07/15/2003

Viability Assessment Report
For
Rock Outcrops Habitat Association

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I. Description of the Habitat Association

A. Physical Description

Location of Habitat Association on the Daniel Boone National Forest

Rock outcrops appear in a variety of forms throughout the Daniel Boone National Forest (DBNF) on all administrative Districts. Outcrops generally occur as sandstone, limestone or to a lesser extent mudstone/siltstone/shale rock exposures. These outcrops can take several forms including: exposed rock on the surface of the landscape, glades, talus slopes and, in their most striking appearance, as cliffs. Cliffline associated caves and rockshelters are also found throughout the DBNF and are an important part of this habitat association. Caves that are not associated with clifflines are also part of this habitat association. Additional information regarding cave systems is delineated in the Karst water section of the Lotic Water Habitat Association. Rockshelters, either sandstone or limestone, are overhangs or shallow caves that may include dark zones and are usually located along clifflines throughout the Forest.

Primary Landtype Associations (LTAs) on the DBNF which contain elements of the Rock Outcrop Habitat Association include:

- Central Knobstone Escarpment (221Hb0010
- Central Cliff (221Hb002)
- North Fork Kentucky Cliffs (221Hb003)
- Northern Escarpment (221Hb004)
- Northern Low Hills/Cliff Transition (221Hb005)
- Northern Cliff/Karst (221Hb006)
- Southern Knobstone Escarpment (221Hc001)
- Southern Knobstone Escarpment Transition (221Hc002)

- Southern Cliff (221Hc003)
- Big South Fork Plateau (221Hc004)
- Rockcastle Hills (221Hc005)
- London-Corbin Plain Transition (221Hc007)
- Northwest Face Pine Mountain (M221Ce001)

Much of the physical and vegetation description for the rock outcrop habitat association was taken from the above landtype association map unit descriptions (USDA, 1997).

Physiographic Position of Habitat Association

This habitat association is located in the Appalachian Plateaus physiographic province. Rock outcrops are found from the highest to the lowest elevations on the Forest (700-2800 feet). Rock outcrops are usually associated with wide to narrow winding ridges between valleys that range from relatively narrow to wide, but usually have steep slopes. Small waterfalls are a common occurrence. Sandstone outcrops including glades, clifflines, rockshelters and caves are usually found near broad to narrow ridgetops at higher positions on the ridge. Limestone outcrops may occur near ridgetops, but are usually found at mid to lower slope areas. Talus slopes can be found immediately below clifflines, but can occur at other locations on the landscape. Sandstone and limestone glades are characteristically found on ridges above clifflines that contain their respective parent material. Mudstone/siltstone/shale rock are usually associated with low ridgetops or toe slopes.

Geology and Soil Types

All the exposed rocks in the DBNF are of sedimentary origin. Rock formations of the Pennsylvanian-age make up most of the exposed rock, but along the western edge of the Forest, Mississippian-age rock is present at the surface (USDA, 1985). The primary geomorphic process for shaping this landscape is water and wind erosion and Karst solution in areas of limestone. Ridges are often capped with resistant sandstone and may or may not have limestone exposed at lower elevations. Some ridgetops are capped with clay shales, siltstone or coal. Cliff formation along valley walls is a result of differential erosion and bedrock block slides.

Soils vary from deep to moderately deep Ultisols, moderately deep Alfisols and moderately deep to shallow Inceptisols. Soil depth ranges from 0 to 40 + inches. Glade communities are normally restricted to xeric shallow soils along the tops of cliffs or rock outcrops. Thin rocky soils accumulate in crevices, on ledges, and along rock margins. Deep soils, up to 40 inches or more can occur immediately adjacent to the base of clifflines.

Hydrology

Maintenance of moisture and temperature regimes in this habitat association is thought to be a principal concern in maintaining viable populations of indigenous plant and animal species. Soils tend to be moderately well- to well-drained. Clifflines are often xeric, however waterfalls and/or seeps are also common in this habitat association and create localized hydric communities. Limestone conduits quickly transmit surface water to underground aquifers and limestone cave systems. Limestone caves are unique ecosystems strongly influenced by a lack of light, a stable and high relative humidity, a limited distribution of nutrients and energy, and moderate, relatively stable temperatures. Many of these caves are associated with underground stream systems and are actively undergoing development while other caves are extremely dry (SAMAB, 1996).

Energy Sources

Direct sunlight provides the basic energy source for much of the trophic pyramid associated with the Rock Outcrop Habitat Association. Energy sources for cave systems are only indirectly associated with sunlight. Much of the energy source in caves is brought in from outside sources. Water flowing through caves brings in outside minerals and nutrients. Bats, woodrats and raccoons, through their guano, provide an important source of organic nutrients for other life forms. Cave crickets, found in nearly all caves on the DBNF, live in caves but exit at night to forage on nearby vegetation. Their feces provide another important energy source to caves. Alleghney woodrats bring in vegetation from outside sources that is utilized by other cave creatures.

B. Vegetation Associated with the Habitat Association

Rock outcrops, in their many forms, occur throughout the DBNF on all administrative Districts and from elevations of 700 to 2800 feet. As a consequence of this wide distribution, vegetation associated with this habitat association is extremely varied. Generally, the rock outcrops occur within a mixed mesophytic and Appalachian oak forest and to a very limited extent, northern hardwood forest. At any specific location within this habitat association, existing vegetation depends greatly upon soil depth and type, aspect, slope, local hydrology and in some cases the presence of cold air-flows down-slope from caves. Clifflines not only form physical transition zones within forested communities, they also delineate vegetation edges in habitat types because of the moisture and soil depth differences between the top and bottom of the cliffline. Oaks and pines are scattered along the tops of sandstone clifflines with pines becoming more prevalent in the southern parts of the DBNF.

Talus Slopes

On the DBNF these rocky slopes are usually forested and a full spectrum of forest types may occur immediately adjacent to them. These areas tend to be moist and usually have a dense moss covering. Some talus slopes with little or no soil accumulation and very little moisture occur throughout the DBNF as sparsely to non-vegetated rock fields. At these sites vegetation is very limited, but does include lichens and some mosses. Rooted, herbaceous plants occur around the periphery of these bare rock areas.

Glades

Both sandstone and limestone glades are frequently associated with areas along the tops of clifflines. Glades are generally flat to moderately steep with shallow soils. They lack overstory vegetation and are dominated by the herbaceous layer. Like talus slopes, myriad forest types may surround glades. Grasses, forbs or low shrubs form the dominant understory plant community. The plant community in glades is usually composed of xeric species although conditions do exist which allow more mesic grass and forb species to dominate in the understory.

Caves

Limestone and sandstone caves do not support plant communities due to the absence of light. However, cold airflows below limestone caves sometimes help produce conditions, which support what is in fact cave associated vegetation. Examples of species include Canadian yew and mountain woodsorrel.

Sandstone Cliffs and Rockhouses

Shortleaf pine, pitch pine and Virginia pine along with a scattering of oaks form the usual overstory near the tops of sandstone clifflines. Scarlet and chestnut oaks and pignut hickory commonly occur along cliffline tops and may be found below the cliffline as well. Additional overstory species that commonly occur below sandstone clifflines includes the above tree species and red maple, white, black and northern red oaks. A mixed mesophytic forest often occurs on cool north facing slopes below sandstone clifflines. Overstory species include a mixture of oaks, American beech, sugar maple, yellow poplar, hickories and bigleaf magnolia.

The cliff face itself is extremely xeric and little vegetation exists in this area. Vegetation is typically sparse and consists of lichens and mosses on the rock face with grasses, sedges, ferns and other vascular plants in deeper soils of ledges and crevices. Locally, hydrologic conditions such as waterfalls, seeps and aspect, create a spray cliff or moist cliff habitat utilized by other vascular herbs, mosses, liverworts and algae.

Rockhouses, in a variety of sizes, commonly occur along the base of sandstone clifflines. Because of cliff overhangs and the sheltered condition of the sandstone rockhouse itself, conditions are usually quite xeric. Some herbaceous vegetation, such as the Federally threatened white-haired goldernrod, occur in these dry sites.

Understory species common to sandstone clifflines include grasses, forbs and blueberries along the top and mountain laurel and rhododendron at the base.

Limestone Cliffs and Rockhouses

White, black, chestnut and scarlet oaks along with scattered pignut hickory make up the dominant overstory along the tops of limestone clifflines. Occasionally, shortleaf, pitch or Virginia pine appears along the tops of limestone cliffs. Overstory species found below limestone clifflines include the oaks mentioned above plus sugar maple white ash, yellow poplar, eastern hemlock, bigleaf magnolia, hickories, sweet buckeye and American beech trees. Red maple is common throughout the limestone cliffline area.

The cliff face itself is fairly xeric and little vegetation exists in this area. Vegetation is typically sparse and consists of lichens and mosses on the rock face with grasses, sedges and other vascular plants in deeper soils of ledges and crevices. Locally, hydrologic conditions such as waterfalls, seeps and aspect, create a spray cliff or moist cliff habitat utilized by other vascular herbs, mosses, liverworts and algae.

Rockhouses, in a variety of sizes, occasionally occur along the base of limestone clifflines. Because of cliff overhangs and the sheltered condition of the limestone rockhouse itself conditions are usually xeric to slightly mesic. Some herbaceous vegetation does occur in these dry sites.

Understory species common to limestone clifflines include a wide variety of herbaceous and shrub species along the top and ferns and other shade tolerant, mesic species along the base.

II. Current Status of the Habitat Association on the Daniel Boone National Forest

Clifflines, Rockshelters and Caves

The DBNF contains approximately 3,040 miles of sandstone and limestone clifflines. Rock outcrops must be at least 10 feet tall and 100 feet long to meet the “cliffline” criteria. Summarized below by Ranger District is the total number of DBNF cliffline miles (USDA, 2000).

District	Miles
London	888
Morehead	300
Redbird	547
Somerset	360
Stanton	435
Stearns	510

Known locations exist for thousands of caves and rockshelters with dark zones within the DBNF. These features are usually associated with some type of cliffline formation. Limestone caves and rockshelters occur primarily on the London, Somerset, Stanton and Morehead Ranger District. Sandstone caves and rockshelters are found on all Ranger

Districts. Many caves remain unsurveyed and it is believed that many caves remain, as yet, undetected. Clifflines and caves are coverage layers in the Geographic Information System (GIS).

Clifflines are currently protected by Forest Plan standards and guidelines that provide a buffer zone of "uninterrupted forest canopy" from 100 feet above to 200 feet below the cliffline (USDA 2000). The purpose of this buffer zone is to protect the moisture, temperature and disturbance sensitive habitats for cliffline associated species.

Mudstone, Siltstone and Shale Outcrops

These rock outcrops do not normally occur as cliffs, but rather low, sloping rock exposures. They occur forest-wide, but are most concentrated on the Morehead Ranger District.

Talus Slopes

Talus slopes occur throughout the DBNF and may or may not be associated with clifflines. Specific locations have not been documented in the GIS database, but these features are known to occur on every Ranger District.

Glades

Glades, although uncommon, do occur along the tops of clifflines and some other locations throughout the DBNF. The size of these areas ranges from about 100 feet to around one acre.

III. Management Needs: Recommendations for the Conservation of Habitat to Ensure Species Viability

The management goal for the rock outcrop habitat association is to maintain the physical and microclimate conditions that will result in a high likelihood that species within this association will persist on the forest over the planning period.

The strategy to accomplish this goal mainly focuses on maintaining zones of limited disturbance around the habitat association. Additional standards and guidelines (S&G) are also recommended when other protective measures are needed to insure the viability of a particular species associated with this habitat association. The management emphasis here is to protect and enhance biological resources associated with this habitat association.

The desired future condition of this habitat association is a generally undisturbed cliffline face, the area above and below the clifflines and a larger area surrounding biologically significant caves and rockshelters.

A. Habitat Association General Direction and S&G

Management standards within the cliffline zone (Unless otherwise noted, the standards and guidelines are current Forest Plan direction.)

- Clifflines forest-wide will be managed to retain a zone of uninterrupted forest canopy 100 feet slope distance from the uphill edge of the cliffline and 200 feet slope distance downhill from the drip line of the cliff. On a site-specific basis vegetative manipulation can be permitted when the objective is to improve habitat conditions for PETS species.

    - *Rationale: Microclimate conditions (temperatures, humidity, moisture) are important in maintaining viable populations of many species occurring in this habitat association. Management activities are sometimes necessary to maintain or enhance individual PETS species habitats.*

- Activities such as rights-of-way, trails, and scenic vistas may be permitted in the cliffline zone as long as they do not negatively impact PETS species or their potential habitat.

    - *Rationale: Limited use of the cliffline zone may not affect species viability on a site-specific basis.*

- Protective measures such as informational signing, posting sites closed and/or barrier construction may be applied to sites that are receiving resource damage through inadvertent human activity.

    - *Rationale: Human use of site-specific areas may need to be modified or restricted.*

- Management activities concentrating public use in the vicinity of sensitive cliffline areas and cliffline faces would be avoided if detrimental impacts were likely to occur.

    - *Rationale: Site-specific activities need to be evaluated to determine the level of potential inadvertent human impacts to species associated with this habitat association.*

B. Species Specific General Direction and S&G for the Rock Outcrop Habitat Association

Provide seasonal protection for peregrine falcon nest sites (Best science available, KDFWR)

- Peregrine falcon eyrie (nesting) sites will be protected from inadvertent human disturbance between 1 February and 30 June. The size of these areas will be determined with consultation from the Kentucky Department of Fish and Wildlife Resources and will be based on terrain and activities that are know to occur near the nest site.

    - *Rationale: Peregrine falcons are very sensitive to human disturbance of nest sites during the reproductive period. Without special protection of these sites abandonment of nest sites is likely to occur.*

Protect or enhance significant (see Amendment 11, Forest Plan, page 58) hibernation and maternity caves/rockshelters for PETS bats. (Forest Plan direction for Virginia and Rafinesque big eared-bats and the Indiana bat) (Additional species of PETS bats were included in this S&G as best science available measure to insure species viability; Bennett 2001)

- The existing forest cover will be left undisturbed by management activities within 1/4 mile of all known significant colony sites, unless the activity is designed to improve habitat for PETS species
    - *Rationale: Forest habitat near the above sites is highly utilized by bat species and is important to maintaining viable populations.*
- Colony sites will be signed or gated to restrict entry where needed.
    - *Rationale: Hibernation and maternity sites are extremely sensitive to human disturbance. Population viability can be negatively affected by continued human use of certain sites.*
- Camping and fire building will be prohibited in or near posted colony sites.
    - *Rationale: Camping in specific areas may serve to invite unwanted, inadvertent use of areas important to maintaining species viability. Smoke associated with campfires may be drawn into caves and cause bats to awaken from hibernation or abandon maternity sites.*
- Sites providing potential (undocumented) habitat for maternity, bachelor, or winter colonies of PETS bats will be managed according to guidelines established for the cliffline zone.
    - *Rationale: Many caves likely remain undetected or unreachable in the cliffline zone. These sites may or may not contain hibernation or maternity bat colonies. The cliffline zone will provide a 300 foot wide protection zone for all cliffline associated caves on the forest.*
- Acquire private lands with known hibernacula or maternity sites from willing sellers.
    - *Rationale: The need for protecting significant bat hibernacula is identified in several bat recovery plans.*
- Acquire private lands located near significant hibernacula and maternity sites from willing sellers.
    - *Rationale: Bats heavily utilize the forest community near hibernation and maternity sites.*

Maintain and protect roost tree and foraging/swarming habitat around significant (see Amendment 11, Forest Plan, page 58) hibernation, staging and maternity sites for PETS bats. (Unless otherwise noted, the S&G are current Forest Plan direction.)

- Overstory tree removal will not be proposed if this activity would result in more than 120 acres of forest less than 10 years in age on all ownerships (public and private) within 1 mile of a known significant hibernacula, maternity colony or staging cave of a PETS bat.
    - *Rationale: The mature forest community is important to foraging bats particularly near significant colony sites. (Forest Plan direction for the Indiana bat) (recommendation by Lacki, 1994 and 1999, for big eared bats)(other PETS bats included as a best available information, Bennett 2001)*
- Within five miles of known significant Indiana bat hibernacula, tree-cutting activities will not be conducted between 1 September and 1 December. Suitable roost trees that are 6" dbh or greater may be removed, without checking for bats, from 2 December thru 31 March.
    - *Rationale: During the fall swarming period Indiana bats frequently forage up to five miles from their hibernation caves. Maintaining relatively undisturbed habitat conditions during this period is important to the buildup of fat reserves prior to hibernation. During the hibernation period bats will not be utilizing roost trees.*
- Prescribed burning will not occur within five miles of a significant Indiana bat hibernacula between 1 September and 1 December.
    - *Rationale: During the fall swarming period Indiana bats frequently forage up to five miles from their hibernation caves. Maintaining relatively undisturbed habitat conditions during this period is important to the buildup of fat reserves prior to hibernation. (best science available, USFWS 2001)*
- Tree cutting activities, involving currently suitable or potential suitable Indiana bat roost trees, will not be conducted within two and one half miles of an Indiana bat maternity colony between 1 May and 15 August.
    - *Rationale: Female Indiana bats frequently forage up to 2 ½ miles from their maternity colony site. Tree cutting activity in this area during the maternity period decreases their chance to successfully raise their young. (USFWS current best available knowledge)*

Maintain, protect and enhance habitat for the white-haired goldenrod. (Unless otherwise noted, the S&G are current Forest Plan direction.)

- Management activities that would concentrate public use in the vicinity of white-haired goldenrod recovery areas will be avoided if detrimental impacts are likely to occur because of human activity.
    - *Rationale: Site-specific activities need to be evaluated to determine the level of potential inadvertent human impacts to white-haired goldenrod in this habitat association.*
- Camping and fire building will be prohibited within sites designated for white-haired goldenrod recovery.
    - *Rationale: Camping or fire building in specific areas may serve to invite unwanted use of areas important to maintaining species viability.*
- Designated sites may be signed or fenced as needed to restrict human entry.
    - *Rationale: White-haired goldenrod sites are extremely sensitive to human disturbance by trampling. Population viability can be negatively affected by continued human use of certain sites.*

IV. Management Needs: Monitoring and Inventory to Ensure Species Viability

1. Conduct systematic inventories of selected bat hibernation caves (hibernacula) on the Forest. (High Priority)
    - *Rationale: Follows bat recovery plan direction and provides a measure of whether or not species viability is being maintained.*
2. Monitor cliffline microclimates to ensure that leave zones are maintaining stable microclimate conditions for species associated with this community. (Medium Priority)
    - *Rationale: The width of the cliffline zone is based upon the need to maintain microclimate conditions. Monitoring of temperature and humidity levels after project completion will provide information for comparison with baseline levels.*
3. Monitor Retention of Immediate Roost Trees within Project Areas. (Medium Priority)
    - *Rationale: These trees must be identified prior to project initiation and their retention is important to maintaining habitat suitable for Indiana bat use.*

References Cited:

SAMAB, Southern Appalachian Man and the Biosphere. 1996. The Southern Appalachian Assessment Terrestrial Technical Report. Report 5 of 5. U.S. Department of Agriculture, Forest Service, Southern Region, Atlanta, GA. 287 pp.

USDA Forest Service. 1985. Draft Environmental Impact Statement for the Daniel Boone National Forest Land and Resource Management Plan. Daniel Boone National Forest, Winchester, KY

USDA Forest Service. 1997. Landtype association map unit descriptions. Unpublished white paper. U.S. Department of Agriculture, Forest Service, Daniel Boone National Forest, Winchester, KY

USDA Forest Service. 2000. Environmental Assessment for Amending the Daniel Boone National Forest Land and Resources Management Plan: The SHNS Amendment. Daniel Boone National Forest, Winchester, KY. 173 pp.

Attachment A.

Species List: Rock Outcrops Habitat Association

Class	Common Name/ Species
ANIMALS	
Amphibians	Green Salamander/ *Aneides aeneus*
	Wehrle's Salamander/ *Plethodon wehrlei*
Birds	Common Raven/ *Corvus corax*
	Peregrine Falcon/ *Falco peregrinus*
Insects	Cliff Caddisfly/ *Manophylax butleri*
	Exotic Cave Beetle/ *Pseudanophthalmus exoticus*
Mammals	Rafinesque's Big-eared Bat/ *Corynorhinus (Plecotus) rafinesquii rafinesquii*
	Virgina Big-eared Bat/ *Corynorhinus (Plecotus) townsendii virginianus*
	Southeastern myotis/ *Myotis austroriparius*
	Gray Bat/ *Myotis grisescens*
	Eastern Small-footed Bat/ *Myotis leibii*
	Indiana Bat/ *Myotis sodalis*
	Allegheny Woodrat/ *Neotoma magister*
	Eastern Spotted Skunk/ *Spilogale putorius*
Reptiles	Timber Rattlesnake/ *Crotalus horridus*
	Northern Coal Skink/ *Eumeces antracinus anthracinus*
	Eastern Earth Snake/ *Virginia valeriae valeriae*
Snails	Banded Globe/ *Anguispira kochi*
	Queen Crater/ *Mesodon chilhoweensis*
	Estill Mesodon/ *Mesodon estillensis*
	Clifty Covert/ *Mesodon wetherbyi*
	Pupilids/ Pupillidae
PLANTS	
Dicots	Cumberland Sandwort/ *Arenaria cumberlandensis*
	Black Cohosh/ *Cimicifuga americana*
	French's Shooting Star/ *Dodecatheon frenchii*
	Lucy Braun's White Snakeroot/ *Eupatorium* (*Ageratina) luciae-brauniae*
	Box Huckleberry/ *Gaylussacia* brachycera
	Cow Wheat/ *Melampyrum lineare*
	Appalachian Sandwort/ *Minuartia glabra*
	Florida Pellitory/ *Parietaria floridana*
	Mountain Lover/ *Paxistima canbyi*

Mock Orange/ *Philadelphus inodorus*
Wafer Ash, Hop-tree/ *Ptelea trifoliata*
Bay Starvine/ *Schisandra glabra*
White-haired Goldenrod/ *Soldiago albopilosa*
Harris's Goldenrod/ *Solidago harrissii*
Riverbar Goldenrod/ *Solidago spathulata*
Snowberry/ *Symphoricarpos albus var*. albus
Roundleaf Fameflower/ *Talinum teretifolium*
Little Mountain Meadow Rue/ *Thalictrum mirabile*
Nettle-leaf Noseburn/ *Tragia urticifolia*

Ferns

Wall rue Spleenwort/ *Asplenium ruta-muraria*
Southern Bog Club-moss/ *Lycopodiella appressa*
Filmy Fern/ *Trichomanes boschianum*
Appalachian Gametophyte Fern/ *Vittaria appalachiana*

Gymnosperms

Ground Juniper/ *Juniperus communis var. depressa*
Eastern Redcedar/ *Juniperus virginiana var. virginiana*
Pitch Pine/ *Pinus rigida*
Canada Yew/ *Taxus canadensis*
Northern White Cedar/ *Thuja occidentalis*

Liverworts

Liverwort/ *Jubula pensylvanica*
Austin's Leafy Liverwort/ *Plagiochila austinii*
Sullivant's Leafy Liverwort/ *Plagiochila sullivantii*
A liverwort/ *Radula sullivantii*

Monocots

Wild Agave/ *Agave virginica*
Ofer Hollow Reed Grass/ *Calamagrostis porteri ssp.insperata*
Porter's Reed Grass/ *Calamagrostis porteri ssp. porteri*
Loesel's Twayblade/ *Liparis loeselii*
Plains Muhlygrass/ *Muhlenbergia cuspidata*

Mosses

Sword Moss/ *Bryoxiphium norvegicum*
Feather Moss, Log Moss/ *Hypnum curvifolium*
Streamside Mnium/ *Mnium hornum*
Cataract Metal Moss/ *Scopelophila cataractae*
Moss/ *Syrrhopodon texanus*
Tortula/ *Tortula norvegica*

Attachment B.

Rock Outcrops Species/Habitat Relationships with References

ANIMALS

Amphibians

Green Salamander – *Aneides aeneus* – The green salamander lives in damp crevices in shaded rock outcrops and ledges. In cove hardwoods, this salamander can be observed under bark and cracks of trees (Gordan, 1967). In the general forested area, the green salamander occurs in mucky, boggy water among decaying leaves and logs around woodland streams and ponds (website. Biodiversity. Wku.edu). The green salamander has also been observed in upland pine areas, Virginia pine and white pine-hemlock with mountain laurel occupying the understory. Moist outcrops are required for egg depositing and larval development. (Wilson, 1995).

Wehrle's Salamander – *Plethodon wehrlei* – The Wehrle's salamander is found in the Appalachian Mountains from extreme southwestern New York southward through Pennsylvania, southeastern Ohio, West Virginia, and Virginia to Stokes County, North Carolina. A disjunct enclave occurs along the Kentucky-Virginia-Tennessee border. Wehrle's salamander is commonly found on wooded hillsides where it hides under rocks and less frequently under and within logs. It has been found near cave entrances, within deep rock crevices and in old second growth, mixed deciduous and coniferous forests. Wehrle's salamander requires moist wooded hillsides with surface debris in the form of rocks, logs and leaf litter. In early summer, the female will deposit a small cluster of eggs in damp logs, soil, or moss. She will remain with the eggs until they hatch. This salamander's diet consists of small invertebrates, especially insects, spiders and earthworms. (Wilson, 1995)

Reptiles

Timber rattlesnake – *Crotalus horridus* – The timber rattlesnake occurs from central Vermont to Iowa in the north and northern Florida to eastern Texas in the south. This rattlesnake inhabits a variety of habitats. In the mountains and foothills it prefers moderately steep, rockyridge tops with light ground cover. During the fall and spring, timber rattlesnakes are frequently found around rocky ledges with southern exposure. Additional habitats include sphagnum swamps, agricultural fields and second growth clearings. Rock outcrops, old buildings or logs are necessary for winter denning. The timber rattlesnake feeds primarily on small mammals, as well as an occasional bird, amphibian or snake (Mount, 1975; Wilson, 1995).

Northern Coal Skink – *Eumeces anthracinus anthracinus* – The Appalachian population of this subspecies extends into eastern KY, while a disjunct population occurs in the west-central part of the State. Suitable habitat includes damp forests of oak, oak-poplar, oak-hickory-pine, and mixed pine-hardwood with moist soils, abundant leaf litter, logs, and/or loose stones; humid wooded or rocky hillsides; rocky bluffs; and similar areas near water sources, such as streams, springs, swamps, and bogs. These skinks seek the cover of rocks, logs, stumps, brush, and rock slabs. When pursued, they will take refuge in shallow water, hiding under rocks at the bottom. Various

rocky areas in which they have been found include: on limestone ledges; in dry leaves beneath rock ledges; beneath flat slabs of sandstone; under rocks in sunlit forest openings and in grassy cut over areas in hardwoods; and under rocks in the slope of a road cut through a mixed forest (VA Dept. of Game and Inland Fisheries 2001). Use of fire to maintain grassy openings within forested stands is of benefit to this species. Coal Skinks feed primarily on insects and spiders.

Eastern Earth Snake – *Virginia valeriae valeriae* – This is a small, highly secretive snake about whose habits much remains unknown. It is sometimes seen on the ground surface following heavy rains, but spends most of its time under leaf litter, logs, warm rocks and stones. Diet consists of earthworms, insects and their larvae, and other small arthropods. Its habitats include: damp, open, deciduous and pine-hardwood forests; abandoned fields; trail and back roads areas; wooded residential areas; forest edge and openings; moist, rocky slopes and hillsides with open canopies. Earth Snakes may congregate in small numbers prior to hibernation in pockets of woodland debris or under large rocks (Behler and King 1979).

Birds

Common Raven – *Corvus corax* – This species is typically found at elevations above 3500 feet but may occur down to 1500 feet (Hamel, 1992). Typically utilizes rocky and remote cliffline for nesting and is rarely found in areas without rocky outcrops. In Kentucky, they are typically birds of remote places and are rarely seen away from extensively forested portions of the mountains (Palmer-Ball, 1996). In Kentucky, this species is more typical of the high elevation areas along Pine and Black Mountain.

Peregrine Falcon – *Falco peregrinus* – Historically, this species likely inhabited clifflines in the Cumberland Mountains and cliffs section of the Cumberland Plateau, as well as bluffs along the Kentucky and Ohio Rivers and hollow trees of cypress swamps in Western KY (Palmer-Ball, 1996). Mengel mentions observing the presence of nesting peregrine falcons in cliffs overlooking the Rockcastle River (1965). The birds nest only in remote sandstone or limestone cliffs that have ledges. Foraging is in open areas with a mix of forest and fields. Reintroduction efforts in the state, primarily on tall buildings in urban areas but also on cliffs on the Stanton R.D. are increasing Kentucky populations of falcons, which were decimated by the effects of DDT.

Insects

Cliff Caddisfly – *Manophylax butleri* – a caddisfly recently described from West Virginia and Kentucky, is the most terrestrial caddisfly known. It is restricted to exposed sandstone rock walls that are moist to the touch or have a very thin film of water on their surfaces. These sites may be consistently moist or may be moist for only a few weeks of the year. While *M. butleri* has been collected from rock surfaces adjacent to streams, most sites on the Daniel Boone are along sandstone cliffline that is not associated with surface water. The hydrology of these sites are maintained by the shading presence of dense woody vegetation in the adjacent forest.

The cave beetle – *Pseudanopthalmus exoticus* – is known from a single cave on Pine Mountain. It is presumed to be endemic to that cave, however much limestone exists on Pine Mountain that has not been checked that may contain suitable caves. Cave beetles depend on organic debris

within the cave. This can include the eggs of cave crickets or animal feces. For this species to persist, cave hydrology and nutrient flow must be preserved.

Mammals

Rafinesque's Big-eared Bat – *Corynorhinus (Plecotus) rafinesquii rafinesquii* – The Rafinesque's big-eared bat a year-round resident throughout the DBNF. During the summer it forages in a variety of forested habitats and in forest edges and open areas. During the day it will roost in limestone and sandstone rockhouses and caves, in hollow trees and under exfoliating bark. During the summer males tend to be solitary roosters while females form maternity colonies. Several maternity colonies, usually associated with cliffline caves and rockhouses, occur on the forest. This species is insectivorous and feeds primarily on moths. Foraging sites often occur along clifflines or ridgelines in an oak-hickory habitat. Cliffline associated rock shelters are used as feeding sites. Clifflines are also thought to provide travel corridors for the Rafinesque's big-eared bat. During the summer this species normally forages within about one mile of the roost site. Hibernation sites occur mainly in caves, but some sites occur in rockshelters and in large cracks in sandstone cliffline. This species is very sensitive to human disturbance of both its hibernation and maternity colony sites.

Virginia Big-eared Bat – *Corynorhinus (Plecotus) townsnedii virginianus* – The Virginia big-eared bat) is a year-round resident on the northern half of the DBNF. Foraging habitat occurs in many different forest overstory types, but is commonly associated with sandstone and limestone clifflines and ridgetops. This species also forages over grassy forest openings (old fields) and along forest edge. Forest openings may provide uncluttered foraging space where preferred prey species occur and can be more easily captured. Sandstone rockshelters and small caves are utilized as temporary feeding roosts. In the summer female and young Virginia big-eared bats form nursery colonies while males are ordinarily solitary although some bachelor colonies do occur. Maternity colonies usually roost near the entrance of rockshelters or caves at the edge of the light zone. Thus, they are very susceptible to human disturbance. Food habits consist primarily of small moths, but also include butterflies, flies and beetles. Forest canopy around roost sites may provide important protection from potential predators such as owls. Virginia big-eared bats hibernate in large clusters in a few limestone caves on the DBNF. As in the summer, they are highly susceptible to human disturbance and may abandon a colony site after repeated human intrusion. Maintaining stable microhabitat conditions and forested communities around the maternity and hibernation caves is important to maintaining these sites.

Southeastern Myotis – *Myotis austroriparius* – The Southeastern myotis rarely occurs on the DBNF which is considered to be on the very edge of the species range. This species utilizes limestone caves for hibernation and is difficult to detect because of its habit of wedging itself far back in cracks and crevices in the ceilings and walls of caves. The Southeastern myotis roosts almost exclusively in caves during the winter and some cave use occurs in the summer. These bats also use hollow trees as summer and maternity roosts. Foraging areas are usually over riparian habitat bordering streams, lakes and ponds. Aquatic insects such as small beetles, moths and mosquitoes form the basis of the food species for the Southeastern myotis.

Eastern Small-footed Bat – *Myotis leibii* – The eastern small-footed bat likely occurs in forested areas throughout the DBNF. Foraging habitat is often associated with riparian areas, but may

occur elsewhere in the forest or forest edge. Summer roosting habitat includes caves, under rocks, bridges (in expansion joints), hollow trees and under exfoliating bark. Food habits are thought to be almost exclusively flying insects associated with riparian habitats. Reproducing females have been found in Eastern Kentucky, but the species is believed to be most common on the DBNF during the winter. Winter hibernation often occurs in relatively cold areas of low humidity just within the entrance of caves or mines. Thus, the eastern small-footed bat may be vulnerable to freezing in severe winters and to human disturbance. The species also hibernates in rock shelters and in fissures within clifflines.

Gray Bat – *Myotis grisescens* – No large hibernating, bachelor or maternity colonies of gray bats are currently known to exist on the DBNF. Gray bats have been observed in small numbers in caves and in riparian forest areas at several locations on the forest. Gray bats roost in limestone caves year-round, but seasonally they may utilize different caves during the summer and winter. They may migrate between caves or sometimes can be considered as residents of a relatively small area. Gray bats feed almost exclusively over water in riparian forest areas. Emerging aquatic insects such as beetles, moths, mayflies, stoneflies and caddisflies make up the bulk of their diet.

Indiana Bat – *Myotis sodalis* – The DBNF is known to support both winter and summer colonies of the Indiana bat. During the non-hibernation season Indiana bats are likely to occur throughout the DBNF. Some males periodically roost in caves during the summer, but most, along with females, roost under exfoliating bark or in hollow cavities in a variety of dead and alive trees. Roost trees with some sun exposure seem to be preferred because they are warmer. Indiana bats forage for insects in a wide variety of forest habitats ranging from riparian corridors to upland oak to higher elevation ridgetops. Forest canopy ranges from relatively closed to fairly open and Indiana bats sometimes forage in and near grass areas at the forest edge. An open forest understory enhances the bats ability to navigate within the forest stands. Available water in the form of shallow waterholes or ponds enhances general habitat suitability and utilization. Maternity populations are known to exist on the DBNF. Female Indiana bats are known to use multiple roost trees during the lactation period and may forage and roost up to 2 ½ miles from their primary roost trees. During the winter Indiana bats hibernate in several cool/cold limestone caves on the DBNF. These bats gather in large clusters on cave ceiling and need protection from human disturbance during this time of year. Significant hibernation caves occur on the Stanton, London and Somerset Ranger Districts. Hibernation caves are most often, but not always, associated with limestone clifflines. Maintaining forest canopy around hibernation caves helps maintain microclimate conditions and provides nearby roosting and foraging habitat, particularly during the fall swarming season.

Allegheny Woodrat – *Neotoma magister* – Allegheny woodrats are found throughout the DBNF in forested habitats associated with sandstone or limestone clifflines. Woodrats find shelter in crevices and caves associated with these clifflines. A variety of forest types provide the overstory in the woodrat's generally shady foraging habitat adjacent to clifflines. Woodrats forage on several different types of hard mast, but have a preference for acorns from numerous oak species.

Eastern Spotted Skunk – *Spilogale putorius* – It is likely that the eastern spotted skunk occurs in low population numbers in the general forest area throughout the DBNF. It is often associated

with rocky areas and clifflines. This species prefers forest borders and brushy fields and avoids heavy timber. Forest openings offer a good combination of preferred habitat types. Natural cavities in clifflines, down logs and hollow snags provide shelter and den sites. They also use abandoned underground burrows of other species as den sites. Several skunks may den together in the winter, but they do not hibernate. Eastern spotted skunks forage for food throughout their habitat and are omnivorous. Food items include beetles, small rodents, ground dwelling birds, eggs, lizards, snakes salamanders mushrooms and fruit.

Snails

Banded Globe Snail – *Anguispira kochi* – requires steep slopes with bluffs and rock talus. It is generally restricted to limestone areas and can be found buried in soft soil, especially during hibernation. The Banded Globe Snail appears to be extirpated throughout much of its former range, especially in the Bluegrass Counties of Kentucky. Extant colonies are known from the Kentucky River corridor from Frankfort east to the Furnace Mountain Area in Estill County and the species may also persist along the Salt River.

Queen Crater Snail – All records for living *Mesodon chilhoweensis* are in McCreary County, with the best populations in the Yahoo Falls area and along Rock Creek south of White Oak Junction. Shells have also been collected from the Tennessee side of Pine Mountain. The Queen Crater is a species of acid woodlands, usually found in mature forests on the steep slopes along rock outcrops or boulder talus areas.

Estil Mesodon -- *Mesodon estillensis sp. nov.*, is an undescribed species recently discovered in Estill County, KY. It is commonly found in and around the limestone cliffline, especially in moist crevices and small caves. They are rarely found away from the cliffline. The distribution of this species is not yet known, but it appears to be restricted to within several miles of Happy Top Mountain.

Clifty Covert Snail – *Mesodon wetherbyi* – is known from several scattered locations along the Cumberland and Rockcastle Rivers, the Jellico Mountains, Pine Mountain, and Big South Fork. In Kentucky, its total range includes portions of Laurel, Whitley, Pulaski, and McCreary Counties. Populations are not continuous, and the species is absent from much apparently suitable habitat within its limited range. All sites are located on extremely steep forested slopes adjacent to rock outcrops or boulder talus areas. All but one site is located in sandstone areas.

Pupillids – The family *Pupillidae* contains a group of small (less than ¼ in. long) snails. On the Daniel Boone, these snails are most often found in open limestone areas such as cedar glades. This group appears to require sunlight and individuals can often be found in thin leaf litter, the bare areas at the base of cedar trees, on bare rock, or within the fine soil or moss mats that covers these exposed areas.

PLANTS

Dicots

Lucy Braun's White Snakeroot – *Ageratina* (*Eupatorium*) *luciae-brauniae* – is endemic to the Cumberland Plateau of Kentucky, including the DBNF, and Tennessee. In Kentucky (and on the

DBNF), it is restricted to the Cumberland River drainage. Throughout its range, the habitat is damp to wet sandstone or conglomerate rockhouses along sandstone cliffs. It usually grows in sandy soil on the rockhouse floor, but may also grow in crevices on the rockhouse wall. Observations have shown that the species is sensitive to direct sunlight, the plants becoming burned and stunted. A shading canopy in front of the shelter appears to be necessary.

Cumberland Sandwort – *Arenaria cumberlandensis* – is known from a very limited distribution in the Big South River drainage of Kentucky and Tennessee. It grows on wet to damp sandstone or conglomerate, in shaded rockhouses or on shaded cliff faces. One site, now extirpated is known from the DBNF. Habitat is present in many areas of the forest within the drainage. Several sites are known nearby on NPS land.

French's Shooting Star – *Dodecatheon frenchii* – is a mid-western species with several stations in Kentucky. The species is found on dry sandstone or conglomerate cliffs or in the dry rockhouses associated with them. On the DBNF, the two known sites are in dry sandstone rockhouses at the northern end of the forest.

Box Huckleberry – *Gaylusaccia brachycera* – is a central Appalachian species. It occurs in upland yellow pine and yellow pine-oak woods. Yellow pine is present in or adjacent to all sites on the DBNF. It is also found on sandstone glades and in the upland portions of utility rights-of-way. The species appears to require well-drained, sandy soils. *Gaylusaccia* will grow in closed canopy (yellow pine) conditions if the mid-story and shrub layers are more or less absent. On the DBNF, the densest, and apparently the healthiest populations, are found in these sites. It also grows under more open canopy conditions where it is tolerant of thicker mid-story and shrub layers. The rhizomes are positioned at the transition between the duff and mineral soil. Fire maintains the general habitat in which it grows. The species is top killed by fire, but does re-sprout, at least if the duff layer is not removed. Recovery appears to be slower than for other *Gaylusaccia* species or *Vaccinium* species, but with the proper interval and intensity of fire, populations should be maintained while enhancing habitat.

American Cow-wheat – *Melampyrum lineare* (generic) – has a somewhat confused taxonomy with numerous uses by various authors. Following Medley (1993), only the var. *pectinatum* is likely to present on the DBNF. Specimens not identified to variety from the DBNF area are assumed to be this variety. Habitat details for the variety are described in other habitat associations.

Appalachian Sandwort – *Minuartia glabra* – is an Appalachian Mountains and Plateaus species. It is associated with sandstone outcrops, glades and cliffs. On the DBNF, it is known from open, dry, sandstone cliffs and glades.

Florida Pellitory – *Parietaria floridana* – is a southern species with disjunct occurrences in the Appalachian provinces. It occurs in open sandy savanna, roadsides and waste areas. The single Kentucky station from the DBNF occurs in a dry sandstone in a sandstone rockshelter.

Cliff Lover -- *Paxistima canbyi* – This species is an Appalachian provinces species that occurs on thin soils associated with limestone (or other calcareous) cliffs. These sites are usually with a hundred feet or so from the cliff edge, are dry, and tend to have a southerly (SE to NW) aspect.

The sites often have a closed canopy, but the mid-story and shrub layers are thin and open. It rarely is found in old fields. At one site observed on private land, the cutting of the overstory (usually eastern red cedar, *Juniperus virginiana* and oak species, *Quercus* spp.) resulted in a thick coppice of tree and shrub species. Over a two-year period, the *Paxistima* population was nearly eliminated. The species is probably not tolerant of fire.

Mock Orange – *Philadelphus inodorus* var. *grandiflorus* (per Medley, 1993) – is an Appalachian provinces species. It is found along stream banks, on moist soil in open forest, and on cliffs. On the DBNF, the species is found on limestone cliffs and glades.

Wafer Ash or Hop-tree – Ptelea trifoliata (as ssp. *trifoliata* var. *trifoliata* per Medley, 1993) – is found in eastern North American. It is found in moist or rich forest. On the DBNF, it is infrequent but locally abundant on limestone outcrops in open dry-mesic forest or along roadsides.

Bay Starvine – *Schisandra glabra* – is a piedmont and Gulf coastal plain species with outlying populations along the Mississippi River, the Atlantic Ocean and the Cumberland Plateau. In the main part of its range, the species is found in beech-magnolia forest. Elsewhere it is found on loess soils. The single population in Kentucky, partially located on the DBNF, is on talus slopes below sandstone cliffs in mesic tulip poplar-hemlock-beech-oak forest. While the plant can be high climbing, it will creep along the ground. Light to moderate shade with well-drained soils and ample moisture is needed.

White-haired Goldenrod – *Soldiago albopilosa* – is endemic to the Red River Gorge area of Kentucky. Most of the occurrences are on the DBNF. It is found in damp to xeric sandy soil in sandstone or conglomerate rockhouses or in crevices on sheltered cliff faces. All occurrences are behind the drip line created by the rock overhang. The species is known to require moisture for germination, but will survive as an adult plant in deep, xeric sandy soil. The species will spread in rock shelters vegetatively, and it appears that trampling by humans is the primary barrier to maintaining the species.

Shale-barren Goldenrod – *Solidago harrisii* – narrowly defined is known only from shale barrens of Maryland and the Virginias. A form occurring on limestone glades and open dry-mesic (usually) to dry-xeric (rarely) forest on limestone outcrops is known from Virginia and Kentucky. Much of the Kentucky material is found on or near the DBNF. It is often in light to moderate shade, but does occur in the open. Soils are usually thin.

Snowberry – *Symphoricarpos albus* var. *albus* – is a northern species that has a range extension south into the Appalachian provinces. It is found on dry or rocky soil, often of calcareous nature. It is usually found in open or lightly shaded forest, or sometimes in open areas. The DBNF area records are from Estill and Madison counties, all from narrow limestone ridges in open forest or in thickets.

Roundleaf Fameflower – *Talinum teretifolium* – is a species of the central and southern Appalachians. It is found on thin soil over rock, in much of its range serpentine. On the DBNF, it is known from several stations in McCreary and Pulaski Counties. It occurs on here on sandstone glades and cliff edges either in the open or in the light shade of yellow pines or oaks.

Little Mountain Meadowrue – *Thalictrum mirabile* – is endemic to the Cumberland Plateau of Kentucky, Tennessee and Alabama. It is found on cool, permanently wet sandstone or conglomerate cliffs, usually in light to moderate shade. On the DBNF, this species is usually found in rockhouses between the drip line and back wall. It is often found just behind small waterfalls. It is taxonomically close to, and possibly indistinct from mountain meadowrue (*T. clavatum*).

Nettle-leaf Noseburn – *Tragia urticifolia* – is a prairie species with scattered stations eastward. It is commonly found in dry prairies and open (low tree density) rocky areas. It is known to Kentucky from only one site in the DBNF area. Here it occurs on a limestone glade above the Big South Fork River.

Ferns

Wallrue Spleenwort – *Asplenium ruta-muraria* – is a strong calciphile throughout its range. On the DBNF, it grows on dry, more or less exposed, limestone cliff faces. It occurs in small clumps.

Filmy Fern – *Trichomanes boschianum* – is endemic to the southern Appalachians and a westward extension to the Dripping Springs escarpment of Kentucky, Indiana and Illinois. It is found on ledges and in crevices of damp, humid and shaded sandstone or conglomerate rockhouses. The populations on the DBNF are found in the same habitat.

Appalachian Gametophyte Fern – *Vittaria appalachiana* – is a central and southern Appalachian endemic with outlying populations on the Dripping Springs escarpment of Kentucky and Indiana. It is found on ledges and in crevices of damp, humid and shaded sandstone or conglomerate rockhouses or crevices in cliffs. On the DBNF, the species is found in the same habitat.

Gymnosperms

Ground Juniper – *Juniperus communis* var. *depressa* – is a northern species whose range extends into the southern Appalachians. It occurs on rocky sites, in the open or under open canopy. On the DBNF, the two known sites occur on sandstone cliff tops, rooted in rocky soil in areas of open canopy. Fire may a detrimental effect on the species.

Pitch pine – *Pinus rigida* – ranges from New England to the Appalachian Mountains. It grows in generally sterile, sandy soil where it competes well against many other woody species. These soils are usually dry, but may be moist. The cones are semi-serotinous, opening following hot fires or occasionally very hot days. Fire also prepares a seedbed advantageous to the light seeds. On the Daniel Boone NF, this species is most commonly found within a few hundred feet of sandstone cliffs. The soils here are sandy, thin and usually dry providing the conditions under which the species competes. These areas also would have been subject to periodic burning, aiding regeneration of the species.

Canada Yew -- *Taxus Canadensis* -- is northeastern species with a range extension southward along the Appalachians. In the northern part of the range, it occurs in mixed mesophytic forest,

hemlock forest, and in other hardwood forest where moderate shade and cool temperatures prevail. It is also known from bogs, swamps, gorges, ravine slopes, and rocky banks. On the DBNF, the species is primarily associated with cool air drainages near caves and in deep, shaded hollows. Here it usually is in mixed mesophytic forest. It also occurs on road cuts and cliffs on lower and mid-slopes within in this forest type.

Northern White Cedar – *Thuja occidentalis* – has a northeastern North American distribution with range extensions southward along the Appalachian provinces and other westerly disjunct stations. In its primary range, the species occurs in moist to damp soil, or swamps where it can form dense monotypic forests. On the DBNF, the species is found on limestone cliffs and talus slopes along the Cumberland River and some of its major tributaries. In most case, the plants are associated with karst seeps on the cliffs. One location is on a sandstone boulder in a creek.

Liverworts

Liverwort – *Jubula pensylvanica* – is found throughout eastern North America. It grows in clean, low flow water where it is attached to sandstone rocks and cobble. These sites are in heavy shade. It grows in similar sites on DBNF as well as on saturated sand in sandstone rockshelters.

Liverwort – *Plagiochila austinii* – is an Appalachian provinces endemic. It found on shaded rock outcrops. On the DBNF, the species is known from a couple of stations, both on shaded and moist sandstone cliff.

Liverwort – *Plagiochila sullivantii* – is a southern Appalachian endemic. It occurs on damp, shaded sandstone and conglomerate cliffs, outcrops, rockshelters and crevices. Humidity is usually high and constant. The habitat for the species on the DBNF is the same.

Liverwort – *Radula sullivanttii* – is a southern Appalachian endemic. A single record is known for Kentucky, from Rockcastle County. All other known records for the species are in the Ridge and Valley and Blue Ridge ecological provinces. It occurs on damp, highly shaded sandstone or conglomerate rocks in areas of constantly high humidity. Such areas do exist along the Rockcastle River, but this specimen may represent a misidentification.

Monocots

Wild Agave – A*gave virginica* – occurs in small to large colonies. The plant is a strong calciphile and is usually found on limestone. It is found in crevices in bedrock, in heavy clay or clay loam soils found on limestone. The sites are usually lightly to moderately shaded. In most cases, the species grows where it is well drained. It is often found in glades, at the base of and on cliffs, and in old quarries.

Ofer Hollow Reed Grass – *Calamagrostis porteri* ssp. *insperata* – is an Appalachian and Ozarkian species with one station within the DBNF proclamation boundary. It occurs here on thin, rocky soils over limestone, sandstone, and siltstone near the edge of cliffs, on ridges and on slopes in dry mesic forest. The oak or oak-cedar forest is open and dry. The species does not appear to flower without fire.

Porter's Reed Grass – *Calamagrostis porteri* ssp. *porteri* – is an Appalachian species associated

with calcareous substrates. On the DBNF, the species is found in thin rocky soils over calcareous siltstone in oak forest. The grass is found in areas of open canopy or in bands along road cuts and other corridors. Fire would maintain open conditions for the species and it is known to induce flowering.

Loesel's Twayblade – *Liparis loeselii* – is a northern and mid-western North American species. It is found in wet to damp forest. On the DBNF, it is known from wet seeps on roadsides, a seep at the base of an abandoned limestone quarry, and at the edge of a strip mine pond.

Plains Muhlygrass – *Muhlenbergia cuspidata* – is a prairie species with disjunct populations in Kentucky. It grows in prairies or other open grassland on dry, usually gravelly or rocky soil. On the DBNF, the few locations occur on limestone in open glade areas.

Rough Dropseed – *Sporobolus clandestinus* – is tall grass prairie species, which also occurs on the coastal plain. It is found in dry sandy soil of prairies, openings, barrens, and along roadways and other rights-of-way. On the DBNF, the species is found in McCreary and Pulaski Counties on limestone cliffs and open, sandy yellow pine or yellow pine-oak forest.

Mosses

Moss – *Brothera leana* – is uncommon throughout its range. It is known from a few sites in the DBNF at the mouths of limestone caves. Cool air flow and moist (at least high humidity) conditions are provided at these locations.

Sword Moss – *Bryoxiphium norvegicum* – is a northern species that extends southward through the Appalachian Mountains. It is found on wet to damp sandstone and conglomerate in areas of constant high humidity. On the DBNF it occurs on overhangs and on the ceilings of rockhouses along cliffs where shade is high. It also occurs on boulder overhangs near streams.

Feather or Log Moss – *Hypnum curvifolium* – has a wide distribution in North America. The species is uncommon to common and occurs in a variety of habitats. It is usually found in moderate to heavy shade under hardwood or hardwood-pine canopy. It frequently grows on downed logs from which it is increasingly stripped for the horticultural industry. It is also found on rocks and boulders and occasionally soils and tree bases. The habitat occupied on the DBNF is usually downed logs or rocks.

Moss – *Mnium hornum* – is found on stream banks and in sandstone or conglomerate rockhouses. On the DBNF, the most common habitat is on sandy stream banks along low gradient sections of streams. These areas are usually under a canopy of hemlock, magnolia and rhododendron. While it may occur with Tricochlea trichomitria, it appears more tolerant of deposition.

Cataract Metal Moss – *Scopelophila cataractae* – is found in isolated populations in the Appalachians and a few western states within the US. It is known from thin soil over rock and from a roadcut near a stream. In Kentucky, it is known from one site (Wolfe County) in the Red River Gorge on the DBNF. It was found in a sandstone rockhouse, most likely in a shaded, damp location.

Moss – *Syrrhopodon texanus* – is a coastal plains species with disjunct distribution in the Appalachian and Ozarkian provinces. It commonly occurs on moist rotten logs and stumps, on rock and the bark of trees, especially in low ground. On the DBNF, the species is almost always encountered on the back walls of moist, shaded sandstone or conglomerate rockhouses or cliff faces.

Moss – *Tortula norvegica* – has a western North American distribution with scattered disjunct populations in the east. In its primary range, it is found on calcareous soil and rock and is montaine. A single location for the species in Kentucky is known from near the DBNF (Estill County). It was found on an open, dry limestone ridge lightly shaded by oak-cedar.

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Storm Damage DEIS (Source provided by lit searchers; on list?)

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Attachment C.

Rock Outcrops Habitat Association Matrix

Association	Habitats	Modifier	Class	Common/Species
13-Rock Outcrop	Limestone Cave/Rock Houses	(blank)	INSEC	Exotic Cave Beetle/ Pseudanophthalmus exoticus
			MAMM	Eastern Small-footed Bat/ Myotis leibii
				Gray Bat/ Myotis grisescens
				Rafinesque's Big-eared Bat/ Corynorhinus (Plecotus) rafinesquii rafinesquii
				Southeastern myotis/ Myotis austroriparius
				Virgina Big-eared Bat/ Plecotus townsendii virginianus
		Cool Temperatures		Indiana Bat/ Myotis sodalis
		Moderate Shade		Allegheny Woodrat/ Neotoma magister
		Moist	GASTR	Estill Mesodon/ Mesodon estillensis
		Open Forest Canopy	MAMM	Indiana Bat/ Myotis sodalis
	Limestone Cliff/Outcrop	(blank)	BIRD	Peregrine Falcon/ Falco peregrinus
			MAMM	Eastern Small-footed Bat/ Myotis leibii
				Rafinesque's Big-eared Bat/ Corynorhinus (Plecotus) rafinesquii rafinesquii
				Virgina Big-eared Bat/ Plecotus townsendii virginianus
			P-DIC	Mountain Lover/ Paxistima canbyi
			P-FER	Wall rue Spleenwort/ Asplenium ruta-muraria
			P-MON	Plains Muhlygrass/ Muhlenbergia cuspidata
			P-MOS	Tortula/ Tortula norvegica
		Acidic Substrate	GASTR	Queen Crater/ Mesodon chilhoweensis
		Aspect (SE to NW)	P-MON	Plains Muhlygrass/ Muhlenbergia cuspidata
		Basic Substrate	GASTR	pupilids/ Pupillidae
			P-GYM	Northern White Cedar/ Thuja occidentalis
		Cold Air Drainage		Canada Yew/ Taxus canadensis
		Dry	GASTR	pupilids/ Pupillidae
			P-FER	Wall rue Spleenwort/ Asplenium ruta-muraria
			P-GYM	Eastern Redcedar/ Juniperus virginiana var. virginiana
			P-MON	Plains Muhlygrass/ Muhlenbergia cuspidata
		Leaf Litter	GASTR	Banded Globe/ Anguispira kochi
		Moderate Shade	MAMM	Allegheny Woodrat/ Neotoma magister
			P-DIC	Harris's Goldenrod/ Solidago harrissii
				Mountain Lover/ Paxistima canbyi
				Wafer Ash, Hop-tree/ Ptelea trifoliata
		Moist	GASTR	Estill Mesodon/ Mesodon estillensis
			P-MON	Wild Agave/ Agave virginica
			REPT	Northern Coal Skink/ Eumeces antracinus anthracinus
		Old Growth Condition	GASTR	Banded Globe/ Anguispira kochi
		Open (Little or No Shade)		pupilids/ Pupillidae
			P-DIC	Harris's Goldenrod/ Solidago harrissii
				Mountain Lover/ Paxistima canbyi
		Open Forest Canopy		Mountain Lover/ Paxistima canbyi
				Snowberry/ Symphoricarpos albus var. albus
		Remote Habitat	BIRD	Peregrine Falcon/ Falco peregrinus
		Rocky/Rocks	MAMM	Eastern Spotted Skunk/ Spilogale putorius
			P-GYM	Northern White Cedar/ Thuja occidentalis
		Seep/Constant Water	P-MON	Loesel's Twayblade/ Liparis loeselii
		Slope (hillside, steepness)	GASTR	Banded Globe/ Anguispira kochi
	Limestone Glade	(blank)	P-DIC	Mountain Lover/ Paxistima canbyi
			P-GYM	Eastern Redcedar/ Juniperus virginiana var. virginiana
			P-MOS	Tortula/ Tortula norvegica
		Dry	GASTR	pupilids/ Pupillidae
			P-GYM	Eastern Redcedar/ Juniperus virginiana var. virginiana
			P-MON	Wild Agave/ Agave virginica
		Moderate Shade	P-DIC	Harris's Goldenrod/ Solidago harrissii
				Mock Orange/ Philadelphus inodorus
		Moist	P-MON	Wild Agave/ Agave virginica
		Open (Little or No Shade)	GASTR	pupilids/ Pupillidae

Association	Habitats	Modifier	Class	Common/Species
			P-DIC	Harris's Goldenrod/ Solidago harrissii
				Nettle-leaf Noseburn/ Tragia urticifolia
	Mudstone/ Siltstone/Shale Cliff/Outcrops	(blank)	AMPHI	Wehrle's Salamander/ Plethodon wehrlei
			BIRD	Peregrine Falcon/ Falco peregrinus
		Cold Air Drainage	P-GYM	Canada Yew/ Taxus canadensis
		Downed Logs	REPT	Northern Coal Skink/ Eumeces antracinus anthracinus
		Dry	P-GYM	Eastern Redcedar/ Juniperus virginiana var. virginiana
			P-MON	Ofer Hollow Reed Grass/ Calamagrostis porteri ssp. insperata
				Porter's Reed Grass/ Calamagrostis porteri ssp. porteri
			REPT	Northern Coal Skink/ Eumeces antracinus anthracinus
		Open (Little or No Shade)	P-DIC	Harris's Goldenrod/ Solidago harrissii
			P-MON	Ofer Hollow Reed Grass/ Calamagrostis porteri ssp. insperata
				Porter's Reed Grass/ Calamagrostis porteri ssp. porteri
		Open Forest Canopy	P-DIC	Harris's Goldenrod/ Solidago harrissii
		Remote Habitat	BIRD	Peregrine Falcon/ Falco peregrinus
		Rocky/Rocks	P-MON	Ofer Hollow Reed Grass/ Calamagrostis porteri ssp. insperata
				Porter's Reed Grass/ Calamagrostis porteri ssp. porteri
			REPT	Northern Coal Skink/ Eumeces antracinus anthracinus
				Timber Rattlesnake/ Crotalus horridus
	Sandstone Cave/ Rock Houses	(blank)	AMPHI	Green Salamander/ Aneides aeneus
			MAMM	Rafinesque's Big-eared Bat/ Corynorhinus (Plecotus) rafinesquii rafinesquii
				Virgina Big-eared Bat/ Plecotus townsendii virginianus
			P-DIC	White-haired Goldenrod/ Soldiago albopilosa
		Acidic Substrate		French's Shooting Star/ Dodecatheon frenchii
		Cool Temperatures		Cumberland Sandwort/ Arenaria cumberlandensis
		High Shade	INSEC	Cliff Caddisfly/ Manophylax butleri
			P-DIC	Cumberland Sandwort/ Arenaria cumberlandensis
			P-FER	Appalachian Gametophyte Fern/ Vittaria appalachiana
				Filmy Fern/ Trichomanes boschianum
			P-MOS	Sword Moss/ Bryoxiphium norvegicum
		High/Constant Humidity (Microclimate)	INSEC	Cliff Caddisfly/ Manophylax butleri
			P-DIC	Cumberland Sandwort/ Arenaria cumberlandensis
				Little Mountain Meadow Rue/ Thalictrum mirabile
			P-FER	Appalachian Gametophyte Fern/ Vittaria appalachiana
				Filmy Fern/ Trichomanes boschianum
		Moderate Shade	MAMM	Allegheny Woodrat/ Neotoma magister
			P-DIC	Lucy Braun's White Snakeroot/ Eupatorium luciae-brauniae
			P-MOS	Moss/ Syrrhopodon texanus
		Moist	INSEC	Cliff Caddisfly/ Manophylax butleri
			P-DIC	Cumberland Sandwort/ Arenaria cumberlandensis
				Lucy Braun's White Snakeroot/ Eupatorium luciae-brauniae
			P-FER	Appalachian Gametophyte Fern/ Vittaria appalachiana
				Filmy Fern/ Trichomanes boschianum
			P-MOS	Moss/ Syrrhopodon texanus
				Streamside Mnium/ Mnium hornum
				Sword Moss/ Bryoxiphium norvegicum
		Rocky/Rocks		Cataract Metal Moss/ Scopelophila cataractae
		Sandy Soil	P-DIC	Cumberland Sandwort/ Arenaria cumberlandensis
				Lucy Braun's White Snakeroot/ Eupatorium luciae-brauniae
		Seep/Constant Water	P-LIV	Liverwort/ Jubula pensylvanica
		Water (Distance Sensitive)	INSEC	Cliff Caddisfly/ Manophylax butleri
	Sandstone Cliff/Outcrop	(blank)	AMPHI	Green Salamander/ Aneides aeneus
			BIRD	Peregrine Falcon/ Falco peregrinus
			INSEC	Cliff Caddisfly/ Manophylax butleri
			MAMM	Rafinesque's Big-eared Bat/ Corynorhinus (Plecotus) rafinesquii rafinesquii
				Virgina Big-eared Bat/ Plecotus townsendii virginianus
			P-DIC	Little Mountain Meadow Rue/ Thalictrum mirabile
				Roundleaf Fameflower/ Talinum teretifolium
			P-GYM	Ground Juniper/ Juniperus communis var. depressa
		Acidic Substrate	GASTR	Queen Crater/ Mesodon chilhoweensis

Association	Habitats	Modifier	Class	Common/Species
		Aspect (SE to NW)	P-GYM	Ground Juniper/ Juniperus communis var. depressa
		Cool Temperatures	INSEC	Cliff Caddisfly/ Manophylax butleri
		Dry	P-DIC	Florida Pellitory/ Parietaria floridana
				Roundleaf Fameflower/ Talinum teretifolium
			P-GYM	Pitch Pine/ Pinus rigida
		High Shade	INSEC	Cliff Caddisfly/ Manophylax butleri
			P-LIV	Austin's Leafy Liverwort/ Plagiochila austinii
				Sullivant's Leafy Liverwort/ Plagiochila sullivantii
			P-MOS	A liverwort/ Radula sullivantii
				Feather Moss, Log Moss/ Hypnum curvifolium
		High/Constant Humidity (Microclimate)	P-LIV	Sullivant's Leafy Liverwort/ Plagiochila sullivantii
			P-MOS	A liverwort/ Radula sullivantii
		Moderate Shade	MAMM	Allegheny Woodrat/ Neotoma magister
		Moist	AMPHI	Green Salamander/ Aneides aeneus
			GASTR	Clifty Covert/ Mesodon wetherbyi
			INSEC	Cliff Caddisfly/ Manophylax butleri
			P-MOS	Feather Moss, Log Moss/ Hypnum curvifolium
			REPT	Northern Coal Skink/ Eumeces antracinus anthracinus
		Open (Little or No Shade)	P-DIC	Box Huckleberry/ Gaylussacia brachycera
				Riverbar Goldenrod/ Solidago spathulata
				Roundleaf Fameflower/ Talinum teretifolium
		Remote Habitat	BIRD	Peregrine Falcon/ Falco peregrinus
		Riparian	P-MOS	A liverwort/ Radula sullivantii
		Rocky/Rocks	BIRD	Common Raven/ Corvus corax
			MAMM	Eastern Spotted Skunk/ Spilogale putorius
			P-DIC	Appalachian Sandwort/ Minuartia glabra
			REPT	Timber Rattlesnake/ Crotalus horridus
		Sandy Soil	P-GYM	Pitch Pine/ Pinus rigida
		Seep/Constant Water	P-FER	Southern Bog Club-moss/ Lycopodiella appressa
		Slope (hillside, steepness)	GASTR	Clifty Covert/ Mesodon wetherbyi
		Water (Distance Sensitive)	INSEC	Cliff Caddisfly/ Manophylax butleri
	Sandstone Glade	Ericaceous Shrub Associate	P-DIC	Cow Wheat/ Melampyrum lineare
		Open Forest Canopy		Box Huckleberry/ Gaylussacia brachycera
	Talus Slopes	(blank)	REPT	Timber Rattlesnake/ Crotalus horridus
		Acidic Substrate	GASTR	Queen Crater/ Mesodon chilhoweensis
		Dry	P-GYM	Eastern Redcedar/ Juniperus virginiana var. virginiana
		Moderate Shade	P-DIC	Bay Starvine/ Schisandra glabra
				Black Cohosh/ Cimicifuga americana
		Open (Little or No Shade)	REPT	Eastern Earth Snake/ Virginia valeriae valeriae
		Rich Soil	P-DIC	Black Cohosh/ Cimicifuga americana
		Rocky/Rocks	MAMM	Eastern Small-footed Bat/ Myotis leibii