# APPENDIX F – SPECIES DIVERSITY REPORT

## *George Washington National Forest*

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# 1.0 INTRODUCTION

Planning for ecological sustainability is an iterative two-stage process that involves first providing for a diversity of ecosystems and then by developing additional direction to meet the biological needs of specific species or species groups. Most plant and animal species will be sustained by managing for a diversity of ecosystems in the Plan area. However, additional provisions may be needed to help provide ecological conditions for specific species such as federally listed threatened and endangered (T&E) species, sensitive species and locally rare species.

This Species Diversity Report is a supplement to the Ecosystem Diversity Report, which described how the ecological characteristics for ecosystems on the George Washington National Forest (GWNF) were identified. Ecosystem characteristics were evaluated through development of an Ecological Sustainability Evaluation (ESE) database or tool, best available science, consideration of data and trends documented in the Evaluation of the Need for Change Report/Analysis of the Management Situation (AMS), annual monitoring evaluations, and internal reviews. A similar analysis process was also used to assess species diversity. This report describes the species evaluation process and uses the understanding gained from analysis of ecosystem diversity to develop additional plan components for species diversity.

# 2.0 SPECIES DIVERSITY

## 2.1 Ecosystem Context for Species

Twenty-three native ecosystems were identified for the GWNF. A system was added to cover caves and karstlands. Current acreage of each system was calculated using Forest Service GIS data. All identified terrestrial ecological systems were documented in a relational database, the ESE tool, which was based on the structure of The Nature Conservancy (TNC) planning tool. The ESE tool served as the primary process record for ecological sustainability analysis. It included documentation of scientific and other sources consulted, uncertainties encountered, and strategic choices made during development of the database.

Ecological conditions that provide for ecosystem diversity are described in detail in the Ecosystem Diversity Report. These ecological conditions were further analyzed to understand the environmental context and ability for National Forest System (NFS) lands to contribute to the diversity of plant and animal species. The following analysis process was used to determine whether, in addition to plan components for maintaining ecosystem diversity, further species-specific plan components were necessary to sustain species diversity.

As we developed the ecosystem diversity analysis, we identified that many of the ecological systems had similar key attributes, indicators, species associates and resulting forest plan components. For purposes of analysis we combined the systems into the following Ecological System Groups for the ESE Tool.

Table F-1. Ecological Systems

| Ecological System Groups | Ecological System |
|---|---|
| Spruce Forests | Central and Southern Appalachian Spruce-Fir Forest |
| Northern Hardwood Forests | Appalachian (Hemlock)-Northern Hardwood Forest |
| | Southern Appalachian Northern Hardwood Forest |
| Cove Forests | Southern and Central Appalachian Cove Forest |
| Oak Forests and Woodlands | Northeastern Interior Dry-Mesic Oak Forest |
| | Central and Southern Appalachian Montane Oak Forest |
| | Central Appalachian Dry Oak-Pine Forest |
| | Southern Appalachian Oak Forest |
| | Southern Ridge and Valley/Cumberland Dry Calcareous Forest |
| Pine Forests and Woodlands | Southern Appalachian Montane Pine Forest and Woodland |
| | Central Appalachian Pine-Oak Rocky Woodland |
| | Southern Appalachian Low-Elevation Pine Forest |
| Mafic Glade and Barrens and Alkaline Glades and Woodlands | Southern and Central Appalachian Mafic Glade and Barrens |
| | Central Appalachian Alkaline Glade and Woodland |
| Cliff, Talus and Shale Barrens | North-Central Appalachian Circumneutral Cliff and Talus |
| | North-Central Appalachian Acidic Cliff and Talus |
| | Appalachian Shale Barrens |
| Floodplains Wetlands and Riparian Areas | Central Appalachian River Floodplain |
| | Central Appalachian Stream and Riparian |
| | Central Interior Highlands and Appalachian Sinkhole and Depression Pond |
| | Southern and Central Appalachian Bog and Fen |
| | North-Central Appalachian Acidic Swamp |
| | North-Central Appalachian Seepage Fen |
| Caves and Karstlands | Caves and Karstlands |

Key attributes and indicators were identified for each of these systems to determine if the systems are performing to their desired conditions.

## 2.2 Identification and Screening of Species

The GWNF started with statewide species lists compiled from a variety of sources including the Birds of Conservation Concern list, Virginia and West Virginia State Heritage Programs tracked plant and animal lists, Virginia and West Virginia State Comprehensive Wildlife Strategy species of greatest conservation need list, Regional Forester's Sensitive Species list, federally listed Threatened and Endangered Species, and demand species. The original list consisted of about 474 plant and animal species with ranges occurring throughout Virginia and West Virginia.

Appendix F1 lists the 97 species which were removed from the list because they did not occur or have potential to occur on National Forest System lands based upon suitable habitat, range, or expert taxonomic consensus. If these species are found to occur on the GWNF, they will be re-evaluated. Of the remaining species an additional 82 species were not analyzed further because: a) the species is unaffected by management; b) the Forest is of marginal importance to conservation of the species; c) knowledge of species' ecology is insufficient to support conservation strategy; d) species' taxonomy is too uncertain to develop conservation strategy; or d) species is common and demonstrably secure on the Forest.

The remaining 295 species are addressed in this analysis. Eighty-four of these species have not been found on the Forest, but could possibly be present and nine are only historical records of species that have not been recently found.

# 3.0 THREATENED AND ENDANGERED SPECIES

This section covers threatened and endangered (T&E) species, which are those species listed by the Department of the Interior, U.S. Fish and Wildlife Service, or the National Oceanic and Atmospheric Administration, National Marine Fisheries Service as threatened or endangered. The U.S. Fish and Wildlife Service (USFWS) is the agency responsible for listing T&E species on lands managed by the GWNF. The Forest Service cooperates with USFWS efforts in conserving T&E species through protection and habitat management. The Forest Service conducts activities and programs to assist in the identification, conservation, and protection of threatened and endangered species and their habitats. Site-specific evaluations are conducted for any proposed activity that may take place within habitat for these species or near known populations. The GWNF program priorities for T&E species include:

(1) Implement Forest Service actions as recommended in recovery plans for federally listed species. In the absence of an approved recovery plan, implement and, if necessary develop interim Forest Service conservation measures. Update interim conservation measures as needed when new science becomes available.
(2) Work with USFWS and other conservation partners to develop recovery plans for federally listed species and candidate conservation agreements for species proposed for listing.
(3) Coordinate with partners to implement measures to resolve conflicts with threatened and endangered species and their habitats.
(4) Monitor trends in population and/or habitat of federally listed species.

## 3.1 Threatened and Endangered Species List

The GWNF worked cooperatively with the USFWS to develop the list of federally threatened or endangered species to be considered in the ESE process. Ten T&E species were evaluated in the ESE process (Table F-2). These 10 species are further described below.

Table F-2. Federally Listed T&E Species included in Forest Plan Revision Process

| Taxa | Species | Status |
|---|---|---|
| Mammal | Indiana Bat (*Myotis sodalis*) | Endangered |
| Mammal | Virginia Big-Eared Bat (*Corynorhinus townsendii virginianus*) | Endangered |
| Mammal | Virginia northern flying squirrel *(Glaucomys sabrinus fuscus)* | Endangered |
| Invertebrate - Mussel | James Spinymussel (*Pleurobema collina*) | Endangered |
| Invertebrate - Arthropod | Madison Cave isopod *(Antrolana lira)* | Threatened |
| Vascular Plant | Shale Barren Rock Cress (*Arabis serotinai*) | Endangered |

| Taxa | Species | Status |
|---|---|---|
| Vascular Plant | Smooth Cone Flower (*Echinacea laevigata*) | Endangered |
| Vascular Plant | Virginia Sneezeweed (*Helenium virginicum*) | Threatened |
| Vascular Plant | Swamp Pink (*Helonius bullata*) | Threatened |
| Vascular Plant | Northeastern Bulrush (*Scirpus ancistrochaetus*) | Endangered |

## 3.2 Threatened and Endangered Species Descriptions and Needed Plan Components

### 3.2.1 INDIANA BAT

**Background**

The Indiana bat is a medium-sized, *Myotis* species. On March 11, 1967, the Indiana bat was listed as a federal endangered species under the Endangered Species Preservation Act (ESPA) of 1966. Species listed under ESPA carried over and became listed by the Endangered Species Act when it became law in 1973. A recovery plan for the species was completed on October 14, 1983. In October 1996, the Indiana Bat Recovery Team released a Technical Draft Indiana Bat Recovery Plan. In October 1997, a preliminary version entitled "Agency Draft of the Indiana Bat Recovery Plan," which incorporated changes from the 1996 Technical Draft, was released. Subsequently, an agency draft entitled "Indiana Bat (*Myotis sodalis*) Revised Recovery Plan" was distributed for comments in March 1999. A final revision has never been completed. The range of the bat has been divided into recovery units. The GWNF falls within the Appalachian Mountains Recovery Unit.

Critical habitat was designated for the species on September 24, 1976 and includes 11 caves and 2 abandoned mines in Illinois, Indiana, Kentucky, Missouri, Tennessee, and Hellhole Cave in Pendleton County, West Virginia. No critical habitat is on or near the Forest and Hellhole Cave is 12.6 miles west of the Forest. The distribution of Indiana bats is generally associated with limestone caves in the eastern U.S. (Menzel et al. 2001). Within this range, the bats occupy two distinct types of habitat. During winter, the Indiana bat hibernates in caves (and occasionally mines) referred to as hibernacula. Bats are often readily found and easily counted at this time. Census of hibernating Indiana bats is the most reliable method of tracking population trends rangewide. As such, the winter distribution of the Indiana bat is well documented. Less is known about the abundance and distribution of the species during the summer maternity season, and even less is known about its migratory habits and associated range. During summer months, maternity colonies of more than 100 adult females roost under sloughing bark of dead and partially dead trees of many species, often in forested settings (Callahan et al. 1997). Reproductive females may require multiple alternate roost trees to fulfill summer habitat needs. Adults forage on winged insects within three miles of the occupied maternity roost. Swarming of both males and females and subsequent mating activity occurs at cave entrances prior to hibernation (MacGregor et al. 1999). During this autumn swarming period, bats roost under sloughing bark and in cracks of dead, partially dead and live trees in proximity to the cave used for hibernation.

Population

Based on winter surveys at Priority 1 & 2 hibernacula, plus data from Priority 3 & 4 hibernacula when available, the U.S. Fish and Wildlife Service reported in 2007 that the total population of Indiana bats was at a recent historic high of approximately 467,947 individuals (this total is still less than half the estimated population in 1960). The 2009 rangewide population estimate was 415,512 individuals, a decline of 52,435 from 2007. Reasons for the decline are unknown, but perhaps the decline was caused by White Nose Syndrome (WNS),

which was causing severe bat mortality in some cave hibernating bats in the northeastern and eastern U.S. In January 2012, the January-February 2011 rangewide total was reported at 424,708, an increase of 9,196 bats, and a number comparable to the 2005 count of 425,372 individuals (USFWS 2012).

In 2011, there were 411 hibernacula considered extant, and 62 considered historic or uncertain (USFWS 2012). In 2007, Indiana bats were known to hibernate in approximately 281 hibernacula in 19 states (USFWS 2009). Based on 2011 survey data, Indiana had 52.5% of hibernating individuals, followed by Kentucky 16.6%, Illinois 13.2%, West Virginia 4.8%, New York 3.8%, Missouri 3.2%, Tennessee 3.0%, Ohio 2.3% and the remaining eight states with hibernacula (including Virginia) 0.6% (USFWS 2012). In 2011 the eighteen Priority 1A hibernacula contained 368,597 Indiana bats, or 87% of the total known population, and 36 of 53 hibernacula classified as Priority 2A&B contained 43,328 Indiana bats, or 10% of the total known population. The remaining 340 caves considered extant, Priority 3 or 4 hibernacula contained 12,783 bats, or 3% of the total population. The four hibernacula on or near the Forest – Starr Chapel, Mountain Grove, Clarks, and Hupman's Saltpetre Caves – are considered Priority 3 or 4 hibernacula.

Data on the Indiana bat has been collected in Virginia since the early 1960's, when the state's Indiana bat population was estimated at over 5,000. Dalton (1987) found 2,500 Indiana bats hibernating in eight caves during a 10-year survey of 170 caves in 22 counties. In 1997 the state's population was estimated to be 1,840 bats. Since 2001, the estimated number of bats in Virginia has remained relatively constant, at 700 – 1100. West Virginia, has seen a steady increase in bats during the past decade, from 10,000 to 20,000 bats.

Table F-3. Indiana bat population levels

| | 2001 | 2003 | 2005 | 2007 | 2009 | 2011 |
|---|---|---|---|---|---|---|
| Virginia | 969 | 1,158 | 769 | 723 | 730 | 863 |
| West Virginia | 9,714 | 11,443 | 13,417 | 14,745 | 17,965 | 20,358 |

Population estimates of hibernating bats, provided by Rick Reynolds of the Virginia Department of Game and Inland Fisheries, suggest that bat populations in the four hibernacula on associated with the GWNF fluctuate substantially. In general, however, caves with lower numbers of bats seem to maintain low numbers, while caves with higher numbers maintain relative higher numbers of bats (Table F-3a).

Four hibernacula are known to occur on, or within 2 miles, of the Forest. All four caves are gated to control human access. Bat numbers fluctuate from count-to-count, but caves with lower numbers of bats seem to maintain low numbers, while caves with higher numbers maintain relative higher numbers of bats (Table F-3a).

Table F-3a. Indiana Bats in Hibernacula on or Near the GWNF
(Caves with Primary and Secondary Cave Protection Areas on land managed by GWNF)
(Number of Bats Counted per Rick Reynolds - VDGIF)

| Winter Survey Year | Starr Chapel Cave | Mt. Grove Cave | Clarks Cave | Hupman's Saltpetre Cave |
|---|---|---|---|---|
| 1960 | 600 | | | |
| 1962 | 600 | | | |
| 1970 | | | | |
| 1972 | 35 | | | |
| 1974 | 30 | | | |
| 1978 | 2 | | | |
| 1979 | 1 | | | |
| 1980 | 0 | | | |
| 1981 | | 0 | | |
| 1982 | 16 | 0 | | |

| Winter Survey Year | Starr Chapel Cave | Mt. Grove Cave | Clarks Cave | Hupman's Saltpetre Cave |
|---|---|---|---|---|
| 1983 | 29 | | | |
| 1984 | | | | |
| 1985 | 30 | | | |
| 1986 | | 0 | 21 | |
| 1987 | 5 | | 52 | |
| 1988 | | | 31 | 0 |
| 1989 | 36 | | | |
| 1990 | 37 | 5 | 22 | 26 |
| 1991 | 23 | | | 0 |
| 1992 | 38 | 23 | 0 | 220 |
| 1993 | 31 | 0 | | |
| 1994 | 42 | 1 | 20 | 300 |
| 1995 | 60 | | | |
| 1996 | | | 0 | 225 |
| 1997 | 54 | | | |
| 1998 | | 2 | | |
| 1999 | 55 | | 1 | |
| 2000 | | | | |
| 2001 | | 2 | | 5 |
| 2002 | | | | |
| 2003 | 67 | | 47 | 4 |
| 2004 | | | | |
| 2005 | 57 | | 50 | 0 |
| 2006 | | | | |
| 2007 | 68 | | 49 | |
| 2008 | | | | |
| 2009 | 61 | | 48 | |
| 2010 | | | | |
| 2011 | 74 | | 64 | 3 |
| 2012 | 92 | | 63 | 1 |

Blank cells = no survey done that winter.

Prior to 2003, there were no documented areas of Indiana bat maternity activity in West Virginia, although a juvenile male was captured during the maternity period in Nicholas County in 1999. This bat was not tracked so no additional information on the potential maternity usage in the area is available. In the summer of 2003, two post-lactating female Indiana bats were captured and tracked to roost trees in Boone County, West Virginia. These captures represented the first confirmed Indiana bat maternity activity in West Virginia. Surveys at this site during 2005 located two primary roost trees and resulted in a maximum emergence count of 73 bats. Maternity activity at this site has consistently been confirmed since then through annual surveys. In the summer of 2004, a second maternity colony of approximately 25 bats was confirmed through the capture and tracking of a lactating female Indiana bat. This colony was located adjacent to the Monongahela National Forest (MNF) in Tucker County and is located within 2 miles (3.2 km) of a known Indiana bat hibernaculum. The roost tree that the bats were eventually tracked to fell down the following summer. Subsequent surveys in

the area have not been successful in capturing any reproductively-active females, although a number of male Indiana bats have been caught. The status of this maternity colony is unknown. A third maternity colony was documented as a result of surveys conducted in 2005 near Kanawha State Forest in Boone County. Emergence counts at the two identified primary roost trees documented a maximum count of 49 bats. In the spring of 2010, female bats tracked emerging from a hibernaculum in Pennsylvania were found to have established a roosting area just over the State border in Ohio County, West Virginia. A maximum of 58 bats were found to emerge from a roost tree in this area. In the summer of 2010, a pregnant female was captured in Wetzel County. Radio telemetry was not conducted on this bat, and follow-up surveys were not able to locate any additional Indiana bats, so no additional information on this maternity area is available. In July and August 2012, five female Indiana bats were captured in Brooke and Ohio Counties. Subsequent tracking and emergence counts documented a number of separate roost areas, and up to 26 bats flying out of an individual roost tree. These captures may represent a number of different maternity colonies within the northern panhandle of West Virginia.

In addition to these captures near potential or confirmed maternity colonies, individual male Indiana bats have been captured in numerous locations throughout the State in the following counties: Clay, Fayette, Nicholas, Pendleton, Preston, Pocahontas, Randolph, Raleigh, and Tucker. Three male Indiana bats were captured on another site on the MNF in Pendleton County in 2004. These bats were tracked to a roost tree and subsequent emergence counts on that tree revealed 23 bats. Surveys conducted since that time confirmed this area supports a bachelor male colony roost. In July 2012, a number of male Indiana bats were captured along the Kanawha/Fayette County line in the same area that the juvenile male was captured in 2010. These adult male bats were subsequently tracked to a number of roost trees, as well as to the underside of an Interstate Highway bridge that was later documented to have up to 89 Indiana bats roosting underneath. All the bats that were captured, tracked, or examined were found to be males, providing evidence of an extensive bachelor colony in the area. These captures of both male and female bats confirm that the Indiana bat uses forested habitats throughout the State for summer foraging and roosting. The increase in captures after 2002 may not reflect an actual increase in densities of Indiana bats summering within the State; rather these results may reflect the fact that survey efforts in relation to project review and monitoring have increased in recent years.

### Migration

The timing of spring and autumn migration has been generally inferred as the time between when bats leave the hibernacula and when they are found in maternity areas (spring), and vice-versa (autumn). In most portions of the range, this is generally considered to be from 15 April to 15 May in spring, and 15 August to 15 November in autumn, although these dates are sometimes adjusted regionally to accommodate latitudinal differences in season. Essentially all acres within the Forest could serve as potential migratory Forest habitat for the Indiana bat.

Little is known about the habitat used by either sex during migration, although it is generally presumed to include a variety of wooded habitats. The following is an excerpt from the USDI Fish and Wildlife Service (1999) Revised Draft Indiana Bat Recovery Plan: “Although certain migration patterns may be inferred from limited band returns, they should be interpreted with caution. The sparse band recovery records, all of which are from the Midwest, indicate that females and some males migrate north in the spring upon emergence from hibernation (Hall 1962; Barbour and Davis 1969; LaVal and LaVal 1980), although there is also evidence that movements may occur in other directions. However, summer habitats in the eastern and southern United States have not been well investigated; it is possible that both sexes of Indiana bats occur throughout these regions. Very little is known about Indiana bat summer habitat use in the southern and eastern United States, or how many Indiana bats may migrate to form maternity colonies there. Most summer captures of reproductively active Indiana bats (pregnant or lactating females or juveniles) have been made between April 15 and August 15 in areas generally north of the major cave areas. While these observations suggest that many or most female Indiana bats in the Midwest migrate north in the spring and south in the fall, potentially significant numbers also migrate in other directions.” When Indiana bats are captured in spring or autumn, especially when caught near a cave or mine, there is generally no way to determine why the bat was in the area. In West Virginia, a male juvenile caught on August 5, 1999 (Kiser et al. 1999) was likely migrating to a nearby hibernaculum. As noted above, Indiana bats hibernating in mountainous regions of West Virginia may travel to warmer areas in the western part of the state or states to the west to raise their young. Brack et al. (2002) indicated that nursery colonies were less likely in higher elevations and areas of cooler temperatures.

During a survey of coal mining operations in Wise County Virginia, a consulting firm documented use of an abandoned coal mine by a female Indiana bat on April 14, 2001 which may have been a migratory individual. During autumn swarming and spring staging, Indiana bats use the cave hibernacula and nearby wooded habitats. In autumn, use of woodlands decreases over time as bats enter hibernation. The converse is true in spring. Two recent telemetry studies documented use of a variety of habitats within 2 miles of two caves on the Jefferson National Forest. In late September 1999 four Indiana bats (3 males, 1 female) were trapped and fitted with radio transmitters at the entrance of Rocky Hollow Cave in Wise County. From September 23rd to October 13th (21 days) three roost trees were located (all on private land) that were used by two of the bats (one male and one female). The female used two different trees in open woodlands approximately 1.5 miles southwest of the cave near the Lonesome Pine Country Club. One was a shagbark hickory 19" DBH (diameter breast height) and the other was a yellow poplar with peeling bark that was next to a skid-road and had been damaged during a logging operation. The tree occupied by the male bat was used as a roost on multiple days and was a pignut hickory 27.9" DBH located 0.15 miles north of the cave. Other observations made during the course of the study included extensive foraging activity over hayfields and along edges of forests and fields.

McShea and Lessig (2005) conducted a study in April 2005 where thirteen female Indiana bats were fitted with radio transmitters while still in their winter hibernacula in Bath County, VA. They were released and followed closely with both ground and aerial telemetry in an attempt to track them to their unknown summer maternity roost sites. Radio tracking was conducted on a daily basis from the day of their release until their signal disappeared. All bats but one could be followed for up to three weeks and their flight paths were recorded mostly traveling north or south. Four roost trees were found along natural corridors of creeks and ridges and one was still occupied at the end of the study. Several of the bats were observed to travel large distances in a short amount of time. The major directions of travel were generally north and south, with only one bat flying east (into the Shenandoah Valley) and none flying west (over the higher mountain ridges into West Virginia) following release from the winter caves. The bats were located mostly in line with ridges, suggesting that they use these corridors as flyways to follow for easy transportation routes. When they do decide to move the bats can cover large distances in a short amount of time. For example, one bat moved 50-miles south in four days and another moved 25-miles north in two days. The small size of the transmitters necessitated "direct line of sight" to locate the animals, so ground crews were only effective when near the animal or above the animal on a ridge. An aerial crew was a necessity in order to keep track of all individuals when they foraged at night and as the bats dispersed following release. The four roost trees found by McShea and Lessig had similar characteristics. All were large snags and three were along the forest edge (creek or road) where they received significant sunlight during April. All roost sites were within oak-dominated forest types. The three bats that ultimately left their roost trees only stayed in them a few days before moving elsewhere. The overall movement pattern suggests flying to a nearby roost tree, resting for a few days and then flying a long distance before resting again.

A study that started in the spring of 2012 tracked two female Indiana bats from their hibernacula on the Cumberland Plateau in Tennessee south to two locations. One location was on the Talladega National Forest in Alabama, and the other on a wildlife management area in Gilmer County, Georgia. Information is still being gathered, but the tracked bat on the Talladega National Forest is roosting with approximately 25 to 30 other Indiana bats in an old woodpecker cavity in a dead loblolly pine on the Shoal Creek Ranger District. Both bats and associated roost trees are in an area where recent management has occurred, including thinning and prescribed burning.

There is limited data in WV that can make an overall assessment of Indiana bat migration patterns. This is based on numerous returns from bats who were banded in the non-hibernation period (spring, summer, or fall) and then later recovered during hibernation in the same county where they were banded, indicating that many bats will stay in the vicinity of their hibernacula. The following band returns from bats that moved outside the vicinity of their hibernacula into another county for the summer. Some of the bats went north (movement to Greene Co., PA was frequent) both others went south.

| Summer Capture Location | Winter Capture Cave/Location |
|---|---|
| Greene Co., PA | Cliff Cave, Pendleton Co., WV |
| Greene Co., PA | Big Springs Cave, Tucker Co., WV |
| Greene Co., PA | Izaak Walton Cave, Randolph Co., WV |
| Greene Co., PA | Hellhole, Pendleton Co., WV |
| Somerset Co., PA | Hellhole, Pendleton Co., WV |
| Nicholas Co., WV | Hellhole, Pendleton Co., WV |
| Tucker Co., WV | Hellhole, Pendleton Co., WV |
| Pocahontas Co., WV | Minor Rexrode Cave, Pendleton Co., WV |

There are at least four abandoned mines in WV that are being used by Indiana bats in the late fall swarming period, indicating that they are likely being used as hibernacula.

Maternity Colonies

During summer, reproductive females form maternity colonies in trees. Maternity colonies may form hundreds of miles from the hibernacula, and females from a maternity colony may come from more than one hibernaculum. In contrast, males often use wooded areas near the hibernaculum, occasionally visiting the hibernaculum throughout the summer. Males sometime migrate long distances to summer habitat, although they tend to be less migratory than females, and often, though not always, remain geographically close to the hibernacula. During this time, males often roost individually, and likely use trees similar in character to those used near hibernacula in autumn and spring. Wooded lands closer to hibernacula are more likely to support males in summer than areas farther away, but essentially all of the Forest may provide suitable summer habitat.

The core summer range of the Indiana bat is southern Iowa, northern Missouri, northern Illinois, northern Indiana, southern Michigan, and western Ohio. West Virginia is within the eastern maternity range, but not within the core range. Maternity colonies are known to occur in some eastern states, such as Kentucky and North Carolina, but, to date, none have been found in Virginia or neighboring areas in other states.

During a previous study in the summer of 1995, six male Indiana bats were captured in Tucker County, West Virginia. These captures represented the first documented summer use in West Virginia by Indiana bats, and suggest that males in West Virginia use areas near the hibernacula during summer. Until 2004 the best evidence of maternity activity in West Virginia was the discovery of a juvenile male on August 5, 1999. This is outside the defined maternity period and likely represents a juvenile migrating to a nearby hibernaculum. Then during the summer of 2004 surveys found a maternity colony estimated at 25 Indiana bats in Tucker County, West Virginia within two-miles of a known hibernaculum (USFS 2009). That same summer three male Indiana bats were captured on the Monongahela National Forest in Pendleton County and tracked to a roost tree where 23 other bats were subsequently counted (USFS 2009). To date no maternity colonies or reproductive female Indiana bats have been captured in Virginia during the summer reproductive season. In summer 1993, Chris Hobson of the Virginia Division of Natural Heritage surveyed areas of Bath, Bland, Highland, Lee, Tazewell, and Wise counties in proximity to known hibernacula. No female Indiana bats were captured and seven males were captured at five sites. One of the males, captured on July 28, 1993 in Cumberland Gap National Historic Park, Lee County, was a juvenile, suggesting that a maternity colony may be located in the Cumberland Gap area of Virginia, Kentucky, or Tennessee. These captures are the only documented summer Indiana bat occurrences in Virginia and suggest that males, at the least, use areas near the hibernacula during summer in western Virginia (Hobson 1993). Brack and others (2002) analyzed summer netting efforts 1995 to 2000 to identify summer reproductive populations in Virginia, West Virginia, and portions of Pennsylvania considered within the summer range of the Indiana bat. Over 3,000 net nights of effort failed to produce evidence of any maternity colonies.

Summer Foraging

Due to the variability of known roost sites and the lack of knowledge about landscape-scale habitat characteristics, it is difficult to quantify summer roosting habitat for Indiana bat at a range-wide, regional, or

local level. Forest management practices that affect occupied roost trees may have local impacts on Indiana bat populations. Across the historic range of the Indiana bat vegetation disturbances are prevalent and the species depends on an ephemeral resource (standing snags; living, dead or dying trees with cavities and/or exfoliating bark). Anecdotal evidence suggests that Indiana bats may benefit from limited disturbance around potential roosting areas (Menzel et al. 2001). Limited disturbance can create potential roost trees and open the canopy around potential roost trees (Gardner et al. 1991; Kurta et al. 1993). Indiana bats may be resilient to minor perturbations on the landscape such as targeted forest management and prescribed fire. General standards that would help ensure adequate roost habitat include retention of snags and suitable roost trees whenever possible, prescribed burning to restore and maintain open midstory foraging conditions (using only cool season backing fires in karst areas), and ensuring a continuous supply of oaks, hickories, and yellow pines as well as other trees with exfoliating bark (Menzel et al. 2001).

Fall Swarming

Indiana bats may use caves and mines during the non-maternity season (autumn through spring) for one of several reasons: 1) winter hibernation; 2) autumn swarming; 3) spring staging; and 4) vagrant or migratory use. Autumn swarming and spring staging typically occur in woodlands near the hibernacula, with use of the hibernacula increasing as autumn progresses towards winter, and decreasing as spring progresses towards summer. Hibernacula tend to have higher use in spring and autumn, and larger winter concentrations typically produce greater spring and autumn use.

During autumn, when Indiana bats swarm and mate at hibernacula, male bats roost in trees nearby during the day and fly to the cave or mine at night. Work in Missouri (Romme et al. 2002) and Kentucky (Kiser and Elliott 1996; Gumbert 1996) have found that Indiana bats range up to 5 miles from hibernacula during autumn and spring swarming activity periods. In Kentucky, Kiser and Elliott (1996) found male Indiana bats roosting primarily in dead trees on upper slopes and ridgetops, within 1.5 mi of their hibernaculum. In West Virginia, some male Indiana bats roosted within 3.5 mi of their cave, in trees near ridgetops, and often switched roost trees from day to day (C. Stihler, West Virginia Division of Natural Resources, pers. observ., October, 1996). One Indiana bat in Michigan roosted 1.4 mi away from the hibernaculum during fall swarming, and another chose trees at a distance of 2.1 mi (Kurta 2000). Gumbert (2001) found an average of 1.2 mi between roost trees and the hibernaculum for 20 radio-tagged Indiana bats. Brack found a range of 0.18 to 0.87 mi between roost trees and a hibernaculum in Virginia, although he did not follow bats if they left the "project area" and the range may actually be greater. Based on terrain and landscape characteristics of these areas (generally rolling without great vertical relief) when compared to the Ridge and Valley terrain of Virginia (mountainous with vertical relief 1,300 to 2,500 feet) it is likely Indiana bat activity in this portion of the Appalachians is confined to the valley in which the hibernaculum occurs and may extend into adjacent valleys via gaps in the surrounding ridges or mountains.

During September and October of 2000 an extensive survey was made of fall swarming activity near Newberry-Bane Cave in Bland County, Virginia as part of the proposed American Electric Power (AEP) 765 kV Wyoming (WV) to Jacksons Ferry (VA) powerline project. This work was conducted by Virgil Brack of Environmental Solutions and Innovations, Cincinnati, Ohio and is documented in the Appendix to the Biological Assessment for the EIS associated with that project. Of 27 Indiana bats captured (24 males and 3 females) at the mouth of Newberry-Bane Cave, 17 (14 males and 3 females) were fitted with transmitters. Radio-tagged bats were monitored between September 9th and October 21st within 2-miles of the cave entrance.

The Brack study found that Indiana bats most frequently foraged over agricultural land (44.7%), intermediate deciduous forests (22.6%), and open deciduous forests (19.0%) habitats types, comprising 86.3% of all habitat types used for foraging during the survey. The bats' activity areas included proportionally more agricultural lands and open forests than was available in the study area. Closed canopy woodlands were not used by foraging bats to the extent they were available. This study concluded that Indiana bats more frequently used rights-of-way, pasture edges, savannah-like woods, and other openings rather than large, continuous tracts of closed canopy forests. These findings are consistent with the interpretation of telemetry data in similar studies. For roosting ecology the study by Brack found a total of 26 roost trees for 8 of 17 bats fitted with transmitters. Of the 26 roost trees, 39% were shagbark hickories (Carya ovata) and 12 % northern red oak (Quercus rubra), for a total of 51%. Other tree species used as roosts included white oak (Quercus alba), red maple (Acer rubrum), sugar maple (Acer saccharum), black oak (Quercus velutina), bitternut hickory (Carya cordiformis), American basswood (Tilia americana), and yellow birch (Betula alleghaniensis). Five (19%) of the roost trees

were dead snags. All roost trees were located in close proximity to the cave entrance ranging from 0.16 to 0.86 miles, with an average distance of 3,280 feet (0.6 miles). All roost trees were located near forest canopy openings such as open woodlands of pastures, scattered trees of recently logged areas, old logging roads, utility line corridors, and natural drainages. Five of the eight bats used the same roost tree for two to three consecutive days. Roosts were located in all types of deciduous forests, but exhibited a disproportionately small use of mixed evergreen and deciduous forests. Roost trees were very exposed with little or no canopy shading by other trees. It is likely that in doing so the bats were taking advantage of exposure to solar radiation in order to better regulate body temperature. Many open-canopy areas existed due to recent logging activity that left scattered trees within the harvested areas. Roosts in closed canopy deciduous forests were often in small openings near open corridor flyways.

While much of the activity observed during the study was close to the cave (within approximately 0.6 mile) bats also left the 2-mile study area all together. Males more so than females tended to range further from the cave. Perhaps they would leave to forage where there was less competition for prey (the caves in the area serve as hibernacula for over 8,000 individual bats of at least five different species) and return to the cave area periodically to mate. It's therefore likely roosting and foraging activity also occurred outside this 2-mile area but all documented roost trees and foraging behavior observed were within two miles of the Newberry-Bane cave.

Hibernacula

Indiana bats tend to hibernate in the same cave or mine at which they swarm (LaVal et al. 1976; C. Stihler pers. observation, October 1996), although swarming has been observed at hibernacula other than those in which the bats hibernated (Cope and Humphrey 1977). It is generally accepted that Indiana bats, especially females, are philopatric, that is, they return annually to the same hibernaculum (LaVal and LaVal 1980). Most bats of both sexes enter hibernation by the end of November (mid-October in northern areas–Kurta et al. 1997). Indiana bats hibernate in large, dense clusters, ranging from 300 bats per square foot to 484 bats per square foot (Clawson et al. 1980; Hicks and Novak 2002).

Caves must possess certain characteristics to be suitable as Indiana bat hibernacula. Raesly and Gates (1986) compared microhabitat and microclimate variables between occupied and unoccupied caves and mines. They found that Indiana bat hibernacula tended to have larger openings, more cave passage length, and higher ceilings compared to unoccupied sites. In addition, occupied hibernacula have noticeable airflow (Henshaw 1965). Once Indiana bats enter hibernation, they require specific roost sites in caves or mines that reach appropriate temperatures (Tuttle and Taylor 1994). Indiana bats choose roosts with a low risk of freezing. Stable low temperatures allow the bats to maintain a low metabolic rate and conserve fat reserves until they are ready to emerge in spring; thus, Indiana bats select roosts within hibernacula that best meet their needs for cool temperatures. Indiana bat hibernacula usually host other species of bats. Indiana bats are occasionally observed clustered with or adjacent to other species, including gray bats (*M. grisecens*), Virginia big-eared bats (*Plecotus townsendii virginianus*), little brown bats and northern longeared Myotis (Myers 1964; LaVal and LaVal 1980; Kurta and Teramino 1994).

**Threats**

Additional recent threats include White Nose Syndrome (WNS) and commercial scale wind power development. WNS is a fungus caused disease that was first seen in New York caves during the winter of 2006-2007. The newly discovered, cold-loving fungus (*Geomyces destructans*) has spread south during the past several years and was first confirmed in Virginia and West Virginia during the winter of 2008-2009 with additional spread and caves now contaminated. To date well over 1-million bats have been killed by this fungus which irritates bats during hibernation causing them to wake and use precious fat reserves. The bats then starve and or freeze when they attempt to fly and leave the cave in search of food during the midst of winter conditions.

Commercial wind power development has rapidly expanded across the Appalachians. Multiple sites have been developed in West Virginia and one site is being constructed in Virginia west of Monterey in Highland County. Bats are often killed during wind tower operations when they fly into the lower pressure area surrounding the trailing edge of spinning blades and suffer extreme barotrauma where decompression causes capillaries in the lungs to explode. Bats are most affected during periods of fall migration when they often follow ridgetops and come into contact with wind towers built along those same ridgetops.

**Plan Components**

Effects to the federally endangered Indiana bat (*Myotis sodalis*) were considered because there are hibernacula on and near the Forest, plus it is assumed the entire Forest is potential roosting and foraging habitat for this species. Potential effects include direct effects on hibernacula and effects on foraging and roosting habitat. The main management tool used in the Forest Plan to protect and manage habitat for the Indiana bat is the continued use of a management prescription area with an emphasis on the Indiana bat. This management area is located around the four caves known to contain the Indiana bat. This prescription area is established to: 1) protect hibernacula (caves in which the bats spend the winter); 2) maintain and enhance upland and riparian swarming and foraging areas; and 3) identify and protect summer roosting and maternity site habitat.

Management activities can degrade Indiana bat habitat if implemented in an unrestricted manner, therefore all alternatives continues to employ standards that apply to vegetation management across the entire forest to protect roosting and foraging habitat. Alternatives B, C, D, E, F, G, H and I also expand the areas defined as riparian corridors, providing additional protection to vegetation in the riparian corridors which have been reported to be important foraging areas.

Effects on Hibernacula

Steps have been taken by the Forest to protect and maintain these caves as suitable for the Indiana bat. Since 1995, bat gates have been installed on all caves known to be used by endangered bat species on the Forest. Starr Chapel Cave and Mountain Grove Cave on the Warm Springs Ranger District in Bath County are the only caves with entrances on Forest land that serve as hibernacula for Indiana bats. Clarks Cave and Hupman's Saltpeter Cave are on private land, but within 2-miles of National Forest land. The Indiana Bat Primary Cave Protection Area is defined by a radius of no less than one half mile around each hibernaculum, defined by national forest surface ownership and topography. This area is intended to protect the integrity of the cave and the immediate surrounding uplands where bats may swarm and forage in the fall. Commercial timber harvest, road construction, and creation of new wildlife openings are prohibited. Prescribed burning, tree cutting, and road maintenance are evaluated in terms of effects on the Indiana bat before approval. This area is not available for gas leasing and is unsuitable for wind energy development. Two Indiana bats were found to have WNS during an April 21, 2010 cave survey conducted by Rick Reynolds (VDGIF) and Wil Orndorff (VDCR) in Starr Chapel Cave. This represents the first time Indiana bats have been documented with WNS on the Forest. Indiana bats occur in other caves infested with WNS, and where other bat species have been found infected, but individual Indiana bats in those other caves have not shown signs of WNS infection. Caves with significant bat populations on Forest land will continue to be gated and locked year-round. Currently, a Regional Forester closure order is in effect that closes all caves and mines year-round on National Forest lands to human intrusion. If and when access is needed, WNS protocols will be followed that should eliminate contamination from other caves.

Effects on Roosting or Foraging Habitat

The Indiana Bat Secondary Cave Protection Area is defined by a radius of approximately 1 ½ miles around each primary cave protection area, defined by easily recognizable features on the ground. This configuration of the two protection areas provides management direction to protect and enhance the two-mile area around the hibernacula that is most critical to fall swarming. This secondary area is designed to further maintain and enhance swarming, foraging, and roosting habitat. Timber harvest, prescribed burning, wildlife habitat improvement, road construction, trail construction, and special uses may occur following evaluation of the effects on Indiana bats. Vegetation management is allowed to enhance foraging conditions. Timber management activities are suspended during the fall swarming season. The area is unsuitable for wind energy development.

Potential roosting habitat (mature forests with trees having exfoliating bark) exists across the entire Forest and contains tree species of the size and type known to be used by the Indiana bat. The retention of some snags, shagbark hickory, and hollow trees (as available) will allow for potential Indiana bat roost sites. Decreasing canopy closure as occurs with timbering and prescribed fire activities will increase the degree of exposure of some potential maternity roost trees to solar radiation, providing improved thermal conditions for raising young during a wide range of weather conditions. Pond/waterhole construction will increase the number of upland water sources available for Indiana bats. Persistence of early successional habitats and forests with an open

understory and patchy overstory would create favorable foraging areas and flight corridors leading to potential roost trees. Harvesting would produce a mosaic of regeneration areas intermixed with mature and late successional forests. Likewise, prescribed fire would also create a mosaic of forest successional stages from early to late resulting from varying fire intensities associated with topographic features, vegetative types, and fuel accumulations. This will indirectly provide feeding areas since bats are known to forage within the canopy openings of upland forests, over clearings with early successional vegetation, and even along the borders of croplands, or wooded strips (fencerows), and over ponds. In contrast, negative impacts to the Indiana bat will be: (a) the slight chance that individuals or small groups of roosting bats (including summer maternity colonies if present) could be unintentionally killed by the felling of trees harboring undetected roosts (e.g. dead limbs with loose bark, or small cavities in the boles), or by the accidental felling of occupied snags, or damaged or hollow trees during timber harvest or other activities; and (b) a short-term reduction in the total amount of foraging habitat available to individual Indiana bats which would be incurred on regeneration cuts immediately after harvest. Although the likelihood is very low, tree cutting activities could result in the inadvertent loss of individual Indiana bats or small groups of Indiana bats via removal of some large-diameter hardwood trees occupied by bats during the period from approximately April 1 to October 15. Occupied and potential roost trees could be directly affected by vegetation management, firewood and salvage sales, routine maintenance/permitting of small clearings including easements, rights-of-way and access to privately-owned lands, and road construction. Plan implementation will result in vegetation disturbance and possible impact to currently occupied and potentially occupied roost trees. There is potential for adverse effects to a maternity roost tree if one occurs on the Forest and in an area where trees are being felled. However, forest-wide standards minimize, if not eliminate, the chance of adverse effects under all alternatives. Any Indiana bat roosts that are discovered would be protected until they were no longer suitable (unless treatments were needed for public or employee safety) under all alternatives.

The National Forest fuelwood program allows the public to purchase and collect wood, often recently downed or standing/leaning dead trees, for personal use. The program is regulated by issuance of an area-specific permit and collection occurs primarily along roadsides and other specified sites with easy access. Vehicles must remain on open roads are not allowed to travel through the forest in order to facilitate finding, cutting, and loading firewood. This, therefore, restricts the distance at which most people are willing to cut and haul firewood and results in firewood being cut within 150 feet (about two tree lengths) of an open road, and is limited almost exclusively to level terrain or the uphill side. Volume of firewood cut on the Forest during 2008 was 4,488 CCF (hundred cubic feet) and during 2009 5,256 CCF, for an average of 4,872 CCF over the two-year period. A 14" DBH tree contains approximately 0.5 CCF of firewood; therefore approximately 9,744 dead trees were cut for firewood each year. The number of standing dead trees on the Forest can be calculated based on analysis of data collected during the 2002-2007 Forest Inventory and Analysis conducted by the Southern Forest Research Station, Asheville, NC and published in 2009. The number of dead standing trees at that time was 14.9 per acre for all trees larger than 5" DBH and 6.1 per acre for trees larger than 9" DBH. Given that the Forest is approximately 1.1 million acres, this equates to at least 6.5 million dead standing trees >9" DBH. All portions of the Forest continue to be infested with gypsy moths and infestations are forest-wide with cycles of defoliation and mortality resulting from population fluctuations of gypsy moths. The result of these infestations is extensive areas of hardwood (especially oak) mortality in the overstory. Therefore, if 10,000 standing dead trees are cut each year for firewood, this equals 0.15% of the total available standing dead trees. Since most of these dead trees are not close to roads or are in Management Prescriptions where firewood cutting is not allowed, the possibility of harming an Indiana bat is extremely remote. In addition, most Indiana bats roost in live trees. Brack and Brown (2002) reported 81% of roost sites used by radio-tagged Indiana bats were live trees and 19% were snags. The odds of encountering a roosting bat are even further reduced since only dead trees are available for cutting as firewood and these dead trees represent perhaps 20% of the trees where they roost. Assuming this trend represented Indiana bat roost selection throughout the Forest; personal use firewood collection could affect 0.0003% of the potential Indiana bat roost trees. Firewood collecting is not allowed in the Primary and Secondary Indiana Bat Cave Protection Management Prescription Areas, ensuring that snags near hibernacula are retained. Although the risk of "take" resulting from firewood cutting cannot be completely eliminated, the risk of direct effects to roosts in the vicinity of hibernacula is further minimized since the collection of firewood in the Primary and Secondary Indiana Bat Cave Protection areas is not allowed by prescription standard. Some minimal risk of taking a bat roosting in a standing dead tree cut for firewood elsewhere on the Forest would continue to exist. However, given the relatively low number of Indiana bats on the Forest when compared to the number of acres, standing trees and

snags, the use of any individual dead tree as a roost is likely to be brief, and the likelihood of take from firewood cutting is extremely small under all alternatives.

Most types of timber harvest (salvage, even-aged, uneven-aged, etc.) would require some snag and potential roost tree retention, plus specific retention of leave trees such as shagbark hickories. Forestwide standards in all alternatives require stand regeneration treatments greater than ten acres in size, retaining a minimum average basal area of 15 square feet per acre of live trees, and giving priority to retaining the largest available trees that exhibit characteristics favored by roosting Indiana bats (sloughing bark, cracks and crevices).

To maintain flight and foraging corridors in upland and riparian areas, a Conservation Recommendation in the 1997 Biological Opinion encouraged the Forest to increase its prescribed burning program on lands unsuitable for timber harvest. Over the past 15 years, the Forest has steadily increased its prescribed burn program. Alternative E would have the highest acres with 20,000 acres estimated to be prescribed burned each year. Alternatives B, F, G, H and I have an objective to burn 12,000 to 20,000 acres per year. Prescribed fire is used for ecosystem restoration, wildlife and rare species management, site preparation and oak-pine regeneration. Most prescribed burns occur from March to mid-May, with a few during late May and June. Depending on weather and fuel conditions, a few may occur in late October and November. Control lines consist of existing roads, trails, and streams wherever possible. In areas where control lines need to be constructed, handtools and/or bulldozer will be used to dig a two to five foot wide strip to mineral soil. Some trees will need to be felled during line construction, but in most cases larger trees will be avoided with the line going around and between the largest trees. Some standing trees and snags near the line will be felled because they pose a hazard to personnel, or may burn and fall across the line, potentially spreading the fire into areas not scheduled for burning.

Some of the ridgetops on the GWNF have been identified as having potential for developing wind energy. The total area with a potential rated as fair to superb is about 117,000 acres. Plan Alternatives C and E do not allow for commercial wind power development. Alternatives B, D, F, G, H and I allow for consideration of wind power development. Alternatives B, F, G, H and I assume one development site and assume 15 towers per site, while Alternative D assumes three sites and assumes 45 towers. Currently, there are no proposals for wind power development on the GWNF. Any such proposal will be evaluated with an environmental analysis and impacts to bats will be disclosed at that time.

Cumulatively, with implementation of any alternative, the Forest will maintain a supply of snags, live potential roost trees, upland water sources, and other habitat features across the landscape to allow for the maintenance, and promote the recovery, of Indiana bat populations. At the same time, activities can still continue to meet other multiple-use objectives. For example, timber harvesting can still occur to accomplish sufficient forest regeneration to provide diverse insect productions and provide for the continuation of diverse forest conditions across the Forest. Overall, there will be both potential benefits and potential impacts to the Indiana bat from management activities on the Forest. From a beneficial standpoint, the retention of most snags, all shagbark hickory, and hollow trees in sale areas would allow potential Indiana bat roost sites to be conserved; the reduction of canopy closure in sale areas and along unit margins would increase the degree of exposure of potential roost trees to solar radiation, providing improved thermal conditions for roosting and perhaps raising young; pond/waterhole construction would increase the number of upland water sources available for Indiana bats along with other bat species. Slightly positive benefits for Indiana bat would result as harvested units create insect-rich foraging areas and flight corridors leading to any tree roosts that might be present there. Positive benefits would result from prescribed burning by decreasing understory vegetation density and reducing canopy closure plus favoring oak, yellow pines, and hickory while reducing the in-growth of yellow poplar, red maple, and white pine. Positive benefits will also be realized from the application of prescriptions and associated standards focused on protecting caves and managing vegetation structure and conditions within 2-miles of hibernacula.

Contrastingly, negative impacts to the Indiana bat would be: (a) the slight chance that individuals or small groups of roosting bats (including possible summer maternity colonies) could be unintentionally killed by the intentional felling of trees harboring undetected roosts (e.g. dead limbs with loose bark, or small cavities in the boles), or by the accidental felling of occupied snags, or damaged or hollow trees during timber harvest or other activities; and (b) a short-term reduction in the total amount of foraging habitat available to individual Indiana bats which would be incurred on regeneration cuts. Although these bats will use small forest openings

and edges as foraging habitat, they would be unlikely to utilize the central portions of harvested units during the early years of regeneration unless the residual basal area was high enough. It is possible that the increased rate of insect production in the regeneration areas would make up for any loss of foraging habitat acreage, but such a determination would be difficult to make without extensive long-term research on the subject. The level of estimated timber harvest ranges from 1,000 to 5,000 acres depending on Alternative. Specific acreage by type of silvicultural system for each alternative is discussed in the Social/Economic Environment, Timber Management section of the EIS. See specifically Table 3C6-14.

Although the likelihood is very low, implementation of any alternative may result in the inadvertent loss of individual Indiana bats or small groups of Indiana bats, via removal of some large-diameter hardwood trees occupied by bats during the period April 1 through October 15. This risk would be greatest in those alternatives with the highest acres of timber harvest. Alternative D has the highest acres estimated, followed by Alternatives A, B, E, G, H and I, and F in order. Alternative C has no timber harvest allowed.

Under all alternatives, Forest-wide and management prescription standards will provide adequate protection for summering and transitory Indiana bats. These standards and prescriptions provide for maintenance of extensive forest areas that would remain undisturbed. These areas are characterized by disturbance events where net losses and gains of potential roost trees would be dependent on ecological processes including tree mortality due to aging, insect and disease, wildland fires, and weather events.

In addition, all alternatives allocate areas surrounding known Indiana bat hibernacula to Management Prescriptions 8E4a and 8E4b. In the future, any newly discovered hibernacula will be added to this prescription through the Forest Plan amendment process. In the 1997 Biological Opinion for the Forest, and the 2004 BO for the Jefferson NF, the USDI Fish and Wildlife Service determined that the level of anticipated take (4,500 acres not including prescribed burning on the Forest and 16,800 acres including prescribed burning on the JNF) is not likely to result in jeopardy to the Indiana bat or destruction or adverse modification of any critical habitat. Although the loss of a few individuals from time to time during timber harvest is remotely possible, the overall large amount of improvement of roosting and foraging habitat for the Indiana bat, coupled with management activities taking bat life requirements into account, plus an increasing number of upland drinking water sources, and gating of hibernacula, suggests that these potential losses would be offset by overall future net gains in the population.

Long-term effects of WNS are unknown at this time. It's likely that Indiana bats will be further affected by WNS and those cumulative effects may exceed any action Forest Plan implementation will cause.

Cumulative effects of wind power development will be addressed in project level analysis if and when the Forest receives a proposal for construction.

## 3.2.2 VIRGINIA BIG-EARED BAT

**Background**

Formerly included in the genus *Plecotus*, the Virginia big-eared bat is a subspecies of the more common and widespread Western (or Townsend's) big-eared bat that occurs throughout the western U.S., southwest Canada, and most of Mexico. The subspecies, *virginianus*, occupies a very limited geographic range in the Central Appalachians that includes portions of four states: West Virginia, Virginia, Kentucky, and North Carolina (Bayless et al. 2011). The species was listed under provisions of the Endangered Species Act as "Endangered" in December 1979. The Recovery Plan was issued on May 8, 1984 and a draft revised recovery plan was submitted for review in 1996, but was never finalized. The first substantive 5-year review of the species was released by the USFWS, West Virginia Field Office, during the summer of 2008. On March 6, 2012, a request was made in the Federal Register by the USFWS for information to initiate a 5-year review of 9 listed species in the northeast, including the Virginia big-eared bat.

Population numbers have shown moderate to strong increases range-wide over the past 20 years. In the late 1970s, when the recovery plan was drafted, the known population of Virginia big-eared bats in maternity colonies was approximately 3,600, and the known hibernating population was approximately 2,585 (U.S. Fish

and Wildlife Service 2008). In the late 1980s, the estimated, total population of the subspecies in West Virginia, Virginia, Kentucky, and North Carolina was approximately 10,000 bats (Dalton 1987). By 1997 the range-wide population of *C.t. virginianus* was estimated to have almost doubled to just under 20,000 individuals (Pupek 1997). In West Virginia some cave populations grew as much as 350% from 1983 to 1995 (Pupek 1997). Survey data from 2006-2007 indicate a population of 11,694 hibernating bats and 7,630 maternity colony bats (USFWS 2008). These surveys did not include bachelor colonies or several caves with significant bat use due to access or safety concerns. The 2012 surveys of the 10 summer colonies in West Virginia show that the Virginia big-eared bats continue to do well with the total being the highest count on record with 7,531 bats, up 0.9% from 2011 and up 18.2% since 2008, pre-WNS (WNS was found in WV in 2009). The 2012 count increased in 8 of the 10 caves compared to the 2011 count (Stihler 2012 per comm).

In Virginia, this bat is known from eight caves in six counties in two separate geographic areas. One area is in the upper headwaters of the James River (Cowpasture and Bullpasture Rivers) and the other is in the New River watershed. According to the Virginia Fish and Wildlife Information Service, the Virginia big-eared bat is known from three caves in Tazewell County and one in Highland County during the summer and five caves during the winter in Tazewell, Bland, and Highland Counties. Previous observations of single or a few (<5) individuals in caves found in Rockingham, Bath, and Pulaski Counties are likely transient males and are only seen occasionally in these locations.

In West Virginia, the Virginia big-eared bat is known from at least 30 caves in five counties, with most of the occurrences (20) in Pendleton County. The final rule that placed the Virginia big-eared bat on the endangered species list also designated five caves in West Virginia as Critical Habitat: one cave in Tucker County (Cave Hollow Cave) and four caves in Pendleton County (Cave Mountain Cave, Hellhole Cave, Hoffman School Cave, and Sinnit Cave).

The Virginia big-eared bat occupies caves year-round. These bats are not migratory and their longest recorded movement is approximately 64 kilometers (40 miles; Dalton & Handley 1991). Males and females hibernate singly or in mixed gender, single species clusters in a few caves, and move in the spring to other cave(s), with females forming smaller summer maternity/nursery colonies and males remaining solitary, or forming bachelor groups, during the summer.

Mating begins in late summer/early autumn and continues into early winter. Ovulation and fertilization are delayed until late winter/early spring. Maternity colonies form as early as March or as late as June depending on when the roost site reaches a suitably warm temperature. Gestation lasts 2-3.5 months. Solitary pups are born in late spring/early summer. Young can fly at about 2.5-3 weeks of age, are weaned by 6-8 weeks, and leave the cave to forage on their own by the end of July or August. Most individuals leave the nursery cave by mid to late September. Females are sexually mature their first summer. Males may not be sexually active until their second year. Nearly all adult females breed every year (NatureServe 2011).

The Virginia big-eared bat primarily feeds on moths. Morphological adaptations (long ears and wing shape that results in low wing loadings) facilitate foraging tactics which involve slow-maneuverable flight where prey can be captured in air or from the surface of objects. Foraging techniques consist both of aerial hawking and gleaning. Lacki and Dodd (2011) noted that Lepidopteran prey comprises >80% volume of the diet of all *Corynorhinus* species. Food habits of the maternity colony in Tazewell County, Virginia found that moths formed over 90% of the diet, with beetles a distant second, followed by lesser quantities of other flying insects. The bats typically leave the cave after sunset with the onset of full darkness to begin foraging. Level of flight activity in Virginia big-eared bats is negatively associated with moon phase and wind speed, and directly related to percent relative humidity (Adam et al. 1994). Foraging area averages approximately 280 acres (60 – 650 acres). Maximum flight distance of foraging from caves is 7.0 miles, with 80% of foraging occurring within 3.7 miles (Stihler 2010). Bats have been observed foraging over corn and alfalfa fields as well as mature upland forests, wherever moths occur in abundance (Dalton et al. 1986). An overriding pattern of habit usage in foraging is a preference for abrupt changes in vertical structure, such as along forested and riparian corridors and forest/edge interfaces. The vertical surfaces likely help in capturing stationary moth prey by gleaning. Because most of these same habitats are avoided by families of moths typically eaten by *Corynorhinus*, Lacki and Dodd suggest that foraging habitats are better predicted by structural configuration than by local abundance of preferred moth prey (Lacki and Dodd 2011).

**Threats**

Limiting factors for the Virginia big-eared bat include caves with suitable temperature regimes (cold in winter and warm in summer). Compared to other bats, Virginia big-eared bats tolerate lower cave temperatures during hibernation, and often occupy areas in caves that receive cold-air flow near entrances. Maternity caves are typically warmer than hibernation caves. Declines appear to be primarily related to human disturbance and loss of cave habitat quality. The Virginia big-eared bat is extremely intolerant of any human disturbance. Former declines in bat populations are likely attributable to human intrusion into caves, which depletes energy reserves of aroused bats and may lead to cave abandonment if disturbance is frequent (NatureServe 2011). The recovery plan (USDI Fish and Wildlife Service 1984) recommends recovery actions focused on cave acquisition and gating of entrances to control human access. The increased population of Virginia big-eared bats over the past 30-years is likely attributable to gating and year-round closure of caves occupied by these bats.

On the Forest there are no caves regularly occupied by the Virginia big-eared bat at any time of the year. All occupied caves in Virginia, during both summer and winter, are on private land. Cave occurrences of the Virginia big-eared bat closest to the Forest are located in Highland County, Virginia, and Pendleton County, West Virginia, where the closest distance from an occupied cave to Forest managed land is approximately 2.5-miles (Arbegast Cave, Highland County). In Pendleton County the closest distance from caves designated as Critical Habitat to Forest land is: Hellhole Cave, 12.6 miles; Cave Mountain Cave, 10.25 miles; Sinnit Cave, 5.0 miles; and Hoffman School Cave, 3.6 miles. It's therefore possible, based on observed flight distances for foraging activity of 2.2 – 5.2 miles, that Virginia big-eared bats may forage over some portions of the North River Ranger District, from the Brandywine area of Pendleton County, WV south to the McDowell area of Highland County, VA.

The greatest threat currently known to Virginia big-eared bats is human disturbance in hibernacula, roosting, and maternity caves. None of these caves occur on the Forest. The Forest has assisted with building and maintaining cave gates, such as the purchase of materials and construction of the gate on Arbegast Cave in 2007. Currently, all the caves on or near the Forest utilized by the endangered Indiana bats are gated and locked year-round, plus a Closure Order, issued by the Regional Forester to lessen spread of WNS and prevent disturbance to bats, continues on all caves and mines.

Negative effects to Virginia big-eared bats from vegetation management are minimal because these bats utilize caves year-round for all roosting and hibernation. Vegetation management such as timber harvest, thinning, and prescribed burning will increase vertical structure in closed canopy forests creating a spatial mosaic of conditions and will therefore provide and enhance foraging habitat.

**Plan Components**

Under all alternatives, Forest Plan standards relevant to the Virginia big-eared bat and associated cave habitat would protect all caves now known on the Forest, as well as any cave discovered or purchased that may support Virginia big-eared bats. Although no hibernacula, summer roost, or maternity caves have been identified on the Forest, forestwide standards maintain vegetation, and require installation of gates or other protective structures, at entrances of all caves occupied by populations of any threatened or endangered bats. Until a newly discovered cave has been surveyed for bats, it is assumed that federally listed bats are present and the cave and surrounding habitat are maintained for them until surveyed. Potential foraging habitat will be maintained in a mosaic of vegetative conditions, and any changes will result from forest succession and management activities such as timber sales and prescribed burning.

Recent potential and known threats include White Nose Syndrome (WNS) and commercial-scale wind power development.

WNS is a fungus caused disease that was first seen in New York caves during the winter of 2006-2007. The newly discovered, cold-loving fungus (*Geomyces destructans*) has spread south during the past several years and was first confirmed in Virginia and West Virginia during the winter of 2008-2009. Since 2009, the fungus has continued to spread and contaminate caves in and near the Forest. To date, there have been no Virginia

big-eared bats found with WNS (Stihler 2012 pers. Comm.). WNS has been documented in caves occupied by Virginia big-eared bats, yet the bats do not show signs of infection, and no mortality attributable to WNS has been documented.

All caves with significant bat populations on Forest land will continue to be gated and locked. Currently, a Regional Forester closure order is in effect that closes all caves and mines on the National Forest to human intrusion. If and when access is needed to any cave, WNS protocols will be followed that are designed to reduce the potential for contamination from caving activity.

Commercial wind power development has rapidly expanded across the Appalachians. Multiple sites have been developed in West Virginia and one site is being constructed in Virginia west of Monterey in Highland County. Bats are often killed by wind towers when they fly into the lower pressure surrounding the trailing edge of spinning blades, and suffer extreme barotrauma because the decompression causes capillaries in their lungs to explode. Bats are most affected during periods of fall migration because they often follow ridgetops and come into contact with wind towers built along those same ridgetops.

Alternatives C, and E do not allow for commercial wind power development. Alternatives B, D, F, G, H and I allow for consideration of wind power development. Alternatives B, F, G, H and I assume one development site and assume 15 towers per site, while Alternative D assumes three sites and assumes 45 towers. Currently there are no proposals for wind power development on the GWNF. Any such proposal will be evaluated with an environmental analysis and impacts to bats will be disclosed at that time.

There are expected to be no cumulative effects to the Virginia big-eared bat resulting from implementation of any alternative. As stated above, the caves where this species occurs are on private land near the Forest. Landowners of these caves are aware of the bats' presence and the caves are either gated or protected to limit human entrance and disturbance. Individual Virginia big-eared bats may forage or fly over National Forest land, but current conditions will be maintained, and habitat enhanced through active management for preferred foraging habitat in all alternatives except Alternative C. Active management will include timber harvest, thinning, and prescribed burning will designed to increase forest openings and decrease canopy closure.

There have been concerns about the effect gypsy moth (*Lymantria dispar*) defoliation and suppression efforts may have on Virginia big-eared bats. Gypsy moths are well established across the Forest. Defoliation, and the subsequent short-term loss of forest cover, may suppress insect populations and thus food sources for the bats. Likewise, pesticides suppress or eliminate insect populations to varying degrees, depending on the type of insecticide used (USDA 1996). Suppression of gypsy moth outbreaks have not been done on the Forest since Spring of 2003 when 1,311 acres in six areas were treated with Btk and none of those areas were within 50-miles of known Virginia big-eared bat occurrences. If necessary in the future decisions on gypsy moth management will be made at that time and further analysis handled at the project level including consultation with the U.S. Fish and Wildlife Service.

Effects of WNS are unknown at this time. If infection occurs in Virginia big-eared bats and they are negatively affected by WNS there is little if anything the Forest can do other than assist with surveys and monitoring, plus keep caves gated and closed on a year-round basis.

Direct and cumulative effects of wind power development will be addressed in project level analysis, including consultation, if and when the Forest receives a proposal for construction.

### 3.2.3 VIRGINIA NORTHERN FLYING SQUIRREL

**Background**

The Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*; hereafter abbreviated VNFS) is a nocturnal small mammal endemic to the Alleghany Highlands of West Virginia and Virginia. The species was federally listed as Endangered in 1985, along with another subspecies, the Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*), and is also state listed as endangered under the Virginia Endangered Species Act (Fies

and Pagels 1991). VNFS is a relatively short-lived species primarily inhabiting mature spruce forest, as well as the ecotone between spruce and northern hardwood forests (Ford et al. 2004; Ford and Rodrigue 2007; Loeb et al. 2000; Menzel et al. 2004, 2006a; Reynolds et al. 1999; Schuler et al. 2002; Smith 2007; USFWS 1990, 2001, 2006, 2008; Weigl et al. 1999). VNFS will eat a range of seeds, buds, fruits, and insects, but, in the Appalachians, the squirrels rely heavily on hypogeal fungi (truffles) and lichens associated with the root systems of red spruce (Ford et al. 2004; Ford and Rodrigue 2007; Loeb et al. 2000; Maser et al. 1978, 1986; Maser and Maser 1988; Mitchell et al. 2001). While nesting mainly in tree cavities in live hardwoods and snags (yellow birch and American beech are preferred), the VNFS will also utilize leaf or 'drey' nests in conifers such as red spruce and eastern hemlock, and have been observed using multiple den/nest sites in one season (Hackett and Pagels 2003; Menzel 2003; Menzel et al. 2000, 2004; Weigl et al. 1999). Den sites have often been found in trees and snags larger and taller than surrounding tress, and near trails, old logging roads, or railroad grades (Hackett and Pagels 2004; Menzel et al. 2004). VNFS will occupy artificial nest boxes (Reynolds et al. 1999). Individual home range sizes are variable, ranging from 5 to > 100 ha in West Virginia (Urban 1988; Menzel et al. 2006b). Home range size varies by habitat structure quality and seasonal food abundance, with males tending to have larger home ranges than females (Weigle et al. 1999). Optimal habitat is red spruce forest exhibiting mature to old-growth characteristics on north and east-facing slopes, with large trees, numerous snags, high volumes of coarse wood debris, and abundant lichens and hypogeal fungi providing year-round lifecycle needs (Carey 1989, 1991, 1995; Ford et al. 2004; Hackett and Pagels 2003; Odom et al. 2001; Payne et al. 1989; Rosenburg 1990; Shuler et al. 2002; Weigl et al. 1999). However, VNFS can persist in and around remnant patches of red spruce and mixed spruce-northern hardwood forest (Ford et al. 2004; Menzel 2003; Menzel et al. 2004; 2006a, b; Smith 2007).

In a 2006 5 year review and 2008 final rule, the USFWS estimated a range of 242,000 to 600,000 acres of potential suitable habitat for VNFS, generally following the spine of the high Allegheny Plateau in a northeast to southwest alignment (Menzel et al. 2006b; USFWS 2006 and 2008). No critical habitat has been designated for this species. Based on the Menzel habitat suitability model, the majority of 'optimal' (80%) and 'likely' (65%) habitat is found on the Monongahela National Forest in West Virginia (Menzel et al. 2006b; USFWS 2006 and 2008). Approximately 6,268 acres of mixed spruce and northern hardwood habitat occurs in the Laurel Fork area on the Forest, in Highland County, Virginia. This represents approximately 3% of the total estimated habitat for the VNFS rangewide and 25% of an estimated 25,250 acres of 'likely' habitat in Highland County, Virginia, as determined by the Menzel habitat suitability model (Menzel et al. 2006a; USFWS 2006 and 2008). At Laurel Fork, mature red spruce is found mixed within northern hardwood forest types, primarily associated with riparian areas along Buck, Slabcamp, Bearwallow, and Newman Runs, all on the upper east flank of Alleghany Mountain (Fleming and Moorhead 1996). Current estimates of mature red spruce is 219 acres, with an additional 154 acres of mature red spruce in plantations on the upper slopes of Allegheny Mountain, in the vicinity of Buck Knob and Locust Spring Run (Fleming and Moorhead 1996; USFS 2011). In addition, 116 acres of mature red pine plantation is present in the same area. Most of the spruce and red pine is estimated to be 90 years or older. Adjacent to the spruce and pine plantations and intermixed along the tributaries to Laurel Fork and Laurel Fork itself are an estimated 158 acres of open beaver meadow/wetland glades, and herbaceous and shrubby old field habitat (Fleming and Moorhead 1996). In total, 373 acres of mature red spruce and an additional 116 acres of mature red pine are components of the 6,268 acre mixed spruce/northern hardwood forest complex in Laurel Fork. Abundant red spruce regeneration is present throughout the area, both in the understory of spruce/northern hardwood forests and in adjacent old beaver meadows and wetland glades, making the total acreage of the spruce forest component estimated at around 600 acres (Fleming and Moorhead 1996; USFS 2011).

At the time of federal listing in 1985, VNFS was known to occur in four geographic areas, three in West Virginia (Cranberry Glades, Cheat Bridge/Cheat Mountain, Stuart Knob) and one in Virginia (Laurel Fork). The USFWS has documented 109 known sites with VNFS, 107 in West Virginia, and two in Virginia (USFWS 2006 and 2008). The Virginia population is known only from Highland County, Virginia and is considered part of the Spruce Knob/Laurel Fork population cluster (Pocahontas, Randolph, Pendleton Counties, West Virginia, and Highland County, Virginia) (USFWS 2006 and 2008). A population of uncertain genetic status is also located in southwestern Virginia at Mt. Rogers National Recreation Area and adjacent Grayson Highlands State Park (USFWS 2006 and 2008). Several studies have attempted to determine whether this population is the Virginia or Carolina northern flying squirrel subspecies, or an intergrade between the two, with the most recent research indicating a likely genetically distinct population (Arbogast and Schumacher 2010; Fies and Pagels

1991, Reynolds et al. 1999; Sparks 2005). Until the genetic uncertainties are officially resolved, the USFWS recovery plan for Carolina flying squirrel includes this population for conservation and management purposes, and is addressed in the Jefferson National Forest Revised Land Management Plan (USFS 2004; USFWS 2006).

Since 1985, the Laurel Fork area has been monitored for VNFS using a combination of presence/absence surveys with nest box checks and live capture/recapture methods (J. Pagels unpublished data; Reynolds et al. 1999). At the time the first Forest Plan Revision was signed (1993), monitoring efforts estimated fewer than 20 individuals in the Laurel Fork Area (USFS 2011). Despite repeated monitoring efforts for over twenty years, very few VNFS have been captured. During a 10 year mark/recapture study on two sites in Laurel Fork (1986-1996), only one squirrel was captured in 10 years on site one, and 3-6 captured in four of 10 years on site two (Reynolds et al. 1999). Despite a low capture rate throughout the years, VNFS have been shown to persist in the Laurel Fork area with the most recent capture in 2004 (J.Pagels unpublished data). Three sites in Laurel Fork on the Forest have now been documented to have VNFS, as well as two sites on private land in Highland County, one adjacent to Forest land in Laurel Fork (Rick Reynolds, VDGIF and Marek Smith, TNC, pers. comm., 2012). The USFWS acknowledges known inadequacies in current monitoring techniques for VNFS to prove or disprove presence of the VNFS (USFWS 2001, 2006, 2008). The current Recovery Plan for VNFS, as amended, encourages the assumption of presence in suitable habitat, because the squirrels are less likely to use nest boxes or enter traps in good quality habitat due to the abundance of natural den sites and preferred foods in these areas (USFWS 2001).

**Threats**

A number of natural and human-related threats have been documented for the VNFS in the USFWS recovery plan, USFWS 5 year review, USFWS Final 2008 Rule, and published research.

*Loss of suitable habitat and connectivity*. Historically, the Allegheny Highlands contained over 500,000 acres of old-growth spruce-dominated forest in the Allegheny Highlands (USFWS 2006 and 2008). Much of this was lost through historical logging and associated wildfires, which led to the replacement forest being more dominated by northern hardwood types, with a reduced spruce/conifer component (Adams and Stephenson 1989; Schuler et al. 2002). This habitat change and resulting fragmentation of suitable habitat had a serious negative impact on the size and distribution of VNFS populations throughout their range (Ford and Rodrigue 2007, USFWS 2006 and 2008). Currently, an estimated 242,000 – 600,000 acres of varying suitability exists for VNFS, based on the consolidation of several habitat suitability models (USFWS 2006 and 2008). In the Laurel Fork area on the Forest, 373 acres of mature red spruce, an additional 116 acres of mature red pine, and an estimated 300 acres of red spruce regeneration are intermixed within 6,268 acres of mixed spruce/northern hardwood forest ecological system. The current Forest Plan Revision (1993) identifies this area as the Laurel Fork Special Management Area and the Laurel Fork Roadless Area (USFS 1993), and management of the area has been in compliance with the guidelines of the VNFS Recovery Plan, as amended.

*Disease.* Several disease threats to the habitat of the VNFS have been documented at Laurel Fork. The hemlock woolly adelgid (*Adelges tsugae*) has caused serious death and decline of Eastern hemlock forests across the Forest (USFS 2011). Eastern hemlock was identified as a component of the spruce/northern hardwood system in Laurel Fork (Fleming and Moorhead 1996), but not a dominant overstory type in the area of Laurel Fork known to have VNFS populations. Because a predominately montane conifer component is still present, it is not anticipated that hemlock woolly adelgid would pose a serious threat to the habitat quality for VNFS, given the limited role of hemlock in flying squirrel survival (USFWS 2006 and 2008). Beech bark disease results from attack by the beech scale insect, *Cryptococcus fagisuga*; subsequent fungal infestations can either cause serious decline or mortality to mature trees (Cammermeyer 1993). Evidence of beech bark disease is present in Laurel Fork (Fleming and Moorhead 1996), resulting in scattered mortality of mature trees, but the beech component is still present in the spruce/northern hardwood community. Scattered mortality provides potential suitable cavities for VNFS (USFWS 2006 and 2008). Due to the limited amount of beech present in Laurel Fork, Beech bark disease is not considered to be a serious threat to the quality of habitat for VNFS in the life of proposed Forest Plan Revision.

*Impacts from southern flying squirrel.* The FWS Recovery Plan states VNFS can be threatened by competition for available den sites with the southern flying squirrel (*Glaucomys volans*) and by spread of a parasitic nematode (*Strongyloides*) from the southern to northern flying squirrel (USFWS 2001). Recently, however, the USFWS has documented that while co-occurrence of both species in areas of the VNFS range has been documented, available evidence indicates occurrence and potential severity of impacts due to sympatric existence appears limited (USFWS 2006 and 2008). One possible explanation could be the decline of available beech nuts by the spread of beech bark disease, an important food source for southern flying squirrels. With regards to parasitic infestations, research has hypothesized that the parasitic nematode (*Strongyloides*) is limited by below-freezing temperatures, such as occurs throughout the range of VNFS (Wetzel and Weigel 1994). Twenty years of capture data documenting VNFS with no signs of debilitating effects due to parasitic infestation appear to bolster this hypothesis (USFWS 2006 and 2008). Therefore, the USFWS has concluded the risk of competition with the southern flying squirrel does not threaten the continued existence of the VNFS (USFWS 2006 and 2008).

*Acid precipitation and climate change.* Since federal listing of VNFS, acid precipitation and climate change have been cited as factors in the decline of the spruce-fir ecosystem throughout the Appalachians. The negative effects of acid deposition on fir species have been well documented, though long-term effects to red spruce have not been as conclusive (USFWS 2006 and 2008). The long-term impacts of a rise of average high temperatures due to climate change could negatively affect the extent and quality of northern hardwood and spruce ecosystems, further reducing available habitat throughout the range of VNFS (Delcourt and Delcourt 1984).

Across the range of the VNFS, the Monongahela National Forest in West Virginia contains the majority of the estimated suitable 242,000 acres of suitable habitat (Menzel 2003; USFWS 2006 and 2008). The Laurel Fork area in the Forest, with an estimated 6,268 acres of suitable habitat, and representing approximately 3% of the available suitable habitat range-wide, borders the Monongahela National Forest, with two Monongahela NF Management Prescription 4.1 (Spruce and Spruce-hardwood Restoration) areas within 3 and 10 miles respectively of the Forest (USFS 2006). The Laurel Fork area is considered part of the larger Spruce Knob/Laurel Fork VNFS Recovery population cluster (Pocahontas, Randolph, Pendleton Counties, West Virginia, and Highland County, Virginia) and affords the best opportunity for connectivity of habitat and long term population gene flow for VNFS (USFWS 2006 and 2008). In Virginia, smaller areas of spruce/northern hardwood on private land adjacent to and in the vicinity of Laurel Fork, and have known VNFS populations, are under Conservation Easement through the Virginia Nature Conservancy (Marek Smith, TNC, pers. Comm. 2012). The current Forest Plan Revision (1993) identifies the Laurel Fork area as the Laurel Fork Special Management Area and the Laurel Fork Roadless Area (USFS 1993). Vegetation desired conditions and management have been performed in compliance with the guidelines of the VNFS Recovery Plan, as amended, (USFS 1993). Current spruce and northern hardwood systems in the Laurel Fork area are mature and will continue to age through the life of the proposed plan revision.

Several studies have attempted to determine whether this population is the Virginia or Carolina northern flying squirrel subspecies, or an intergrade between the two, with the most recent research indicating a likely genetically distinct population (Arbogast and Schumacher 2010; Fies and Pagels 1991; Reynolds et al. 1999; Sparks 2005). Until the genetic uncertainties are officially resolved, the USFWS recovery plan for Carolina flying squirrel includes this population for conservation and management purposes (USFWS The Whitetop and Mount Rogers areas containing northern flying squirrel habitat (approximately 6,000 acres) have been allocated to special areas in the Jefferson National Forest Land Management Plan Revision (management prescriptions 4.K.3. and 4.K.4.) (USFS 2004). Both of these special areas are classified as unsuitable for timber management and management is primarily focused on protecting and restoring the high elevation rare communities and species that inhabit this area (including the spruce-fir and northern hardwood forest and northern flying squirrel), managing forest visitor use, maintaining the outstanding vistas and natural scenery that led to designation of this area as a National Recreation Area. Key spruce-fir and northern hardwoods restoration areas have been identified in the Jefferson NF Revised Forest Plan to provide linkages to connect suitable habitat types for northern flying squirrels.

Habitat on the Forest currently occupied by the northern flying squirrel is protected and habitat and gene flow linkages are being restored through management prescriptions on the adjacent Monongahela National Forest, as well as Conservation Easements on adjacent and nearby private land. The northern flying squirrel population of uncertain genetic status at Mt. Rogers is also being protected through provisions in the Jefferson National Forest Revised Land Management Plan. These actions will provide suitable habitat, connectivity, and opportunities for gene flow over the life of the proposed Plan Revision and into the future. Therefore the cumulative effects of the proposed George Washington Revised Forest Plan will be beneficial to the VNFS.

**Plan Components**

Alternatives A, B, D, E, G, H and I identify the Laurel Fork Area as a Special Biological Area and as Remote Backcountry. The Laurel Fork Area is also a Potential Wilderness Area. VNFS Recovery Plan Guidelines will continue to be followed in habitat with known populations or the potential to have populations of VNFS. Objectives for the Spruce Forest and Northern Hardwood Ecological Systems are to maintain current acreage. In Alternatives B, D, E, G, H and I there is also an objective to re-establish about 1,300 acres of regenerating spruce across the planning period. Where non-native red pines were planted, red spruce should be restored. Forestwide standards for the Spruce Forest Ecological System are to maintain or restore the forest type.

Current spruce and northern hardwood systems in the Laurel Fork area are mature and will continue to age through the life of the proposed plan revision. Spruce regeneration is also present and will continue through mostly natural means throughout the proposed planning period, although active restoration may also occur. Habitat suitable for VNFS will continue to be available through the foreseeable future.

Alternatives B, D, E, G, H and I have strategies to help mitigate, as much as possible, potential effects of habitat quality and reduction of the spruce and northern hardwood ecosystem.

In Alternatives C and F the Laurel Fork area is recommended for Wilderness designation. Natural processes would continue in the area, but active restoration activities would not occur.

Under all alternatives, the Laurel Fork area is not available for gas leasing so would not be affected by the decision on lands available for leasing.

## 3.2.4 JAMES SPINYMUSSEL

**Background**

The James spinymussel was federally listed as endangered in 1988 (USDI Fish and Wildlife Service 1990). Historically, this species was apparently throughout the James River above Richmond, in the Rivanna River, and in ecologically suitable areas in all the major upstream tributaries (Clarke and Neves 1984). The species remained widespread through the mid-1960's, but now appears extirpated from 90% of the historic range. Since 1990, James spinymussel populations have been found in three tributaries to the Dan River in Virginia and North Carolina, which is outside of the species' range known at the time of listing.

This species is found in slow to moderate currents over stable sand and cobble substrates with or without boulders, pebbles, or silt (Clarke and Neves 1984). Hove and Neves (1994) found James spinymussels in 1.5 to 20 m wide second and third order streams at water depths of 0.3 to 2 m. Seven fish hosts, all in the family Cyprinidae, have been identified (Hove 1990): bluehead chub, rosyside dace, blacknose dace, mountain redbelly dace, rosefin shiner, satinfin shiner, and stoneroller. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column. The following excerpt from Hove and Neves (1994) states the current thinking on threats:

> "There are several anthropogenic and natural threats to the James spinymussel's continued existence. Nearly all the riparian lands bordering streams with the James spinymussel are privately owned. With more intensive use of the land, it is probable that water quality and habitat suitability will deteriorate. At

present, the most detrimental activities include road construction, cattle grazing, and feed lots that often introduce excessive silt and nutrients into the stream."

The introduced Asian clam is also considered to be a threat to the James spinymussel and is beginning to invade several sites (Hove and Neves 1994).

Occurrences of the James spinymussel near the Forest include Potts Creek, Craig Creek, Pedlar River, Cowpasture River, Bullpasture River, Mill Creek, and there are historic records from the James and Calfpasture Rivers. In the Craig Creek watershed, the species is stable due to population(s) in Johns, Dicks, and Little Oregon creeks (near the Jefferson National Forest). The species appears to be extirpated in Potts Creek or at such low numbers that detection is extremely difficult. In the Cowpasture River watershed, population status in the Cowpasture and Bullpasture is uncertain with the population in Mill Creek stable (see Table 4, Watson 2010).

Table F-4. Location and Status of James spinymussel populations in the James River Watershed

| Watershed | Tributary | County/State | Status |
|---|---|---|---|
| James River | Bullpasture River | Highland/VA | Unknown |
| James River | Calfpasture River | Rockbridge/VA | Extirpated? |
| James River | Catawba Creek | Botetourt/VA | Extirpated? |
| James River | Cowpasture River | Bath & Alleghany/VA | Stable? |
| James River | Mill Creek | Bath/VA | Stable |
| James River | Craig Creek | Craig/VA | Declining |
| James River | Dicks Creek | Craig/VA | Stable to increasing |
| James River | James River mainstem | Various | Extirpated |
| James River | Johns Creek | Craig/VA | Stable |
| James River | Little Oregon Creek | Craig/VA | Stable to increasing |
| James River | Patterson Creek | Botetourt/VA | Extirpated? |
| James River | Pedlar River | Amherst/VA | Stable |
| James River | Potts Creek | Monroe/WV | Stable |
| James River | Potts Creek | Craig & Alleghany/VA | Extirpated? |
| James River | Upper Potts Creek | Monroe/WV | Stable? |

Despite extensive searches, no occurrences of the spinymussel have been located on the Forest (Watson 2010). The 14 miles of potential habitat modeled for this species in the Ecological Sustainability Analysis assumes all of the river mileage is suitable substrate, which is not probable; in all of the watersheds with spinymussels near the Forest, the occurrences are all on private land. The James spinymussel does occur both upstream and downstream from the Forest. Current Forest management provides for water quantity and quality that contributes to the persistence of mussel populations. The main avenues for the Forest to aid in this species recovery are through land acquisition, assisting in augmentation efforts, and working with landowners to protect streams and streamside habitat. Several isolated reaches of habitat on the Forest could provide sites for augmentation if the substrate were suitable. Working cooperatively with State biologists, university experts, and the US Fish and Wildlife Service, the Forest developed a pro-active conservation plan for federally listed fish and mussels in 2004. The standards and guidelines in the plan are implemented in 6$^{th}$ level HUC watersheds that contain listed fish or mussel species. The following watersheds on the Forest are covered by the Federally Listed Mussel and Fish Conservation Plan.

Table F-5. Sixth Level HUC watersheds on the George Washington National Forest included in the Federally Listed Mussel and Fish Conservation Plan

| 6th Level HUC | Watershed Name |
|---|---|
| 020802010403 | Mill Branch-Potts Creek |
| 020802010404 | Cast Steel Run-Potts Creek |
| 020802010405 | Hays Creek-Potts Creek |
| 020802010601 | Wolfe Draft-Cowpasture River* |
| 020802010602 | Shaws Fork* |
| 020802010603 | Benson Run-Cowpasture River* |
| 020802010701 | Scotchtown Draft-Cowpasture River |
| 020802010702 | Dry Run* |
| 020802010703 | Thompson Creek-Cowpasture River* |
| 020802010801 | Mill Creek-Cowpasture River* |
| 020802010803 | Simpson Creek-Cowpasture River |
| 020802011201 | Rolands Run Branch-Craig Creek |
| 020802011202 | Barbours Creek* |
| 020802011205 | Roaring Run-Craig Creek |
| 020802011302 | Town Branch-Catawba Creek |
| 020802020104 | Hamilton Branch* |
| 020802020105 | Fridley Branch-Calfpasture River* |
| 020802020106 | Cabin Creek-Mill Creek |
| 020802020108 | Guys Run-Calfpasture River* |
| 020802020506 | Poague Run-Maury River* |
| 020802030201 | Lynchburg Reservoir-Pedlar River |
| 020802030202 | Browns Creek-Pedlar River |
| 020802030203 | Horsley Creek-Pedlar River |

* No spinymussel occurrence in this watershed, but is found in downstream HUC(s)

**Threats**

The decline and extirpation of most populations of the James spinymussel may be attributed to habitat modification, sedimentation, eutrophication, and other forms of water quality degradation. Restricted movement of host fish may also be a factor in the decline of this species. For populations of the James spinymussel on or near the Forest, potential management influences include sedimentation, altered flow, and blockage of host fish passage associated with roads and crossings. Forestwide and riparian standards will protect the James spinymussel and its habitat from sediment released during management activities.

A cumulative effects analysis should consider incremental impacts of actions when added to past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. For this document, cumulative effects were analyzed through a two-part watershed analysis, which included resource assessment and management prescription (Reid 1998).

Throughout the planning process, the Forest evaluated watersheds using information including, but not limited to: Virginia Department of Environmental Quality 303d report for impaired waters; Virginia Department of Environmental Quality and Virginia Department of Conservation and Recreation 305b report on non-point

source pollution; Virginia Department of Game and Inland Fisheries collection records; West Virginia Division of Natural Resources collection records and reports; local knowledge of forest recovery from past conditions; local knowledge of current watershed problems; macroinvertebrate, stream habitat, and water chemistry information; and geographic information system layers of land use, point source, road and mine locations. Through this resource assessment, the Forest evaluated cumulative watershed effects associated with land use practices at the 5th Hydrologic Unit Code (HUC) watershed level, and their effect on aquatic fauna and habitat.

Concurrently, the Forest carried out an interdisciplinary analysis looking at interactions between resources with a goal of managing riparian corridors to retain, restore, and /or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components within the corridor, while minimizing effects to aquatic and riparian resources from other activities. This was done through many meetings and discussions, which included not only multi-agency resource professionals, but members of the public as well. From this work, prescriptions, goals, objectives, and standards were developed in order to focus management on riparian, aquatic, and healthy watershed needs. They were designed to not only minimize adverse impacts to aquatic and riparian areas, but to maintain them as healthy, functioning systems.

Resulting from the careful development of prescriptions and standards, there should be beneficial effects on in-stream uses (including federally listed aquatic species) during the implementation of the proposed Forest Plan. These beneficial effects include, but are not limited to: watershed restoration activities, and road and recreation site maintenance, reconstruction, relocation, and/or closure/rehabilitation; control and management of livestock grazing will reduce sediment that is currently entering the stream system. Buffer zone filter strips will limit sediment produced by ground disturbing activities (including road construction, firelines, trails, livestock grazing, wildlife habitat improvements, prescribed and wildland fire, recreation development, and timber harvest) from entering a stream system. Management of streamside areas for riparian purposes and needs will increase large woody debris and shade. Stream crossings of roads and trails will allow the passage of desired aquatic organisms.

Any effects from management activities will be insignificant or discountable; therefore there will be no adverse direct or indirect watershed effects to the James spinymussel. Since it does not occur on the National Forest, the main avenues for the Forest to aid in this species recovery are through educating and working with landowners to protect streams and streamside habitat, and assisting efforts to identify additional suitable habitat and restore these species to historical habitats as appropriate. In some cases, acquisition of lands within the Forest's Proclamation Boundary may also be part of recovery actions.

**Plan Components**

The expansion of riparian areas in Alternatives B, C, D, E, F, G, H and I will manage all riparian areas in watersheds that support James spinymussel in line with the Forests' Federally Listed Mussel and Fish Conservation Plan. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed. Prior to the stocking of any non-native species, the Forest coordinates with the appropriate State agencies to ensure populations and habitats of native species are maintained.

The Forest will manage and protect extant populations and historical habitats of the James spinymussel. Protection and active management will be implemented where the species is physically on or historically occurred on Forest lands. Protection, monitoring, and augmentation will be the primary recovery objectives. Actions will be taken in order to identify additional suitable habitat and restore fish hosts and mussels to areas on Forest lands. Recovery objectives will include annual or bi-annual monitoring within Virginia of representative populations by qualified biologists for populations trend and habitat quality. Monitoring will include either search indices or transects depending on local conditions and mussel densities. Inventories of additional potential habitat will also be conducted.

## 3.2.5 MADISON CAVE ISOPOD

**Background**

The Madison Cave isopod was federally listed as a threatened species in 1982. It is an eyeless, unpigmented, freshwater crustacean, belonging to a family that consists of mostly marine species. It is the only free-swimming stygobitic isopod known in the Appalachians (Holsinger et al. 1994). With a maximum length of 0.7 inches, its body is flattened and bears seven pairs of long walking legs; the first pair are modified as grasping structures (USDI 1996).

The Madison Cave isopod is found in flooded limestone caves beneath the Shenandoah Valley in Virginia and West Virginia where it swims through calcite-saturated waters of deep karst aquifers. It is known from 19 caves and wells, spanning a range 150 miles long and less than 15 miles wide, stretching from Lexington, VA to Charles Town, WV (Hutchins et al. 2010). There are documented population centers in the Waynesboro-Grottoes area (Augusta County, VA), the Harrisonburg area (Rockingham County, VA), and the valley of the main stem of the Shenandoah River (Warren and Clarke counties, VA and Jefferson County, WV) (USDI 2009).

The population size of the Madison Cave isopod is unknown at most sites. Sampling results suggest that the population is dominated by adults. It is thought that the isopod has a lengthy life span and low rate of reproduction; it is unknown how this species reproduces. Feeding habits are unknown, but it is believed to be carnivorous (USDI 2009).

Recent genetic studies of the Madison Cave isopod indicate there are three genetically distinct clades corresponding to three geographic groups of sites. The groups are strongly correlated with the geographic pattern of carbonate rock outcropping in the Shenandoah Valley indicating potential barriers to subterranean hydrologic connectivity (Hutchins et al. 2010).

The Madison Cave isopod is not known from the Forest, the closest occurrence is approximately four miles straight line distance to Forest Service land. To date, all known collections of the Madison Cave isopod have come from caves and wells that tap into the karst aquifer(s) hosted by and formed in Cambro-Ordovician aged carbonate bedrock (limestone and dolostone) of the Great Valley province in Virginia and West Virginia. Orndorff and Hobson (2007) combined Great Valley outcrop areas of the following units from the 1993 Geologic Map of Virginia (VA-DMR, 1993) to create a map of potential habitat for Madison Cave isopods in Virginia: Shady Dolomite, Tomstown Dolomite, Elbrook Formation, Conococheague Formation, Upper Cambrian and Lower Ordovocian Formations (undivided), Beekmantown Group (including Stonehenge, Rockdale Run, and Pinesburg Station Formations), and the Edinburg/Lincolnshire/New Market association. The following additional formations have some minor carbonate units, and have a small potential to host the species: Waynesboro Formation, Pumpkin Valley Shale (including Rome Formation). Carbonate rocks in the base of the Martinsburg Formation, immediately adjacent to the Edinburg/Lincolnshire/New Market association, may also host the species, but are generally confined to an area within a few hundred feet of the contact.

**Threats**

The Madison Cave isopod appears to be long-lived and have low reproductive potential, suggesting that populations are highly sensitive to disturbance. As a subterranean aquatic obligate, potential threats include the loss and modification of habitat (including the surface environment that is their primary source of water and nutrients), groundwater contamination, and groundwater drawdown (USDI 1996). Agriculture and encroaching industrial and urban development threaten the quality and quantity of groundwater habitat and thus the survival of this species (USDI 2009).

To protect Madison Cave isopod habitat, the USDI Fish and Wildlife Service (2009) recommends avoiding chemical and fertilizer use where it could enter a waterway that supports the Madison Cave isopod, maintaining a buffer of natural vegetation along waterbodies and sinkholes to control erosion and reduce run-off, not disposing of waste or other material into sinkholes, fencing livestock out of streams, properly disposing of household wastes, including used motor oil, and properly maintaining septic tanks. Forest Service activities

meet or exceed all of the above recommendations. Based on the limited amount and type of management proposed in the management prescriptions that intersect with potential Madison Cave isopod habitat, there will be no loss or modification of karst aquifer habitat, groundwater contamination, or groundwater drawdown from Forest Service activities; thus no effect to potential habitat.

The strategy on groundwater issues that cross national forest boundaries and are affected by multiple region-wide impacts such as increased agricultural use, growing urban development, is to focus on sustaining and improving watershed areas within national forest control while working cooperatively with other agencies and landowners to improve statewide watershed health.

The high probability potential Madison Cave isopod habitat identified by Orndorff and Hobson (2007) is 352,205 acres; the Forest Service portion of that is 280 acres, or 0.08%. The medium probability potential habitat is 513,215 acres, with the Forest Service owning 428 acres, or 0.08%.

The species range is the Shenandoah Valley in Virginia and West Virginia; it is mostly private land, where agriculture, urban and industrial development dominate the landscape. Because there will be no direct or indirect effects to Madison Cave isopod from Forest Service management activities, and only a fraction (less than a tenth of one percent) of potential habitat is on Forest Service land, any cumulative effects to the quality or quantity of Madison Cave isopod habitat will be from private land.

**Plan Components**

The potential habitat described above was divided into high, medium, and low probability of Madison Cave isopod occurrence by the Virginia Division of Natural Heritage (Orndorff and Hobson 2007). The high and medium likelihood potential habitat was intersected with Forest Service land boundaries to determine quantity and quality of potential habitat on National Forest. Only about 300 acres on National Forest System lands are in the high probability potential Madison Cave isopod habitat. About 400 acres are in the medium probability potential habitat. With no known populations on the GWNF and the very limited amount of land in potential habitat, none of the alternatives are expected to have any impact on this species.

The high probability potential habitat is within the Remote Backcountry Management Area Prescription (12D) along the western flank of Massanutten Mountain in all alternatives except Alternative C, where it is in Recommended Wilderness. The emphasis for this area is to provide recreation opportunities in large remote, core areas where users can obtain a degree of solitude and the environment can be maintained in a near-natural state. There is little evidence of humans or human activities other than recreation use and nonmotorized trails.

In Alternatives A, B, D, E, G, H and I the majority of the medium probability potential habitat is within the Pastoral Landscapes and Rangelands Management Area Prescription (7G), along the South Fork Shenandoah River; emphasis is on maintaining high quality, generally open landscapes with a pastoral landscape character. These lands are unsuitable for timber production but allow limited recreational facilities, that might include pullouts, small parking areas, trailheads, bulletin boards, interpretive signage, fence stiles, rail, and other fences, and low development trails. In Alternative C the majority of the medium probability potential habitat is in the Eligible Recreation River Corridor Management Area Prescription (2C3).

Based on the limited amount and type of management proposed in the Management Prescriptions of all of the alternatives that intersect with potential Madison Cave isopod habitat, there will be no loss or modification of karst aquifer habitat, groundwater contamination, or groundwater drawdown from Forest Service activities; thus no effect to potential habitat.

## 3.2.6 SHALE BARREN ROCK CRESS

**Background**

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2012).

Shale barren rockcress was listed as endangered under the Endangered Species Act on August 8, 1989. It is an endemic of shale deposits, occurring only on sparsely-vegetated xeric, south or west-facing shale slopes (barrens) at elevations generally ranging from 1300 to 2600 feet. Populations are known from both the shale openings and shale woodlands adjacent to the shale openings. All extant occurrences are on shales of Devonian age (Ludwig pers. comm.); a single occurrence was known from the Martinsburg shale of Ordovician age, but it is no longer extant. This narrow endemic is known only from shale barren regions of Virginia and West Virginia and is one of the most restricted shale barren endemics. According to NatureServe, approximately 56 occurrences are believed extant, 34 in Virginia and 22 in West Virginia, of these, most are made up of fewer than 50 individuals; there are perhaps fewer than 4,000 plants altogether. Most occurrences are on public lands, predominantly National Forests.

Recovery tasks for the Forest identified in the shale barren rockcress Recovery Plan include: Implement and evaluate the monitoring program.

The following is from the Forest's Monitoring and Evaluation Report 2004:

> *"In 1993 there were 17 known occurrences of shale barren rockcress on the Forest. The Forest's focus since this species was listed has been to attempt to locate additional populations and further define its range on the Forest. From 1994 to 1998 agency personnel worked cooperatively with the Virginia Division of Natural Heritage and the USFWS to inventory shale barrens on the Forest (Belden, Ludwig, and Van Alstine 1999). The Virginia Division of Natural Heritage identified 809 potential shale barrens from aerial photographs. Of these, 188 were examined for rare species. The inventory resulted in 27 new occurrences of shale barren rockcress, bringing the total known sites on the Forest (in Virginia) to 42. This number does not include two sites where shale barren rockcress was known to occur recently, but could not be found in 1994. In 2004 the West Virginia Department of Natural Resources discovered a new population of shale barren rockcress at the Little Fork North Shale Barren."*

Currently on the Forest there are 26 Special Biological Areas (SBAs) in Virginia and 8 SBAs in West Virginia that support shale barren rockcress. These SBAs contain all of the known shale barren rockcress populations on the Forest. Within those sites the plants may be in more than one location. Depending on how one counts populations or subpopulations, there are about 75 occurrences of this species on the Forest. The *Arabis serotina* Recovery Task Force and the Shale Barren Protection Strategy Group devised a monitoring plan for shale barren rockcress in 1993. The plan calls for monitoring this species at several sites across its range by the WVDNR between 15 August and 5 September each year, and all other sites every five years. This protocol was followed from 1993 through 2001 in WV. In 2001, it was decided that, to limit the impact of repeatedly crossing the barrens, monitoring would be conducted biennially at the Little Fork and Brandywine shale barrens in Pendleton County, as opposed to every year. In 2011 the VDNH and the USFWS entered into an agreement to resurvey all sites on U.S. Forest Service (USFS) lands in Virginia to determine their persistence and to provide information needed to enable permanent protection measures to be taken by the USFS in cooperation with the Service.

Although adequate moisture is available for most plants within the substrata of the shale layers, adverse surface conditions act to restrict germination and establishment success of plants (Platt 1951). It is primarily the effect of high surface temperatures that limits plant reproductive success in these habitats. Surface soil temperatures are often well above the physiological tolerance of most plant species, reaching maximum temperatures of 63 degrees Celsius (Dix 1990). Such temperatures are high enough to cause direct damage to seedlings. For additional detailed information pertaining to the shale-barren community, see Dix (1990).

Recovery tasks for the Forest identified in the shale barren rock cress Recovery Plan include: implement and evaluate the monitoring program.

Recovery tasks for the Forest identified in the shale barren rockcress Recovery Plan include:

1. Implement and evaluate the monitoring program.

**Threats**

Threats include:

- Construction of roads, railroads, and hiking trails has impacted occurrences in the past; several occurrences are now located adjacent to these corridors where they may be impacted by erosion or maintenance activities.
- Flood control measures are a potential threat at some locations (e.g. South Fork Valley of West Virginia) (Bartgis in lit.); one barren has already been destroyed by a stream dam (Dix 1990).
- Most extant occurrences are moderately to severely browsed by deer, which is considered by some to be a prime threat to the species (USFWS 1989); quantifying the impact of deer browsing is an area of active research (Ludwig pers. comm.).
- Moderately xeric sites may be subject to encroachment of exotic plant species such as *Centauria biebersteinii* and numerous grasses (Dix 1990). Such encroachment is a particular concern for *Arabis serotina* since it does not tolerate competition well; it is generally restricted to the more open portions shale barren communities.
- A significant threat to the insect pollinators of *A. serotina* is presented by the spraying of Dimilin and BT insecticides for gypsy moth control. Because of the open habitat, shale barren insects are maximally exposed to pesticides (Dix 1990). Dimilin is a broad-spectrum biocide that persists until leaf fall and up to a few years in the duff and would have a long-term impact of shale-barren slopes. All insect occurrences on shale barrens sprayed with Dimilin should be considered extirpated (Schweitzer in litt). BT is lepidopteran-specific and only persists for roughly one week (Dix 1990). Application during larval development may have devastating impacts on the fauna.
- Finally, the very small number of individuals within many occurrences suggests that the long-term persistence of these occurrences is uncertain, especially considering that populations tend to fluctuate dramatically.

The term "shale barren" is a general reference to certain mid-Appalachian slopes that possess the following features: 1) southern exposures, 2) slopes of 20-70 degrees and 3) a covering of lithologically hard and weather-resistant shale or siltstone fragments (Dix 1990). These barrens support sparse, scrubby growth; frequently-observed species include *Quercus ilicifolia, Q. prinus, Q. rubra, Pinus virginiana, Juniperus virginiana, Prunus alleghaniensis, Rhus aromatica, Celtis tenuifolia, Kalmia latifolia, Bouteloua curtipendula, Andropogon scoparius, Phlox subulata var. brittonii, Silene caroliniana ssp. pensylvanica, Sedum telephoides, Antennaria spp., Aster spp.*, and *Solidago spp.* (Dix 1990). Local variations in associated flora may be considerable (Braunschweig et al. 1999; Jarrett et al. 1996; Keener 1970; Keener 1983; Wieboldt 1987).

Although adequate moisture is available for most plants within the substrata of the shale layers, adverse surface conditions act to restrict germination and establishment success of plants (Platt 1951). It is primarily the effect of high surface temperatures that limits plant reproductive success in these habitats. Surface soil temperatures are often well above the physiological tolerance of most plant species, reaching maximum temperatures of 63 degrees Celsius (Dix 1990). Such temperatures are high enough to cause direct damage to seedlings. For additional detailed information pertaining to the shale-barren community, see Dix (1990).

Because of the highly stressful nature of shale barren environments, this species is not believed to be capable of tolerating much additional disturbance. Specific threats (NatureServe 2012) include:

1) Construction of roads, railroads, and hiking trails has impacted occurrences in the past; several occurrences are now located adjacent to these corridors where they may be impacted by erosion or maintenance activities.
2) Flood control measures are a potential threat at some locations (e.g. South Fork Valley of West Virginia) (Bartgis in litt.); one barren has already been destroyed by a stream dam (Dix 1990).
3) Most extant occurrences are moderately to severely browsed by deer, which is considered by some to be a prime threat to the species (USFWS 1989); quantifying the impact of deer browsing is an area of active research (Ludwig pers. comm. and WVDNR 2011).
4) Moderately xeric sites may be subject to encroachment of exotic plant species such as *Centauria maculata* and numerous grasses (Dix 1990). Such encroachment is a particular concern for *Arabis serotina* since it does not tolerate competition well; it is generally restricted to the more open portions shale barren communities.
5) A significant threat to the insect pollinators of *A. serotina* is presented by the spraying of Dimilin and BT insecticides for gypsy moth control. Because of the open habitat, shale barren insects are maximally exposed to pesticides (Dix 1990). Dimilin is a broad-spectrum biocide that persists until leaf fall and up to a few years in the duff and would have a long-term impact of shale-barren slopes. All insect occurrences on shale-barrens sprayed with Dimilin should be considered extirpated (Schweitzer in litt). BT is lepidopteran-specific and only persists for roughly one week (Dix 1990). Application during larval development may have devastating impacts on the lepidopteran fauna.
6) The very small number of individuals within many occurrences suggests that the long-term persistence of these occurrences is uncertain, especially considering that populations tend to fluctuate dramatically.
7) Fire suppression is a potential threat. In his draft report on the classification of West Virginia shale barrens, Vanderhorst (in Norris and Sullivan 2002) states:

   *"A potential threat to shale barrens is succession, or woody encroachment. Although shale barrens are usually thought to be edaphicly [sic] maintained, it is possible that disturbance such as fire may have some role in maintaining the open physiognomy necessary for survival of shale barren endemics. Fire may be a factor in some shale barren community types and not in others. It is possible that the high cover by deciduous woody species in plots of this community type is due to fire suppression and that the quality of these barrens is declining. Fire is thought to have played a historical role in maintenance of white pine-mixed oak communities near shale barrens on the Greenbrier District of the Monongahela National Forest and in the absence of fire these communities appear to be succeeding towards dominance by more mesophytic species (Abrams et al. 1995). Research into the historical role of fire in maintaining shale barrens is needed to determine appropriate management of this rare community."*

Fire

The specific role of fire in relation to shale barren rockcress is uncertain. No in-depth studies have been conducted about the direct or indirect effects of fire on this species; however, an increasing number of studies are showing the historical importance of fire in the Central Appalachians in shaping vegetation communities. Shale barren rockcress habitat is on extremely xeric south to southwest facing slopes in oak forests that are prone to wildfire. It would seem logical that fire would periodically burn through forest communities containing shale barren habitat and there is an increasing body of research that shows, until the early 1900s when fire suppression became universal, that fires occurred regularly on the Central Appalachian landscape. Abrams and others (1995) studied a forest that is transitional between the Ridge and Valley and Appalachian Plateau in Greenbrier County, WV. They concluded that without active management, including the use of prescribed fire, the present white pine-oak forest would transition to a more mesic maple-beech-hemlock forest. Lafon (2010) discusses the role of fire in table mountain pine-pitch pine stands. These pine types are found on dry ridgetops and south to west facing slopes often similar to areas supporting shale barrens. Dendroecological work shows these stands burned frequently in the past, with a regime of frequent surface fires at intervals of 2 to 10 years, and more severe burns at 50 to 100 years intervals. The surface fires maintained open understories needed by shade intolerant herbs and small shrubs. The more severe burns exposed mineral soil and created large canopy gaps enabling shade intolerant pine seedlings to become established. Lafon goes on to discuss the 'fire-oak' hypothesis which posits that many oak forests developed during many centuries of frequent burning. Fire benefits oaks by inhibiting fire sensitive tree species, which do not have oaks' protective bark, ability to compartmentalize fire damaged wood to prevent decay spread, extensive root systems, and strong sprouting ability. Aldrich and others (2010) studied fire chronology from 1704 to 2003 of trees on Mill Mountain in Bath County, VA on the Forest in an area where at least 10 *Arabis serotina* populations occur

within 3.5 miles. They found a local fire return interval of about 5 years from the early 1700s until 1930 when fire suppression began. They also found that area-wide fires affecting multiple pine stands were common, recurring approximately every 16 years. The fires were frequent surface fires with occasional severe ones. In the Rough Mountain Wilderness, on the National Forest near the Mill Mountain study site, there were two lightning caused wildfires in 1999 alone (S. Croy pers. comm.). Aldrich and others (2010) conclude that "The greatest impact of industrial society is fire exclusion, which permitted hardwood establishment." There has been a trend since the initiation of widespread fire suppression of pine stands being overtaken by hardwoods in general, and of oak species being replaced by fire intolerant species such as red maple, white pine, tulip poplar, beech, and black gum (Groninger et al. 2005; Harrod and White 1999; Lafon and Grissino-Mayer 2005; Schuler and McLain 2003). It is possible that prescribed burning can halt and perhaps reverse this "mesophication" (Nowacki and Abrams 2008) of the forest.

Most shale barrens have little to no fuel loading so fire intensity, if any, would be expected to be low on the barren itself. Platt (1951) states fires are not a causal agent in shale barren formation. He goes on to say that "Fires in this region are quite rare and localized. Since shale barrens surfaces are bare and tree cover sparse, they usually escape even those fires which completely surround them. Careful examination of tree trunks gave no indication of fire scars." It could well be that Platt's observations are the result of the vigorous program of fire suppression. His comments about the fate of shale barrens in the event of fire are important. The lack of fuel loading would make fire spread nearly impossible in the shale barren environment. However, periodic fire might open and maintain habitat adjacent to the shale barren allowing shale barren rockcress populations to persist or expand. The LANDFIRE Biophysical Setting Model for Appalachian Shale Barrens states that "The absence or sparseness of fuel makes fire relatively unimportant on the barrens themselves, but is likely important in maintaining the adjacent pine and pine-oak dominated woodlands and limiting their encroachment along the barren-woodland edge. Likewise the "shale ridge bald" is maintained by edaphic conditions, but fire is likely important in limiting tree and shrub encroachment" (Croy and Smith 2009). Jarrett and others (1996) conducted an ecological study of shale barren rockcress on property managed by the U.S. Navy in West Virginia. In comparing their vegetation data with data collected ten years earlier they note that "(tree) canopies have closed somewhat at various West Virginia shale barrens, and that some shale barren endemics are no longer there." They suggest that controlled burning or periodic thinning of the canopy may be necessary to set back plant succession (see discussion of mesophication above). This view is echoed by the West Virginia Department of Natural Resources factsheet on shale barren rockcress (accessed online in 2012), "Some observations suggests [sic] that some shale barrens may not always remain barren and dry. Over time, it is possible for conditions there to change, and more trees may eventually grow on them. If more trees grow there, shale barren rockcress may not be able to survive." Several prescribed burns on the Forest in the past included shale barren rockcress habitat and plants.

Fire that burns immediately adjacent to shale barren rockcress plants might have a negative effect depending on the fire's intensity and duration. The higher the intensity and the longer the duration of fire exposure, the greater the effect and an individual plant may be killed. Fire may also have a beneficial effect as noted above. In the past, fire was considered to not be an important factor on shale barrens, especially if they are larger (larger buffer of the interior from fire) and/or steeper (less fuel build up on steep slopes). Since shale barren rockcress plants are usually more abundant in the more open parts of shale barrens, plants growing on smaller shale barrens would be more susceptible to encroachment by woody plants in the absence of fire, although all barrens could be affected to some extent. In addition to potentially enhancing seed germination, plant growth, and flowering and fruiting, fire could open the canopy on the periphery of shale barrens benefitting shale barren rockcress plants. Frequent low intensity fires would have a protective effect by lessening fuel loading in the vicinity of shale barrens and reducing fire intensity and duration. Observations have also shown that deer browse is lessened on rockcress plants when the areas around shale barrens have been burned. This is likely due to increased browse available as the result of coppice growth from top-killed trees and shrubs. This effect lasts for several years as coppicing continues and berry and nut production increases.

There are possible threats to shale barren communities from invasive native and exotic species, deer browsing, and mesophication.

**Plan Components**

All known locations of shale barren rock cress on the Forest in WV and VA are on land allocated to management prescription 4D, Special Biological Areas. Habitat for this species is stable on the Forest. There are possible threats to shale barren communities from invasive native and exotic species. Populations appear stable, but since they naturally tend to fluctuate greatly from year to year, this is uncertain. Potential habitat is being inventoried and continues to reveal new populations that will be protected. Management activities are having no effect on the habitat that contains the shale barren rock cress and thus are having no effect on the rock cress.

Overall, viability is being maintained through identification and protection of occurrences, however, viability is still of concern due to the naturally limited distribution of this species. Shale barren rock cress populations are expected to remain relatively stable in the near future.

The Forest encompasses several populations of the endemic shale barren rock cress that are in the core of its limited distribution in the Northern Ridge and Valley Section of the mid-Appalachians. This species is inherently rare and not well distributed across the Forest. Current management provides for ecological conditions capable to maintain the shale barren rock cress populations considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to maintain viability (persistence over time) of populations on national forest land.

## 3.2.7 SMOOTH CONE FLOWER

**Background**

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2010).

Smooth coneflower was listed as endangered under the Endangered Species Act on September 8, 1992. This species is known from about 100 occurrences, a majority of which are of fair to poor viability in several southeastern states. Most historically known populations were destroyed by development and habitat alteration, especially the suppression of fire, and a number of remaining populations are primarily in marginal locations, where they are vulnerable to urbanization, the use of herbicides, repeated mowing, and potentially, collection for the medicinal trade. Small remote populations may suffer from loss of habitat due to succession. The Recovery Plan for smooth coneflower does not have any recovery tasks specific to the Forest.

Formerly a plant of prairie-like habitats or oak-savannas maintained by natural or Native American-set fires as well as large herbivores (such as bison), it now primarily occurs in openings in woods, such as cedar barrens and clear cuts, along roadsides and utility line rights-of-way, and on dry limestone bluffs. It is usually found in areas with magnesium and calcium-rich soils and requires full or partial sun. Associated species include: *Juniperus virginiana* and *Eryngium yuccifolium*. Fire or some other suitable form of disturbance, such as well-timed mowing or the careful clearing of trees, is essential to maintaining the glade remnants upon which this species depends. Without such periodic disturbance, the habitat is overtaken by shrubs and trees [Endangered Spp. Tech. Bull. 17(1-2): 9-10].

**Threats**

Habitat loss and degradation due to habitat alteration affected 19 of 21 populations known in 1992 (USFWS 1992). Conversion of habitat to agriculture and/or silviculture, residential and industrial development, and highway maintenance (e.g., herbicides) has threatened this species in the past and may continue. Habitat loss and degradation as a result of prolonged fire suppression is also considered a major threat to the species' habitat. Commercial digging was not thought to be a problem as this practice is generally confined to Echinacea populations west of the Mississippi River. However, the Southern Appalachian Species Viability Project (2002) reported that this showy species with medicinal uses is occasionally harvested. Remaining populations appear to be small in numbers which may result in low genetic diversity.

**Plan Components**

All known locations of smooth coneflower on the Forest are on lands allocated to management prescription 4D, Special Biological Areas. There are currently two known populations of this species on the Forest. Both are in Alleghany County. One is a roadside occurrence that continues to be difficult to manage due to the steepness of the site and encroaching woody vegetation. This population is very small and may not be viable over the long term. The second population is more robust and occurs in an open woodland area. The site needs prescribed fire to maintain the open conditions this species requires.

## 3.2.8 VIRGINIA SNEEZEWEED

**Background**

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2010).

Virginia sneezeweed was listed as threatened under the Endangered Species Act on November 3, 1998. A limited amount of habitat in two Virginia counties and six Missouri counties make up this species' entire global range. There are currently 61 documented occurrences, although 4 or fewer may not be extant, with the majority in Missouri as of 2006. The Virginia occurrences were located during extensive survey work from 1985 to 1995 in over 100 limestone sinkhole ponds along the western edge of the Blue Ridge Mountains, in the Shenandoah Valley of Virginia (USFWS 1998). The Virginia occurrences are restricted to small, discrete areas around sinkholes, and occupying, in total, less than 20 acres (8 ha). Missouri occurrences occupy ca. 11 acres within both discrete and less discrete wetland habitat. Seven Virginia occurrences are currently protected by being on National Forest land. Only 9 Missouri occurrences have some protection although it is not complete. Sites in both states are threatened by drainage and residential development.

The number of Virginia documented occurrences has been revised downward to 17 by using a 1 km separation distance between occurrences (J. Townsend, VA Dept. of Conservation and Recreation 2006 pers. comm.) These 17 occurrences had previously been recognized as 30 occurrences, with an occurrence at that time being equal to the plants within a discrete pond or wet meadow. It is expected that additional survey work will find more occurrences; some of these may be within the more disturbed farm pond type of habitat. In fact, a new, small population was found on the Forest in 2009 by VDNH cooperators (C. Ludwig pers. comm.). Based on what was known at the time the draft Recovery Plan was written in 2000 there were 4 sites where plants had not been seen over several years of surveys (U.S. Fish and Wildlife Service 2000).

The Draft Recovery Plan includes the Forest in the following recovery tasks:

- Seek permanent protection for known populations.
- Identify essential habitat.
- Identify sinkhole habitat adjacent to the National Forest lands, but within the proclamation boundary, to target for future acquisitions by the GWJNF.
- Conduct studies to characterize environmental parameters of the sinkhole ponds.
- Conduct studies to characterize the hydrologic regime at selected sinkhole ponds.
- Alleviate site specific threats as the need and opportunity arise.
- Develop a monitoring plan including standard monitoring methodologies.
- Implement the monitoring plan.
- Conduct surveys for additional populations in Virginia.
- Develop guidelines as to what constitutes a self-sustaining population.
- Maintain seed sources for the species.

On the Forest all known populations of Virginia sneezeweed are located in Augusta County except for a very small population that was located in 2009 between Glasgow and Buena Vista in Rockbridge County.

**Threats**

In Virginia the long-term viability of existing populations is primarily threatened by human-induced disruptions of hydrologic regimes, particularly by encroaching agriculture, residential land development, and logging (Van Alstine 1991; J. Knox, C. Williams pers. obs.). In addition, a private site and adjacent sites on the George Washington National Forest are sporadically impacted by off road vehicles (e.g., during summer 1991 on the private land; J. Knox, C. Williams, pers. obs.).

Exotic organisms may pose threats to H. virginicum populations in the near future. Purple loosestrife, *Lythrum salicaria*, is slowly spreading through Virginia and may eventually invade some *H. virginicum* sites, especially following disturbances to hydrologic regime and/or substrate. The gypsy moth, *Lymantria dispar*, is currently defoliating large areas of the George Washington National Forest and adjacent lands but it is unclear whether the gypsy moth will negatively impact *H. virginicum* populations. For example, as *H. virginicum* is shade-intolerant, defoliation of trees and shrubs that grow on the periphery of sinkholes may increase light availability and allow *H. virginicum* to expand into areas from which it was formerly excluded.

The following paragraphs are taken, with modifications, from U.S. Fish and Wildlife Service (2000):
The most serious threat to *H. virginicum* appears to be habitat loss, most often arising from changes in the natural hydrological regime of the sinkhole pond habitat. Four of the sites, three of which are grazed by cattle, have had a portion of the wetland deepened to create a permanent pond; prior to being excavated, much of this section once undoubtedly supported *H. virginicum* and so loss of some habitat has occurred. In contrast, actions have been taken at some of the Virginia sites to stop or lessen the periodic inundation. Significant ditches have been dug at two sites, with smaller ditching at three sites. Ditching and plowing occurred at one site in the past, and some evidence of the ditch remains, but does not significantly affect the hydrologic regime. Portions of the sites at 2 sites have been filled in. It is safe to assume that the pressure to control seasonal flooding will only increase, as the area of the Shenandoah Valley where the Virginia populations of *H. virginicum* are found is experiencing rapid growth, particularly in the building and expansion of residential subdivisions.

In addition to obvious hydrological alterations made directly to the sinkhole ponds, off-site actions may affect the hydrology of the ponds. Input from groundwater sources may be decreased by withdrawals for wells for adjacent developments such as subdivisions. Overland surface water flow may be altered by activities such as timber harvesting or road building in upslope areas. Little is known about the relative importance of groundwater vs. surface flow to the hydrological regime of the sinkhole ponds, but preliminary research suggests that the relative importance of these water sources is unique for each pond (E. Knapp, Washington and Lee University pers. comm.).

A variety of site-specific threats to *H. virginicum* from habitat loss have appeared over the last ten years. The Virginia Department of Transportation (VDOT) has proposed to widen to four lanes Route 340, a currently two lane north-south corridor on the east side of the Shenandoah Valley. A portion of one site in Augusta County is immediately east of Route 340. The Virginia Department of Conservation and Recreation's Division of Natural Heritage reviewed the proposal for this project in 1991 and recommended against any road widening to the east in the area of the pond and further recommended that VDOT consult with the U.S. Fish and Wildlife Service before any construction began. While the long range plans still include widening Rt. 340 to 4 lanes in this section, this project is not active; VDOT will coordinate with USFWS whenever the project becomes active (S. Stannard, VDOT pers. comm.)

Another *H. virginicum* population is near the site of silos built in the early 1990s that are used to store septic waste. This waste is eventually dumped on the ground elsewhere on this landowners' ridge-top property and not near the *H. virginicum* site. However, in a 1995 site visit by DCR-DNH a large pile of soil was present on the north side of the shallow basin that supports the *H. virginicum* population. The landowner was considering pushing the soil into the seasonally wet basin to level it out, but was agreeable to not do that. In a 1997 site visit the pile was still present and was larger than in 1995. In 1995 and 1997, it was noted that sediment from the pile had washed into the edge of the pond site, creating different soil conditions in that area and making it more favorable for weedy species (DCR-DNH database).

Mowing occurs in at least 3 of the Virginia sites. Continued mowing may provide beneficial effects to the species; a site that is one of the largest if not the largest and densest population, has been periodically mowed and bush-hogged by the landowner for an extended period of time. Repeated mowing before seed is set and the seed bank is replenished, may lead to local extinction as vegetative plants die out and the seed bank ultimately becomes depleted.

Herbivory does not appear to be a problem; however, the threat to *H. virginicum* from cattle grazing needs evaluation. Large populations of *H. virginicum* co-exist in three sites with cattle grazing. This suggests that the species may respond favorably to limited amounts of disturbance. Knox and others (1999) tested the hypothesis that H. virginicum is unpalatable to generalist herbivores in a common garden study; none of the H. virginicum plants were grazed by either vertebrate or invertebrate herbivores. Knox notes that this is consistent with reports of toxicity in other *Helenium* species associated with the presence of sesquiterpene lactones (Hesker 1982; Anderson et al. 1983; Anderson et al. 1986; Arnason et al. 1987). *Helenium virginicum* has been shown to contain a sesquiterpene lactone, virginolide (Herz and Santhanam 1967). According to J.S. Knox (pers. comm.), the leaves of *H. virginicum* are bitter-tasting; selective grazing by cattle of more palatable associated species therefore may eliminate plant competitors. However, other effects on *H. virginicum* from cattle grazing such as the increased nutrient loads, soil compaction, and trampling of plants are unknown. As the soils of the *H. virginicum* sites have been found to be nutrient-limiting (Knox 1997), long-term nutrient enrichment from cattle could ultimately create more favorable habitat for other plant species.

With federally listed wetland species, the federal permitting process carried out by the US Army Corps of Engineers (USACOE) under authority of the Clean Water Act of 1977, is often the point at which proposed actions can be reviewed in light of their effect on a federally listed species and protection actions can be recommended. The isolated and often small seasonally wet habitat of *Helenium virginicum*, however, does not currently have direct federal protection. United States vs. Wilson 133 F. 3d 251(4th Cir. 1997) ruled that the USACOE has no jurisdiction over isolated water bodies that have no surface connection with any tributary stream that flows into traditional navigable waters or interstate waters. Nationwide Permit 26, under federal wetlands regulations (56 CFR 59134-59147, Part 330-Nationwide Permit Program), which has applied to headwater areas and isolated wetlands, is currently being revised including a lower minimum acreage (1/10 acre); the Norfolk District of the USACOE is proposing a regional minimum threshold of 1/4 acre (E. Gilinsky, DEQ, pers. comm.). These lower minimum acreages, however, will not apply to the *Helenium virginicum* habitat if the ruling in U.S. vs. Wilson stands.

Currently, so-called Tulloch ditching, draining by ditching in which excavation occurs by mechanical means that do not require placing excavated material into a wetland and in which the material is lifted and hauled to an upland disposal site, does not require that USACOE be notified or a permit obtained. Major ditching has been used at three of the *H. virginicum* sites to control the seasonal flooding with more minor ditching used at another three sites.

As most of the populations of *H. virginicum* are on private lands, the current legal protections in place for this species will not be adequate to insure the long-term survival of *H. virginicum*. The effects of future regulation changes are not known.

Extremes in the fluctuating hydroperiod of the sinkhole ponds could, when preceded by low investment in the seed bank, result in the local extinction of populations. Extended drought at a site could make a site more favorable for colonization by other plants previously hampered by the periodic inundation of the site. This would include tree species, which could result in increased shading within the site and so reduce the areas favorable for *H. virginicum*. An extended period of inundation, coupled with development of a floating vegetation mat, such as occurred at one site (Knox 1997), could lead to local extinction if an insufficient seed bank existed to recover from the death of the vegetative plants. Either of these extremes in hydroperiod could result from normal variability in weather patterns or from larger scale climate changes, of either natural or human origin.

If found to hold true for other populations of *H. virginicum*, the self-incompatible breeding system of *H. virginicum* found in one of the populations may eventually lead to local extinction at sites with low population numbers as the chance of successful pollination decreases (Messmore and Knox 1997).

In Missouri threats include grazing and/or trampling of plants in the pasture sites and haying of the plants during the growing season. Herbicide or plant growth hormones used on roadside pose a threat to the roadside populations.

**Plan Components**

All known locations of Virginia sneezeweed on the Forest are on land allocated to 4D Special Biological Areas. These Special Biological Areas are managed specifically to restore and maintain conditions to benefit the community and/or rare species for which the area was established. There are still threats from illegal ATV use on this species.

## 3.2.9 SWAMP PINK

**Background**

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2010).

Swamp pink was listed as a threatened species under the Endangered Species Act on September 9, 1988. *Helonias bullata* is known from the Coastal Plain of New Jersey, Delaware, Maryland, and Virginia (formerly also Staten Island, NY, where now extirpated), as well as from higher elevations in northern New Jersey, Virginia, North Carolina, South Carolina, and Georgia. Restricted to forested wetlands that are perennially water-saturated with a low frequency of inundation, habitat specificity appears to be a critical factor in this species' rarity. Approximately 225 occurrences are believed extant, over half of which are in New Jersey; 80 additional occurrences are considered historical and 15 are extirpated. The species is locally abundant at several sites in New Jersey, Delaware, Virginia, and North Carolina; some have 10,000+ clumps of plants. In addition to sites known to have been extirpated, significant habitat has been lost throughout the range due to factors such as drainage for agriculture. A number of local population declines have also been documented in the past 20 years. Degradation of this species' sensitive habitat via changes to the hydrologic regime is the primary threat. Such changes can be direct (ditching, damming, draining) or indirect (from development in the watershed); indirect impacts are particularly difficult to address. Other threats include poor water quality, invasive species, trash, all-terrain vehicles, deer herbivory, trampling, and collection. Given this species' very specific hydrological requirements, climate change could also be an issue. *H. bullata* has limited ability to colonize new sites (low incidence of flowering, limited seed dispersal, and poor seedling establishment) and low genetic variation, limiting its ability to adapt to changing conditions and recover when sites are destroyed.

Overall trends of local population declines and extirpations are beginning to emerge (USFWS 2007). The number of occurrences considered historic has increased from 79 to 97 since 1991, a loss of 18 sites (8 in NJ, 8 in DE, and 2 in NC) (USFWS 2007). More than 20 occurrences in New Jersey and Delaware alone have documented declines in population size or condition since the early 1990s (USFWS 2007). In New Jersey, the number of occurrences ranked A or B has decreased by 7 since 1991; comparing occurrence ranks from 1997 and 2004, 6 occurrences were upgraded while 20 were downgraded (USFWS 2007). Of the 27 occurrences discovered in Delaware between 1983 and 1999, 16 showed substantial declines in plant numbers during the most recent site visits (USFWS 2007).

Recovery tasks for Federal agencies in the swamp pink Recovery Plan include:

- Monitor threats to extant sites.
- Develop and maintain site-specific conservation plans.
- Enforce regulations protecting the species and its wetland habitat.
- Investigate population dynamics, using a standard method.
- Identify and, as needed, implement management techniques.

**Threats**

Habitat degradation is the primary range wide threat. This degradation is difficult to address through either land protection or regulatory mechanisms because it is often brought about by off-site land uses, particularly

development. Evidence of detrimental effects of development on *H. bullata* habitat and population quality continues to accumulate; such impacts are anticipated to worsen as development continues (USFWS 2007). A major component of habitat degradation is changes to the hydrologic regime. Such changes can be direct (e.g., ditching, damming, draining) or indirect (i.e., from development in the watershed). Indirect impacts often result from increased impervious surface in the watershed, which reduces infiltration and increases overland flow of stormwater, leading to increased stream erosion, wetland sedimentation, flood volumes and velocities, water level fluctuations, and hydrologic drought (USFWS 2007). Other components of degradation associated with adjacent development include poor water quality, invasive exotic species, trash, all-terrain vehicles, herbivory by overabundant deer populations, trampling, and collection (USFWS 2007). Direct habitat losses have slowed, but historical losses were substantial (USFWS 2007). Because this species requires a very specific hydrology in order to thrive, climate change, which has the potential to either increase or decrease water levels at established sites, is an anticipated threat. For example, increased drought in southern Appalachians mountain bogs may already be having detrimental impacts. Also, about 10% of known occurrences are in areas with increased vulnerability to coastal flooding due to sea level rise (USFWS 2007).

The specific wetland habitat required by this species is easily degraded through both direct and secondary disturbances; among the wetland types it inhabits, some such as sphagnum bogs and Atlantic white cedar swamps are particularly fragile. A low incidence of flowering, limited seed dispersal, and poor seedling establishment combine to make colonization of new sites via reproduction from seed rare for this species (Godt et al. 1995; USFWS 2007). Finally, Godt and others (1995) found low overall genetic diversity both within the species and within populations, even relative to the means found for other endemic and narrowly distributed species. This suggests that *H. bullata* may have limited capacity to adapt to future environmental change.

Habitat specificity appears to be the critical factor in defining *H. bullata* as a rare species (USFWS 2007). Adapted to stable habitats with a number of specialized conditions (e.g., low light, limited nutrients, and saturated soils), this species appears to compete poorly when change in one or more habitat parameters creates an opportunity for the establishment of other species (USFWS 2007). Habitat availability may be a limiting factor across much of the range; Coastal Plain forested headwater wetlands have been significantly reduced by development, and mountain bogs are both historically uncommon and impacted by agricultural conversion (USFWS 2007). Nevertheless, the New Jersey Pine Barrens contain some apparently suitable but unoccupied sites, suggesting that this species' habitat requirements are not fully understood and/or that low dispersal limits colonization of these areas (USFWS 2007). Efforts to create or restore *H. bullata* habitat have had limited success (USFWS 2007).

**Plan Components**

All known occurrences of swamp pink are on land that will be allocated to 4D, Special Biological Areas, and/or 1A Designated Wilderness. These Special Biological Areas are managed specifically to restore and maintain conditions to benefit the community and/or rare species for which the area was established. Herbivory and shading may continue to be threats. Use of wildland fire may be a tool to reduce shading in some areas.

## 3.2.10 NORTHEASTERN BULRUSH

**Background**

Unless otherwise noted, the information used in this analysis comes from NatureServe (accessed in 2010).

Northeastern bulrush (*Scirpus ancistrochaetus*) was listed as endangered under the Endangered Species Act in 1991. Populations are known from MA, MD, NH, NY (presumed extirpated), PA, VA, VT, and WV. The habitat seems to vary geographically, although there are not enough sites to allow generalizations to be made. However, one does observe that in the south, sinkhole ponds are the most common habitat for the plant, and in the north, other kinds of wetlands, including beaver-influenced wetlands, provide suitable habitat. When this species was listed as endangered there were 33 known populations. As of 2007, there were about 113 extant occurrences known in the Appalachians from southern Vermont and New Hampshire to western Virginia, with most occurrences in Pennsylvania.

Most populations are in Pennsylvania (70) and Vermont (22) (USFWS 2008). The other populations are in Massachusetts (1), Maryland (1), New Hampshire (9), Virginia (7), and West Virginia (3) (USFWS 2008). There are about ten historical occurrences: New York (1), Pennsylvania (7), Virginia (1), Quebec (1). The plants are restricted to fairly specific wetland habitats that are infrequent, especially in the southern part of the range.

Various threats are associated with the habitat, including drainage and development, agricultural runoff, and any developments that could alter the local hydrology. Additional, unsurveyed habitat does exist, and more populations of this species may be found in the future if the potential habitats remain intact.

Long-term monitoring of known sites is needed before any conclusions can be drawn about the habitat needs of the plant, or about the stability of its populations in changing environments.

The implementation schedule for the northeastern bulrush recovery plan (USDI Fish and Wildlife Service 1993) includes five items that directly relate to Forest Service management:

- Secure permanent protection for known populations;
- Resurvey sites thought to have suitable habitat;
- Verify, monitor, and protect any additional populations;
- Identify potentially suitable habitat for additional surveys; and
- Survey potential sites.

Throughout its range, northeastern bulrush is found in open, tall herb-dominated wetlands. Often it grows at the water's edge, or in a few centimeters of water, but it may also be in fairly deep water (0.3-0.9 m) or away from standing water. In the southern part of its range, the most common habitat is sinkhole ponds, usually in sandstone. Water levels in these ponds tend to vary both with the season and from year to year. At least one site (in Massachusetts) is in a sand plain, where water level fluctuates as well. Two sites in Vermont are influenced to some extent by beaver activity as well as other hydrological factors.

With the information available it is difficult to compare sites throughout the plant's range. For example, lists of associated species may represent an entire wetland or the immediate vicinity of the plant, but this is not always possible to determine from available information. Nevertheless, examination of field reports indicates that there is considerable variety in associated species. A few species, however, are common to several of the sites. These are *Dulichium arundinaceum, Scirpus cyperinus sens. lat., Glyceria canadensis*, and *Triadenum virginicum*.

**Virginia.** There are seven extant northeastern bulrush sites in Virginia, with two ranked as A/AB, two ranked B/BC, and one ranked E. The status of most of these sites is unknown because they have not been surveyed since the 1980s or 1990s. Habitat includes emergent ridgetop shallow ponds, shallow sinkhole depressions and mountainside bench ponds. Four sites are located on private land, three are on public land, and ownership of one site is undetermined. In Virginia, the northeastern bulrush is listed as State endangered; however, no additional protection (e.g., buffers) is afforded to wetlands supporting the species. No upland buffers are regulated or protected around any wetlands in the State. The northeastern bulrush is protected under the Endangered Plant and Insect Species Act of 1979, which prohibits take without a permit, but individual landowners are exempt from these permitting requirements.

**West Virginia.** There are three northeastern bulrush populations in West Virginia, two of which are ranked B, and one of which is ranked D. According to the U.Ss Fish and Wildlife Service 5-year status review for northeastern bulrush these occurrences were surveyed and last observed in 2005, however, known populations on Forest Service property have been resurveyed (Cipollini and Cipollini 2011) and monitored annually, either by Forest Service personnel or by the West Virginia Department of Natural Resources WVDNR. Habitat includes sinkhole ponds atop a low, flat sandstone ridge, and small seasonal ponds. Two of these sites are located on private lands, and one is located on National Forest land managed by the U.S. Forest Service (USFWS 2008).

The northeastern bulrush has no official status in West Virginia, and this State does not have an endangered species law. No upland buffers are required around any wetlands in the State.

**Threats**

Among the potential human threats are agricultural runoff, construction of logging and fire roads, development, all-terrain vehicle use, collection, and dredging. In addition to human activity, there may be natural threats to the species as well, although more information about the biology and ecology of the species is needed before these threats can be fully assessed. Among possible natural threats are deer, beaver (one Vermont population has suffered fluctuations, apparently as a result of beaver activity), natural water level fluctuations, fire (this may have damaged a population in Pennsylvania), and succession. Fluctuations in population size have been observed at several localities for the species. It is very likely that botanists visiting the known sites for the species do not identify vegetative plants, and it is possible that, in some cases, the fluctuations are in number of flowering/ fruiting culms rather than actual number of plants.

The 5-year review of northeastern bulrush by the USFWS stated that new information indicates that shading may be a threat, "Therefore, in some cases, it may be helpful to manage the habitat surrounding these sites by selectively removing larger trees to reduce canopy cover to increase light exposure" (USFWS 2008). The 5-year review also noted that alterations of the hydrology of wetlands supporting northeastern bulrush could have negative effects.

Exotic organisms may pose threats to northeastern bulrush populations in the near future. Purple loosestrife, *Lythrum salicaria*, is slowly spreading through Virginia and may eventually invade some northeastern bulrush sites, especially following disturbances to hydrologic regime and/or substrate. The gypsy moth (*Lymantria dispar*) is currently defoliating large areas of the Forest and adjacent lands but it is unclear whether if or how the gypsy moth will negatively impact northeastern bulrush populations.

**Plan Components**

The known occurrences of this species on the Forest are protected under all alternatives, except A (the 1993 Revised Forest Plan), as management prescription 4D - Special Biological Areas. These Special Biological Areas are managed specifically to restore and maintain conditions to benefit the community and/or rare species for which the area was established. Without regular monitoring and maintenance the cumulative impacts of the OHV trail that passes near the pond on Potts Mountain have the potential to negatively affect the pond and the northeastern bulrush through illegal OHV use (or through maintenance of the OHV road affecting the hydrology of the area. The Pond Run Pond site is very near the intersection of two trails that are used by hikers and horses. In the past there has been evidence of horses in the pond basin, although there has been no apparent negative impact to the Northeastern bulrush. In 2009 the U.S. Forest Service constructed a barbed wire fence that is keeping horses out of the pond. Shading has also been a concern at this site and over the past several years a slow process of girdling trees has been occurring that appears to have increased the number of flowering columns.

## 3.3 THREATENED AND ENDANGERED SPECIES SUMMARY OF PLAN COMPONENTS

Table F-6. T&E species, associated ecological systems, and plan component

| Species | Ecosystem | Forest Plan Component |
|---|---|---|
| Indiana bat | Caves and Karstlands | Management Prescription Areas: designation of the primary and secondary Indiana bat cave areas<br><br>Standards/Guidelines: standards for activities within the primary and secondary Indiana bat cave areas; standards for activities throughout the Forest in regard to leave trees during timber harvest activities<br><br>Objectives: improvement of habitat through increased open woodlands |
| Virginia Big-Eared Bat | Caves and Karstlands | Standards: Forestwide cave standards |
| Virginia Northern Flying Squirrel | Spruce and Northern Hardwoods | Management Prescription Areas: All occupied habitat is in Special Biologic Areas |
| James Spinymussel | Floodplains, Wetlands and Riparian Areas | Standards: Riparian standards |
| Madison Cave Isopod | Caves and Karstlands | Not found on the Forest;<br>Standards: Forestwide cave standards |
| Shale Barrens Rock Cress | Appalachian Shale Barrens | Management Prescription Areas: All known locations are in Special Biologic Areas |
| Smooth Cone Flower | | Management Prescription Areas: All known locations are in Special Biologic Areas |
| Virginia Sneezeweed | Floodplains, Wetlands and Riparian Areas | Management Prescription Areas: All known locations are in Special Biologic Areas<br>Standards: Riparian standards |
| Swamp Pink | Floodplains, Wetlands and Riparian Areas | Management Prescription Areas: All known locations are in Special Biologic Areas<br>Standards: Riparian standards |
| Northeastern Bulrush | Floodplains, Wetlands and Riparian Areas | Management Prescription Areas All known locations are in Special Biologic Areas<br>Standards: Riparian standards |

# 4.0 OTHER SPECIES ADDRESSED

## 4.1 SPECIES LIST

Criteria for identifying other species to be addressed include the following:

- Species identified as proposed and candidate species under ESA
- Species ranked G-1, G-2 and G-3 on the NatureServe ranking system.
- Subspecific taxa ranked T-1, T-2 and T-3 on the NatureServe ranking system
- Species that have been petitioned for federal listing and for which a positive "90-day finding" has been made
- Species that have been recently delisted, including those delisted within the past five years and other delisted species for which regulatory agency monitoring is still considered necessary
- Species with ranks of S-1, S-2, N-1, or N-2 on the NatureServe ranking system[1]
- State-listed threatened and endangered species that do not meet other criteria
- Species identified as species of conservation concern in state comprehensive wildlife strategies for which habitat on the Forest is important
- Bird species on the U.S. Fish and Wildlife Service Birds of Conservation Concern National Bird Priority List
- Additional species that valid existing information indicates are of regional or local conservation concern due to factors that may include:
    - Significant threats to populations or habitat
    - Declining trends in populations or habitat
    - Rarity
    - Restricted ranges
- Southern Region regional forester's sensitive species
- Species that are hunted or fished
- Other species of public interest
- Invasive species may also be considered

The 282 species remaining for further consideration were screened to determine whether ecosystem diversity plan components fully covered their sustainability needs. If species habitat needs were not met solely through meeting the desired conditions of the ecological systems, additional direction was developed.

## 4.2 SPECIES GROUPS

The GWNF used species groups as an evaluation and analysis tool to improve planning efficiency and for development of management strategies. Species were grouped according to their habitat needs, limiting factors, threats, and specific habitat elements (snags, den trees, woody debris, etc.). Many species occurred in multiple groups.

Where possible, species groups were associated with ecological systems. Some groups are directly related to specific systems. Other groups may be more closely related to some ecological systems than others, but may be associated with multiple systems. Some groups may occur in any of the systems. The list of species groups and the ecosystem(s) with which they are associated are listed in Table F-7. Where multiple ecological systems are listed, the predominant system is listed first.

[1] The NatureServe ranking system is available at http://www.natureserve.org/.

Table F-7. Species group and Associated Ecological Systems

| Species Group | Associated Ecological System(s) |
|---|---|
| Alkaline Glades and Barrens | Alkaline Glade and Woodlands and Mafic Glades and Barrens |
| Area Sensitive Grassland and Shrubland and Open Woodlands | Pine Forest and Woodlands, Oak Forests and Woodlands |
| Area Sensitive Grasslands | Oak Forests and Woodlands<br>Floodplains, Wetlands and Riparian Areas |
| Area Sensitive Shrubland and Open Woodlands | Pine Forest and Woodlands, Oak Forests and Woodlands |
| Area Sensitive Late Successional Coniferous, Deciduous and/or Mixed Forests | Spruce Forest, Northern Hardwood Forest, Cove Forest, Oak Forests and Woodlands, Pine Forests and Woodlands, Floodplains Wetlands and Riparian Areas. |
| Calciphiles | Caves and Karstlands<br>Alkaline Glade and Woodlands and Mafic Glades and Barrens<br>All |
| Caves | Caves and Karstlands |
| Cavity Trees, Den Trees and Snags | Oak Forests and Woodlands<br>All |
| Cliff and Talus and Large Rock Outcrops | Cliff, Talus and Shale Barrens |
| Cove Forests | Cove Forests |
| Fire Dependent and Fire Enhanced | Pine Forests and Woodlands,<br>Alkaline Glade and Woodlands and Mafic Glades and Barrens<br>Oak Forests and Woodlands |
| Grasslands | Oak Forests and Woodlands<br>All |
| Hard and Soft Mast Dependent | Pine Forests and Woodlands, Oak Forests and Woodlands |
| High Elevation Coniferous, Deciduous and/or Mixed Forests | Northern Hardwood Forests<br>Cove Forests<br>Spruce Forests<br>Pine Forests and Woodlands<br>Oak Forests and Woodlands |
| High Elevation Openings, Grassy or Shrubby or Open Woodlands | Oak Forests and Woodlands<br>Northern Hardwood Forests<br>Cove Forests<br>Spruce Forests<br>Pine Forests and Woodlands |
| Late Successional Hardwood Dominated Forest | Oak Forests and Woodlands<br>Cove Forests<br>Floodplains, Wetlands and Riparian Areas<br>Northern Hardwood Forests |
| Lepidopterans | Oak Forests and Woodlands<br>All |
| Mafic Rocks | Alkaline Glade and Woodlands and Mafic Glades and Barrens |
| Occurrence Protection | Oak Forests and Woodlands<br>All |
| Open Woodlands | Oak Forests and Woodlands<br>Alkaline Glade and Woodlands and Mafic Glades and Barrens<br>Cliff, Talus and Shale Barrens<br>Pine Forests and Woodlands |
| Regenerating Forests | Oak Forests and Woodlands<br>All |
| Riparian | Floodplains, Wetlands and Riparian Areas |

| Species Group | Associated Ecological System(s) |
|---|---|
| Ruderal | Any |
| Sandstone Glades and Barrens | Any |
| Sensitive to Over-Collection | All |
| Sensitive to Recreation Traffic | Any |
| Shale Barrens | Cliff, Talus and Shale Barrens |
| Shrublands | Oak Forests and Woodlands<br>All |
| Species in a Special Biologic Area | All |

Since species may be associated with many species groups a description of the level of association is included in each of the following tables that list the species in each group. The levels are defined as follows:

| Group Weight | Group Weight Description |
|---|---|
| Very High | All or nearly all of the species' needs are covered by needs of this group |
| High | A high proportion of the species' needs are covered by the needs of this group |
| Moderate | A moderate proportion of the species' needs are covered by the needs of this group |
| Low | A low proportion of the species' needs are covered by the needs of this group |

## 4.2.1 Alkaline Glade and Barren Associates

These species are associated with alkaline glades and barrens. Their habitat needs are tied directly to the Mafic Glade and Barrens and Alkaline Glades and Woodlands ecological system. Maintaining those ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Alkaline Glad and Barren Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Houstonia canadensis* | Canada bluets | High |
| *Ruellia purshiana* | Pursh's wild petunia | High |

## 4.2.2 Calciphile Associates

These species generally require basic soils (pH greater than seven) in areas underlain by carbonate bedrock. They are often associated with the Cave and Karstland ecological systems, but can be found in other areas where the bedrock geology and soil conditions present the appropriate conditions. Additional measures beyond those identified for the ecological system are needed to assure that the habitat needs for these species are addressed.

Species in Calciphine Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Campanula rotundifolia* | American harebell | High |
| *Delphinium exaltatum* | tall larkspur | High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Desmodium cuspidatum* | toothed tick-trefoil | High |
| *Echinacea laevigata* | smooth coneflower | High |
| *Euphorbia purpurea* | glade spurge | Moderate |
| *Glyphyalinia raderi* | Maryland glyph | High |
| *Helicodiscus diadema* | Shaggy coil | High |
| *Helicodiscus triodus* | Talus coil | High |
| *Houstonia canadensis* | Canada bluets | High |
| *Juniperus communis var depressa* | ground juniper | Moderate |
| *Linum lewisii* | prairie flax | High |
| *Linum sulcatum* | grooved yellow flax | High |
| *Melica nitens* | Three-flowered melic grass | High |
| *Nampabius turbator* | Cave centipede | High |
| *Oligoneuron rigidum* | stiff goldenrod | High |
| *Onosmodium virginianum* | Virginia false-gromwell | High |
| *Paronychia virginica* | yellow nailwort | High |
| *Paxistima canbyi* | Canby's mountain lover | High |
| *Phlox amplifolia* | Broadleaf phlox | High |
| *Pseudanophthalmus avernus* | Avernus cave beetle | High |
| *Pseudanophthalmus intersectus* | Crossroads cave beetle | High |
| *Pseudanophthalmus nelsoni* | Nelson's cave beetle | High |
| *Pseudanophthalmus petrunkevitchi* | Petrunkevitch's cave beetle | High |
| *Pseudotremia princeps* | South Branch Valley cave millipede | High |
| *Pycnanthemum torreyi* | Torrey's mountain-mint | High |
| *Pygmarrhopalites carolynae* | Cave springtail | High |
| *Pygmarrhopalites sacer* | Cave springtail | High |
| *Rosa setigera* | prairie rose | Moderate |
| *Ruellia purshiana* | Pursh's wild petunia | High |
| *Scutellaria parvula var. parvula* | small skullcap | High |
| *Sporobolus neglectus* | small dropseed | High |
| *Stygobromus gracilipes* | Shenandoah Valley cave amphipod | High |
| *Stygobromus hoffmani* | Alleghany County cave amphipod | High |
| *Stygobromus morrisoni* | Morrison's cave amphipod | High |
| *Stygobromus mundus* | Bath County cave amphipod | High |
| *Stygobromus sp. 7* | Sherando spinosid amphipod | High |
| *Stygobromus sp. nov.* | Massanutten Spring Amphipod | High |
| *Symphoricarpos albus* | snowberry | High |
| *Thuja occidentalis* | northern white cedar | High |
| *Zigadenus elegans ssp. glaucus = Anticlea glauca* | white camas | Moderate |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Zygonopus weyeriensis* | Grand Caverns blind cave millipede | High |
| *Zygonopus whitei* | Luray Caverns blind cave millipede | High |

## 4.2.3 Cave Associates

These species live in caves. Temperature, humidity, water flow, water quality and level of human disturbance are all important components of the cave habitat. The habitat needs of the species in this group are tied directly to the Cave and Karstland ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Cave Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Apochthonius holsingeri* | A cave pseudoscorpion | Very High |
| *Corynorhinus townsendii virginianus* | Virginia big-eared bat | Very High |
| *Kleptochthonius anophthalmus* | A cave pseudoscorpion | Very High |
| *Miktoniscus racovitzai* | Racovitza's terrestrial cave isopod | Very High |
| *Myotis leibii* | eastern small-footed bat | Very High |
| *Myotis sodalis* | Indiana bat | Very High |
| *Nampabius turbator* | Cave centipede | Very High |
| *Neotoma magister* | Alleghany woodrat | Moderate |
| *Pseudanophthalmus avernus* | Avernus cave beetle | Very High |
| *Pseudanophthalmus intersectus* | Crossroads cave beetle | Very High |
| *Pseudanophthalmus nelsoni* | Nelson's cave beetle | Very High |
| *Pseudanophthalmus petrunkevitchi* | Petrunkevitch's cave beetle | Very High |
| *Pseudognaphalium macounii* | Winged cudweed | Very High |
| *Pseudotremia princeps* | South Branch Valley cave millipede | Very High |
| *Pygmarrhopalites carolynae* | Cave springtail | Very High |
| *Pygmarrhopalites sacer* | Cave springtail | Very High |
| *Pygmarrhopalites caedus* | A cave springtail | Very High |
| *Stygobromus gracilipes* | Shenandoah Valley cave amphipod | Very High |
| *Stygobromus hoffmani* | Alleghany County cave amphipod | Very High |
| *Stygobromus morrisoni* | Morrison's cave amphipod | Very High |
| *Stygobromus mundus* | Bath County cave amphipod | Very High |
| *Stygobromus sp. 7* | Sherando spinosid amphipod | Very High |
| *Stygobromus sp. nov.* | Massanutten Spring Amphipod | Very High |
| *Zygonopus weyeriensis* | Grand Caverns blind cave millipede | Very High |
| *Zygonopus whitei* | Luray Caverns blind cave millipede | Very High |

## 4.2.4 Cavity Tree, Den Tree and Snag Associates

Cavity and den trees are live or dead trees with openings or broken out tops that provide habitat for reproduction, shelter, and/or hibernation. Snags are dead trees or live trees with dead limbs or tops that provide sloughing bark, perches, and food sources for a variety of animals. This habitat and these species can be found throughout the GWNF. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Cavity Tree, Den Tree and Snag Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Aegolius acadicus* | northern saw-whet owl | High |
| *Certhia americana* | brown creeper | Very High |
| *Contopus borealis* | olive-sided flycatcher | High |
| *Myotis sodalis* | Indiana bat | High |
| *Sciurus carolinensis* | gray squirrel | High |
| *Sciurus niger* | Eastern fox squirrel | High |
| *Sitta canadensis* | red-breasted nuthatch | High |
| *Sphyrapicus varius* | yellow-bellied sapsucker | High |
| *Thryomanes bewickii altus* | Appalachian Bewick's wren | High |
| *Troglodytes troglodytes* | winter wren | Moderate |
| *Tyto alba* | barn owl | High |
| *Ursus americanus* | black bear | High |

## 4.2.5 Cliff, Talus and Large Rock Outcrop Associates

These species are dependent on cliffs, the talus slopes below cliffs, other talus slopes and large rock outcrops. The rock substrate is the key component and type of rock can be important to some species. The habitat needs of the species in this group are tied directly to the Cliff, Talus and Shale Barrens ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need. There are smaller cliffs and talus areas that are not readily recognized and large rock outcrops can be found throughout many other ecological systems. Therefore, additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Cliff, Talus and Large Rock Outcrop Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Aralia hispida* | bristly sarsaparilla | High |
| *Betula cordifolia* | mountain paper birch | Very High |
| *Campanula rotundifolia* | American harebell | High |
| *Cheilanthes eatonii* | chestnut lipfern | Very High |
| *Crotalus horridus* | Timber rattlesnake | Very High |
| *Cuscuta coryli* | hazel dodder | Very High |
| *Cystopteris fragilis* | fragile fern | Very High |
| *Falco peregrinus* | peregrine falcon | Very High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Geranium robertianum* | herb-robert | High |
| *Helianthemum bicknellii* | plains frostweed | High |
| *Linum lewisii* | prairie flax | High |
| *Linum sulcatum* | grooved yellow flax | High |
| *Minuartia groenlandica* | mountain sandwort | Very High |
| *Myotis leibii* | eastern small-footed bat | Very High |
| *Neotoma magister* | Alleghany woodrat | High |
| *Paronychia virginica* | yellow nailwort | High |
| *Paxistima canbyi* | Canby's mountain lover | High |
| *Plethodon punctatus* | Cow Knob salamander | Moderate |
| *Plethodon virginia* | Shenandoah Mt. salamander | Moderate |
| *Scutellaria parvula var. parvula* | small skullcap | High |
| *Scutellaria saxatilis* | Rock skullcap | Moderate |
| *Sibbaldiopsis tridentata* | three-toothed cinquefoil | Very High |
| *Spilogale putorius* | Spotted Skunk | High |
| *Sporobolus neglectus* | small dropseed | High |
| *Symphoricarpos albus* | snowberry | High |
| *Thuja occidentalis* | northern white cedar | High |
| *Zigadenus elegans ssp. glaucus = Anticlea glauca* | white camas | High |

## 4.2.6 Cove Forest Associates

These species are known to be associated with cove forests. The habitat needs of the species in this group are tied directly to the Cove Forest ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Cove Forest Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Leucothoe fontanesiana* | highland dog-hobble | High |
| *Panax quinquefolius* | Ginseng | High |
| *Panax trifolius* | Dwarf ginseng | High |

## 4.2.7 Fire Dependent and Fire Enhanced Associates

These species are generally associated with open woodland conditions that require frequent fires.

These species range from those generally dependent upon fire (weighted very high) to those that are not dependent upon fire, but whose habitat is enhanced through frequent fires. This habitat type is found in the ecological systems where fire is an active component of the disturbance regime. The habitat needs of the species in this group are tied directly to the Pine Forests and Woodlands, Alkaline Glade and Woodlands, Mafic Glades and Barrens, and Oak Forests and Woodlands ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Fire Dependent and Fire Enhanced Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Anaphalis margaritacea* | pearly everlasting | High |
| *Arabis serotina* | shale barren rockcress | High |
| *Aralia hispida* | bristly sarsaparilla | Very High |
| *Arnoglossom muehlenbergii* | great Indian-plantain | Moderate |
| *Bartramia longicauda* | upland sandpiper | Moderate |
| *Betula cordifolia* | mountain paper birch | High |
| *Bonasa umbellus* | ruffed grouse | Moderate |
| *Bromus kalmii* | wild chess | High |
| *Buckleya distichophylla* | Piratebush | Very High |
| *Callophrys irus* | Frosted elfin | High |
| *Caprimulgus carolinensis* | chuck-will's widow | High |
| *Caprimulgus vociferus* | whip-poor-will | Moderate |
| *Carex polymorpha* | variable sedge | Very High |
| *Colinus virginianus* | northern bobwhite | Moderate |
| *Crataegus pruinosa* | prunose hawthorn | Moderate |
| *Delphinium exaltatum* | tall larkspur | High |
| *Dendroica discolor* | prairie warbler | Moderate |
| *Echinacea laevigata* | smooth coneflower | High |
| *Elymus trachycaulus* | slender wheatgrass | High |
| *Erynnis martialis* | Mottled duskywing | High |
| *Gaylussacia brachycera* | box huckleberry | Very High |
| *Liochlorophis vernalis* | Smooth green snake | High |
| *Meleagris gallopavo* | wild turkey | Moderate |
| *Odocoileus virginianus* | white-tailed deer | Moderate |
| *Onosmodium virginianum* | Virginia false-gromwell | Moderate |
| *Oporornis philadelphia* | mourning warbler | High |
| *Phlox buckleyi* | sword-leaved phlox | High |
| *Pituophis melanoleucus* | northern pinesnake | High |
| *Prunus alleghaniensis* | Alleghany sloe | High |
| *Pyrgus wyandot* | Appalachian grizzled skipper | High |
| *Ruellia purshiana* | Pursh's wild petunia | Moderate |
| *Sciurus niger* | Eastern fox squirrel | Moderate |
| *Vermivora chrysoptera* | golden winged warbler | High |

## 4.2.8 Hard and Soft Mast Associates

These species need a mixture of both hard and soft mast as food. The habitat associated with these species can be found in other ecological systems, but is most common in the oak forests and woodlands. Maintaining the Oak Forest and Woodland ecological systems and moving them towards their desired condition will satisfy most of the needs of the species in this group related to this habitat need. The one additional need is to maintain existing shrubland areas.

Species in Hard and Soft Mast Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Bonasa umbellus* | ruffed grouse | High |
| *Meleagris gallopavo* | wild turkey | High |
| *Odocoileus virginianus* | white-tailed deer | High |
| *Sciurus carolinensis* | gray squirrel | High |
| *Sciurus niger* | Eastern fox squirrel | High |
| *Ursus americanus* | black bear | High |

## 4.2.9 High Elevation Coniferous, Deciduous and/or Mixed Forest Associates

These species are generally found at high elevation (>3,000 feet) in forested environments. The habitat associated with these species can be found throughout the ecological systems, but is confined to the high elevations. The habitat needs of the species in this group are tied directly to the Spruce Forest and Northern Hardwood ecological systems. Additional measures are needed to assure that the high elevation Oak Forests and Woodlands and the Pine Forests and Woodlands that are at high elevation will also be maintained. Maintaining these ecological systems, implementing additional measures, and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in High Elevation Coniferous, Deciduous and/or Mixed Forest Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Aegolius acadicus* | northern saw-whet owl | High |
| *Carpodacus purpureus* | purple finch | High |
| *Catharus guttatus* | hermit thrush | High |
| *Certhia americana* | brown creeper | High |
| *Coccyzus erythropthalmus* | black-billed cuckoo | High |
| *Contopus borealis* | olive-sided flycatcher | High |
| *Cornus canadensis* | bunchberry | High |
| *Dendroica fusca* | blackburnian warbler | High |
| *Dendroica magnolia* | magnolia warbler | High |
| *Empidonax alnorum* | alder flycatcher | High |
| *Glaucomys sabrinus fuscus* | Virginia northern flying squirrel | Very High |
| *Gymnocarpium appalachianum* | Appalachian oak fern | Very High |
| *Heuchera alba* | white alumroot | Very High |
| *Huperzia appalachiana* | Appalachian fir clubmoss | High |
| *Hypericum mitchellianum* | Blue Ridge St. John's-wort | High |
| *Lepus americanus* | snowshoe hare | High |
| *Lonicera canadensis* | American fly-honeysuckle | Very High |
| *Loxia curvirostra* | red crossbill | Very High |
| *Martes pennanti* | fisher | Very High |
| *Microtus chrotorrhinus carolinensis* | Southern rock vole | High |
| *Oporornis philadelphia* | mourning warbler | High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Plethodon punctatus* | Cow Knob salamander | Very High |
| *Plethodon virginia* | Shenandoah Mt. salamander | High |
| *Pyrola elliptica* | shinleaf | High |
| *Regulus satrapa* | golden-crowned kinglet | Very High |
| *Schizachne purpurascens* | purple oat-grass | High |
| *Seiurus noveboracensis* | northern waterthrush | High |
| *Sitta canadensis* | red-breasted nuthatch | High |
| *Sorex palustris punctulatus* | southern water shrew | High |
| *Sphyrapicus varius* | yellow-bellied sapsucker | High |
| *Sylvilagus obscurus* | Appalachian Cottontail | Very High |
| *Trillium pusillum var. virginianum* | mountain least trillium | High |
| *Troglodytes troglodytes* | winter wren | Very High |

## 4.2.10 Late Successional Hardwood Dominated Forest Associates

These species are associated with late successional systems usually dominated by hardwoods. These areas have developing or well-developed canopy gap dynamics, large woody material on the ground, and den and cavity trees. The habitat needs of the species in this group are tied directly to the Northern Hardwood, Cove Forest, and Oak Forest and Woodlands ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Late Successional Hardwood Dominated Forest Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Ambystoma tigrinum* | Eastern tiger salamander | High |
| *Bonasa umbellus* | ruffed grouse | High |
| *Dendroica cerulea* | cerulean warbler | High |
| *Glyptemys insculpta* | wood turtle | Moderate |
| *Meleagris gallopavo* | wild turkey | High |
| *Neotoma magister* | Alleghany woodrat | Moderate |
| *Odocoileus virginianus* | white-tailed deer | High |
| *Plethodon punctatus* | Cow Knob salamander | Moderate |
| *Plethodon virginia* | Shenandoah Mt. salamander | Moderate |
| *Sciurus carolinensis* | gray squirrel | High |
| *Semionellus placidus* | Millipede | High |
| *Spilogale putorius* | Spotted Skunk | Moderate |
| *Ursus americanus* | black bear | High |

## 4.2.11 Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates

These are species requiring large blocks (generally 500 acres or greater) of mature successional forest systems. These areas have developing or well-developed canopy structural dynamics, large woody material on the ground, and den and cavity trees. The habitat needs of the species in this group are tied directly to the Spruce, Northern Hardwood, Pine Forests and Woodlands, Oak Forest and Woodlands, Cover Forest, and Wetlands and Riparian ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Area Sensitive Mature Coniferous, Deciduous and/or Mixed Forest Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Aegolius acadicus* | northern saw-whet owl | High |
| *Aquila chrysaetos* | golden eagle | Very High |
| *Catharus guttatus* | hermit thrush | High |
| *Certhia americana* | brown creeper | High |
| *Corynorhinus townsendii virginianus* | Virginia big-eared bat | High |
| *Dendroica cerulea* | cerulean warbler | High |
| *Dendroica fusca* | blackburnian warbler | Moderate |
| *Empidonax virescens* | acadian flycatcher | Moderate |
| *Glaucomys sabrinus fuscus* | Virginia northern flying squirrel | High |
| *Loxia curvirostra* | red crossbill | Moderate |
| *Martes pennanti* | fisher | Very High |
| *Myotis sodalis* | Indiana bat | Very High |
| *Plethodon punctatus* | Cow Knob salamander | High |
| *Plethodon virginia* | Shenandoah Mt. salamander | High |
| *Seiurus noveboracensis* | northern waterthrush | High |
| *Ursus americanus* | black bear | Very High |

## 4.2.12 Lepidopterans

These are lepidopterans that are either sensitive to fire injury (due to their limited distribution) or to treatment of gypsy moths with insecticides like Bt or Dimilin. Many of these species rely on host plants that occur in open conditions, so fire is an important aspect of maintaining their habitat. However, since at least one of their life stages is always present in the area, care must be taken in planning prescribed burns. These species and habitats could be found in many ecological systems. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Lepidopterans Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Autochton cellus* | Golden-banded skipper | High |
| *Boloria selene* | Silver-bordered fritillary | Very High |
| *Callophrys irus* | Frosted elfin | Very High |
| *Catocala herodias gerhardi* | Herodias underwing | Very High |
| *Catocala marmorata* | Marbled underwing | Very High |
| *Colias interior* | Pink-edged sulphur | Very High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Erora laeta* | Early hairstreak | Very High |
| *Erynnis martialis* | Mottled duskywing | Very High |
| *Erynnis persius* | Persius duskywing | Very High |
| *Euchloe olympia* | Olympia marble | Very High |
| *Incisalia polia* | Hoary elfin | Very High |
| *Phyciodes batesii* | Tawny crescent | Very High |
| *Phyciodes cocyta* | Northern crescent | Very High |
| *Polygonia progne* | Gray comma | Very High |
| *Pyrgus wyandot* | Appalachian grizzled skipper | Very High |
| *Satyrium favonius ontario* | Northern Hairstreak | Very High |
| *Speyeria atlantis* | Atlantis fritillary | Very High |
| *Speyeria diana* | Diana fritillary | Very High |
| *Speyeria idalia* | Regal fritillary | Very High |

## 4.2.13 Mafic Rock Associates

These species are associated with mafic rock substrates and often with seepage areas. The habitat needs of the species in this group are tied directly to the Mafic Glades and Barrens ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Mafic Rock Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Clematis occidentalis* | purple clematis | High |
| *Muhlenbergia glomerata* | marsh muhly | High |
| *Poa saltuensis* | drooping bluegrass | High |
| *Potentilla arguta* | tall cinquefoil | Very High |
| *Pycnanthemum torreyi* | Torrey's mountain-mint | High |
| *Ruellia purshiana* | Pursh's wild petunia | High |
| *Solidago randii = S. simplex var. randii* | Rand's goldenrod | Very High |

## 4.2.14 Species Needing Occurrence Protection

Species in this group are rare in occurrence on the GWNF although habitat is widespread. Habitat assessments cannot accurately predict the presence of these species. Most of these species occur in less than 5 populations on the Forest and are sensitive to management actions. Those species which have more than 5 known occurrences represent populations which are critical to the survival of the species and have limited occurrence outside of GWNF. T&E species are not included in this group because they require species-specific protection and have specific guidance described in Section 2. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species Needing Occurrence Protection Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Adlumia fungosa* | Climbing fumatory | High |
| *Ammodramus henslowii* | Henslow's sparrow | High |
| *Arnoglossom muehlenbergii* | great Indian-plantain | High |
| *Bartramia longicauda* | upland sandpiper | High |
| *Buckleya distichophylla* | Piratebush | High |
| *Callophrys irus* | Frosted elfin | High |
| *Carex polymorpha* | variable sedge | High |
| *Carex roanensis* | Roan Mountain sedge | High |
| *Catocala herodias gerhardi* | Herodias underwing | High |
| *Catocala marmorata* | Marbled underwing | High |
| *Circus cyaneus* | northern harrier | High |
| *Corallorhiza bentleyi* | Bentley's coalroot | High |
| *Cornus canadensis* | bunchberry | High |
| *Cornus rugosa* | roundleaf dogwood | High |
| *Corynorhinus townsendii virginianus* | Virginia big-eared bat | High |
| *Crataegus calpodendron* | pear hawthorn | Moderate |
| *Crataegus pruinosa* | prunose hawthorn | Moderate |
| *Cuscuta coryli* | hazel dodder | High |
| *Cuscuta rostrata* | beaked dodder | High |
| *Cypripedium reginae* | showy lady's-slipper | Moderate |
| *Desmodium cuspidatum* | toothed tick-trefoil | High |
| *Erora laeta* | Early hairstreak | High |
| *Erynnis martialis* | Mottled duskywing | High |
| *Eumeces anthracinus* | coal skink | High |
| *Falco peregrinus* | peregrine falcon | High |
| *Gaylussacia brachycera* | box huckleberry | High |
| *Glyphyalinia raderi* | Maryland glyph | Low |
| *Goodyera repens* | dwarf rattlesnake plantain | High |
| *Gymnocarpium appalachianum* | Appalachian oak fern | High |
| *Haliaeetus leucocephalus* | bald eagle | High |
| *Helicodiscus diadema* | Shaggy coil | High |
| *Helicodiscus triodus* | Talus coil | High |
| *Heuchera alba* | white alumroot | High |
| *Hypericum mitchellianum* | Blue Ridge St. John's-wort | High |
| *Juglans cinerea* | butternut | High |
| *Leucothoe fontanesiana* | highland dog-hobble | High |
| *Monotropsis odorata* | sweet pinesap | High |
| *Myotis leibii* | eastern small-footed bat | High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Myotis sodalis* | Indiana bat | High |
| *Nannaria shenandoah* | Shenandoah Mountain xystodesmid | High |
| *Phlox amplifolia* | Broadleaf phlox | Moderate |
| *Phlox buckleyi* | sword-leaved phlox | High |
| *Phyciodes batesii* | Tawny crescent | High |
| *Pituophis melanoleucus* | northern pinesnake | Low |
| *Pygmarrhopalites caedus* | A cave springtail | High |
| *Pyrola elliptica* | shinleaf | High |
| *Satyrium favonius ontario* | Northern Hairstreak | High |
| *Semionellus placidus* | Millipede | High |
| *Triodopsis picea* | Spruce Knob threetooth | High |
| *Triphora trianthophora* | nodding pogonia | High |

## 4.2.15 Open Area Associates

Many species require open areas for at least some part of their life history. Openings allow sunlight to reach the ground and that often allows for more herbaceous vegetation and shrubby vegetation to become established. Herbaceous vegetation also allows for development of a richer insect population which can provide food which is often important for the early portion of several species lives. Open areas can take many forms. A stand of trees that is harvested, blown down, or burned creates an opening while the new stand regenerates. The opening for the first ten years is referred to as early successional habitat and is important for many species as a temporary opening. As the stand continues to grow, the dense stand of saplings in the range of 11 to 20 years provides habitat important to ruffed grouse. Openings can be as small as the opening created by a tree falling (canopy gaps) or as large as grasslands greater than 100 acres in size which are desired by Henslow's sparrows. If disturbance of an area occurs on a regular basis, trees will not be reestablished on the site. It may stay as a grassland with very frequent disturbance or as a shrubland with less frequent disturbance. Open woodlands are created when fire is frequent in a mature stand of trees. The few mature trees will maintain an open canopy, but the understory will be open enough for a grassy or herbaceous understory will develop that can be maintained with frequent fire. These openings are sometimes hard to distinguish from each other and they may move from one type to another depending upon the type and frequency of disturbance.

## 4.2.15.a Area Sensitive Grassland and Shrubland and Open Woodlands Associates

These species require the presence of large blocks (from 40 to 100+ acres) of a combination of grasslands and shrublands and/or open woodlands. It is important to have complexes of all these habitat components. It is important to retain existing sites. While many of these habitats would be found in the Oak Forest and Woodland ecological system, these could be found in other systems as well. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Area Sensitive Grassland and Shrubland and Open Woodlands Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Caprimulgus carolinensis* | chuck-will's widow | High |
| *Caprimulgus vociferus* | whip-poor-will | High |
| *Colinus virginianus* | northern bobwhite | High |
| *Dendroica discolor* | prairie warbler | High |
| *Sciurus niger* | Eastern fox squirrel | High |
| *Vermivora chrysoptera* | golden winged warbler | High |

## 4.2.15.b Area Sensitive Grasslands Associates

These species require the presence of large blocks (40 to 100 acres or greater) of open grassland habitat. It is important to retain existing sites and expand them where possible. Most of these species prefer areas at the larger end of this size range. While many of these habitats would be found in the Oak Forest and Woodland ecological system, these could be found in other systems as well. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Area Sensitive Grasslands Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Ammodramus henslowii* | Henslow's sparrow | Very High |
| *Bartramia longicauda* | upland sandpiper | Very High |
| *Circus cyaneus* | northern harrier | Very High |
| *Lanius ludovicianus* | loggerhead shrike | Very High |
| *Speyeria idalia* | Regal fritillary | Very High |
| *Tyto alba* | barn owl | High |

## 4.2.15.c Area Sensitive Shrubland and Open Woodland Associates

These species require the presence of large blocks (100 acres or greater) of a mix of open shrubland and open woodland habitat. It is important to retain existing sites and expand them where possible. While many of these habitats would be found in the Oak Forest and Woodland ecological system, these could be found in other systems as well. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Area Sensitive Shrubland and Open Woodlands Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Erynnis martialis* | Mottled duskywing | High |

## 4.2.15.d Grassland Associates

These species are associated with open areas of any size with grass or forb dominated vegetation. These areas may be permanent openings or temporary openings that will eventually become shrublands or forests. While many of these habitats would be found in the Oak Forest and Woodland ecological system, these could be found in other systems as well. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Grasslands Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Anaphalis margaritacea* | pearly everlasting | High |
| *Arnoglossom muehlenbergii* | great Indian-plantain | Moderate |
| *Bonasa umbellus* | ruffed grouse | Moderate |
| *Colinus virginianus* | northern bobwhite | High |
| *Erynnis persius* | Persius duskywing | High |
| *Glyptemys insculpta* | wood turtle | Moderate |
| *Incisalia polia* | Hoary elfin | High |
| *Lanius ludovicianus* | loggerhead shrike | High |
| *Liochlorophis vernalis* | Smooth green snake | High |
| *Meleagris gallopavo* | wild turkey | High |
| *Mustela nivalis* | least weasel | High |
| *Odocoileus virginianus* | white-tailed deer | High |
| *Polygonia progne* | Gray comma | Moderate |
| *Scolopax minor* | American woodcock | High |
| *Thryomanes bewickii altus* | Appalachian Bewick's wren | High |
| *Tyto alba* | barn owl | High |
| *Ursus americanus* | black bear | High |
| *Vermivora chrysoptera* | golden winged warbler | High |
| *Virginia valeriae pulchra* | mountain earth snake | High |

## 4.2.15.e High Elevation Opening (Grassy or Shrubby) or Open Woodland Associates

These species are associated with openings or open woodlands at elevations greater than 3,000 feet. The habitat needs of the species in this group are tied directly to the Northern Hardwood, Oak Forest and Woodlands and Pine Forest and Woodlands ecological systems. Additional measures will need to assure that the high elevation grasslands and shrublands are also maintained. Maintaining these ecological systems and these additional measures and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in High Elevation Opening or Open Woodland Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Carpodacus purpureus* | purple finch | High |
| *Catharus guttatus* | hermit thrush | Moderate |
| *Coccyzus erythropthalmus* | black-billed cuckoo | High |
| *Contopus borealis* | olive-sided flycatcher | High |
| *Cuscuta rostrata* | beaked dodder | Very High |
| *Gnaphalium uliginosum* | low cudweed | High |
| *Hypericum mitchellianum* | Blue Ridge St. John's-wort | High |
| *Juniperus communis var depressa* | ground juniper | High |
| *Lepus americanus* | snowshoe hare | Moderate |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Liochlorophis vernalis* | Smooth green snake | Very High |
| *Melospiza georgiana* | swamp sparrow | High |
| *Oporornis philadelphia* | mourning warbler | High |
| *Rubus idaeus ssp. strigosus* | American red raspberry | Very High |
| *Sphyrapicus varius* | yellow-bellied sapsucker | High |
| *Sylvilagus obscurus* | Appalachian Cottontail | Very High |
| *Thryomanes bewickii altus* | Appalachian Bewick's wren | High |
| *Vermivora chrysoptera* | golden winged warbler | Very High |

## 4.2.15.f Shrubland Associates

These species are associated with shrub dominated vegetation. The habitat needs of the species in this group are tied directly to the Cove Forest, Northern Hardwood, Pine Forest and Woodland, Oak Forest and Woodlands, and Mafic Glade and Barrens and Alkaline Glades and Woodlands ecological systems. Additional measures will need to assure that the existing shrublands are also maintained. Maintaining these ecological systems and these additional measures and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Shrubland Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Anaphalis margaritacea* | pearly everlasting | Moderate |
| *Bonasa umbellus* | ruffed grouse | High |
| *Colinus virginianus* | northern bobwhite | High |
| *Erynnis persius* | Persius duskywing | Moderate |
| *Eumeces anthracinus* | coal skink | Low |
| *Glyptemys insculpta* | wood turtle | High |
| *Incisalia polia* | Hoary elfin | High |
| *Lanius ludovicianus* | loggerhead shrike | High |
| *Meleagris gallopavo* | wild turkey | High |
| *Mustela nivalis* | least weasel | High |
| *Odocoileus virginianus* | white-tailed deer | High |
| *Oryzopsis asperifolia* | white-grained mtn-ricegrass | High |
| *Polygonia progne* | Gray comma | Moderate |
| *Prunus nigra* | Canada plum | Moderate |
| *Spilogale putorius* | Spotted Skunk | Moderate |
| *Thryomanes bewickii altus* | Appalachian Bewick's wren | High |
| *Ursus americanus* | black bear | High |
| *Vermivora chrysoptera* | golden winged warbler | High |
| *Virginia valeriae pulchra* | mountain earth snake | Moderate |

## 4.2.15.g Regenerating Forest Associates

These species utilize regenerating even-aged forests of pole-size timber (typically in the 10-30 year old age class group). The habitat needs of the species in this group are tied directly to the Cove Forest, Pine Forest and Woodland, and Oak Forest and Woodlands ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Regenerating Forest Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Bonasa umbellus* | ruffed grouse | High |
| *Caprimulgus carolinensis* | chuck-will's widow | High |
| *Caprimulgus vociferus* | whip-poor-will | High |
| *Dendroica discolor* | prairie warbler | High |
| *Dendroica magnolia* | magnolia warbler | High |
| *Lepus americanus* | snowshoe hare | Very High |
| *Odocoileus virginianus* | white-tailed deer | High |
| *Oporornis philadelphia* | mourning warbler | High |
| *Ursus americanus* | black bear | High |

## 4.2.15.h Open Woodland Associates

These species are associated with mature stands of trees with open (26-60% open) canopies and well developed grassy or shrubby understories. The habitat needs of the species in this group are tied directly to the Cove Forest, Northern Hardwood, Pine Forest and Woodland, Oak Forest and Woodlands, and Mafic Glade and Barrens and Alkaline Glades and Woodlands ecological systems. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Open Woodland Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Bonasa umbellus* | ruffed grouse | High |
| *Callophrys irus* | Frosted elfin | High |
| *Caprimulgus carolinensis* | chuck-will's widow | High |
| *Caprimulgus vociferus* | whip-poor-will | High |
| *Catocala herodias gerhardi* | Herodias underwing | High |
| *Colinus virginianus* | northern bobwhite | High |
| *Delphinium exaltatum* | tall larkspur | Moderate |
| *Desmodium sessilifolium* | sessile-leaf tick-trefoil | Moderate |
| *Echinacea laevigata* | smooth coneflower | High |
| *Erysimum capitatum* | western wallflower | High |
| *Euchloe olympia* | Olympia marble | High |
| *Eumeces anthracinus* | coal skink | High |
| *Falco peregrinus* | peregrine falcon | High |
| *Glyptemys insculpta* | wood turtle | High |
| *Helianthemum bicknellii* | plains frostweed | High |
| *Helianthemum propinquum* | low frostweed | High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Linum lewisii* | prairie flax | High |
| *Linum sulcatum* | grooved yellow flax | High |
| *Liochlorophis vernalis* | Smooth green snake | High |
| *Meleagris gallopavo* | wild turkey | High |
| *Melica nitens* | Three-flowered melic grass | High |
| *Myotis sodalis* | Indiana bat | Very High |
| *Odocoileus virginianus* | white-tailed deer | High |
| *Oligoneuron rigidum* | stiff goldenrod | High |
| *Onosmodium virginianum* | Virginia false-gromwell | High |
| *Oryzopsis asperifolia* | white-grained mtn-ricegrass | High |
| *Pituophis melanoleucus* | northern pinesnake | High |
| *Plethodon sherando* | Big levels salamander | High |
| *Poa saltuensis* | drooping bluegrass | High |
| *Polygonia progne* | Gray comma | Moderate |
| *Prunus alleghaniensis* | Alleghany sloe | High |
| *Pycnanthemum torreyi* | Torrey's mountain-mint | High |
| *Pyrgus wyandot* | Appalachian grizzled skipper | High |
| *Rosa setigera* | prairie rose | High |
| *Satyrium favonius ontario* | Northern Hairstreak | High |
| *Scutellaria parvula var. parvula* | small skullcap | High |
| *Scutellaria saxatilis* | Rock skullcap | Moderate |
| *Speyeria diana* | Diana fritillary | High |
| *Spiranthes ochroleuca* | yellow nodding ladies'-tresses | High |
| *Trichostema setaceum* | narrow-leaved blue curls | High |
| *Ursus americanus* | black bear | High |
| *Vermivora chrysoptera* | golden winged warbler | Very High |
| *Virginia valeriae pulchra* | mountain earth snake | High |
| *Zigadenus elegans ssp. glaucus = Anticlea glauca* | white camas | High |

## 4.2.16 Riparian Area Associates

Species occurring in this group require wetlands, aquatic systems (streams, lakes, or ponds), springs, seeps or areas adjacent to these systems. The habitat needs of the species in this group are tied directly to the Floodplain, Wetland and Riparian Area ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need. There are also a number of the species in this group that benefit from open canopies. These include wetland plants and many of the birds. Flood events, canopy gaps, edaphic conditions and beaver activity are expected to meet most of the needs of these species.

Species in Riparian Area Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Aegolius acadicus* | northern saw-whet owl | High |
| *Alnus incana ssp. rugosa* | speckled alder | Very High |
| *Ambystoma tigrinum* | Eastern tiger salamander | High |
| *Anas rubripes* | American black duck | Very High |
| *Arnoglossom muehlenbergii* | great Indian-plantain | High |
| *Aster radula* | rough-leaved aster | Very High |
| *Autochton cellus* | Golden-banded skipper | Very High |
| *Boloria selene* | Silver-bordered fritillary | Very High |
| *Boltonia montana* | no common name | Very High |
| *Bonasa umbellus* | ruffed grouse | High |
| *Bromus ciliatus* | fringed brome grass | Very High |
| *Calopogon tuberosus* | Grass pink | Very High |
| *Carex aquatilis* | water sedge | Very High |
| *Carex arctata* | black sedge | Very High |
| *Carex barrattii* | Barratt's sedge | Very High |
| *Carex buxbaumii* | Buxbaum's sedge | Very High |
| *Carex lasiocarpa var. americana* | slender sedge | Very High |
| *Carex schweinitzii* | Schweinitz's sedge | High |
| *Carex vesicaria* | Inflated sedge | Very High |
| *Castor canadensis* | Beaver | Very High |
| *Catocala marmorata* | Marbled underwing | High |
| *Certhia americana* | brown creeper | High |
| *Cicindela ancocisconensis* | a tiger beetle | Very High |
| *Clemmys guttata* | spotted turtle | Very High |
| *Coccyzus erythropthalmus* | black-billed cuckoo | High |
| *Colias interior* | Pink-edged sulphur | Very High |
| *Contopus borealis* | olive-sided flycatcher | High |
| *Cyperus dentatus* | toothed flatsedge | High |
| *Cypripedium reginae* | showy lady's-slipper | Very High |
| *Dendroica cerulea* | cerulean warbler | High |
| *Dendroica magnolia* | magnolia warbler | High |
| *Desmodium canadense* | showy tick-trefoil | High |
| *Desmodium sessilifolium* | sessile-leaf tick-trefoil | High |
| *Echinodorus tenellus* | dwarf burhead | Very High |
| *Eleocharis compressa* | flat-stemmed spikerush | Very High |
| *Eleocharis melanocarpa* | black-fruited spikerush | Very High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Eleocharis robbinsii* | Robbins spikerush | Very High |
| *Elymus canadensis* | nodding wild rye | High |
| *Empidonax alnorum* | alder flycatcher | High |
| *Empidonax virescens* | acadian flycatcher | Very High |
| *Epilobium ciliatum* | Hair willow-herb | High |
| *Epilobium leptophyllum* | linear-leaved willow-herb | Very High |
| *Equisetum sylvaticum* | woodland horsetail | Very High |
| *Eriocaulon aquaticum* | white buttons | Very High |
| *Erynnis persius* | Persius duskywing | High |
| *Eupatorium maculatum* | spotted joe-pye weed | High |
| *Euphorbia purpurea* | glade spurge | High |
| *Glaucomys sabrinus fuscus* | Virginia northern flying squirrel | Moderate |
| *Glyceria acutiflora* | sharp-scaled manna-grass | Very High |
| *Glyceria grandis* | American manna-grass | Very High |
| *Glyptemys insculpta* | wood turtle | High |
| *Gnaphalium uliginosum* | low cudweed | High |
| *Goodyera repens* | dwarf rattlesnake plantain | Moderate |
| *Haliaeetus leucocephalus* | bald eagle | Very High |
| *Hansonoperla appalachia* | Appalachian stonefly | Very High |
| *Helenium virginicum* | Virginia sneezeweed | Very High |
| *Helonias bullata* | swamp-pink | Very High |
| *Huperzia appalachiana* | Appalachian fir clubmoss | Very High |
| *Hydraena maureenae* | Maureen's shale stream beetle | Very High |
| *Hypericum boreale* | northern St. John's-wort | Very High |
| *Iliamna remota* | Kankakee globe-mallow | Moderate |
| *Isoetes lacustris* | lake quillwort | Very High |
| *Isonychia tusculanensis* | a mayfly | Very High |
| *Juncus brachycephalus* | small-head rush | Very High |
| *Juncus brevicaudatus* | narrow-panicled rush | Very High |
| *Leuctra mitchellensis* | Mitchell needlefly | Very High |
| *Leuctra monticola* | montane needlefly | Very High |
| *Liparis loeselii* | Loesel's twayblade | Very High |
| *Lonicera canadensis* | American fly-honeysuckle | High |
| *Lontra canadensis* | river otter | Very High |
| *Lycopodiella inundata* | northern bog clubmoss | High |
| *Lythrum alatum* | winged loosestrife | Very High |
| *Maianthemum stellatum* | stary false Solomon's-seal | High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Megaleuctra flinti* | Shenandoah needlefly | Very High |
| *Melospiza georgiana* | swamp sparrow | High |
| *Microtus chrotorrhinus carolinensis* | Southern rock vole | High |
| *Muhlenbergia glomerata* | marsh muhly | High |
| *Myotis sodalis* | Indiana bat | High |
| *Nemotaulius hostilis* | a limnephilid caddisfly | Very High |
| *Nyctanassa violacea* | yellow-crowned night-heron | Very High |
| *Nycticorax nycticorax* | black-crowned night-heron | Very High |
| *Osmunda cinnamomea var. glandulosa* | glandular cinnamon fern | Very High |
| *Panicum hemitomon* | maidencane | Very High |
| *Paragnetina ishusa* | widecollar stonefly | Very High |
| *Paraleptophlebia jeanae* | a mayfly | Very High |
| *Parnassia grandifolia* | Large-leaved grass-of-parnassus | Very High |
| *Peltigera hydrothyria* | Waterfan | Very High |
| *Perlesta frisoni* | Blue Ridge stonefly | Very High |
| *Platanthera grandiflora* | large purple fringed orchid | Very High |
| *Platanthera peramoena* | purple fringeless orchid | Very High |
| *Poa paludigena* | bog bluegrass | Very High |
| *Poa palustris* | fowl bluegrass | Very High |
| *Polanisia dodecandra* | common clammy-weed | Very High |
| *Polygonia progne* | Gray comma | Moderate |
| *Potamogeton amplifolius* | Largeleaf pondweed | Very High |
| *Potamogeton hillii* | Hill's pondweed | Very High |
| *Potamogeton oakesianus* | Oakes pondweed | Very High |
| *Potamogeton tennesseensis* | Tennessee pondweed | Very High |
| *Ribes americanum* | wild black currant | Very High |
| *Sabatia campanulata* | slender marsh rose-pink | Very High |
| *Sagittaria calycina var calycina* | long-lobed arrowhead | Very High |
| *Sagittaria rigida* | sessile-fruited arrowhead | Very High |
| *Saxifraga pensylvanica* | swamp saxifrage | High |
| *Schizachne purpurascens* | purple oat-grass | High |
| *Schoenoplectus subterminalis* | water bulrush | Very High |
| *Scirpus ancistrochaetus* | northeastern bulrush | Very High |
| *Scirpus torreyi* | Torrey's bulrush | Very High |
| *Sciurus carolinensis* | gray squirrel | High |
| *Scolopax minor* | American woodcock | Very High |
| *Seiurus noveboracensis* | northern waterthrush | High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Sida hermaphrodita* | Virginia mallow | Very High |
| *Solidago rupestris* | riverbank goldenrod | Very High |
| *Solidago uliginosa* | bog goldenrod | Very High |
| *Sorex palustris punctulatus* | southern water shrew | High |
| *Sparganium chlorocarpum = S. emersum* | narrow-leaf burreed | Very High |
| *Spartina pectinata* | freshwater cordgrass | Very High |
| *Speyeria atlantis* | Atlantis fritillary | Very High |
| *Sphagnum russowii* | Russow's peatmoss | Very High |
| *Sphyrapicus varius* | yellow-bellied sapsucker | Very High |
| *Spiranthes lucida* | shining ladies'-tresses | Very High |
| *Spiranthes ochroleuca* | yellow nodding ladies'-tresses | High |
| *Sylvilagus obscurus* | Appalachian Cottontail | Moderate |
| *Triadenum fraseri* | Fraser's marsh St. John's-wort | Very High |
| *Triantha racemosa* | coastal false-asphodel | Very High |
| *Troglodytes troglodytes* | winter wren | High |
| *Vaccinium macrocarpon* | large cranberry | Very High |
| *Verbena scabra* | sandpaper vervain | Very High |
| *Vermivora chrysoptera* | golden winged warbler | Very High |
| *Veronica scutellata* | marsh speedwell | Very High |
| *Viburnum lentago* | nannyberry | Very High |
| *Vicia americana* | American purple vetch | Very High |
| *Vitis rupestris* | sand grape | Very High |
| *Woodwardia virginica* | Virginia chainfern | Very High |

## 4.2.17 Ruderal Associates

These species are associated with previously disturbed habitats like old fields, old homesites and roadsides. These species are not associated with any particular ecological system so additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Ruderal Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Arnoglossom muehlenbergii* | great Indian-plantain | High |
| *Cicindela patruela* | Barrens tiger beetle | High |
| *Cirsium altissimum* | tall thistle | Very High |
| *Desmodium cuspidatum* | toothed tick-trefoil | Moderate |
| *Eumeces anthracinus* | coal skink | High |
| *Gnaphalium uliginosum* | low cudweed | Moderate |
| *Phlox buckleyi* | sword-leaved phlox | Very High |

| | | |
|---|---|---|
| *Polygonia progne* | Gray comma | High |
| *Prunus nigra* | Canada plum | Moderate |
| *Vicia americana* | American purple vetch | High |

## 4.2.18 Sandstone Glades and Barrens Associates

These species inhabit sandstone glades and barrens. Additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Sandstone Glades and Barrens Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Cicindela patruela* | Barrens tiger beetle | High |
| *Helianthemum bicknellii* | plains frostweed | High |
| *Incisalia polia* | Hoary elfin | High |

## 4.2.19 Species Sensitive to Over-Collection

Species in this group are sensitive to excessive collection which could lead to sharp population declines. These species are collected commercially and used for a variety of purposes including food, medicinal, decorative, gardening/landscaping, pet trade, and trophy hunting (rattlesnake rattle collection). These species are not associated with any particular ecological system so additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Sensitive to Over-Collection Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Crotalus horridus* | Timber rattlesnake | Very High |
| *Cypripedium reginae* | showy lady's-slipper | Very High |
| *Glyptemys insculpta* | wood turtle | Very High |
| *Panax quinquefolius* | Ginseng | Very High |
| *Panax trifolius* | Dwarf ginseng | High |
| *Platanthera grandiflora* | large purple fringed orchid | Moderate |
| *Platanthera peramoena* | purple fringeless orchid | Moderate |
| *Pyrgus wyandot* | Appalachian grizzled skipper | High |
| *Speyeria diana* | Diana fritillary | High |
| *Speyeria idalia* | Regal fritillary | High |

## 4.2.20 Species Sensitive to Recreational Traffic

Species in this group are sensitive to excessive human disturbance such as trampling, harassment, vehicular mortality, and direct mortality. Reptile species are especially sensitive to being harmed, harassed, and killed by humans. This interaction with humans can have long-term negative effects on population sizes and sustainability. Plant species on this list are especially sensitive to trampling by off-road vehicles, heavy equipment, horses, and human traffic. These species are not associated with any particular ecological system so additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Sensitive to Recreation Traffic Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Minuartia groenlandica* | mountain sandwort | High |
| *Sibbaldiopsis tridentata* | three-toothed cinquefoil | Moderate |

## 4.2.21 Shale Barren Associates

Species occurring in this group require shale barrens. The habitat needs of the species in this group are tied directly to the Cliff, Talus and Shale Barrens ecological system. Maintaining these ecological systems and moving them towards their desired condition will satisfy the needs of the species in this group related to this habitat need.

Species in Shale Barren Associates Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Arabis patens* | Spreading rockcress | Very High |
| *Arabis serotina* | shale barren rockcress | Very High |
| *Astragalus distortus* | bent milkvetch | Very High |
| *Bromus kalmii* | wild chess | Very High |
| *Cheilanthes eatonii* | chestnut lipfern | High |
| *Clematis albicoma* | White-haired Leatherflower | Very High |
| *Clematis coactilis* | Virginia white-haired leatherflower | Very High |
| *Clematis viticaulis* | Millboro leatherflower | Very High |
| *Elymus trachycaulus* | slender wheatgrass | Very High |
| *Eriogonum allenii* | Yellow Buckwheat | Very High |
| *Erysimum capitatum* | western wallflower | High |
| *Euchloe olympia* | Olympia marble | High |
| *Liatris helleri* | shale -barren blazing star | Very High |
| *Melica nitens* | Three-flowered melic grass | Moderate |
| *Oenothera argillicola* | Shale-barren evening primrose | Very High |
| *Paronychia argyrocoma* | Silver Nail-wort | Very High |
| *Paronychia virginica* | yellow nailwort | Very High |
| *Prunus alleghaniensis* | Alleghany sloe | Moderate |
| *Pyrgus wyandot* | Appalachian grizzled skipper | High |
| *Rosa setigera* | prairie rose | Moderate |
| *Solidago arguta var. harrisii* | Shale Barren Goldenrod | Very High |
| *Sporobolus neglectus* | small dropseed | Moderate |
| *Taenidia montana* | Virginia mountain pimpernel | Very High |
| *Trichostema setaceum* | narrow-leaved blue curls | High |
| *Trifolium virginicum* | Kate's mountain clover | Very High |
| *Viola pedatifida* | prairie violet | Very High |

## 4.2.22 Species with Habitat in Special Biologic Areas

These are species that occupy habitat that has been designated as special biologic areas. These areas are established with the goal to manage the area for the particular rare communities or species at the site. These species are not associated with any particular ecological system so additional measures beyond those identified for the ecological systems are needed to assure that the habitat needs for these species are addressed.

Species in Habitat in Special Biologic Areas Group

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Aegolius acadicus* | northern saw-whet owl | Moderate |
| *Ambystoma tigrinum* | Eastern tiger salamander | Very High |
| *Anaphalis margaritacea* | pearly everlasting | Moderate |
| *Arabis serotina* | shale barren rockcress | Very High |
| *Aralia hispida* | bristly sarsaparilla | Moderate |
| *Betula cordifolia* | mountain paper birch | Very High |
| *Boloria selene* | Silver-bordered fritillary | Very High |
| *Boltonia montana* | no common name | Very High |
| *Bromus kalmii* | wild chess | Very High |
| *Campanula rotundifolia* | American harebell | Very High |
| *Carex aquatilis* | water sedge | High |
| *Carex arctata* | black sedge | High |
| *Carex barrattii* | Barratt's sedge | Very High |
| *Carex buxbaumii* | Buxbaum's sedge | Very High |
| *Carex lasiocarpa var. americana* | slender sedge | High |
| *Carex polymorpha* | variable sedge | Moderate |
| *Carex roanensis* | Roan Mountain sedge | High |
| *Carex vesicaria* | Inflated sedge | High |
| *Carpodacus purpureus* | purple finch | Very High |
| *Castor canadensis* | Beaver | Low |
| *Catharus guttatus* | hermit thrush | Moderate |
| *Certhia americana* | brown creeper | Moderate |
| *Cheilanthes eatonii* | chestnut lipfern | High |
| *Cicindela patruela* | Barrens tiger beetle | Moderate |
| *Cirsium altissimum* | tall thistle | Very High |
| *Clematis viticaulis* | Millboro leatherflower | Very High |
| *Clemmys guttata* | spotted turtle | Very High |
| *Colias interior* | Pink-edged sulphur | Very High |
| *Contopus borealis* | olive-sided flycatcher | Moderate |
| *Cornus canadensis* | bunchberry | Very High |
| *Cornus rugosa* | roundleaf dogwood | Very High |
| *Crataegus pruinosa* | prunose hawthorn | Very High |
| *Cuscuta rostrata* | beaked dodder | High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Cypripedium reginae* | showy lady's-slipper | Very High |
| *Cystopteris fragilis* | fragile fern | Very High |
| *Dendroica fusca* | blackburnian warbler | Moderate |
| *Dendroica magnolia* | magnolia warbler | Moderate |
| *Desmodium cuspidatum* | toothed tick-trefoil | High |
| *Echinacea laevigata* | smooth coneflower | Very High |
| *Echinodorus tenellus* | dwarf burhead | Very High |
| *Eleocharis melanocarpa* | black-fruited spikerush | High |
| *Eleocharis robbinsii* | Robbins spikerush | Very High |
| *Elymus trachycaulus* | slender wheatgrass | High |
| *Empidonax alnorum* | alder flycatcher | Moderate |
| *Epilobium leptophyllum* | linear-leaved willow-herb | Very High |
| *Equisetum sylvaticum* | woodland horsetail | Very High |
| *Eriocaulon aquaticum* | white buttons | Very High |
| *Erynnis martialis* | Mottled duskywing | High |
| *Erysimum capitatum* | western wallflower | High |
| *Gaylussacia brachycera* | box huckleberry | Very High |
| *Glaucomys sabrinus fuscus* | Virginia northern flying squirrel | Very High |
| *Glyceria grandis* | American manna-grass | Very High |
| *Gnaphalium uliginosum* | low cudweed | Moderate |
| *Gymnocarpium appalachianum* | Appalachian oak fern | High |
| *Helenium virginicum* | Virginia sneezeweed | Very High |
| *Helianthemum bicknellii* | plains frostweed | High |
| *Helonias bullata* | swamp-pink | Very High |
| *Heuchera alba* | white alumroot | Very High |
| *Houstonia canadensis* | Canada bluets | Very High |
| *Hypericum mitchellianum* | Blue Ridge St. John's-wort | Moderate |
| *Isoetes lacustris* | lake quillwort | Very High |
| *Juncus brachycephalus* | small-head rush | High |
| *Juncus brevicaudatus* | narrow-panicled rush | High |
| *Juniperus communis var depressa* | ground juniper | Very High |
| *Lepus americanus* | snowshoe hare | Very High |
| *Leucothoe fontanesiana* | highland dog-hobble | Very High |
| *Liparis loeselii* | Loesel's twayblade | Very High |
| *Loxia curvirostra* | red crossbill | High |
| *Martes pennanti* | fisher | High |
| *Minuartia groenlandica* | mountain sandwort | Low |
| *Monotropsis odorata* | sweet pinesap | Moderate |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Muhlenbergia glomerata* | marsh muhly | Very High |
| *Oligoneuron rigidum* | stiff goldenrod | Very High |
| *Oryzopsis asperifolia* | white-grained mtn-ricegrass | High |
| *Osmunda cinnamomea var. glandulosa* | glandular cinnamon fern | Very High |
| *Panicum hemitomon* | maidencane | Very High |
| *Phlox buckleyi* | sword-leaved phlox | Moderate |
| *Platanthera grandiflora* | large purple fringed orchid | Very High |
| *Plethodon punctatus* | Cow Knob salamander | Very High |
| *Plethodon sherando* | Big levels salamander | Very High |
| *Plethodon virginia* | Shenandoah Mt. salamander | Very High |
| *Poa palustris* | fowl bluegrass | Very High |
| *Poa saltuensis* | drooping bluegrass | Very High |
| *Polygonia progne* | Gray comma | Moderate |
| *Potamogeton oakesianus* | Oakes pondweed | Very High |
| *Potentilla arguta* | tall cinquefoil | Very High |
| *Pyrgus wyandot* | Appalachian grizzled skipper | High |
| *Pyrola elliptica* | shinleaf | Moderate |
| *Regulus satrapa* | golden-crowned kinglet | High |
| *Ribes americanum* | wild black currant | High |
| *Rubus idaeus ssp. strigosus* | American red raspberry | Very High |
| *Sabatia campanulata* | slender marsh rose-pink | Very High |
| *Sagittaria calycina var calycina* | long-lobed arrowhead | Very High |
| *Schizachne purpurascens* | purple oat-grass | High |
| *Schoenoplectus subterminalis* | water bulrush | Very High |
| *Scirpus ancistrochaetus* | northeastern bulrush | Very High |
| *Seiurus noveboracensis* | northern waterthrush | High |
| *Sibbaldiopsis tridentata* | three-toothed cinquefoil | Moderate |
| *Sitta canadensis* | red-breasted nuthatch | High |
| *Solidago randii = S. simplex var. randii* | Rand's goldenrod | Very High |
| *Solidago rupestris* | riverbank goldenrod | High |
| *Solidago uliginosa* | bog goldenrod | Very High |
| *Sorex palustris punctulatus* | southern water shrew | Moderate |
| *Sparganium chlorocarpum = S. emersum* | narrow-leaf burreed | High |
| *Speyeria atlantis* | Atlantis fritillary | Very High |
| *Sphagnum russowii* | Russow's peatmoss | High |
| *Spiranthes ochroleuca* | yellow nodding ladies'-tresses | Moderate |
| *Symphoricarpos albus* | snowberry | High |
| *Thuja occidentalis* | northern white cedar | High |

| Species Name | Common Name | Group Weight |
|---|---|---|
| *Triadenum fraseri* | Fraser's marsh St. John's-wort | Very High |
| *Triantha racemosa* | coastal false-asphodel | Very High |
| *Trichostema setaceum* | narrow-leaved blue curls | High |
| *Trifolium virginicum* | Kate's mountain clover | Very High |
| *Trillium pusillum var. virginianum* | mountain least trillium | Very High |
| *Triphora trianthophora* | nodding pogonia | Moderate |
| *Troglodytes troglodytes* | winter wren | High |
| *Vaccinium macrocarpon* | large cranberry | Very High |
| *Viola pedatifida* | prairie violet | Very High |
| *Vitis rupestris* | sand grape | High |
| *Woodwardia virginica* | Virginia chainfern | Moderate |

A summary of all of the groups with which individual species are associated is in Appendix F2.

# 5.0 EFFECTS OF ALTERNATIVES ON SPECIES

For species and species groups whose needs are addressed by the condition of the ecological systems, the effects by alternative are described in the Ecological Systems Report.

For the species and species groups that require additional direction, their key attributes and indicators are described as follows.

**Attributes and Indicators**
The following key attributes were identified for each species group.

Table F-8. Key Attributes and Indicators for Species Groups

| Species Group | Key Attribute | Indicator Name |
|---|---|---|
| Area Sensitive Grassland and Shrubland and Open Woodlands | Habitat Type Abundance | Total acres of area sensitive grasslands, shrublands or open woodlands |
| Area Sensitive Grasslands. | Habitat Type Abundance | Area sensitive open Habitat grasslands greater than 100 ac |
| Area Sensitive Grasslands. | Habitat Type Abundance | Area sensitive open habitat grasslands greater than 40 ac |
| Area Sensitive Shrubland and Open Woodlands | Habitat Type Abundance | Area sensitive open habitat shrubland and open woodland greater than 100 ac |
| Grasslands | Existing grasslands | Existing grasslands in open conditions |
| Grasslands | Habitat Type Abundance | Total grasslands acres |
| High Elevation Openings, Grassy or Shrubby or Open Woodlands | Habitat Type Abundance | Total High Elevation Grassland acres |
| High Elevation Openings, Grassy or Shrubby or Open Woodlands | Habitat Type Abundance | Total high elevation shrubland acres |

| Species Group | Key Attribute | Indicator Name |
|---|---|---|
| Shrublands | Habitat Type Abundance | Total shrubland acres |
| Cavity Trees, Den Trees and Snags | Habitat Element Abundance | Compliance with den/cavity tree and snag guidelines |
| Lepidopterans - sensitive to fire injury and sensitive to some insecticides (Bt, dimilin) | Fire Regime | Compliance with lepidopteran guidelines |
| Lepidopterans - sensitive to fire injury and sensitive to some insecticides (Bt, dimilin) | Sensitivity to invasive species treatments | Compliance with guidelines for lepidopterans |
| Sensitive to Over-Collection | Persistence of Species Occurrences | Compliance with guidelines for over collection |
| Sensitive to Recreation Traffic | Persistence of Species Occurrences | Compliance with recreation traffic guidelines |
| Cliff and Talus and Large Rock Outcrops | Habitat Element Abundance | Compliance with cliff, talus and large rock outcrop guidelines |
| Calciphiles | Habitat Type Abundance | Acres of habitat that supports calciphiles |
| Calciphiles | Habitat Type Abundance | Total High-Quality Habitat Type Acres |
| Occurrence Protection | Persistence of Species Occurrences | Compliance with Species Occurrence Guidelines |

The following tables display the current condition of each indicator identified for the species groups. It also displays the estimated condition of the indicator after 10 years (Table F-9), or 50 years (Table F-10), of implementation of each alternative. Table F-11 identifies a description (poor, fair, or good) for the indicator based on the indicator values.

The effects by alternative are summarized in the following table:

Table F-9. Current Condition and Expected Condition of Indicators at End of First Decade

| Species Group / Indicator | Current Condition | Condition of Indicator at end of 10 years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alt A | Alt A[1] | Alt B | Alt C | Alt D | Alt D* | Alt E | Alt F | Alt G | Alts H and I |
| Alkaline Glades and Barrens | See Mafic and Alkaline Glades Ecological System | | | | | | | | | | |
| Area Sensitive Grassland and Shrubland and Open Woodlands | | | | | | | | | | | |
| Total acres of area sensitive grasslands, shrublands or open woodlands | 23,247 | 56,414 | 74,113 | 119,587 | 26,676 | 85,057 | 64,414 | 119,587 | 119,587 | 119,587 | 119,587 |
| Shrublands > 40 acres | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 |
| Area Sensitive Grasslands | | | | | | | | | | | |
| Area sensitive open Habitat grasslands greater than 100 ac | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 |
| Area Sensitive Grasslands | | | | | | | | | | | |
| Area sensitive open habitat grasslands greater than 40 ac | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 |
| Area Sensitive Shrubland and Open Woodlands | | | | | | | | | | | |
| Area sensitive open habitat shrubland and open woodland greater than 100 ac | 22,569 | 55,736 | 73,435 | 118,909 | 25,998 | 84,379 | 63,736 | 118,909 | 118,909 | 118,909 | 118,909 |
| Shrublands > 100 acres | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 |
| Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | | | | | | | | | | | |
| Cove, spruce, pine, oak, northern hardwood and riparian ecological systems | 898,162 | 890,272 | 912,998 | 884,844 | 913,891 | 871,957 | 871,957 | 896,272 | 904,925 | 885,149 | 884,849 |
| Calciphiles | | | | | | | | | | | |
| Total High-Quality Habitat Type Acres | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 |

| Species Group / Indicator | Current Condition | Condition of Indicator at end of 10 years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alt A | Alt A[1] | Alt B | Alt C | Alt D | Alt D* | Alt E | Alt F | Alt G | Alts H and I |
| Caves | | See Caves and Karstlands Ecological System | | | | | | | | | |
| Cavity Trees, Den Trees and Snags | | | | | | | | | | | |
| Compliance with den/cavity tree and snag guidelines | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Cliff and Talus and large rock outcrops | | | | | | | | | | | |
| Compliance with cliff, talus and large rock outcrop guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Cove Forests | | See Cove Forests Ecological System | | | | | | | | | |
| Fire Dependent and Fire Enhanced | | | | | | | | | | | |
| Acres burned at desired frequency in all systems | 26,144 | 35,855 | 53,555 | 99,028 | 6,118 | 64,498 | 43,855 | 99,028 | 99,028 | 99,028 | 99,028 |
| Grasslands | | | | | | | | | | | |
| Existing grasslands in open conditions | 2,773 | 2,773 | 2,773 | 2,773 | 1,387 | 2,773 | 2,773 | 2,773 | 2,773 | 2,773 | 2,773 |
| Total grasslands acres | 2,773 | 3,886 | 4,240 | 5,149 | 1,904 | 4,458 | 4,046 | 5,149 | 5,149 | 5,149 | 5,149 |
| Hard and Soft Mast Dependent | | | | | | | | | | | |
| Total shrubland acres | 31,967 | 42,447 | 19,347 | 48,447 | 18,447 | 61,447 | 61,447 | 36,447 | 28,447 | 48,447 | 48,447 |
| Regenerating forest, pine + oak | 29,232 | 39,742 | 17,622 | 44,242 | 16,742 | 56,947 | 56,947 | 33,742 | 24,162 | 43,442 | 44,228 |
| Mature Oak | 650,442 | 630,526 | 651,696 | 628,526 | 652,526 | 613,321 | 613,321 | 637,536 | 649,156 | 627,836 | 627,050 |
| Open canopy pine + oak | 19,275 | 50,309 | 67,648 | 109,653 | 16,742 | 78,058 | 59,002 | 109,653 | 109,653 | 109,653 | 109,653 |
| High Elevation Coniferous, Deciduous and/or Mixed Forests | | | | | | | | | | | |
| Total acres of oak, cove or pine ecosystems in mid-late succession at elevations >3000 feet | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 |

| Species Group / Indicator | Current Condition | Condition of Indicator at end of 10 years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alt A | Alt A[1] | Alt B | Alt C | Alt D | Alt D* | Alt E | Alt F | Alt G | Alts H and I |
| High Elevation Openings, grassy or shrubby or open woodlands | | | | | | | | | | | |
| Total High Elevation Grassland acres | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Total high elevation shrubland acres | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Regeneration at high elevation | 5,599 | 7,526 | 3,278 | 8,630 | 3,113 | 11,021 | 11,021 | 6,423 | 4,952 | 8,630 | 8,630 |
| Late Successional Hardwood Dominated Forest | | | | | | | | | | | |
| Mature and late successional oak, cove and northern hardwoods | 689,162 | 679,772 | 701,548 | 676,844 | 702,391 | 661,457 | 661,457 | 686,782 | 697,425 | 675,659 | 675,359 |
| Lepidopterans - | | | | | | | | | | | |
| Compliance with lepidopteran guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Mafic Rocks | | See Mafic and Alkaline Glades Ecological System | | | | | | | | | |
| Occurrence Protection | | | | | | | | | | | |
| Compliance with Species Occurrence Guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Open Woodlands | | | | | | | | | | | |
| Open canopy pine, oak, mafic, cliff, riparian, cove, northern hardwood systems | 22,460 | 55,627 | 73,326 | 118,800 | 25,889 | 84,270 | 63,627 | 118,800 | 118,800 | 118,800 | 118,800 |
| Regenerating Forests | | | | | | | | | | | |
| Regenerating forest, pine, oak, cove, northern hardwood systems | 30,444 | 40,924 | 17,824 | 46,924 | 16,924 | 59,924 | 59,924 | 34,924 | 26,924 | 46,924 | 46,924 |
| Riparian | | See Riparian Ecological System | | | | | | | | | |
| Ruderal | | | | | | | | | | | |
| Compliance with ruderal species guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

| Species Group / Indicator | Current Condition | Condition of Indicator at end of 10 years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alt A | Alt A[1] | Alt B | Alt C | Alt D | Alt D* | Alt E | Alt F | Alt G | Alts H and I |
| Sandstone Glades and Barrens | | | | | | | | | | | |
| Compliance with sandstone glades species guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Sensitive to Over-Collection | | | | | | | | | | | |
| Compliance with guidelines for over collection | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Sensitive to Recreation Traffic | | | | | | | | | | | |
| Compliance with recreation traffic guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Shale Barrens | See Cliff, Talus and Shale Barrens Ecological System | | | | | | | | | | |
| Shrublands | | | | | | | | | | | |
| Total shrubland acres | 31,967 | 42,447 | 19,347 | 48,447 | 18,447 | 61,447 | 61,447 | 36,447 | 28,447 | 48,447 | 48,447 |
| Total maintained Shrubland acres | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 |
| Species in a Special Biologic Area | | | | | | | | | | | |
| Special Biological Area Managed for the habitat needed by the species | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

*This version of Alternative D uses a level of prescribed burning of 5,000 acres per year

Alt A[1] represents the effects of the level of activities accomplished during the past three years (2009 through 2011) under the 1993 Forest Plan.

Table F-10. Current Condition and Expected Condition of Indicators at End of Fifth Decade

| Species Group / Indicator | Current Condition | Condition of Indicator at end of 50 years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alt A | Alt A[1] | Alt B | Alt C | Alt D | Alt D* | Alt E | Alt F | Alt G | Alts H and I |
| Alkaline glades and barrens | See Mafic and Alkaline Glades Ecological System | | | | | | | | | | |
| Area Sensitive Grassland and Shrubland and Open Woodlands | | | | | | | | | | | |
| Total acres of area sensitive grasslands, shrublands or open woodlands | 23,247 | 63,278 | 107,916 | 191,191 | 32,777 | 129,231 | 87,207 | 191,191 | 191,200 | 191,191 | 191,191 |
| Shrublands > 40 acres | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 | 398 |
| Area Sensitive Grasslands. | | | | | | | | | | | |
| Area sensitive open Habitat grasslands greater than 100 ac | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 |
| Area Sensitive Grasslands. | | | | | | | | | | | |
| Area sensitive open habitat grasslands greater than 40 ac | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 | 389 |
| Area Sensitive Shrubland and Open Woodlands | | | | | | | | | | | |
| Area sensitive open habitat shrubland and open woodland greater than 100 ac | 22,569 | 62,600 | 107,238 | 190,513 | 32,099 | 128,553 | 86,529 | 190,513 | 190,522 | 190,513 | 190,513 |
| Shrublands > 100 acres | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 |
| Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | | | | | | | | | | | |
| Cove, spruce, pine, oak, northern hardwood and riparian ecological systems | 898,162 | 882,514 | 993,786 | 863,259 | 998,078 | 788,388 | 788,388 | 916,563 | 965,265 | 857,706 | 857,280 |
| Calciphiles | | | | | | | | | | | |
| Total High-Quality Habitat Type Acres | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 | 6,823 |

| Species Group / Indicator | Current Condition | Condition of Indicator at end of 50 years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alt A | Alt A[1] | Alt B | Alt C | Alt D | Alt D* | Alt E | Alt F | Alt G | Alts H and I |
| Caves | | See Caves and Karstlands Ecological System | | | | | | | | | |
| Cavity Trees, Den Trees and Snags | | | | | | | | | | | |
| Compliance with den/cavity tree and snag guidelines | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Cliff and Talus and large rock outcrops | | | | | | | | | | | |
| Compliance with cliff, talus and large rock outcrop guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Cove Forests | | See Cove Forests Ecological System | | | | | | | | | |
| Fire Dependent and Fire Enhanced | | | | | | | | | | | |
| Acres burned at desired frequency in all systems | 26,144 | 42,720 | 87,358 | 170,641 | 12,219 | 108,681 | 66,657 | 170,641 | 170,641 | 170,641 | 170,641 |
| Grasslands | | | | | | | | | | | |
| Existing grasslands in open conditions | 2,773 | 2,773 | 2,773 | 2,773 | 1,387 | 2,773 | 2,773 | 2,773 | 2,773 | 2,773 | 2,773 |
| Total grasslands acres | 2,773 | 4,023 | 4,916 | 6,581 | 2,026 | 5,342 | 4,501 | 6,581 | 6,581 | 6,581 | 6,581 |
| Hard and Soft Mast Dependent | | | | | | | | | | | |
| Total shrubland acres | 31,967 | 42,400 | 19,300 | 48,392 | 18,400 | 61,392 | 61,392 | 36,392 | 28,400 | 48,392 | 48,392 |
| Regenerating forest, pine + oak | 29,232 | 39,742 | 17,622 | 44,242 | 16,742 | 56,947 | 56,947 | 33,742 | 24,162 | 43,442 | 44,228 |
| Mature Oak | 650,442 | 611,059 | 716,909 | 601,059 | 721,059 | 525,034 | 525,034 | 646,109 | 703,959 | 597,609 | 593,679 |
| Open canopy pine + oak | 19,275 | 55,389 | 96,730 | 175,165 | 16,742 | 118,485 | 79,539 | 175,165 | 175,165 | 175,165 | 175,165 |
| High Elevation Coniferous, Deciduous and/or Mixed Forests | | | | | | | | | | | |
| Total acres of oak, cove or pine ecosystems in mid-late succession at elevations >3000 feet | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 | 156,312 |

| Species Group / Indicator | Current Condition | Condition of Indicator at end of 50 years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alt A | Alt A[1] | Alt B | Alt C | Alt D | Alt D* | Alt E | Alt F | Alt G | Alts H and I |
| High Elevation Openings, grassy or shrubby or open woodlands | | | | | | | | | | | |
| Total High Elevation Grassland acres | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 | 411 |
| Total high elevation shrubland acres | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 151 |
| Regeneration at high elevation | 5,599 | 7,518 | 3,269 | 8,620 | 3,104 | 11,010 | 11,010 | 6,413 | 4,943 | 8,620 | 8,620 |
| Late Successional Hardwood Dominated Forest | | | | | | | | | | | |
| Mature and late successional oak, cove and northern hardwoods | 689,162 | 672,015 | 782,337 | 654,418 | 786,579 | 577,047 | 577,047 | 706,232 | 757,766 | 647,375 | 646,949 |
| Lepidopterans - | | | | | | | | | | | |
| Compliance with lepidopteran guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Mafic Rocks | | See Mafic and Alkaline Glades Ecological System | | | | | | | | | |
| Occurrence Protection | | | | | | | | | | | |
| Compliance with Species Occurrence Guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Open Woodlands | | | | | | | | | | | |
| Open canopy pine, oak, mafic, cliff, riparian, cove, northern hardwood systems | 22,460 | 62,491 | 107,129 | 190,404 | 31,990 | 128,444 | 86,420 | 190,404 | 190,413 | 190,404 | 190,404 |
| Regenerating Forests | | | | | | | | | | | |
| Regenerating forest, pine, oak, cove, northern hardwood systems | 30,444 | 40,877 | 17,777 | 46,869 | 16,877 | 59,869 | 59,869 | 34,869 | 26,877 | 46,869 | 46,869 |
| Riparian | | See Riparian Ecological System | | | | | | | | | |
| Ruderal | | | | | | | | | | | |
| Compliance with ruderal species guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

| Species Group / Indicator | Current Condition | Condition of Indicator at end of 50 years | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Alt A | Alt A[1] | Alt B | Alt C | Alt D | Alt D* | Alt E | Alt F | Alt G | Alts H and I |
| Sandstone Glades and Barrens | | | | | | | | | | | |
| Compliance with sandstone glades species guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Sensitive to Over-Collection | | | | | | | | | | | |
| Compliance with guidelines for over collection | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Sensitive to Recreation Traffic | | | | | | | | | | | |
| Compliance with recreation traffic guidelines | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Shale Barrens | See Cliff, Talus and Shale Barrens Ecological System | | | | | | | | | | |
| Shrublands | | | | | | | | | | | |
| Total shrubland acres | 31,967 | 42,400 | 19,300 | 48,392 | 18,400 | 61,392 | 61,392 | 36,392 | 28,400 | 48,392 | 48,392 |
| Total maintained Shrubland acres | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 | 1,523 |
| Species in a Special Biologic Area | | | | | | | | | | | |
| Special Biological Area Managed for the habitat needed by the species | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

*This version of Alternative D uses a level of prescribed burning of 5,000 acres per year

Alt A[1] represents the effects of the level of activities accomplished during the past three years (2009 through 2011) under the 1993 Forest Plan.

Table F-11. Description of Indicator Condition

| Species Group Indicator | Current Condition | Poor | Fair | Good |
|---|---|---|---|---|
| Area Sensitive Grassland and Shrubland and Open Woodlands | | | | |
| Total acres of area sensitive grasslands, shrublands or open woodlands | 23,247 | <200,637 acres, >751,549 acres | 200,637 – 520,927 acres or 631,109 – 751,549 acres | 520,927 – 631,109 acres |
| Shrublands > 40 acres | 398 | <90% (358 acres) of existing blocks are maintained | 90-99% of existing blocks are maintained | 100% (398 acres) existing blocks are maintained |
| Area Sensitive Grasslands | | | | |
| Area sensitive open Habitat grasslands greater than 100 ac | 224 | <90% (202 acres) of existing blocks are maintained | 90-99 % of existing blocks are maintained | 100% (224 acres) existing blocks are maintained |
| Area Sensitive Grasslands | | | | |
| Area sensitive open habitat grasslands greater than 40 ac | 389 | <90% (350 acres) of existing blocks retained | 90-99% of existing blocks retained | 100% (389 acres) existing blocks are maintained |
| Area Sensitive Shrubland and Open Woodlands | | | | |
| Area sensitive open habitat shrubland and open woodland greater than 100 ac | 22,569 | <199,959 acres, >750,871 acres | 199,959 – 520,249 or 630,431 – 750,871 | 520,249 – 630,431 |
| Shrublands > 100 acres | 109 | <90% (90 acres) of existing blocks are maintained | 90-99% of existing blocks are maintained | 100% (109 acres) existing blocks are maintained |
| Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | | | | |
| Cove, spruce, pine, oak, northern hardwood and riparian ecological systems | 898,162 | <404,838 acres, >940,427 acres | 404,838 – 524,246 acres or 706,398 – 940,427 acres | 524,246 – 706,398 acres |
| Calciphiles | | | | |
| Total High-Quality Habitat Type Acres | 6,823 | 0-25% (1,705 acres) of locations in SBA | 26-49% of locations in SBA | 50% (3,412 acres) of locations in SBA |
| Cavity Trees, Den Trees and Snags | | | | |
| Compliance with den/cavity tree and snag guidelines | Yes | No | | Yes |

| Species Group<br>Indicator | Current Condition | Poor | Fair | Good |
|---|---|---|---|---|
| Cliff and Talus and large rock outcrops | | | | |
| Compliance with cliff, talus and large rock outcrop guidelines | No | No | | Yes |
| Fire Dependent and Fire Enhanced | | | | |
| Acres burned at desired frequency in all systems | 26,144 | <199,850 acres, >750,762 acres | 199,850 – 520,140 acres or 630,322 – 750,762 acres | 520,140 – 630,322 acres |
| Grasslands | | | | |
| Existing grasslands in open conditions | 2,773 | <80% (2,218 acres) of existing grasslands | 80-100% of existing grasslands, many dominated by native grasses | all (2,773 acres) existing grasslands in native grasses |
| Total grasslands acres | 2,773 | <1% (7,561 acres) of oak ecosystem acres | 1-3% of oak ecosystem acres | 3-5% (22,682 - 37,803 acres) of Oak ecosystem acres |
| High Elevation Coniferous, Deciduous and/or Mixed Forests | | | | |
| Total acres of oak, cove or pine ecosystems in mid-late succession at elevations >3000 feet | 156,312 | =<70% (109,418 acres)of current forested area >3000 feet | 70-90% of current forested area >3000 feet | >90% (140,680 acres) of current forested area >3000 feet |
| High Elevation Openings, grassy or shrubby or open woodlands | | | | |
| Total High Elevation Grassland acres | 411 | <80% (329 acres) of existing high elevation grasslands maintained | 80-100% of existing high elevation grasslands maintained, many dominated by native grasses | all existing (411 acres) high elevation grasslands maintained in native grasses |
| Total high elevation shrubland acres | 151 | <80% (121 acres) of existing high elevation shrublands maintained | 80-100% of existing high elevation shrublands maintained | all existing (151 acres) high elevation shrublands maintained in native grasses |

| Species Group<br>Indicator | Current Condition | Poor | Fair | Good |
|---|---|---|---|---|
| Late Successional Hardwood Dominated Forest | | | | |
| Mature and late successional oak, cove and northern hardwoods | 689,162 | <256,617 acres, >733,839 acres | 256,617 – 337,114 acres or 507,917 – 733,839 acres | 337,114 acres – 507,917 acres |
| Lepidopterans | | | | |
| Compliance with lepidopteran guidelines | No | No | | Yes |
| Occurrence Protection | | | | |
| Compliance with Species Occurrence Guidelines | No | No | | Yes |
| Open Woodlands | | | | |
| Open canopy pine, oak, mafic, cliff, riparian, cove, northern hardwood systems | 22,460 | <199,850 acres, >750,762 acres | 199,850 – 520,140 acres or 630,322 – 750,762 acres | 520,140 – 630,322 acres |
| Regenerating Forests | | | | |
| Regenerating forest, pine, oak, cove, northern hardwood systems | 30,444 | <29,777 acres, >295,766 acres | 29,777 - 58,543 acres or 92,992 – 295,766 acre | 58,543 – 92,992 acres |
| Ruderal | | | | |
| Compliance with ruderal species guidelines | No | No | | Yes |
| Sandstone Glades and Barrens | | | | |
| Compliance with sandstone glades species guidelines | No | No | | Yes |
| Sensitive to Over-Collection | | | | |
| Compliance with guidelines for over collection | No | No | | Yes |
| Sensitive to Recreation Traffic | | | | |
| Compliance with recreation traffic guidelines | No | No | | Yes |
| Shrublands | | | | |
| Total shrubland acres | 31,967 | <31,569 acres, >300,659 acres | 31,569 – 79,238 acres or 125,434 – 300,659 acres | 79,238 - 125,434 acres |
| Total maintained Shrubland acres | 1,523 | <762 acres | | 1,523 acres |
| Species in a Special Biologic Area | | | | |
| Special Biological Area Managed for the habitat needed by the species | Yes | No | | Yes |

The complete summary of stresses and threats for each species and how it is addressed in the Forest Plan is in Appendix F3.

# 6.0 PLAN COMPONENTS NEEDED FOR SPECIES DIVERSITY

## 6.1 INTRODUCTION

A wide array of species occurs on the GWNF, with many species sharing common habitat requirements that are associated with particular ecological systems. Plan components developed for ecosystem diversity are fundamental to providing appropriate ecological conditions for sustaining species diversity. Most species' requirements would be met in whole through ecosystem diversity plan components, meaning that provisions to restore, maintain, and protect ecological systems are sufficient to sustain plant and animal species on the forest. The first portion of this section describes how species with similar habitat needs are grouped and addressed through plan components for ecosystem diversity.

Although most species on NFS lands would be conserved through the management of healthy and productive ecosystems, even under the best conditions some species require additional attention. In the second portion of this section, those species that require further plan components are grouped by similar species needs and additional recommended plan components (typically standards) are identified for each species group. With the addition of these plan components, sustainability needs for all species would be addressed.

## 6.2 SPECIES GROUPS COVERED BY ECOSYSTEM DIVERSITY PLAN COMPONENTS

Those species groups whose habitat needs would be met in whole, or in part, through achieving the desired conditions for the ecological systems are identified in the following table.

Table F-12. Relationship of Species Groups to Ecological Systems

| Species Group | Associated Ecological System(s) | Needs Met in Whole |
|---|---|---|
| Alkaline Glades and Barrens | Alkaline Glade and Woodlands and Mafic Glades and Barrens | X |
| Area Sensitive Late Successional Coniferous, Deciduous and/or Mixed Forests | Spruce Forest, Northern Hardwood Forest, Cove Forest, Oak Forests and Woodlands, Pine Forests and Woodlands, Floodplains Wetlands and Riparian Areas. | X |
| Calciphiles | Caves and Karstlands | |
| Caves | Caves and Karstlands | X |
| Cliff and Talus and Large Rock Outcrops | Cliff, Talus and Shale Barrens | |
| Cove Forests | Cove Forests | X |
| Fire Dependent and Fire Enhanced | Pine Forests and Woodlands,<br>Alkaline Glade and Woodlands and Mafic Glades and Barrens<br>Oak Forests and Woodlands | X |
| Hard and Soft Mast Dependent | Oak Forests and Woodlands | |
| High Elevation Coniferous, Deciduous and/or Mixed Forests | Northern Hardwood Forests<br>Spruce Forests<br>Pine Forests and Woodlands<br>Oak Forests and Woodlands | |
| Late Successional Hardwood Dominated Forest | Oak Forests and Woodlands<br>Cove Forests<br>Northern Hardwood Forests | X |
| Mafic Rocks | Alkaline Glade and Woodlands and Mafic Glades and Barrens | X |

| Species Group | Associated Ecological System(s) | Needs Met in Whole |
|---|---|---|
| High Elevation Openings, Grassy or Shrubby or Open Woodlands | Oak Forests and Woodlands<br>Northern Hardwood Forests<br>Pine Forests and Woodlands | X |
| Shale Barrens | Cliff, Talus and Shale Barrens | |
| Regenerating Forests | Oak Forests and Woodlands<br>Cove Forest<br>Pine Forests and Woodlands | X |
| Shrublands | Oak Forests and Woodlands<br>Cove Forest<br>Pine Forests and Woodlands<br>Alkaline Glade and Woodlands and Mafic Glades and Barrens Northern Hardwood Forests | |
| Open Woodlands | Oak Forests and Woodlands<br>Cove Forest<br>Pine Forests and Woodlands<br>Alkaline Glade and Woodlands and Mafic Glades and Barrens Northern Hardwood Forests | X |
| Shale Barrens | Cliff, Talus and Shale Barrens | X |
| Riparian | Floodplains, Wetlands and Riparian Areas | X |

## 6.3 SPECIES GROUPS REQUIRING ADDITIONAL PLAN COMPONENTS

This section provides details on groups of species that will require further plan components in addition to those already provided by ecological diversity. Management strategies and appropriate plan components are recommended for each group. These groups represent small spatial scales and groups of species associated with localized conditions and features that cross ecosystem boundaries.

### 6.3.1 Calciphile Associates

**Plan Components**

Ecosystem diversity plan components include desired conditions and objectives for the Cave and Karstland Ecological System and standards for caves and karstlands. Special Biological Areas should be established for the most representative calciphile sites.

**Management Strategies**

The communities that are most representative of the calciphile associates should be established as Special Biological Areas. These include all the areas recommended by the Virginia Natural Heritage Program. As additional significant areas are identified they should be added as special biological areas.

### 6.3.2 Cavity Tree, Den Tree and Snag Associates

**Plan Components**

Ecosystem diversity plan components include desired conditions for managed forest to provide habitat for denning and cavity nesting species. Rock falls, caves, uprooted trees, and cavity trees of all sizes serve as suitable nesting and denning sites.

The following make up the den/cavity tree and snag guidelines. Compliance with these guidelines should be met through use of standards that will address the needs of the cavity and den tree associates like:

- FW: Favor the retention of large (>20" d.b.h.) standing snags and den trees when implementing silvicultural treatments. Active bear den trees are retained in harvest areas along with an unharvested buffer of at least 100 feet wide on all sides of the den.
- FW: When applying herbicide, protect non-target vegetation, especially threatened, endangered, proposed, or sensitive plants by employing a physical barrier between them and the area being treated. The physical barrier must be sufficient to protect the non-target vegetation from herbicide drift and flow.
- 7C: Favor the retention of large (>20" d.b.h.[2]) standing snags and den trees when implementing silvicultural treatments.
- Desired Condition for Management Prescription 13: Rockfalls, caves, road culverts, uprooted trees, and trees larger than 22 inches in diameter serve as potential dens. Known den trees are retained in harvest areas and future den trees will be recruited over the long term on the many acres in older age classes.
- Indiana-bat standards
  FW: In order to promote potential summer roost trees and maternity sites for the Indiana bat throughout the Forest, planned silvicultural practices in hardwood-dominated forest types will leave all shagbark hickory trees greater than 6 inches d.b.h. and larger, except when they pose a safety hazard. In addition:
  - Clearcut openings 10 to 25 acres in size will also retain a minimum average of 6 snags or cavity trees per acre, 9 inches d.b.h. or larger, scattered or clumped.
  - Group selection openings and clearcuts less than 10 acres in size have no provision for retention of a minimum number of snags, cavity trees, or residual basal area due the small opening size and safety concerns.
  - All other harvesting methods (and clearcut openings 26-40 acres in size) will retain a minimum residual 15 square feet of basal area per acre (including 6 snags or cavity trees) scattered or clumped. Residual trees are greater than 6 inches d.b.h. with priority given to the largest available trees, which exhibit characteristics favored as roost trees by Indiana bats.
- 8E4: In order to promote fall foraging and swarming areas, timber activities will leave all shagbark hickory trees and retain a minimum average of 6 snags or cavity trees (greater than or equal to 9 inches d.b.h.) per acre as potential roost sites (except where they pose a safety hazard). For group selection harvest method, all shagbark hickories are maintained (except where they pose a safety hazard) with no provision for minimum number of snags or cavity trees due to the small opening size.

**Management Strategies**

Cavity and den trees are generally not limiting and with the increasing age of most of the trees in most of the ecological systems, cavity and den trees will become even more common. The key characteristics for this group are recruitment of new den/cavity trees and retention of existing trees, particularly in areas where management activities are planned. This should be done through the use of den/cavity tree and snag guidelines.

## 6.3.3 Cliff, Talus and Rock Outcrop Associates

**Plan Components**

Ecosystem diversity plan components include desired conditions and objectives for the Cliff and Talus and Shale Barrens ecological systems. In addition is the Cliff, Talus and Large Rock Outcrop guideline, described in the following standard:
When land disturbing projects are proposed in these areas:

- identified species associated with this group will be searched for; and
- effects of the proposed project on the species will be evaluated

**Management Strategies**

Manage these areas to enhance habitat for TESLR species that may occur there. Follow the Cliff, Talus and Large Rock Outcrop guidelines for managing these areas.

## 6.3.4 Hard and Soft Mast Associates

**Plan Components**

Ecosystem diversity plan components include desired conditions and objectives for open canopy, regenerating forests and mature trees (oak) in the Oak and Pine Forest and Woodlands ecological systems. In addition, an objective is needed to maintain existing shrubland areas on the GWNF.

**Management Strategies**

Manage to restore and maintain the open woodlands, regenerating forests and existing shrublands that produce a mixture of hard and soft mast.

## 6.3.5 High Elevation Coniferous, Deciduous and/or Mixed Forest Associates

**Plan Components**

Desired conditions and objectives that maintain the Spruce, Northern Hardwood Forest, Cove Forest, Oak Forest and Woodland, and Pine Forest and Woodland ecological systems will support this group.

**Management Strategies**

Manage to maintain the forested environment at high elevations (>3,000 feet). This would include all successional stages of the forests. Spruce restoration may include planting red spruce seedlings, removing exotic tree plantations, and releasing red spruce from hardwood overstory.

## 6.3.6 Lepidopterans

**Plan Components**

Lepidopteran guidelines should be incorporated with the following standard:

When projects are proposed in areas where these species occur:

- the area where the species occurs and adjacent habitat will not be treated with Dimilin, BT or other insecticides that kill lepidopterans other than gypsy moth; and
- the entire area where the species occurs will not be part of a single prescribed burn; burning will be done only in patches of the occupied habitat.

**Management Strategies**

Species in this group are especially sensitive to the direct effects of fire, and care should be taken whenever fire is used in areas where they are known to occur. There are no direct key characteristics for this group; however, project monitoring can determine if damage is occurring to species. These species are limited in occurrence on the GWNF, therefore implementation of special provisions at the project level are unlikely to interfere with completion of work.

- When developing burn plans, the following should be considered at a minimum for all species in this group:
- Is any species from this group present or have potential to be present in project area?
- Is species habitat present in project area?
- What are the negative effects of fire to species?

- What mitigation can be performed to reduce impacts to species, i.e. burning during specific part of life-cycle (hibernation, non-breeding, dormancy, etc.); protecting individuals from direct effects of fire; protecting duff layer in mesic areas; etc.?
- Are there sufficient populations of this species adjacent to the project area to re-populate after the project?
- Are there any additional techniques that can be used to reduce impacts?

Consideration of and mitigation for these questions should provide for species in this group.

## 6.3.7 Species Needing Occurrence Protection

**Plan Components**

Because these species are low in occurrence across the GWNF and cannot be accurately predicted by availability of habitat, ecosystem and species diversity plan components should provide some protection for these species, but additional provisions are needed due to their rarity and sensitivity to management. The following standard should be created to implement the Species Occurrence Guidelines:

When projects are proposed in areas where species in this group are likely to occur (known county, proximity to known populations, suitable habitat):

- identified species associated with this group will be searched for; and
- effects of the proposed project on the species will be evaluated

**Management Strategies**

These species are rare in occurrence across the forest and known populations should be protected. Implement the Species Occurrence Guidelines to protect these species.

## 6.3.8 Open Area Associates

**Plan Components**

Because these openings blend into one another, the objectives to meet the needs for these species groups could include:

- Maintain and enhance old fields, short/medium/tall grasslands at old farm tracts.
- Maintain grassland habitat. Maintain all current areas that are greater than 40 acres in size in patches at least that size, or greater. Maintain all current areas that are greater than 100 acres in size in patches at least that size.
- Maintain shrubland habitat.

Areas of forest will be in the 0-10 year age class from regeneration harvest.
Restore and maintain areas in open woodland conditions through the use of fire on an annual basis.
Create or maintain grasslands, shrublands or regenerating forests on high elevation (>3,000 feet) land.

- Maintain or create old fields or clusters of maintained openings (1-5 acres in size) on sites greater than 2,000 feet elevation.

**Management Strategies**

All of these types of opening are important. Manage to maintain existing grasslands and shrublands of all sizes. For some species it is important to maintain openings of a given size (greater than 40 acres or greater than 100 acres). Moving towards the desired open woodland component of the Oak Forest and Woodland and Pine Forest and Woodland ecological systems will produce open woodlands of a variety of sizes, including those greater than 100 acres in size. Meeting the regenerating forest objectives of the ecological systems is also important for this group. Objectives for openings at high elevations also need to be included.

It is important that these open conditions be incorporated within a forested environment. Many species need a combination of closed canopy and open canopy conditions during various parts of their life cycle. This is particularly important for many bird species.

## 6.3.9 Ruderal Associates

**Plan Components**

Add a standard to manage the old home sites, roadsides, old fields where members of the ruderal species group are found in conditions that maintain their open character.

**Management Strategies**

Manage the old home sites, roadsides, old fields where these species are found in conditions that maintain their open character.

## 6.3.10 Sandstone Glades and Barrens Associates

**Plan Components**

Establish Special Biological Areas for areas that represent high quality examples of this habitat.

**Management Strategies**

Sandstone glades and barrens may transition with other systems like cliff, talus and shale barrens. Where good examples of the sandstone glade and barren habitat are present, they are identified as Special Biological Areas. As more are identified they will be added as Special Biological Areas.

## 6.3.11 Species Sensitive to Over-Collection

**Plan Components**

Plan components include species diversity desired conditions and the following standards to limit collection of species occurring within rare communities to approved scientific purposes only:

- Limit permission to collect these species;
- Limit sharing of location information of these species;
- Avoid improving access to these locations;
- Evaluate seasonal closure of access to these locations;
- Evaluate relocation of access to these locations.

**Management Strategies**

The strategy for these species is to continue to educate the public on species needs, restrict access to known populations, and limit approval of collections of these species to scientific purposes only.

## 6.3.12 Species Sensitive to Recreational Traffic

**Plan Components**

The following standard applies to this species group:

- Provide education regarding the recreational impacts to these species;
- Alert recreation users of the concerns in the area;
- Avoid improving access to these locations;
- Evaluate seasonal closure of access to these locations;
- Evaluate relocation of access to these locations.

**Management Strategies**

All species on this list occur outside of rare and wetland communities. There are no ecosystem diversity plan components which cover these species. The strategy for these species is to continue to educate the public on species needs, restrict access to rare or sensitive populations, increase road ecopassage, and implement standards to protect these species where they occur during projects that involve heavy equipment or ground disturbance. New roads and trails should be located to avoid populations of these species and existing roads and trails should be evaluated for closure if they are causing declines to populations. Many roads on the Forest are not under our control, so partnerships and collaborative efforts may be required to help sustain species in this group.

## 6.3.13 Species with Habitat in Special Biologic Areas

These species are addressed in the Ecological Diversity Report.

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# APPENDIX F1. SPECIES NOT CARRIED FORWARD INTO THE ECOLOGICAL SUSTAINABILITY ANALYSIS

| Taxon | Scientific Name | Common Name | Rationale |
|---|---|---|---|
| Amphibian | *Plethodon shenandoah* | Shenandoah salamander | 1 |
| Amphibian | *Pseudacris brachyphona* | Mountain chorus frog | 5 |
| Arachnid | *Anthrobia mammouthia* | Mammoth cave spider | 4a |
| Arachnid | *Apochthonius coecus* | A cave pseudoscorpion | 4a |
| Arachnid | *Chitrella superba* | A cave pseudoscorpion | 4a |
| Arachnid | *Mundochthonius holsingeri* | A cave pseudoscorpion | 1 |
| Bird | *Dendroica caerulescens* | black-throated blue warbler | 5 |
| Bird | *Ixobrychus exilis exilis* | least bittern | 1 |
| Bird | *Melanerpes erythrocephalus* | red-headed woodpecker | 3 |
| Bird | *Oporornis formosus* | Kentucky warbler | 3 |
| Bird | *Rallus elegans* | King rail | 1 |
| Insect | *Euphyes bimacula* | Two-spotted skipper | 4a |
| Insect | *Properigea costa* | A noctuid moth | 4a |
| Insect | *Pseudanophthalmus fuscus* | A cave beetle | 1 |
| Insect | *Pseudanophthalmus hubbardi* | Hubbard's cave beetle | 1 |
| Insect | *Pseudanophthalmus hypertrichosis* | A cave beetle | 1 |
| Insect | *Pseudanophthalmus pontis* | Natural Bridge cave beetle | 1 |
| Insect | *Pseudanophthalmus potomaca* | South Branch Valley cave beetle | 4a |
| Insect | *Pseudanopthalmus parvicollis* | Thin-necked cave beetle | 4a |
| Insect | *Pseudosinella granda* | A cave springtail | 4a |
| Insect | *Pygmarrhopalites lacuna* | A cave springtail | 1 |
| Insect | *Pygmarrhopalites pavo* | A cave springtail | 1 |
| Insect | *Pygmarrhopalites silvus* | A cave springtail | 1 |
| Insect | *Remenus kirchneri* | Blue Ridge springfly | 1 |
| Insect | *Schaefferia hubbardi* | A cave springtail | 4a |
| Insect | *Strophopteryx limata* | Newfound willowfly | 1 |
| Insect | *Sweltsa voshelli* | Virginia sallfly | 1 |
| Invertebrate | *Amaurobius borealis* | Spider | 4a |
| Invertebrate | *Anaplectoides brunneomedia* | Brown-lined dart moth | 4a |
| Invertebrate | *Antrolana lira* | Madison Cave isopod | 1 |
| Invertebrate | *Caecidotea bowmani* | Natural Bridge cave isopod | 4a |
| Invertebrate | *Caecidotea vandeli* | Vandel's cave isopod | 4a |
| Invertebrate | *Cleidogona fidelitor* | Faithful millipede | 4a |
| Invertebrate | *Clubiona spiralis* | Two-clawed hunting spider | 4a |
| Invertebrate | *Euchlaena milnei* | Looper moth | 4a |

| Taxon | Scientific Name | Common Name | Rationale |
|---|---|---|---|
| Invertebrate | *Lytrosis permagnaria* | Geometrid moth | 4a |
| Invertebrate | *Melanoplus acrophilus acrophilus* | Short-winged melanoplus | 1 |
| Invertebrate | *Melanoplus cherokee* | Cherokee melanoplus | 1 |
| Invertebrate | *Melanoplus divergens* | Divergent melanoplus | 1 |
| Invertebrate | *Melanoplus serrulatus* | Serrulate melanoplus | 1 |
| Invertebrate | *Paravitrea reesei* | Round supercoil | 1 |
| Invertebrate | *Procotyla typhlops* | A groundwater planarian | 1 |
| Invertebrate | *Pseudanophthalmus limicola* | Mud-dwelling cave beetle | 1 |
| Invertebrate | *Pseudotremia alecto* | Millipede | 4a |
| Invertebrate | *Scudderia septentrionalis* | Northern bush katydid | 1 |
| Invertebrate | *Sphaeroderus schaumii* | Schaum's ground beetle | 4a |
| Invertebrate | *Sphalloplana virginiana* | Rockbridge County cave planarian | 1 |
| Invertebrate | *Stygobromus baroodyi* | Rockbridge County cave amphipod | 4a |
| Invertebrate | *Stygobromus biggersi* | Bigger's cave amphipod | 1 |
| Invertebrate | *Stygobromus estesi* | Craig County cave amphipod | 1 |
| Invertebrate | *Stygobromus fergusoni* | Montgomery County cave amphipod | 1 |
| Invertebrate | *Stygobromus pseudospinosus* | Luray Caverns amphipod | 4a |
| Invertebrate | *Stygobromus spinosus* | Blue Ridge spring amphipod | 4a |
| Invertebrate | *Stylodrilus beattiei* | A cave lumbriculid worm | 4a |
| Invertebrate | *Synanthedon castaneae* | Chestnut clearwing moth | 1 |
| Invertebrate | *Trimerotropis saxatalis* | Rock-loving grasshopper | 1 |
| Mammal | *Juncus articulatus* | jointed rush | 4a |
| Mammal | *Stygobromus stegerorum* | Madison Cave amphipod | 4a |
| Nonvascular Plant | *Anastrophyllum saxicola* | Liverwort | 1 |
| Nonvascular Plant | *Anzia americana* | Foliose lichen | 1 |
| Nonvascular Plant | *Brachydontium trichodes* | Peak moss | 1 |
| Nonvascular Plant | *Bryoerythrophyllum ferruginascens* | Moss | 1 |
| Nonvascular Plant | *Buxbaumia minakatae* | Bug-on-a-stick moss | 4a |
| Nonvascular Plant | *Cephaloziella massalongi* | Liverwort | 1 |
| Nonvascular Plant | *Cephaloziella spinicaulis* | Liverwort | 1 |
| Nonvascular Plant | *Diplophyllum obtusatum* | Liverwort | 1 |
| Nonvascular Plant | *Drepanolejeunea appalachiana* | Liverwort | 1 |
| Nonvascular Plant | *Entodon sullivantii* | Sullivant's entodon | 1 |
| Nonvascular Plant | *Ephebe solida* | Fructicose lichen | 1 |
| Nonvascular Plant | *Fissidens appalachensis* | Appalachian pocket moss | 1 |
| Nonvascular Plant | *Heterodermia appalachensis* | Foliose lichen | 1 |
| Nonvascular Plant | *Homaliadelphus sharpii* | Sharp's homaliadelphus | 1 |

| Taxon | Scientific Name | Common Name | Rationale |
|---|---|---|---|
| Nonvascular Plant | *Hygrohypnum closteri* | Closter's brook-hypnum | 1 |
| Nonvascular Plant | *Hypotrachyna virginica* | Foliose Lichen | 1 |
| Nonvascular Plant | *Lejeunea blomquistii* | Liverwort | 1 |
| Nonvascular Plant | *Leptodontium excelsum* | Grandfather Mountain excelsum | 1 |
| Nonvascular Plant | *Lophocolea appalachiana* | Liverwort | 1 |
| Nonvascular Plant | *Macrocoma sullivantii* | Sullivant's manned-moss | 1 |
| Nonvascular Plant | *Melanelia stygia* | Foliose lichen | 1 |
| Nonvascular Plant | *Metzgeria fruticulosa (=M. temperata)* | Liverwort | 1 |
| Nonvascular Plant | *Metzgeria uncigera* | Liverwort | 1 |
| Nonvascular Plant | *Palamocladium leskeoides* | Palamocladium | 1 |
| Nonvascular Plant | *Pannaria conoplea* | Foliose lichen | 1 |
| Nonvascular Plant | *Pellia appalachiana (= Pelia X appalachiana)* | Liverwort | 1 |
| Nonvascular Plant | *Physcia pseudospeciosa* | Rosette lichen | 1 |
| Nonvascular Plant | *Plagiochila austinii* | Liverwort | 1 |
| Nonvascular Plant | *Plagiochila caduciloba* | Liverwort | 1 |
| Nonvascular Plant | *Plagiochila sullivantii var. sullivantii* | Sullivant's leafy liverwort | 1 |
| Nonvascular Plant | *Plagiochila virginica var virginica* | Liverwort | 1 |
| Nonvascular Plant | *Polytrichum appalachianum* | Appalachian haircap moss | 1 |
| Nonvascular Plant | *Riccardia jugata* | Liverwort | 1 |
| Nonvascular Plant | *Sphagnum fallax* | Pretty peatmoss | 3 |
| Nonvascular Plant | *Sphagnum flavicomans* | Peatmoss | 1 |
| Nonvascular Plant | *Sphagnum girgensohnii* | Girgensohn's peatmoss | 1 |
| Nonvascular Plant | *Sphagnum quinquefarium* | Five-rowed peatmoss | 1 |
| Nonvascular Plant | *Tetrodontium brownianum* | Little Georgia moss | 1 |
| Nonvascular Plant | *Tortula ammonsiana = Syntrichia ammonsiana* | Ammon's tortula | 1 |
| Nonvascular Plant | *Xanthoparmelia monticola* | Xanthoparmelia lichen | 1 |
| Reptile | *Terrapene carolina* | eastern box turtle | 5 |
| Snail | *Fontigens tartarea* | Organ cavesnail | 4a |
| Snail | *Glyphyalinia picea* | Rust glyph | 4a |
| Snail | *Helicodiscus lirellus* | Rubble coil | 4a |
| Vascular Plant | *Aconitum reclinatum* | white monkshood | 1 |
| Vascular Plant | *Agastache scrophulariifolia* | Giant purple hyssop | 5 |
| Vascular Plant | *Allium oxyphilum* | Nodding onion | 1 |
| Vascular Plant | *Anemone canadensis* | Canada anemone | 1 |
| Vascular Plant | *Arabis hirsuta var. adpressipilis* | hairy rockcress | 1 |
| Vascular Plant | *Arethusa bulbosa* | Dragon's mouth | 1 |
| Vascular Plant | *Aster laevis var. concinnus* | Smooth purple aster | 5 |
| Vascular Plant | *Baptisia australis* | blue wild-indigo | 5 |

| Taxon | Scientific Name | Common Name | Rationale |
|---|---|---|---|
| Vascular Plant | *Berberis canadensis* | American barberry | 1 |
| Vascular Plant | *Botrychium matricariifolium* = *Sceptridium oneidense* | Chamomile grape fern | 4a |
| Vascular Plant | *Botrychium oneidense* | Blunt-lobed grape fern | 4b |
| Vascular Plant | *Bouteloua curtipendula* | Side-oats grama | 5 |
| Vascular Plant | *Calamagrostis canadensis* | Canada reedgrass | 5 |
| Vascular Plant | *Camassia scilloides* | wild hyacinth | 1 |
| Vascular Plant | *Campanula aparinoides* | Marsh bellflower | 5 |
| Vascular Plant | *Carex conoidea* | field sedge | 1 |
| Vascular Plant | *Carex cristatella* | crested sedge | 1 |
| Vascular Plant | *Carex hitchcockiana* | Hitchcock's sedge | 5 |
| Vascular Plant | *Carex interior* | inland sedge | 1 |
| Vascular Plant | *Carex ormostachya* | necklace spike sedge | 1 |
| Vascular Plant | *Carex pedunculata* | longstalk sedge | 1 |
| Vascular Plant | *Carex plantaginea* | Plantain-leaved sedge | 3 |
| Vascular Plant | *Carex tetanica* | rigid sedge | 5 |
| Vascular Plant | *Carex trisperma* | Three-seeded sedge | 5 |
| Vascular Plant | *Carex verrucosa* | Warty sedge | 1 |
| Vascular Plant | *Chenopodium simplex* | Giant-seed goosefoot | 3 |
| Vascular Plant | *Cymophyllus fraserianus* | Fraser's sedge | 5 |
| Vascular Plant | *Diarrhena americana* | Eastern beakgrass | 5 |
| Vascular Plant | *Dicentra eximia* | Bleeding heart | 5 |
| Vascular Plant | *Dirca palustris* | Leatherwood | 3 |
| Vascular Plant | *Eriophorum virginicum* | Tawny cotton-grass | 3 |
| Vascular Plant | *Eupatorium godfreyanum* | Godfrey's thoroughwort | 5 |
| Vascular Plant | *Geum aleppicum* | yellow avens | 1 |
| Vascular Plant | *Hasteola suaveolens* | False Indian-plantain | 1 |
| Vascular Plant | *Helianthus atrorubens* | Savanna hairy sunflower | 5 |
| Vascular Plant | *Helianthus laevigatus* | smooth sunflower | 5 |
| Vascular Plant | *Heuchera parviflora* | Little-leaved alumroot | 1 |
| Vascular Plant | *Hexalectris spicata* | crested coralroot | 5 |
| Vascular Plant | *Hydrocotyle americana* | American pennywort | 3 |
| Vascular Plant | *Hypericum ellipticum* | pale St. John's-wort | 1 |
| Vascular Plant | *Isoetes virginica* | Virginia quillwort | 1 |
| Vascular Plant | *Isotria medeoloides* | small whorled pogonia | 1 |
| Vascular Plant | *Juncus subcaudatus* | Woods rush | 5 |
| Vascular Plant | *Lachnanthes caroliniana* | Carolina redroot | 1 |
| Vascular Plant | *Listera smallii* | Kidney-leaf twayblade | 5 |

| Taxon | Scientific Name | Common Name | Rationale |
|---|---|---|---|
| Vascular Plant | *Lithospermum latifolium* | American gromwell | 5 |
| Vascular Plant | *Lycopodiella margueritae* | Marguerite's clubmoss | 1 |
| Vascular Plant | *Lycopodium annotinum* | Stiff clubmoss | 5 |
| Vascular Plant | *Lysimachia radicans* | trailing loosestrife | 1 |
| Vascular Plant | *Malaxis bayardii* | Appalachian adder's-mouth | 1 |
| Vascular Plant | *Milium effusum* | Millet grass | 5 |
| Vascular Plant | *Monarda didyma* | Oswego Tea | 5 |
| Vascular Plant | *Orontium aquaticum* | Golden club | 3 |
| Vascular Plant | *Penstemon hirsutus* | hairy beardtoungue | 5 |
| Vascular Plant | *Platanthera flava var. herbiola* | Turbercled rein-orchid | 5 |
| Vascular Plant | *Polygonum arifolium = arifolia* | Halberdleaf tearthumb | 5 |
| Vascular Plant | *Polygonum cilinode = Fallopia cilinodis* | Fringed black bindweed | 4b |
| Vascular Plant | *Pycnanthemum virginianum* | Virginia mountain mint | 5 |
| Vascular Plant | *Ranunculus trichophyllus* | white water crowfoot | 1 |
| Vascular Plant | *Ribes lacustre* | bristly black currant | 4b |
| Vascular Plant | *Robinia hispida var kelseyi* | Kelsey's locust | 4b |
| Vascular Plant | *Robinia viscosa* | Clammy locust | 4b |
| Vascular Plant | *Sanicula trifoliata* | Large-fruited snakeroot | 5 |
| Vascular Plant | *Saxifraga careyana* | Golden-eye saxifrage | 1 |
| Vascular Plant | *Saxifraga caroliniana* | Carolina saxifrage | 1 |
| Vascular Plant | *Solidago squarrosa* | Squarrose goldenrod | 5 |
| Vascular Plant | *Sphenopholis pensylvanica* | Swamp wedgescale | 3 |
| Vascular Plant | *Stellaria longifolia* | Longleaf stitchwort | 5 |
| Vascular Plant | *Talinum teretifolium* | Roundleaf flame-flower | 1 |
| Vascular Plant | *Taxus canadensis* | Canada yew | 5 |
| Vascular Plant | *Thermopsis mollis (= T. m. var. mollis)* | Appalachian golden-banner | 1 |
| Vascular Plant | *Torreyochloa pallida* | Pale mannagrass | 5 |
| Vascular Plant | *Triosteum aurantiacum* | Horse gentian | 5 |
| Vascular Plant | *Vaccinium hirsutum* | Hairy blueberry | 1 |
| Vascular Plant | *Viola appalachiensis* | Appalachian blue violet | 1 |
| Vascular Plant | *Viola conspersa* | American dog violet | 5 |
| Vascular Plant | *Woodwardia areolata* | Netted chain fern | 5 |

**Key to Rationale**

1 - No occurrences or habitat known on the Unit
2 - Species is unaffected by Management
3 - Unit is of marginal importance to conservation of the species
4a - Knowledge of species' ecology is insufficient to support conservation strategy
4b - Species' taxonomy is too uncertain to develop conservation strategy
5 - Species is common and demonstrably secure on the Unit
O - Other (describe in comments)

# APPENDIX F2. SPECIES GROUPS BY INDIVIDUAL SPECIES

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Adlumia fungosa* | Climbing fumatory | Occurrence Protection | | | | | | |
| *Aegolius acadicus* | northern saw-whet owl | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Cavity Trees, Den Trees and Snags | Riparian | Species in a Special Biologic Area | | |
| *Alnus incana ssp. rugosa* | speckled alder | Riparian | | | | | | |
| *Ambystoma tigrinum* | Eastern tiger salamander | Late Successional Hardwood Dominated Forest | Riparian | Species in a Special Biologic Area | | | | |
| *Ammodramus henslowii* | Henslow's sparrow | Area Sensitive Grasslands. | Occurrence Protection | | | | | |
| *Anaphalis margaritacea* | pearly everlasting | Fire Dependent and Fire Enhanced | Grasslands | Shrublands | Species in a Special Biologic Area | | | |
| *Anas rubripes* | American black duck | Riparian | | | | | | |
| *Apochthonius holsingeri* | A cave pseudoscorpion | Caves | | | | | | |
| *Aquila chrysaetos* | golden eagle | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Arabis patens* | Spreading rockcress | Shale barrens | | | | | | |
| *Arabis serotina* | shale barren rockcress | Fire Dependent and Fire Enhanced | Shale barrens | Species in a Special Biologic Area | | | | |
| *Aralia hispida* | bristly sarsaparilla | Cliff and Talus and large rock outcrops | Fire Dependent and Fire Enhanced | Species in a Special Biologic Area | | | | |
| *Arnoglossom muehlenbergii* | great Indian-plantain | Fire Dependent and Fire Enhanced | Grasslands | Occurrence Protection | Riparian | Ruderal | | |
| *Aster radula* | rough-leaved aster | Riparian | | | | | | |
| *Astragalus distortus* | bent milkvetch | Shale barrens | | | | | | |
| *Autochton cellus* | Golden-banded skipper | Lepidopterans | Riparian | | | | | |
| *Bartramia longicauda* | upland sandpiper | Area Sensitive Grasslands. | Fire Dependent and Fire Enhanced | Occurrence Protection | | | | |
| *Betula cordifolia* | mountain paper birch | Cliff and Talus and large rock outcrops | Fire Dependent and Fire Enhanced | Species in a Special Biologic Area | | | | |
| *Boloria selene* | Silver-bordered fritillary | Lepidopterans | Riparian | Species in a Special Biologic Area | | | | |
| *Boltonia montana* | no common name | Riparian | Species in a Special Biologic Area | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Bonasa umbellus* | ruffed grouse | Fire Dependent and Fire Enhanced | Grasslands | Hard and Soft Mast Dependent | Late Successional Hardwood Dominated Forest | Riparian | Open Woodlands | Regenerating Forests & Shrublands |
| *Bromus ciliatus* | fringed brome grass | Riparian | | | | | | |
| *Bromus kalmii* | wild chess | Fire Dependent and Fire Enhanced | Shale barrens | Species in a Special Biologic Area | | | | |
| *Buckleya distichophylla* | Piratebush | Fire Dependent and Fire Enhanced | Occurrence Protection | | | | | |
| *Callophrys irus* | Frosted elfin | Fire Dependent and Fire Enhanced | Lepidopterans | Occurrence Protection | Open Woodlands | | | |
| *Calopogon tuberosus* | Grass pink | Riparian | | | | | | |
| *Campanula rotundifolia* | American harebell | Calciphiles | Cliff and Talus and large rock outcrops | Species in a Special Biologic Area | | | | |
| *Caprimulgus carolinensis* | chuck-will's widow | Area Sensitive Grassland and Shrubland and Open Woodlands | Fire Dependent and Fire Enhanced | Open Woodlands | Regenerating Forests | | | |
| *Caprimulgus vociferus* | whip-poor-will | Area Sensitive Grassland and Shrubland and Open Woodlands | Fire Dependent and Fire Enhanced | Open Woodlands | Regenerating Forests | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Carex aquatilis* | water sedge | Riparian | Species in a Special Biologic Area | | | | | |
| *Carex arctata* | black sedge | Riparian | Species in a Special Biologic Area | | | | | |
| *Carex barrattii* | Barratt's sedge | Riparian | Species in a Special Biologic Area | | | | | |
| *Carex buxbaumii* | Buxbaum's sedge | Riparian | Species in a Special Biologic Area | | | | | |
| *Carex lasiocarpa var. americana* | slender sedge | Riparian | Species in a Special Biologic Area | | | | | |
| *Carex polymorpha* | variable sedge | Fire Dependent and Fire Enhanced | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Carex roanensis* | Roan Mountain sedge | Occurrence Protection | Species in a Special Biologic Area | | | | | |
| *Carex schweinitzii* | Schweinitz's sedge | Riparian | | | | | | |
| *Carex vesicaria* | | Riparian | Species in a Special Biologic Area | | | | | |
| *Carpodacus purpureus* | purple finch | High Elevation Openings, grassy or shrubby or open woodlands | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Castor canadensis* | Beaver | Riparian | Species in a Special Biologic Area | | | | | |
| *Catharus guttatus* | hermit thrush | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | High Elevation Openings, grassy or shrubby or open woodlands | Species in a Special Biologic Area | | | |
| *Catocala herodias gerhardi* | Herodias underwing | Lepidopterans | Occurrence Protection | Open Woodlands | | | | |
| *Catocala marmorata* | Marbled underwing | Lepidopterans | Occurrence Protection | Riparian | | | | |
| *Certhia americana* | brown creeper | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Cavity Trees, Den Trees and Snags | Riparian | Species in a Special Biologic Area | | |
| *Cheilanthes eatonii* | chestnut lipfern | Cliff and Talus and large rock outcrops | Shale barrens | Species in a Special Biologic Area | | | | |
| *Cicindela ancocisconensis* | a tiger beetle | Riparian | | | | | | |
| *Cicindela patruela* | Barrens tiger beetle | Ruderal | Sandstone glades and barrens | Species in a Special Biologic Area | | | | |
| *Circus cyaneus* | northern harrier | Area Sensitive Grasslands. | Occurrence Protection | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Cirsium altissimum* | tall thistle | Ruderal | Species in a Special Biologic Area | | | | | |
| *Clematis albicoma* | White-haired Leatherflower | Shale barrens | | | | | | |
| *Clematis coactilis* | Virginia white-haired leatherflower | Shale barrens | | | | | | |
| *Clematis occidentalis* | purple clematis | Mafic rocks | | | | | | |
| *Clematis viticaulis* | Millboro leatherflower | Shale barrens | Species in a Special Biologic Area | | | | | |
| *Clemmys guttata* | spotted turtle | Riparian | Species in a Special Biologic Area | | | | | |
| *Coccyzus erythropthalmus* | black-billed cuckoo | High Elevation Coniferous, Deciduous and/or Mixed Forests | High Elevation Openings, grassy or shrubby or open woodlands | Riparian | | | | |
| *Colias interior* | Pink-edged sulphur | Lepidopterans | Riparian | Species in a Special Biologic Area | | | | |
| *Colinus virginianus* | northern bobwhite | Area Sensitive Grassland and Shrubland and Open Woodlands | Fire Dependent and Fire Enhanced | Grasslands | Open Woodlands | Shrublands | | |
| *Contopus borealis* | olive-sided flycatcher | High Elevation Coniferous, Deciduous and/or Mixed Forests | High Elevation Openings, grassy or shrubby or open woodlands | Riparian | Species in a Special Biologic Area | Cavity Trees, Den Trees and Snags | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Corallorhiza bentleyi* | Bentley's coalroot | Occurrence Protection | | | | | | |
| *Cornus canadensis* | bunchberry | High Elevation Coniferous, Deciduous and/or Mixed Forests | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Cornus rugosa* | roundleaf dogwood | Occurrence Protection | Species in a Special Biologic Area | | | | | |
| *Corynorhinus townsendii virginianus* | Virginia big-eared bat | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | Caves | Occurrence Protection | | | | |
| *Crataegus calpodendron* | pear hawthorn | Occurrence Protection | | | | | | |
| *Crataegus pruinosa* | prunose hawthorn | Fire Dependent and Fire Enhanced | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Crotalus horridus* | Timber rattlesnake | Cliff and Talus and large rock outcrops | Sensitive to Over-Collection | | | | | |
| *Cuscuta coryli* | hazel dodder | Cliff and Talus and large rock outcrops | Occurrence Protection | | | | | |
| *Cuscuta rostrata* | beaked dodder | High Elevation Openings, grassy or shrubby or open woodlands | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Cyperus dentatus* | toothed flatsedge | Riparian | | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Cypripedium reginae* | showy lady's-slipper | Occurrence Protection | Riparian | Sensitive to Over-Collection | Species in a Special Biologic Area | | | |
| *Cystopteris fragilis* | fragile fern | Cliff and Talus and large rock outcrops | Species in a Special Biologic Area | | | | | |
| *Delphinium exaltatum* | tall larkspur | Calciphiles | Fire Dependent and Fire Enhanced | Open Woodlands | | | | |
| *Dendroica cerulea* | cerulean warbler | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | Late Successional Hardwood Dominated Forest | Riparian | | | | |
| *Dendroica discolor* | prairie warbler | Area Sensitive Grassland and Shrubland and Open Woodlands | Fire Dependent and Fire Enhanced | Regenerating Forests | | | | |
| *Dendroica fusca* | blackburnian warbler | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | | | | |
| *Dendroica magnolia* | magnolia warbler | High Elevation Coniferous, Deciduous and/or Mixed Forests | Regenerating Forests | Species in a Special Biologic Area | Riparian | | | |
| *Desmodium canadense* | showy tick-trefoil | Riparian | | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Desmodium cuspidatum* | toothed tick-trefoil | Calciphiles | Occurrence Protection | Ruderal | Species in a Special Biologic Area | | | |
| *Desmodium sessilifolium* | sessile-leaf tick-trefoil | Open Woodlands | Riparian | | | | | |
| *Echinacea laevigata* | smooth coneflower | Calciphiles | Fire Dependent and Fire Enhanced | Open Woodlands | Species in a Special Biologic Area | | | |
| *Echinodorus tenellus* | dwarf burhead | Riparian | Species in a Special Biologic Area | Riparian | | | | |
| *Eleocharis compressa* | flat-stemmed spikerush | Riparian | | | | | | |
| *Eleocharis melanocarpa* | black-fruited spikerush | Riparian | Species in a Special Biologic Area | | | | | |
| *Eleocharis robbinsii* | Robbins spikerush | Riparian | Species in a Special Biologic Area | | | | | |
| *Elymus canadensis* | nodding wild rye | Riparian | | | | | | |
| *Elymus trachycaulus* | slender wheatgrass | Fire Dependent and Fire Enhanced | Shale barrens | Species in a Special Biologic Area | | | | |
| *Empidonax alnorum* | alder flycatcher | High Elevation Coniferous, Deciduous and/or Mixed Forests | Riparian | Species in a Special Biologic Area | Riparian | | | |
| *Empidonax virescens* | acadian flycatcher | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed | Riparian | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| | | Forest Associates | | | | | | |
| *Epilobium ciliatum* | Hair willow-herb | Riparian | | | | | | |
| *Epilobium leptophyllum* | linear-leaved willow-herb | Riparian | Species in a Special Biologic Area | | | | | |
| *Equisetum sylvaticum* | woodland horsetail | Species in a Special Biologic Area | Riparian | | | | | |
| *Eriocaulon aquaticum* | white buttons | Riparian | Species in a Special Biologic Area | | | | | |
| *Eriogonum allenii* | Yellow Buckwheat | Shale barrens | | | | | | |
| *Erora laeta* | Early hairstreak | Lepidopterans | Occurrence Protection | | | | | |
| *Erynnis martialis* | Mottled duskywing | Area Sensitive Shrubland and Open Woodlands | Fire Dependent and Fire Enhanced | Lepidopterans | Occurrence Protection | Species in a Special Biologic Area | | |
| *Erynnis persius* | Persius duskywing | Grasslands | Lepidopterans | Riparian | Shrublands | | | |
| *Erysimum capitatum* | western wallflower | Open Woodlands | Shale barrens | Species in a Special Biologic Area | | | | |
| *Euchloe olympia* | Olympia marble | Lepidopterans | Open Woodlands | Shale barrens | | | | |
| *Eumeces anthracinus* | coal skink | Occurrence Protection | Open Woodlands | Ruderal | Shrublands | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Eupatorium maculatum* | spotted joe-pye weed | Riparian | | | | | | |
| *Euphorbia purpurea* | glade spurge | Calciphiles | Riparian | | | | | |
| *Falco peregrinus* | peregrine falcon | Cliff and Talus and large rock outcrops | Occurrence Protection | Open Woodlands | | | | |
| *Gaylussacia brachycera* | box huckleberry | Fire Dependent and Fire Enhanced | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Geranium robertianum* | herb-robert | Cliff and Talus and large rock outcrops | | | | | | |
| *Glaucomys sabrinus fuscus* | Virginia northern flying squirrel | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Riparian | Species in a Special Biologic Area | | | |
| *Glyceria acutiflora* | sharp-scaled manna-grass | Riparian | | | | | | |
| *Glyceria grandis* | American manna-grass | Riparian | Species in a Special Biologic Area | | | | | |
| *Glyphyalinia raderi* | Maryland glyph | Calciphiles | Occurrence Protection | | | | | |
| *Glyptemys insculpta* | wood turtle | Late Successional Hardwood Dominated Forest | Riparian | Open Woodlands | Sensitive to Over-Collection | Shrublands | Grasslands | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Gnaphalium uliginosum* | low cudweed | High Elevation Openings, grassy or shrubby or open woodlands | Riparian | Ruderal | Species in a Special Biologic Area | | | |
| *Goodyera repens* | dwarf rattlesnake plantain | Occurrence Protection | Riparian | | | | | |
| *Gymnocarpium appalachianum* | Appalachian oak fern | High Elevation Coniferous, Deciduous and/or Mixed Forests | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Haliaeetus leucocephalus* | bald eagle | Occurrence Protection | Riparian | | | | | |
| *Hansonoperla appalachia* | Appalachian stonefly | Riparian | | | | | | |
| *Helenium virginicum* | Virginia sneezeweed | Riparian | Species in a Special Biologic Area | | | | | |
| *Helianthemum bicknellii* | plains frostweed | Cliff and Talus and large rock outcrops | Open Woodlands | Sandstone glades and barrens | Species in a Special Biologic Area | | | |
| *Helianthemum propinquum* | low frostweed | Open Woodlands | | | | | | |
| *Helicodiscus diadema* | Shaggy coil | Calciphiles | Occurrence Protection | | | | | |
| *Helicodiscus triodus* | Talus coil | Calciphiles | Occurrence Protection | | | | | |
| *Helonias bullata* | swamp-pink | Species in a Special Biologic Area | Riparian | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Heuchera alba* | white alumroot | High Elevation Coniferous, Deciduous and/or Mixed Forests | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Houstonia canadensis* | Canada bluets | Alkaline glades and barrens | Calciphiles | Species in a Special Biologic Area | | | | |
| *Huperzia appalachiana* | Appalachian fir clubmoss | High Elevation Coniferous, Deciduous and/or Mixed Forests | Riparian | | | | | |
| *Hydraena maureenae* | Maureen's shale stream beetle | Riparian | | | | | | |
| *Hypericum boreale* | northern St. John's-wort | Riparian | | | | | | |
| *Hypericum mitchellianum* | Blue Ridge St. John's-wort | High Elevation Coniferous, Deciduous and/or Mixed Forests | High Elevation Openings, grassy or shrubby or open woodlands | Occurrence Protection | Species in a Special Biologic Area | | | |
| *Iliamna remota* | Kankakee globe-mallow | Riparian | | | | | | |
| *Incisalia polia* | Hoary elfin | Grasslands | Lepidopterans | Sandstone glades and barrens | Shrublands | | | |
| *Isoetes lacustris* | lake quillwort | Riparian | Species in a Special Biologic Area | | | | | |
| *Isonychia tusculanensis* | a mayfly | Riparian | | | | | | |
| *Juglans cinerea* | butternut | Occurrence Protection | | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Juncus brachycephalus* | small-head rush | Species in a Special Biologic Area | Riparian | | | | | |
| *Juncus brevicaudatus* | narrow-panicled rush | Species in a Special Biologic Area | Riparian | | | | | |
| *Juniperus communis var depressa* | ground juniper | High Elevation Openings, grassy or shrubby or open woodlands | Species in a Special Biologic Area | Calciphiles | | | | |
| *Kleptochthonius anophthalmus* | A cave pseudoscorpion | Caves | | | | | | |
| *Lanius ludovicianus* | loggerhead shrike | Area Sensitive Grasslands. | Grasslands | Shrublands | | | | |
| *Lepus americanus* | snowshoe hare | High Elevation Coniferous, Deciduous and/or Mixed Forests | High Elevation Openings, grassy or shrubby or open woodlands | Regenerating Forests | Species in a Special Biologic Area | | | |
| *Leucothoe fontanesiana* | highland dog-hobble | Cove forests | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Leuctra mitchellensis* | Mitchell needlefly | Riparian | | | | | | |
| *Leuctra monticola* | montane needlefly | Riparian | | | | | | |
| *Liatris helleri* | shale -barren blazing star | Shale barrens | | | | | | |
| *Linum lewisii* | prairie flax | Calciphiles | Cliff and Talus and large rock outcrops | Open Woodlands | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Linum sulcatum* | grooved yellow flax | Calciphiles | Cliff and Talus and large rock outcrops | Open Woodlands | | | | |
| *Liochlorophis vernalis* | Smooth green snake | Fire Dependent and Fire Enhanced | | | | | | |
| *Liochlorophis vernalis* | Smooth green snake | High Elevation Openings, grassy or shrubby or open woodlands | Open Woodlands | Grasslands | | | | |
| *Liparis loeselii* | Loesel's twayblade | Riparian | Species in a Special Biologic Area | | | | | |
| *Lonicera canadensis* | American fly-honeysuckle | High Elevation Coniferous, Deciduous and/or Mixed Forests | Riparian | | | | | |
| *Loxia curvirostra* | red crossbill | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | | | | |
| *Lycopodiella inundata* | northern bog clubmoss | Riparian | | | | | | |
| *Lythrum alatum* | winged loosestrife | Riparian | | | | | | |
| *Maianthemum stellatum* | stary false Solomon's-seal | Riparian | | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Martes pennanti* | fisher | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | | | | |
| *Megaleuctra flinti* | Shenandoah needlefly | Riparian | | | | | | |
| *Meleagris gallopavo* | wild turkey | Fire Dependent and Fire Enhanced | Grasslands | Hard and Soft Mast Dependent | Late Successional Hardwood Dominated Forest | Open Woodlands | Shrublands | |
| *Melica nitens* | Three-flowered melic grass | Calciphiles | Open Woodlands | Shale barrens | | | | |
| *Melospiza georgiana* | swamp sparrow | High Elevation Openings, grassy or shrubby or open woodlands | Riparian | | | | | |
| *Microtus chrotorrhinus carolinensis* | Southern rock vole | High Elevation Coniferous, Deciduous and/or Mixed Forests | Riparian | | | | | |
| *Miktoniscus racovitzai* | Racovitza's terrestrial cave isopod | Caves | | | | | | |
| *Minuartia groenlandica* | mountain sandwort | Cliff and Talus and large rock outcrops | Sensitive to Recreation Traffic | Species in a Special Biologic Area | | | | |
| *Monotropsis odorata* | sweet pinesap | Occurrence Protection | Species in a Special Biologic Area | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Muhlenbergia glomerata* | marsh muhly | Mafic rocks | Species in a Special Biologic Area | Riparian | | | | |
| *Mustela nivalis* | least weasel | Grasslands | Shrublands | | | | | |
| *Myotis leibii* | eastern small-footed bat | Caves | Cliff and Talus and large rock outcrops | Occurrence Protection | | | | |
| *Myotis sodalis* | Indiana bat | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | Caves | Cavity Trees, Den Trees and Snags | Occurrence Protection | Open Woodlands | Riparian | |
| *Nampabius turbator* | Cave centipede | Calciphiles | Caves | | | | | |
| *Nannaria shenandoah* | Shenandoah Mountain xystodesmid | Occurrence Protection | | | | | | |
| *Nemotaulius hostilis* | a limnephilid caddisfly | Riparian | | | | | | |
| *Neotoma magister* | Alleghany woodrat | Caves | Cliff and Talus and large rock outcrops | Late Successional Hardwood Dominated Forest | | | | |
| *Nyctanassa violacea* | yellow-crowned night-heron | Riparian | | | | | | |
| *Nycticorax nycticorax* | black-crowned night-heron | Riparian | | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Odocoileus virginianus* | white-tailed deer | Fire Dependent and Fire Enhanced | Grasslands | Hard and Soft Mast Dependent | Late Successional Hardwood Dominated Forest | Open Woodlands | Regenerating Forests | Shrublands |
| *Oenothera argillicola* | Shale-barren evening primrose | Shale barrens | | | | | | |
| *Oligoneuron rigidum* | stiff goldenrod | Calciphiles | Open Woodlands | Species in a Special Biologic Area | | | | |
| *Onosmodium virginianum* | Virginia false-gromwell | Fire Dependent and Fire Enhanced | Open Woodlands | Calciphiles | | | | |
| *Oporornis philadelphia* | mourning warbler | High Elevation Coniferous, Deciduous and/or Mixed Forests | High Elevation Openings, grassy or shrubby or open woodlands | Regenerating Forests | Fire Dependent and Fire Enhanced | | | |
| *Oryzopsis asperifolia* | white-grained mtn-ricegrass | Open Woodlands | Shrublands | Species in a Special Biologic Area | | | | |
| *Osmunda cinnamomea var. glandulosa* | glandular cinnamon fern | Species in a Special Biologic Area | Riparian | | | | | |
| *Panax quinquefolius* | Ginseng | Cove forests | Sensitive to Over-Collection | | | | | |
| *Panax trifolius* | Dwarf ginseng | Cove forests | Sensitive to Over-Collection | | | | | |
| *Panicum hemitomon* | maidencane | Riparian | Species in a Special Biologic Area | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Paragnetina ishusa* | widecollar stonefly | Riparian | | | | | | |
| *Paraleptophlebia jeanae* | a mayfly | Riparian | | | | | | |
| *Parnassia grandifolia* | Large-leaved grass-of-parnassus | Riparian | | | | | | |
| *Paronychia argyrocoma* | Silver Nail-wort | Shale barrens | | | | | | |
| *Paronychia virginica* | yellow nailwort | Calciphiles | Cliff and Talus and large rock outcrops | Shale barrens | | | | |
| *Paxistima canbyi* | Canby's mountain lover | Calciphiles | Cliff and Talus and large rock outcrops | | | | | |
| *Peltigera hydrothyria* | Waterfan | Riparian | | | | | | |
| *Perlesta frisoni* | Blue Ridge stonefly | Riparian | | | | | | |
| *Phlox amplifolia* | Broadleaf phlox | Calciphiles | Occurrence Protection | | | | | |
| *Phlox buckleyi* | sword-leaved phlox | Fire Dependent and Fire Enhanced | Occurrence Protection | Ruderal | Species in a Special Biologic Area | | | |
| *Phyciodes batesii* | Tawny crescent | Lepidopterans | Occurrence Protection | | | | | |
| *Phyciodes cocyta* | Northern crescent | Lepidopterans | | | | | | |
| *Pituophis melanoleucus* | northern pinesnake | Fire Dependent and Fire Enhanced | Occurrence Protection | Open Woodlands | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Platanthera grandiflora* | large purple fringed orchid | Riparian | Sensitive to Over-Collection | Species in a Special Biologic Area | | | | |
| *Platanthera peramoena* | purple fringeless orchid | Riparian | Sensitive to Over-Collection | | | | | |
| *Plethodon punctatus* | Cow Knob salamander | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Late Successional Hardwood Dominated Forest | Species in a Special Biologic Area | Cliff and Talus and large rock outcrops | | |
| *Plethodon sherando* | Big levels salamander | Open Woodlands | Species in a Special Biologic Area | | | | | |
| *Plethodon virginia* | Shenandoah Mt. salamander | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Late Successional Hardwood Dominated Forest | Species in a Special Biologic Area | Cliff and Talus and large rock outcrops | | |
| *Poa paludigena* | bog bluegrass | Riparian | | | | | | |
| *Poa palustris* | fowl bluegrass | Riparian | Species in a Special Biologic Area | | | | | |
| *Poa saltuensis* | drooping bluegrass | Mafic rocks | Open Woodlands | Species in a Special Biologic Area | | | | |
| *Polanisia dodecandra* | common clammy-weed | Riparian | | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Polygonia progne* | Gray comma | Grasslands | Lepidopterans | Riparian | Open Woodlands | Ruderal | Shrublands | Species in a Special Biologic Area |
| *Potamogeton amplifolius* | | Riparian | | | | | | |
| *Potamogeton hillii* | Hill's pondweed | Riparian | | | | | | |
| *Potamogeton oakesianus* | Oakes pondweed | Riparian | Species in a Special Biologic Area | | | | | |
| *Potamogeton tennesseensis* | Tennessee pondweed | Riparian | | | | | | |
| *Potentilla arguta* | tall cinquefoil | Mafic rocks | Species in a Special Biologic Area | | | | | |
| *Prunus alleghaniensis* | Alleghany sloe | Fire Dependent and Fire Enhanced | Open Woodlands | Shale barrens | | | | |
| *Prunus nigra* | Canada plum | Ruderal | Shrublands | | | | | |
| *Pseudanophthalmus avernus* | Avernus cave beetle | Calciphiles | Caves | | | | | |
| *Pseudanophthalmus intersectus* | Crossroads cave beetle | Calciphiles | Caves | | | | | |
| *Pseudanophthalmus nelsoni* | Nelson's cave beetle | Calciphiles | Caves | | | | | |
| *Pseudanophthalmus petrunkevitchi* | Petrunkevitch's cave beetle | Calciphiles | Caves | | | | | |
| *Pseudognaphalium macounii* | Winged cudweed | Caves | | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Pseudotremia princeps* | South Branch Valley cave millipede | Calciphiles | Caves | | | | | |
| *Pycnanthemum torreyi* | Torrey's mountain-mint | Calciphiles | Mafic rocks | Open Woodlands | | | | |
| *Pygmarrhopalites carolynae* | Cave springtail | Calciphiles | Caves | | | | | |
| *Pygmarrhopalites sacer* | Cave springtail | Calciphiles | Caves | | | | | |
| *Pygmarrhopalites caedus* | A cave springtail | Caves | Occurrence Protection | | | | | |
| *Pyrgus wyandot* | Appalachian grizzled skipper | Fire Dependent and Fire Enhanced | Lepidopterans | Open Woodlands | Sensitive to Over-Collection | Shale barrens | Species in a Special Biologic Area | |
| *Pyrola elliptica* | shinleaf | High Elevation Coniferous, Deciduous and/or Mixed Forests | Occurrence Protection | Species in a Special Biologic Area | | | | |
| *Regulus satrapa* | golden-crowned kinglet | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | | | | | |
| *Ribes americanum* | wild black currant | Species in a Special Biologic Area | Riparian | | | | | |
| *Rosa setigera* | prairie rose | Calciphiles | Open Woodlands | Shale barrens | | | | |
| *Rubus idaeus ssp. strigosus* | American red raspberry | High Elevation Openings, grassy or shrubby or open woodlands | Species in a Special Biologic Area | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Ruellia purshiana* | Pursh's wild petunia | Alkaline glades and barrens | Calciphiles | Fire Dependent and Fire Enhanced | Mafic rocks | | | |
| *Sabatia campanulata* | slender marsh rose-pink | Species in a Special Biologic Area | Riparian | | | | | |
| *Sagittaria calycina var calycina* | long-lobed arrowhead | Species in a Special Biologic Area | Riparian | | | | | |
| *Sagittaria rigida* | sessile-fruited arrowhead | Riparian | | | | | | |
| *Satyrium favonius ontario* | Northern Hairstreak | Lepidopterans | Occurrence Protection | Open Woodlands | | | | |
| *Saxifraga pensylvanica* | swamp saxifrage | Riparian | | | | | | |
| *Schizachne purpurascens* | purple oat-grass | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | Riparian | | | | |
| *Schoenoplectus subterminalis* | water bulrush | Riparian | Species in a Special Biologic Area | | | | | |
| *Scirpus ancistrochaetus* | northeastern bulrush | Riparian | Species in a Special Biologic Area | | | | | |
| *Scirpus torreyi* | | Riparian | | | | | | |
| *Sciurus carolinensis* | gray squirrel | Late Successional Hardwood Dominated Forest | Hard and Soft Mast Dependent | Cavity Trees, Den Trees and Snags | Riparian | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Sciurus niger* | Eastern fox squirrel | Area Sensitive Grassland and Shrubland and Open Woodlands | Cavity Trees, Den Trees and Snags | Fire Dependent and Fire Enhanced | Hard and Soft Mast Dependent | | | |
| *Scolopax minor* | American woodcock | Grasslands | Riparian | | | | | |
| *Scutellaria parvula var. parvula* | small skullcap | Calciphiles | Cliff and Talus and large rock outcrops | Open Woodlands | | | | |
| *Scutellaria saxatilis* | Rock skullcap | Cliff and Talus and large rock outcrops | Open Woodlands | | | | | |
| *Seiurus noveboracensis* | northern waterthrush | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | Riparian | | | |
| *Semionellus placidus* | Millipede | Late Successional Hardwood Dominated Forest | Occurrence Protection | | | | | |
| *Sibbaldiopsis tridentata* | three-toothed cinquefoil | Cliff and Talus and large rock outcrops | Sensitive to Recreation Traffic | Species in a Special Biologic Area | | | | |
| *Sida hermaphrodita* | Virginia mallow | Riparian | | | | | | |
| *Sitta canadensis* | red-breasted nuthatch | Cavity Trees, Den Trees and Snags | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Solidago arguta var. harrisii* | Shale Barren Goldenrod | Shale barrens | | | | | | |
| *Solidago randii = S. simplex var. randii* | Rand's goldenrod | Species in a Special Biologic Area | Mafic rocks | | | | | |
| *Solidago rupestris* | riverbank goldenrod | Species in a Special Biologic Area | Riparian | | | | | |
| *Solidago uliginosa* | bog goldenrod | Species in a Special Biologic Area | Riparian | | | | | |
| *Sorex palustris punctulatus* | southern water shrew | High Elevation Coniferous, Deciduous and/or Mixed Forests | Riparian | Species in a Special Biologic Area | | | | |
| *Sparganium chlorocarpum = S. emersum* | narrow-leaf burreed | Species in a Special Biologic Area | Riparian | | | | | |
| *Spartina pectinata* | freshwater cordgrass | Riparian | | | | | | |
| *Speyeria atlantis* | Atlantis fritillary | Lepidopterans | Species in a Special Biologic Area | Riparian | | | | |
| *Speyeria diana* | Diana fritillary | Lepidopterans | Open Woodlands | Sensitive to Over-Collection | | | | |
| *Speyeria idalia* | Regal fritillary | Area Sensitive Grasslands. | Lepidopterans | Sensitive to Over-Collection | | | | |
| *Sphagnum russowii* | Russow's peatmoss | Species in a Special Biologic Area | Riparian | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Sphyrapicus varius* | yellow-bellied sapsucker | High Elevation Coniferous, Deciduous and/or Mixed Forests | High Elevation Openings, grassy or shrubby or open woodlands | Riparian | Cavity Trees, Den Trees and Snags | | | |
| *Spilogale putorius* | Spotted Skunk | Late Successional Hardwood Dominated Forest | Shrublands | Cliff and Talus and large rock outcrops | | | | |
| *Spiranthes lucida* | shining ladies'-tresses | Riparian | | | | | | |
| *Spiranthes ochroleuca* | yellow nodding ladies'-tresses | Riparian | Open Woodlands | Species in a Special Biologic Area | | | | |
| *Sporobolus neglectus* | small dropseed | Cliff and Talus and large rock outcrops | Shale barrens | Calciphiles | | | | |
| *Stygobromus gracilipes* | Shenandoah Valley cave amphipod | Calciphiles | Caves | | | | | |
| *Stygobromus hoffmani* | Alleghany County cave amphipod | Calciphiles | Caves | | | | | |
| *Stygobromus morrisoni* | Morrison's cave amphipod | Calciphiles | Caves | | | | | |
| *Stygobromus mundus* | Bath County cave amphipod | Calciphiles | Caves | | | | | |
| *Stygobromus sp. 7* | Sherando spinosid amphipod | Calciphiles | Caves | | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Stygobromus sp. nov.* | Massanutten Spring Amphipod | Calciphiles | Caves | | | | | |
| *Sylvilagus obscurus* | Appalachian Cottontail | High Elevation Coniferous, Deciduous and/or Mixed Forests | High Elevation Openings, grassy or shrubby or open woodlands | | | | | |
| *Sylvilagus obscurus* | Appalachian Cottontail | Riparian | | | | | | |
| *Symphoricarpos albus* | snowberry | Calciphiles | Cliff and Talus and large rock outcrops | Species in a Special Biologic Area | | | | |
| *Taenidia montana* | Virginia mountain pimpernel | Shale barrens | | | | | | |
| *Thryomanes bewickii altus* | Appalachian Bewick's wren | High Elevation Openings, grassy or shrubby or open woodlands | Cavity Trees, Den Trees and Snags | Grasslands | Shrublands | | | |
| *Thuja occidentalis* | Northern white cedar | Cliff and Talus and large rock outcrops | Species in a Special Biologic Area | Calciphiles | | | | |
| *Triadenum fraseri* | Fraser's marsh St. John's-wort | Riparian | Species in a Special Biologic Area | | | | | |
| *Triantha racemosa* | coastal false-asphodel | Riparian | Species in a Special Biologic Area | | | | | |
| *Trichostema setaceum* | narrow-leaved blue curls | Open Woodlands | Shale barrens | Species in a Special Biologic Area | | | | |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Trifolium virginicum* | Kate's mountain clover | Species in a Special Biologic Area | Shale barrens | | | | | |
| *Trillium pusillum var. virginianum* | mountain least trillium | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | | | | | |
| *Triodopsis picea* | Spruce Knob threetooth | Occurrence Protection | | | | | | |
| *Triphora trianthophora* | nodding pogonia | Species in a Special Biologic Area | Occurrence Protection | | | | | |
| *Troglodytes troglodytes* | winter wren | High Elevation Coniferous, Deciduous and/or Mixed Forests | Species in a Special Biologic Area | Riparian | Cavity Trees, Den Trees and Snags | | | |
| *Tyto alba* | barn owl | Area Sensitive Grasslands. | Cavity Trees, Den Trees and Snags | Grasslands | | | | |
| *Ursus americanus* | black bear | Area Sensitive Mature Coniferous, Deciduous, and/or Mixed Forest Associates | Late Successional Hardwood Dominated Forest | Cavity Trees, Den Trees and Snags | Grasslands | Hard and Soft Mast Dependent | Open Woodlands | Regenerating Forests & Shrublands |
| *Vaccinium macrocarpon* | large cranberry | Species in a Special Biologic Area | Riparian | | | | | |
| *Verbena scabra* | sandpaper vervain | Riparian | | | | | | |
| *Vermivora chrysoptera* | golden winged warbler | Area Sensitive Grassland and Shrubland and Open Woodlands | High Elevation Openings, grassy or shrubby or open woodlands | Fire Dependent and Fire Enhanced | Grasslands | Riparian | Open Woodlands | Shrublands |

| Species Scientific Name | Common Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name | Species Group Name |
|---|---|---|---|---|---|---|---|---|
| *Veronica scutellata* | marsh speedwell | Riparian | | | | | | |
| *Viburnum lentago* | nannyberry | Riparian | | | | | | |
| *Vicia americana* | American purple vetch | Riparian | Ruderal | | | | | |
| *Viola pedatifida* | prairie violet | Species in a Special Biologic Area | Shale barrens | | | | | |
| *Virginia valeriae pulchra* | mountain earth snake | Grasslands | Open Woodlands | Shrublands | | | | |
| *Vitis rupestris* | sand grape | Species in a Special Biologic Area | Riparian | | | | | |
| *Woodwardia virginica* | Virginia chainfern | Species in a Special Biologic Area | Riparian | | | | | |
| *Zigadenus elegans ssp. glaucus = Anticlea glauca* | white camas | Cliff and Talus and large rock outcrops | Open Woodlands | Calciphiles | | | | |
| *Zygonopus weyeriensis* | Grand Caverns blind cave millipede | Calciphiles | Caves | | | | | |
| *Zygonopus whitei* | Luray Caverns blind cave millipede | Calciphiles | Caves | | | | | |

# APPENDIX F3. SPECIES STRESSES AND THREATS AND FOREST PLAN STRATEGIES

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Adlumia fungosa* | 0 None or Unknown | 0 None or Unknown | |
| *Aegolius acadicus* | 1 Terrestrial System/Habitat Stresses | 8.1 Non-native invasive species | Establish Invasive Species Control Guidelines |
| *Aegolius acadicus* | 1 Terrestrial System/Habitat Stresses | 9.5.1 Acid deposition | Continue air resource management activities to reduce impacts of acid deposition |
| *Aegolius acadicus* | 1.3.1 Limited existing distribution of system/habitat | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Aegolius acadicus* | 1.3.1 Limited existing distribution of system/habitat | 11 Climate Change and Weather | Utilize Jefferson riparian standards |
| *Aegolius acadicus* | 2 Aquatic System/Habitat Stresses | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Aegolius acadicus* | 2 Aquatic System/Habitat Stresses | 11 Climate Change and Weather | Utilize Jefferson riparian standards |
| *Aegolius acadicus* | 2 Aquatic System/Habitat Stresses | 7.33 Lack of disturbance; succession | Utilize Jefferson riparian standards |
| *Alnus incana ssp. rugosa* | 2.5 Aquatic/Riparian system modification | 8.1 Non-native invasive species | Utilize Jefferson riparian standards |
| *Ambystoma tigrinum* | 1.2 Modification of vegetation | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Ammodramus henslowii* | 1.1 Conversion and fragmentation | 7 Modification of natural systems | Establish objective for grasslands of various sizes |
| *Ammodramus henslowii* | 2 Aquatic System/Habitat Stresses | 7.33 Lack of disturbance; succession | Utilize Jefferson riparian standards |
| *Anaphalis margaritacea* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Apochthonius holsingeri* | 0.3 Unknown | 0.2 Unknown | |
| *Aquila chrysaetos* | 1.1 Conversion and fragmentation | A Highly modified land uses | |
| *Aquila chrysaetos* | 3.1.1 Accidental mortality | A Highly modified land uses | |
| *Aquila chrysaetos* | 3.1.2 Persecution mortality | 5.1.1 Hunting and/or poaching of terrestrial animals | Enforce laws on off road use, illegal hunting |
| *Arabis patens* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Arabis patens* | 1.2.2 Modification of vegetation composition | 8.1 Non-native invasive species | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Arabis patens* | 1.3 Limited distribution of the system/habitat | 8.2 Problematic native species | |
| *Arabis serotina* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | |
| *Arabis serotina* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Arabis serotina* | 3.3.2 Predation | 8.2 Problematic native species | |
| *Aralia hispida* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Arnoglossom muehlenbergii* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Aster radula* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Astragalus distortus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Autochton cellus* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish Lepidopteran guidelines |
| *Autochton cellus* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Bartramia longicauda* | 1.1 Conversion and fragmentation | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Bartramia longicauda* | 1.1 Conversion and fragmentation | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Bartramia longicauda* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Betula cordifolia* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Boloria selene* | 1.1 Conversion and fragmentation | 7.33 Lack of disturbance; succession | Establish desired condition for riparian areas |
| *Boloria selene* | 1.1 Conversion and fragmentation | 7.34 Loss of beaver activity | Establish desired condition for riparian areas |
| *Boloria selene* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Boltonia montana* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Bonasa umbellus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Bonasa umbellus* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Bonasa umbellus* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Bromus ciliatus* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Bromus kalmii* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Buckleya distichophylla* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Callophrys irus* | 1 Terrestrial System/Habitat Stresses | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Callophrys irus* | 1 Terrestrial System/Habitat Stresses | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Callophrys irus* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Callophrys irus* | 1.2.2 Modification of vegetation composition | 7 Modification of natural systems | Establish fire objective of 12,000 to 20,000 acres per year |
| *Callophrys irus* | 1.2.2 Modification of vegetation composition | 7 Modification of natural systems | Establish Lepidopteran guidelines |
| *Callophrys irus* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Calopogon tuberosus* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Campanula rotundifolia* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Caprimulgus carolinensis* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Caprimulgus carolinensis* | 1.2.2 Modification of vegetation composition | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Caprimulgus carolinensis* | 1.2.2 Modification of vegetation composition | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Caprimulgus vociferus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Caprimulgus vociferus* | 1.2.2 Modification of vegetation composition | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Caprimulgus vociferus* | 1.2.2 Modification of vegetation composition | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Carex aquatilis* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Carex arctata* | 0 None or Unknown | 0 None or Unknown | |
| *Carex barrattii* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Carex buxbaumii* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Carex lasiocarpa var. americana* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Carex polymorpha* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Carex polymorpha* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | |
| *Carex roanensis* | 1.2 Modification of vegetation | 7 Modification of natural systems | Establish guidelines for species occurrence |
| *Carex schweinitzii* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Carex vesicaria* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Carpodacus purpureus* | 1.2.2 Modification of vegetation composition | 9.5.1 Acid deposition | Continue air resource management activities to reduce impacts of acid deposition |
| *Carpodacus purpureus* | 1.3.1 Limited existing distribution of system/habitat | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Carpodacus purpureus* | 1.3.1 Limited existing distribution of system/habitat | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Carpodacus purpureus* | 1.3.1 Limited existing distribution of system/habitat | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Carpodacus purpureus* | 2.5 Aquatic/Riparian system modification | 7.33 Lack of disturbance; succession | Utilize Jefferson riparian standards |
| *Castor canadensis* | 1.3.1 Limited existing distribution of system/habitat | 5.1.1 Hunting and/or poaching of terrestrial animals | Establish desired condition for riparian areas |
| *Castor canadensis* | 3.1.2 Persecution mortality | 6 Human intrusions and disturbance | Establish desired condition for riparian areas |
| *Catharus guttatus* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Catocala herodias gerhardi* | 1 Terrestrial System/Habitat Stresses | 7.1 Fire and fire suppression | Establish Lepidopteran guidelines |
| *Catocala herodias gerhardi* | 1 Terrestrial System/Habitat Stresses | 8.1 Non-native invasive species | Establish Lepidopteran guidelines |
| *Catocala marmorata* | 0.3 Unknown | 0.2 Unknown | |
| *Certhia americana* | 1 Terrestrial System/Habitat Stresses | 9.5.1 Acid deposition | Continue air resource management activities to reduce impacts of acid deposition |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Certhia americana* | 1.3 Limited distribution of the system/habitat | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Certhia americana* | 1.3 Limited distribution of the system/habitat | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Certhia americana* | 1.3 Limited distribution of the system/habitat | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Certhia americana* | 2 Aquatic System/Habitat Stresses | 9.5.1 Acid deposition | Utilize Jefferson riparian standards |
| *Cheilanthes eatonii* | 1 Terrestrial System/Habitat Stresses | 6 Human intrusions and disturbance | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Cicindela ancocisconensis* | 2 Aquatic System/Habitat Stresses | 7.2 Dams and water management | Utilize Jefferson riparian standards |
| *Cicindela ancocisconensis* | 2 Aquatic System/Habitat Stresses | 7.32 Off Road Vehicles | Enforce laws on off road use, illegal hunting |
| *Cicindela ancocisconensis* | 2 Aquatic System/Habitat Stresses | A.3.2 Mining and quarrying | |
| *Cicindela patruela* | 1 Terrestrial System/Habitat Stresses | 6 Human intrusions and disturbance | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Cicindela patruela* | 1 Terrestrial System/Habitat Stresses | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Cicindela patruela* | 1 Terrestrial System/Habitat Stresses | 7.32 Off Road Vehicles | Enforce laws on off road use, illegal hunting |
| *Cirsium altissimum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Clematis albicoma* | 1.2 Modification of vegetation | 7.33 Lack of disturbance; succession | |
| *Clematis occidentalis* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Clematis occidentalis* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Clematis viticaulis* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Clemmys guttata* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Coccyzus erythropthalmus* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Colias interior* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish Lepidopteran guidelines |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Colias interior* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Contopus borealis* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Corallorhiza bentleyi* | 0.2 Lack of knowledge | 0 None or Unknown | |
| *Corallorhiza bentleyi* | 0.2 Lack of knowledge | 0.2 Unknown | |
| *Cornus canadensis* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for species occurrence |
| *Cornus canadensis* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Cornus rugosa* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Corynorhinus townsendii virginianus* | 3.2 Disrupted activity/energy budgets | 6 Human intrusions and disturbance | Establish guidelines for caves and karstlands |
| *Corynorhinus townsendii virginianus* | 3.3.5 Disease | 8.1 Non-native invasive species | Establish guidelines for caves and karstlands |
| *Crataegus calpodendron* | 3.5 Limited population size | 7 Modification of natural systems | Establish guidelines for species occurrence |
| *Crataegus pruinosa* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Crotalus horridus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Crotalus horridus* | 3.1.2 Persecution mortality | 5.1.1 Hunting and/or poaching of terrestrial animals | Enforce laws on off road use, illegal hunting |
| *Cuscuta coryli* | 0.3 Unknown | 0.2 Unknown | |
| *Cuscuta rostrata* | 0.3 Unknown | 0.2 Unknown | |
| *Cyperus dentatus* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Cypripedium reginae* | 1.2.1 Modification of vegetation structure | 7 Modification of natural systems | Establish guidelines for species occurrence |
| *Cypripedium reginae* | 3.1.2 Persecution mortality | 5.2 Collection of plants | Establish guidelines for overcollection |
| *Cypripedium reginae* | 3.3.2 Predation | 8.2 Problematic native species | |
| *Cystopteris fragilis* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Delphinium exaltatum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Dendroica fusca* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Dendroica magnolia* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Desmodium canadense* | 0.3 Unknown | 0.2 Unknown | |
| *Desmodium cuspidatum* | 0.3 Unknown | 0.2 Unknown | |
| *Desmodium sessilifolium* | 0.3 Unknown | 0.2 Unknown | |
| *Echinacea laevigata* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Echinodorus tenellus* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Eleocharis compressa* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Eleocharis melanocarpa* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Eleocharis robbinsii* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Elymus canadensis* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Elymus trachycaulus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Empidonax alnorum* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Epilobium ciliatum* | 2 Aquatic System/Habitat Stresses | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Epilobium leptophyllum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Equisetum sylvaticum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Eriocaulon aquaticum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Eriogonum allenii* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Eriogonum allenii* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Eriogonum allenii* | 1.2.2 Modification of vegetation composition | 8.1 Non-native invasive species | Establish Invasive Species Control Guidelines |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Erora laeta* | 1 Terrestrial System/Habitat Stresses | 8 Invasive & problematic species | Establish Lepidopteran guidelines |
| *Erora laeta* | 1.2 Modification of vegetation | 7 Modification of natural systems | Establish guidelines for species occurrence |
| *Erora laeta* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Erynnis martialis* | 1 Terrestrial System/Habitat Stresses | 7.1 Fire and fire suppression | Establish Lepidopteran guidelines |
| *Erynnis martialis* | 1 Terrestrial System/Habitat Stresses | 8.1 Non-native invasive species | Establish Lepidopteran guidelines |
| *Erynnis martialis* | 1.2 Modification of vegetation | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Erynnis martialis* | 1.2 Modification of vegetation | 7.33 Lack of disturbance; succession | Utilze timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Erynnis martialis* | 1.2 Modification of vegetation | 8.2 Problematic native species | |
| *Erynnis martialis* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Erynnis persius* | 1 Terrestrial System/Habitat Stresses | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Erynnis persius* | 1 Terrestrial System/Habitat Stresses | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Erynnis persius* | 1.1 Conversion and fragmentation | 8.1 Non-native invasive species | Establish Lepidopteran guidelines |
| *Erynnis persius* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Erysimum capitatum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Euchloe olympia* | 1 Terrestrial System/Habitat Stresses | A Highly modified land uses | Establish Lepidopteran guidelines |
| *Euchloe olympia* | 3 Species Population Stresses | 8.1 Non-native invasive species | Establish Lepidopteran guidelines |
| *Euchloe olympia* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Eumeces anthracinus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Eupatorium maculatum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Euphorbia purpurea* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Gaylussacia brachycera* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Gaylussacia brachycera* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | |
| *Geranium robertianum* | 1.3 Limited distribution of the system/habitat | 5.3 Timber harvest | Establish guidelines for cliff and talus and shale barren areas |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Glaucomys sabrinus fuscus* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Glyceria acutiflora* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Glyceria grandis* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Glyphyalinia raderi* | 1 Terrestrial System/Habitat Stresses | A Highly modified land uses | Establish guidelines for species occurrence |
| *Glyphyalinia raderi* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish guidelines for species occurrence |
| *Glyphyalinia raderi* | 3 Species Population Stresses | 9.5.1 Acid deposition | Continue air resource management activities to reduce impacts of acid deposition |
| *Glyphyalinia raderi* | 3.1.1 Accidental mortality | 6.1 Recreational activities | Establish guidelines for species occurrence |
| *Glyphyalinia raderi* | 3.3 Interspecific interactions | 8.1 Non-native invasive species | |
| *Glyptemys insculpta* | 2 Aquatic System/Habitat Stresses | 7 Modification of natural systems | Establish management strategy for managing wood turtle habitat |
| *Glyptemys insculpta* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | |
| *Glyptemys insculpta* | 3.1.2 Persecution mortality | 5.1.1 Hunting and/or poaching of terrestrial animals | Enforce laws on off road use, illegal hunting |
| *Glyptemys insculpta* | 3.1.2 Persecution mortality | 5.1.1 Hunting and/or poaching of terrestrial animals | Establish guidelines for overcollection |
| *Gnaphalium uliginosum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Goodyera repens* | 1.2 Modification of vegetation | 5.3 Timber harvest | Establish guidelines for species occurrence |
| *Gymnocarpium appalachianum* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Gymnocarpium appalachianum* | 1.2 Modification of vegetation | 5.3 Timber harvest | Establish guidelines for species occurrence |
| *Hansonoperla appalachia* | 2 Aquatic System/Habitat Stresses | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Helenium virginicum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Helenium virginicum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Helianthemum bicknellii* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Helianthemum propinquum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Helicodiscus diadema* | 1 Terrestrial System/Habitat Stresses | 7.32 Off Road Vehicles | Enforce laws on off road use, illegal hunting |
| *Helicodiscus diadema* | 1 Terrestrial System/Habitat Stresses | A Highly modified land uses | Establish guidelines for species occurrence |
| *Helicodiscus diadema* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish guidelines for species occurrence |
| *Helicodiscus diadema* | 3 Species Population Stresses | 9.5.1 Acid deposition | Continue air resource management activities to reduce impacts of acid deposition |
| *Helicodiscus diadema* | 3.1.1 Accidental mortality | 6.1 Recreational activities | Establish guidelines for species occurrence |
| *Helicodiscus diadema* | 3.3 Interspecific interactions | 8.1 Non-native invasive species | |
| *Helicodiscus triodus* | 1 Terrestrial System/Habitat Stresses | A Highly modified land uses | Establish guidelines for species occurrence |
| *Helicodiscus triodus* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish guidelines for species occurrence |
| *Helicodiscus triodus* | 3 Species Population Stresses | 9.5.1 Acid deposition | Continue air resource management activities to reduce impacts of acid deposition |
| *Helicodiscus triodus* | 3.1.1 Accidental mortality | 6.1 Recreational activities | Establish guidelines for species occurrence |
| *Helicodiscus triodus* | 3.3 Interspecific interactions | 8.1 Non-native invasive species | |
| *Helonias bullata* | 1.3.2 Limited potential distribution of system/habitat | 7 Modification of natural systems | |
| *Helonias bullata* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Helonias bullata* | 3.3.2 Predation | 8.2 Problematic native species | |
| *Heuchera alba* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Heuchera alba* | 3.5 Limited population size | 7 Modification of natural systems | Establish guidelines for species occurrence |
| *Houstonia canadensis* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Huperzia appalachiana* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Huperzia appalachiana* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Hydraena maureenae* | 2 Aquatic System/Habitat Stresses | 11.2 Droughts | Utilize Jefferson riparian standards |
| *Hypericum boreale* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Hypericum mitchellianum* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Hypericum mitchellianum* | 1.2 Modification of vegetation | 5.3 Timber harvest | Establish guidelines for species occurrence |
| *Iliamna remota* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Incisalia polia* | 1.2.2 Modification of vegetation composition | 7 Modification of natural systems | Establish Lepidopteran guidelines |
| *Isoetes lacustris* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Isonychia tusculanensis* | 0.3 Unknown | 0.2 Unknown | |
| *Isonychia tusculanensis* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Juglans cinerea* | 3.3.5 Disease | 8 Invasive & problematic species | |
| *Juncus brachycephalus* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Juncus brevicaudatus* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Juniperus communis var depressa* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Kleptochthonius anophthalmus* | 1 Terrestrial System/Habitat Stresses | A Highly modified land uses | Establish guidelines for caves and karstlands |
| *Lepus americanus* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Lepus americanus* | 1.2 Modification of vegetation | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Lepus americanus* | 1.2 Modification of vegetation | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Leucothoe fontanesiana* | 1.3 Limited distribution of the system/habitat | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Leuctra mitchellensis* | 0.3 Unknown | 0.2 Unknown | |
| *Leuctra mitchellensis* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Leuctra monticola* | 0.3 Unknown | 0.2 Unknown | |
| *Leuctra monticola* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Liatris helleri* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Linum lewisii* | 1.3.2 Limited potential distribution of system/habitat | 7 Modification of natural systems | |
| *Linum sulcatum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Liochlorophis vernalis* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Liparis loeselii* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Lonicera canadensis* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Lonicera canadensis* | 2 Aquatic System/Habitat Stresses | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Loxia curvirostra* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Lycopodiella inundata* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Lythrum alatum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Maianthemum stellatum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Martes pennanti* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Megaleuctra flinti* | 2 Aquatic System/Habitat Stresses | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Megaleuctra flinti* | 2 Aquatic System/Habitat Stresses | 7.2 Dams and water management | Utilize Jefferson riparian standards |
| *Megaleuctra flinti* | 2.3 Water temperature modification | 11.3 Temperature extremes | Utilize Jefferson riparian standards |
| *Megaleuctra flinti* | 2.4 Water chemistry modification | 9.5.1 Acid deposition | Utilize Jefferson riparian standards |
| *Melica nitens* | 1.3.2 Limited potential distribution of system/habitat | 7 Modification of natural systems | |
| *Microtus chrotorrhinus carolinensis* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Miktoniscus racovitzai* | 1 Terrestrial System/Habitat Stresses | A Highly modified land uses | Establish guidelines for caves and karstlands |
| *Minuartia groenlandica* | 3.1.1 Accidental mortality | 6.1 Recreational activities | Establish guidelines for recreation traffic |
| *Monotropsis odorata* | 0 None or Unknown | 0 None or Unknown | |
| *Muhlenbergia glomerata* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Myotis sodalis* | 1.3 Limited distribution of the system/habitat | 0.1 None | |
| *Myotis sodalis* | 3.2 Disrupted activity/energy budgets | 6 Human intrusions and disturbance | Establish guidelines for caves and karstlands |
| *Myotis sodalis* | 3.3.5 Disease | 8 Invasive & problematic species | Establish guidelines for caves and karstlands |
| *Nampabius turbator* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Nannaria shenandoah* | 0.3 Unknown | 0.2 Unknown | |
| *Nannaria shenandoah* | 1 Terrestrial System/Habitat Stresses | A Highly modified land uses | Establish guidelines for species occurrence |
| *Nemotaulius hostilis* | 0.3 Unknown | 0.2 Unknown | |
| *Nemotaulius hostilis* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Oenothera argillicola* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Oligoneuron rigidum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Onosmodium virginianum* | 1.3.2 Limited potential distribution of system/habitat | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Oporornis philadelphia* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Oryzopsis asperifolia* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Osmunda cinnamomea var. glandulosa* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Panax quinquefolius* | 3.1 Direct mortality | 5.2 Collection of plants | |
| *Panax quinquefolius* | 3.1.2 Persecution mortality | 5.2 Collection of plants | Establish guidelines for overcollection |
| *Panax trifolius* | 3.1.2 Persecution mortality | 5.2 Collection of plants | Establish guidelines for overcollection |
| *Panicum hemitomon* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Paragnetina ishusa* | 0.3 Unknown | 0.2 Unknown | |
| *Paragnetina ishusa* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Paraleptophlebia jeanae* | 0.3 Unknown | 0.2 Unknown | |
| *Paraleptophlebia jeanae* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Parnassia grandifolia* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Paronychia argyrocoma* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Paronychia argyrocoma* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Paronychia argyrocoma* | 1.2.2 Modification of vegetation composition | 8.1 Non-native invasive species | Establish Invasive Species Control Guidelines |
| *Paronychia virginica* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | |
| *Paronychia virginica* | 1.3.2 Limited potential distribution of system/habitat | 7 Modification of natural systems | Establish fire objective of 12,000 to 20,000 acres per year |
| *Paxistima canbyi* | 1.3.2 Limited potential distribution of system/habitat | 7 Modification of natural systems | |
| *Peltigera hydrothyria* | 2 Aquatic System/Habitat Stresses | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Peltigera hydrothyria* | 2 Aquatic System/Habitat Stresses | 11 Climate Change and Weather | Utilize Jefferson riparian standards |
| *Peltigera hydrothyria* | 2.1 Stream flow modification | 7.2 Dams and water management | Utilize Jefferson riparian standards |
| *Peltigera hydrothyria* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | |
| *Peltigera hydrothyria* | 3.5 Limited population size | 0.2 Unknown | |
| *Perlesta frisoni* | 0.3 Unknown | 0.2 Unknown | |
| *Phlox amplifolia* | 0 None or Unknown | 0 None or Unknown | |
| *Phlox buckleyi* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Phyciodes batesii* | 1.2.2 Modification of vegetation composition | 7 Modification of natural systems | Establish Lepidopteran guidelines |
| *Phyciodes cocyta* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish Lepidopteran guidelines |
| *Phyciodes cocyta* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Pituophis melanoleucus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Platanthera grandiflora* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Platanthera peramoena* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Plethodon punctatus* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Plethodon punctatus* | 1.2.1 Modification of vegetation structure | 5.3 Timber harvest | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Plethodon punctatus* | 1.2.1 Modification of vegetation structure | 7 Modification of natural systems | |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Plethodon sherando* | 0 None or Unknown | 0 None or Unknown | |
| *Plethodon sherando* | 1.2.1 Modification of vegetation structure | 5.3 Timber harvest | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Plethodon virginia* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Plethodon virginia* | 1.2.1 Modification of vegetation structure | 5.3 Timber harvest | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Plethodon virginia* | 1.2.1 Modification of vegetation structure | 7 Modification of natural systems | |
| *Poa paludigena* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Poa palustris* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Poa saltuensis* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Polanisia dodecandra* | 2.1 Stream flow modification | 7.2 Dams and water management | Utilize Jefferson riparian standards |
| *Polanisia dodecandra* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Polygonia progne* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish objective for grasslands of various sizes |
| *Polygonia progne* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish objective for oak open woodlands |
| *Polygonia progne* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Potamogeton amplifolius* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Potamogeton hillii* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Potamogeton oakesianus* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Potamogeton tennesseensis* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Potentilla arguta* | 1.2.1 Modification of vegetation structure | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Prunus alleghaniensis* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Prunus nigra* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Pseudanophthalmus avernus* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Pseudanophthalmus avernus* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Pseudanophthalmus intersectus* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Pseudanophthalmus intersectus* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Pseudanophthalmus nelsoni* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Pseudanophthalmus nelsoni* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Pseudanophthalmus petrunkevitchi* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Pseudanophthalmus petrunkevitchi* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Pseudognaphalium macounii* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Pseudognaphalium macounii* | 3.3.1 Competition | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Pseudotremia princeps* | 0.3 Unknown | 0.2 Unknown | |
| *Pseudotremia princeps* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Pseudotremia princeps* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Pycnanthemum torreyi* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Pygmarrhopalites carolynae* | 0.3 Unknown | 0.2 Unknown | |
| *Pygmarrhopalites sacer* | 0.3 Unknown | 0.2 Unknown | |
| *Pygmarrhopalites caedus* | 0.3 Unknown | 0.2 Unknown | |
| *Pyrgus wyandot* | 1 Terrestrial System/Habitat Stresses | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Pyrgus wyandot* | 1 Terrestrial System/Habitat Stresses | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Pyrgus wyandot* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Pyrgus wyandot* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Pyrgus wyandot* | 1.2.2 Modification of vegetation composition | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Pyrgus wyandot* | 1.2.2 Modification of vegetation composition | 7.1 Fire and fire suppression | Establish Lepidopteran guidelines |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Pyrgus wyandot* | 1.3.1 Limited existing distribution of system/habitat | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Pyrgus wyandot* | 3 Species Population Stresses | 8.1 Non-native invasive species | Establish Lepidopteran guidelines |
| *Pyrgus wyandot* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Pyrola elliptica* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Pyrola elliptica* | 1.2 Modification of vegetation | 5.3 Timber harvest | |
| *Pyrola elliptica* | 1.3.1 Limited existing distribution of system/habitat | 0 None or Unknown | |
| *Regulus satrapa* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Ribes americanum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Rosa setigera* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Rubus idaeus ssp. strigosus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Ruellia purshiana* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Sabatia campanulata* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Sagittaria calycina var calycina* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Sagittaria rigida* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Satyrium favonius ontario* | 1 Terrestrial System/Habitat Stresses | 8.1 Non-native invasive species | Establish Invasive Species Control Guidelines |
| *Satyrium favonius ontario* | 1.2.2 Modification of vegetation composition | 7.1 Fire and fire suppression | Establish Lepidopteran guidelines |
| *Satyrium favonius ontario* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Satyrium favonius ontario* | 3.5 Limited population size | 0.2 Unknown | |
| *Saxifraga pensylvanica* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Schizachne purpurascens* | 1 Terrestrial System/Habitat Stresses | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Schizachne purpurascens* | 1.2 Modification of vegetation | 7 Modification of natural systems | Protect and maintain occurrences of rare communities in SBAs in addition to those in 1993 Plan |
| *Schoenoplectus subterminalis* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Scirpus ancistrochaetus* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Scirpus torreyi* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Scutellaria parvula var. parvula* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Scutellaria saxatilis* | 0 None or Unknown | 0 None or Unknown | |
| *Seiurus noveboracensis* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Semionellus placidus* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for species occurrence |
| *Sibbaldiopsis tridentata* | 3.1.1 Accidental mortality | 6 Human intrusions and disturbance | Establish guidelines for recreation traffic |
| *Sida hermaphrodita* | 2.1 Stream flow modification | 7.2 Dams and water management | Utilize Jefferson riparian standards |
| *Sida hermaphrodita* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Sitta canadensis* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Solidago arguta var. harrisii* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Solidago arguta var. harrisii* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Solidago arguta var. harrisii* | 1.2.2 Modification of vegetation composition | 8.1 Non-native invasive species | Establish Invasive Species Control Guidelines |
| *Solidago randii = S. simplex var. randii* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Solidago rupestris* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Solidago uliginosa* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Sorex palustris punctulatus* | 1 Terrestrial System/Habitat Stresses | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Sparganium chlorocarpum = S. emersum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Spartina pectinata* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Speyeria atlantis* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish Lepidopteran guidelines |
| *Speyeria atlantis* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Speyeria diana* | 1 Terrestrial System/Habitat Stresses | A.3.2 Mining and quarrying | Establish Lepidopteran guidelines |
| *Speyeria diana* | 1.2 Modification of vegetation | 8.1 Non-native invasive species | Establish Invasive Species Control Guidelines |
| *Speyeria diana* | 1.2 Modification of vegetation | 8.2 Problematic native species | |
| *Speyeria diana* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Speyeria idalia* | 1.1 Conversion and fragmentation | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Speyeria idalia* | 1.1 Conversion and fragmentation | 7.1 Fire and fire suppression | Establish Lepidopteran guidelines |
| *Speyeria idalia* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Speyeria idalia* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish Lepidopteran guidelines |
| *Speyeria idalia* | 1.2 Modification of vegetation | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Speyeria idalia* | 3.1.2 Persecution mortality | 5.1.2 Collection of terrestrial animals | Establish guidelines for overcollection |
| *Speyeria idalia* | 3.6 Isolation of metapopulations | 7 Modification of natural systems | |
| *Sphagnum russowii* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Sphyrapicus varius* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Spilogale putorius* | 3.3.2 Predation | 8.2 Problematic native species | |
| *Spiranthes lucida* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Spiranthes ochroleuca* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Sporobolus neglectus* | 1.3.1 Limited existing distribution of system/habitat | 7 Modification of natural systems | |
| *Stygobromus gracilipes* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Stygobromus gracilipes* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Stygobromus hoffmani* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Stygobromus hoffmani* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Stygobromus morrisoni* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Stygobromus morrisoni* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Stygobromus mundus* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Stygobromus mundus* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Stygobromus sp. 7* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Stygobromus sp. 7* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Stygobromus sp. 7* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Stygobromus sp. nov.* | 0.3 Unknown | 0.2 Unknown | |
| *Stygobromus sp. nov.* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Sylvilagus obscurus* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Establish fire objective of 12,000 to 20,000 acres per year |
| *Sylvilagus obscurus* | 1.2.1 Modification of vegetation structure | 7.33 Lack of disturbance; succession | Utilize timber harvest to create early successional habitat, annual harvest of 1,800 - 3,000 acres |
| *Sylvilagus obscurus* | 1.2.1 Modification of vegetation structure | A.2 Agriculture | |
| *Sylvilagus obscurus* | 3.3.1 Competition | 7 Modification of natural systems | |
| *Symphoricarpos albus* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Taenidia montana* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Thuja occidentalis* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Triadenum fraseri* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Triantha racemosa* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Trichostema setaceum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Trifolium virginicum* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Trillium pusillum var. virginianum* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |

| Species Name | Stress | Threat | Management Strategies |
|---|---|---|---|
| *Trillium pusillum var. virginianum* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Triodopsis picea* | 1 Terrestrial System/Habitat Stresses | A Highly modified land uses | Establish guidelines for species occurrence |
| *Triodopsis picea* | 1.2 Modification of vegetation | 7.1 Fire and fire suppression | Establish guidelines for species occurrence |
| *Triodopsis picea* | 3 Species Population Stresses | 9.5.1 Acid deposition | Continue air resource management activities to reduce impacts of acid deposition |
| *Triodopsis picea* | 3.1.1 Accidental mortality | 6.1 Recreational activities | Establish guidelines for recreation traffic |
| *Triodopsis picea* | 3.3 Interspecific interactions | 8.1 Non-native invasive species | |
| *Triphora trianthophora* | 0 None or Unknown | 0 None or Unknown | |
| *Troglodytes troglodytes* | 1.2 Modification of vegetation | 11 Climate Change and Weather | Establish management strategy for climate change incl land allocation, obj and desired conditions |
| *Vaccinium macrocarpon* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Verbena scabra* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Veronica scutellata* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Viburnum lentago* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Vicia americana* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Viola pedatifida* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Virginia valeriae pulchra* | 0 None or Unknown | 0 None or Unknown | |
| *Vitis rupestris* | 2.5 Aquatic/Riparian system modification | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Woodwardia virginica* | 2 Aquatic System/Habitat Stresses | 7 Modification of natural systems | Utilize Jefferson riparian standards |
| *Zigadenus elegans ssp. glaucus = Anticlea glauca* | 1.2.1 Modification of vegetation structure | 7.1 Fire and fire suppression | Establish fire objective of 12,000 to 20,000 acres per year |
| *Zygonopus weyeriensis* | 0.3 Unknown | 0.2 Unknown | |
| *Zygonopus weyeriensis* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Zygonopus weyeriensis* | 1 Terrestrial System/Habitat Stresses | 7 Modification of natural systems | Establish guidelines for caves and karstlands |
| *Zygonopus whitei* | 1 Terrestrial System/Habitat Stresses | 6.1 Recreational activities | Establish guidelines for caves and karstlands |
| *Zygonopus whitei* | 1 Terrestrial System/Habitat Stresses | 8.1 Non-native invasive species | Establish guidelines for caves and karstlands |

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