N	81.69283	°W

Table 2.26.5. Poorly-sited horse trail locations at Whetstone Branch.

Location	GPS N	W	Notes
Catface Ridge	36.59811	81.6903333	flatter part on N aspect has lots of seepage areas and boulderfields
Streamside on Whetstone Branch			scattered *Hydrophyllum virginianum*, *Cimicifuga americana*, *Cardamine clematis*, and *Allium tricoccum*
Rogers Ridge	36.58822	81.6883333	wet low area, needle rush, *Juncus effusus*. Tire tracks in the middle of seeps already & main road is adjacent to seep
Location 4	36.58739	81.6853611	*Hypericum* sp.
Location 5	36.58786	81.6871667	
2nd saddle B4 Roger's Knob	36.58842	81.689	25 m down from old fence
2nd saddle B4 Roger's Knob	36.58847	81.6899722	70 m down from old fence
2nd saddle B4 Roger's Knob	36.58858	81.6899722	8 m SSW of 4 seeps in road
2nd saddle B4 Roger's Knob	36.58864	81.6899167	1 m N of 4 in road
Location 10	36.57614	81.7028333	
Location 11	36.59981	81.67786	*Cardamine clematis*
Location 12	36.58928	81.6906389	*Scutellaria saxatilis*
Location 13	36.60882	81.68343	*Listera smallii*
Location 14	36.60638	81.68329	*Listera smallii*
Location 15	36.60106	81.67907	*Streptopus roseus*
Location 16	36.59981	81.67786	*Hydrophyllum virginianum*
Location 17	36.60055	81.7878	*Allium tricoccum*
Location 18	36.60358	81.69283	*Scutellaria saxatilis*