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Viability Assessment Report For Seeps/Swamp Habitat Association

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I. Description of Habitat Association

Three distinct habitats are included in this association. All are wetland habitats and generally all are forested. The three habitats are related by the function of ground and surface water within the habitats. Each of the three habitats will be addressed individually.

A. Streamhead seeps and wetlands

Streamhead seeps and wetlands are found across the cliff section of the Daniel Boone National Forest (DBNF). They are rare on the Redbird unit. They are most common in the Central Cliffs (221Hb) and Southwestern Cliffs (221Hc) ecological subsections of the Forest, but may occur in the Rugged Eastern Hills (221Ha), Low Hills (221He), and Kinniconick and Licking Knobs (222En) subsections (USDA Forest Service, 1997; 1996). These seeps and wetlands are usually located below the ridge on upper to mid-slopes. On steep ground, the wetlands tend to be close to the ridge or base of a cliff. These wetlands tend to form in 1st order streams immediately below, and generally have no more than 5-11 sq ft (.5-1 sq m) area. On flatter ground, they tend to be further down the slope. Distances at a few sites on the south end of the Forest average 980 ft (300 m) along the slope from the top of the ridge to the seep. Here, they form in near level sections of 2nd and 3rd (rarely 4th) order streams. These seeps are larger, ranging on the Forest from 100-20,000 sq ft (9-1860 sq m). They may be linear to broadly bowl shaped. Streamhead seeps, while occurring in conjunction with streams, are restricted to areas where geologic contact zones allow ground water to emerge at the surface. On the DBNF, these contact zones are at sandstone over shale/siltstone/(rarely) coal, and limestone over shale/siltstone. Soils are usually sandy, and may have a clay lens below the surface acting as bowl to catch and hold water. At least on the 2nd and 3rd order stream sites, the sandiness may be related to the levelness of these habitats. The sites are nearly pure sand, with sand depths ranging from an inch or so to better than 6 feet. It is possible that a past change in water flow allowed sand to deposit and hence create a near level site, or sand may simply settle on sites already near level. These wetlands are characterized by perennial water flow primarily of ground water origin. Even during drought conditions, these wetlands have flowing water, although the water flow may be below the streambed surface. From observation on the Forest, it is known that changes in surface hydrology increasing the flow of water into the system have a generally negative effect on the wetlands. The increased flow can result in the drying of the wetland by dropping the water table. A combination of head cutting and down cutting in the stream drains the saturated sand pockets leaving them literally high and dry. Increased sediment deposition

on these sites can also have a drying effect by raising the surface of the sand above the maximum water table. Sedimentation under other conditions probably contributes to formation of at least some of the 2nd and 3rd order stream associated wetlands by filling in low areas with sand, which then becomes saturated with water.

The primary energy source in these systems is photosynthesis. Other energy sources in these wetlands include surface and groundwater flow. These flows bring organic compounds to the otherwise near sterile soils found in the systems. Leaf litter drop from vegetation in and around the seeps also contributes energy sources.

Vegetation in streamhead wetlands and seeps is characterized by wetland species. Which species occur in the wetlands depends on the particular system in question. Cliff base seeps have the simplest vegetation. At the base of sandstone/conglomerate cliffs, almost always cinnamon fern or interrupted fern are present. Sometimes royal fern maybe found. Other species that may occur are mountain pepperbush, bulrush, and a few caric sedge species. There is usually an open canopy of mixed oak-mesic hardwoods, which may include yellow pines. Occasionally, the seeps occur in rhododendron or mountain laurel thickets, and here, the seeps are generally devoid of vegetation. At the base of limestone cliffs, the seeps are often free of vegetation, but may have present jack-in-the-pulpit, pawpaw, and a few caric sedge species. The larger streamhead seeps found on 2nd to 4th order streams have a much more varied vegetation. Cinnamon fern is almost always present, and royal fern is also common. In somewhat drier areas, New York fern is common to dominant. White-topped aster, ironweed, tear-thumb, climbing fern, bulrushes, caric sedge species, swamp goldenrod, spreading panic grass and several species of sphagnum moss are frequently encountered. Sphagnum mosses often form a carpet over most of the seep through which other species grow. Rare species found in these seeps include white-fringeless orchid, crested orchid, New York ironweed, spreading pogonia, Nuttall's lobelia, fox grape, and appressed bog clubmoss. Woody species in the seeps include red maple, sweet gum, alder, white pepperbush, mountain laurel, mountain holly, American holly, and occasionally white oak, eastern hemlock and tulip poplar. The surrounding forest may be upland pine-oak or oak to more mixed mesic hardwood.

B. Swamp (wooded wetland)

Swamps as defined here are distinct from streamhead wetlands and seeps, and other seeps, in that they are characterized by standing water, in which trees are growing. Streamhead seeps and wetlands may have woody vegetation in them, but in these, the water is flowing and often not standing on the surface. Swamps differ from bogs in that bogs are open and not characterized by woody vegetation, but may have somewhat stagnant water.

Swamps are found across the DBNF, but are nowhere common. They may occur in any landtype association (LTA) on the Forest. Swamps generally occur on lower landscape positions, often associated with a river, large stream or occasionally a reservoir. They can occur in perched positions as well, above larger watercourses. Where they occur, the site is relatively level to concave allowing the pooling of water. The underlying geology can

be shale, limestone or sandstone rock. Soils are important as they determine whether a given site will collect water. A clay layer is necessary at the bottom of the site to enable collection of water. Upper layers of soil in swamps may be sandy, loamy or most commonly clayey. Swamps are characterized by water that is permanent or nearly so. Water sources are usually surface water, but can be ground water as well. Water depth may range from a few inches to several feet and the water is generally stagnant.

Photosynthesis is the primary energy source for swamps. Incoming water provides some energy to the system bringing with it organic material. Leaf fall from vegetation in and around the swamp also provides energy input.

Swamps are characterized by woody vegetation. Woody species that are likely to be present in swamps on the DBNF include black willow, river birch, sycamore, red maple, sweet gum, alder, American holly, and occasionally mountain laurel and shrub dogwood. White oak, tulip poplar and eastern hemlock are occasionally found on hummocks within the swamp. Other species include caric sedge species, bulrush species, wild ramié, swamp sticktight, and smartweeds. The herbaceous layer is frequently sparse, especially in swamps with more closed canopies.

C. Seeps/Bogs-including slopes, not streamheads

These wetlands are uncommon on the DBNF. A cluster of small (10-20 sq ft, 1-2 sq m) to large (1 ac, 0.4 ha) of mostly slope seeps (some streamhead seeps are present) occurs at the north end of the Forest in the Knob Plateau (222En001) LTA (USDA Forest Service, 1997; 1996). Elsewhere on the forest, these wetlands are uncommon, but occur on every district. They occur on gentle to moderate slopes below the ridge, usually between upper and mid-slope. The underlying geology includes a contact zone at which groundwater may emerge at the surface. Contacts include sandstone over shale/siltstone/(coal), limestone over shale/siltstone and sand/gravel over shale/siltstone. Soils in these wetlands are generally sandy, but may be clayey. Slope seeps are characterized by perennial sheet-like water flow, mostly from ground water sources. Even in drought, water moves through the seeps below the surface. Large or sudden increases in surface water flow may disrupt hydrology of the seeps by cutting channels concentrating water in some places and thereby dropping the water table in other places.

Photosynthesis is the primary energy source of these systems. Both ground and surface water contribute to the energy sources of these systems by move organic matter into the wetland. Other organic matter is introduced through leaf fall from vegetation in and around the wetland.

Vegetation in slope wetlands is varied. On many sites, there is a forest canopy composed primarily of oak and species such as sycamore and river birch. Yellow pine is present in some on hummocks. Alder, American holly, chokeberry, mountain holly, and mountain laurel may be in the understory. Herbaceous species include caric sedges (often dominant), cinnamon and royal ferns, and bulrushes. In some, sphagnum mosses form thick mats on the surface through which other vegetation grows. Some of the slope seeps are not forested; most of these occur in utility rights-of-way. Vegetation here is largely

grass consisting of big bluestem, little bluestem, Indiangrass, panic grasses, and purpletop. Numerous forbs may also present including gayfeathers, swamp goldenrod, Appalachian spreading pogonia, sunflowers, spikemoss, and whitetop aster. Occasionally shrubs, including mountain laurel, lowbush blueberry and interior willow, are present.

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

To date, there has been no systematic survey for wetland, seep and swamp habitats on the DBNF. However, cooperative rare species inventories conducted between 1987 and 1993 (United States Forest Service et al., 1988-1994) identified numerous seeps and wetlands, and project species surveys have identified others. Some additional information is available from USDI wetland surveys, but no ground truthing has occurred. Data on known locations is not yet organized in spatial or tabular databases. At least 100 sites are known which fit one of these habitat types. Most are clustered in one area near Morehead, KY.

It is believed that there are fewer sites on the Cumberland Plateau attributable to one of these habitat types now than there were 200 years ago. This is especially true for the streamhead seep type. Currently on land adjacent to or not far from National Forest, streamhead seeps have been cleared in the last 5 years. Large acreage of pastureland with appropriate geology, landform and stream types exists today without the expected streamhead vegetation and form. These sites are largely planted in fescue. Two hundred years ago, many more of these sites would have been in wooded condition with functional wetlands. Many acres around the London, KY area with suitable conditions for streamhead seeps are being converted to subdivisions or other development land. Between 1900 and 1930, most of the land now comprising the DBNF was cut over and burned. This undoubtedly had an effect on these habitats. Equipment likely crossed through many wetlands or seeps (some today still have evidence of past roads), and the cutting of trees changed the hydrology of sites, probably eliminating some, but possibly creating others.

A few important seep and swamp wetlands still exist on private land in the vicinity of the DBNF. However, the bulk of the sites on the Cumberland Plateau are believed to be on the DBNF. The continued local (in some cases, state wide) existence of many of the species found in these habitats is probably dependent on maintaining the sites on National Forest land.

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

The management goal for the seeps 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. (FLRMP, IV:79, in part)

The strategy to accomplish this goal focuses on maintaining zones of limited disturbance around the habitat association. Additional standards and guidelines are also recommended when other management measures are needed to insure the viability of a particular species associated with this habitat association.

The desired future condition of this habitat association is an area of limited disturbance around these systems in which hydrologic systems function with limited or no modification as a result of management actions

1. Habitat Association General Direction and Standards and Guidelines (S&G)

A. Management activities are restricted within the seep or swamp watershed

- Seeps, streamheads and swamps forest-wide will be managed to retain the watershed above and adjacent to the site in forest canopy at a minimum of 60 BA or the existing BA if lower. The midstory layer BA may be reduced or removed.

Rationale: Microclimate conditions (temperatures, humidity, moisture) are important in maintaining viable populations of many species occurring in this habitat association. In addition, removal of overstory affects hydrology of the site, usually increasing runoff. A reduced or removed midstory layer allows more side light to reach the wetlands, increasing light for the target species, but reducing overhead light favored by competing woody species.

- Watershed areas below seeps, streamheads and swamps will be maintained in forest canopy at a minimum of 60 BA, or the existing BA if lower, where changes in water flow have high likelihood of inducing down cutting or head cutting in the associated stream.
 - Rationale: Generally once on extensive bedrock, or below a cataract, head cutting and down cutting concerns are minimized or eliminated. Until bedrock is reached, increased water in the stream below a wetland site can cause negative changes to the hydrology of the habitat above.
- On a site-specific basis, activities, including vegetative management, can be permitted when the objective is to improve habitat conditions for PETS species.

Rationale: Management activities are sometimes necessary to maintain or enhance individual species habitats.

- Roads and skid trails are not permitted in the watershed above and adjacent to the sites. Limited end-lining is permitted on a site-specific basis, but ruts must be rehabilitated to disperse, rather than concentrate, surface water.
 - Rationale: Roads and skid trails tend to concentrate surface water within the watershed and may introduce surface water from another watershed into the site. Increased or concentrated water flow in these systems is known to increase down cutting and head cutting in the streams, which in turn lowers the water table, drying out the wetlands.
- Activities such as rights-of-way, trails, and scenic vistas may be permitted in the seep/streamhead/swamp watersheds as long as they do not negatively impact, primarily through changes in hydrology, PETS species or their potential habitat.

Hydrologic changes include those due to changes in canopy vegetation. (FLRMP, IV-41,129; in part)

- Rationale: Limited use of the watershed area may not affect species viability on a site-specific basis.
- Firelines for prescribed fire may be constructed in watersheds containing seeps, wetlands and swamps. However, where streamhead and slope seeps are present, these will be hand lines only and should be considered primarily for protecting private property, or protecting or enhancing species at risk or habitat for these species. Constructed lines must not concentrate runoff at points along the seep, but rather spread it out along the length of the seep. Soil exposed during line construction will be seeded and mulched, as needed to prevent erosion, within one week of burning.
 - Rationale: Constructed lines tend to interrupt surface hydrology and may cause damage to the sites. Hand lines are less disruptive to sensitive sites. Even these need to be designed to minimize risk of damage and need rehabilitation after the burn.
- Firelines built during wildfire events WILL NOT be built through streamhead seeps occupied by white fringeless orchid, or identified slope seeps. In addition, firelines will exclude the seeps from fire when going around the site. Elsewhere, firelines and other soil exposed in suppression efforts, in watersheds containing seeps, swamps or wetlands will be treated with, but not limited to, waterbars, seeding (native or noninvasive exotic species only-see Region 8 weed list), and mulching as needed to stabilize exposed soil and prevent concentration of runoff in a few areas. This will occur within one week of line construction or soil disturbance.
 - Rationale: Observations on the Forest indicate most sites occupied by white fringeless orchid and slope seeps would not be expected to recover from fireline construction disturbance. Outside of these areas, firelines might be built in suppression efforts. Restoration of the disturbed ground then becomes priority to prevent damage to the seeps, wetlands or swamps.
- 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 or concentrated wildlife use
 - Rationale: Human and wildlife use of site-specific areas may need to be modified or restricted. Several sites receive intensive deer browsing when one S species is in flower, severely limiting reproductive potential.
- Management activities concentrating public use in the vicinity of sensitive seep/streamhead/swamp areas 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.

(S&Gs developed based on direction in SHNS amendment for other naturally occurring, rare habitats or features providing specialized habitat, and on personal observations; by Taylor, 2001)

B. Protect or enhance habitat for PETS species in seep, streamhead or swamp habitat

- *Prescribed fire of low intensity is permitted year around in the watersheds, and late fall through spring through the seeps/streamheads/swamps themselves, providing that the sphagnum moss or duff layer in the wetland is wet enough to prevent more than ten percent of these materials from burning. Flashy fuels such as graminoids and herbs in the wetlands should be allowed to burn, but are not to be directly fired without site-specific objectives addressing the need. (FLRMP, Amend. 7, in part)*
 - Rationale: At least some, if not all of these sites, evolved with fire. Experimental and accidental burns in other states show that fire can be beneficial to the species living in the wetlands. Open midstory provides increased light supporting pollinator attractors and flowering of white-fringeless orchid, without directly favoring woody species with increases in overhead light.
- Single tree cutting is permitted to provide pockets of open conditions in and immediately adjacent to wetlands and seeps. Trees cut generally should be midstory trees. The overstory canopy on a site will generally be left intact. Trees are to be cut leaving a 3-4 feet high stump.
 - Rationale: Some species, such as white-fringeless orchid, require areas of open to promote flowering or make flowers more available to pollinators. Experimental cutting in one site has shown that midstory trees cut at four feet high do not readily sprout from the base, and only poorly sprout from the stem, preserving the open conditions for a greater period of time.
- Herbicides may be applied within watersheds containing seeps, wetlands and swamps. At least 30 feet must be left around these features and the area treated when applying herbicides from the ground. Where a seep, wetland or swamp contains a PETS species, the minimum distance increases to 60 ft. (FLRMP, Veg EIS, in part)
 - Rationale: The application of herbicide may have valid management use in these watersheds. The stated distances with proper application of materials is expected to protect water and PETS resources.

- Maintain and perpetuate all streamhead and slope seeps, and swamps as they provide habitat for species at risk.
 - Rationale: A complete survey for seep/streamhead/swamp wetlands is not completed. Many of these sites may actually harbor PETS organisms, but necessary inventory is not completed. Natural or culturally induced events may damage existing habitat, and replacement habitat may be needed. At present, creation of such habitat is not feasible.
- Restore or reestablish streamhead and slope seeps, and swamps where impacts have not fully destroyed the character and function of the community.
 - Rationale: It may be easier to reconstruct a damaged community, than try create a new one from scratch.
- Acquire private lands from willing sellers with known wetland sites providing habitat for PETS species.
 - Rationale: Wetland sites are limited in number within the DBNF proclamation boundary, and those with existing PETS populations are more limited. Creation of this habitat is not currently feasible and protection of the habitat is more likely on federal land than on private land.
- Acquire private lands from willing sellers located within watersheds containing seeps/streamheads/swamps occupied by PETS species.
 - Rationale: Protection of known wetlands requires management of the watershed associated with the site, at least above and adjacent to the site, and possibly some distance below the site. See rationale above pertaining to roads and canopy disturbance.

(S&Gs added based on general PETS management goals per ESA and FS policy. PETS species, specifically white fringeless orchid, occupy these sites and are known to be affected by changes in hydrology within these sites. Measures were added to this S&G as best science available measure to insure species viability; Taylor 2001)

IV. Management Needs: Monitoring and Inventory

- Maintain an inventory of grassland areas with spatial and tabular attributes including but not limited to, location, size, type of wetland, condition, and the presence of any species at risk. (High priority)
 - *Rationale: An inventory of wetlands and seeps provides information on which to base management decisions, track yearly and plan period maintenance accomplishments, and estimate habitat suitable for various species at risk.*
- Monitor MAR and other reporting systems to help determine accomplishments for each year and the planning period. (Moderate priority)

- Rationale: MAR and other reporting systems will be filled out yearly. Use data as reported to help verify inventory.
- Monitoring populations of white-fringeless orchid. (High priority)
 - Rationale: 5-6 years of data on population trends are already available for this species. This species is a Candidate for listing, and is sensitive to habitat changes.
- Monitor wetland and seep areas for invasive exotic species, primarily plants, which may compromise habitat conditions. (high priority)
 - *Rationale: Invasive exotics can spread quickly, taking over and rendering unusable or marginal wetland or seep habitat, as well as choking out plants at risk.*

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07/15/2003

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Attachment A.**Species List: Seeps Habitat Association**

Class	Common Name/ Species
ANIMALS	
Amphibians	Jefferson Salamander/ <i>Ambystoma jeffersonianum</i> Marbled Salamander/ <i>Ambystoma opacum</i> Mountain Dusky Salamander/ <i>Desmognathus ochrophaeus</i> Black Mountain Salamander/ <i>Desmognathus welteri</i> Green Frog/ <i>Rana clamitans</i> Wood Frog/ <i>Rana sylvestris</i>
Birds	Wood Duck/ <i>Aix sponsa</i> Northern Harrier – <i>Circus cyaneus</i> Sedge Wren – <i>Cistothorus platensis</i> Least bittern/ <i>Ixobrychus exilis</i> Swainson's Warbler – <i>Limnothlypis swainsonii</i> Hooded Merganser/ <i>Lophodytes cucullatus</i> Pied-billed Grebe/ <i>Podilymbus podiceps</i> Prothonotary warbler/ <i>Protonotaria citrea</i> American Woodcock – <i>Scolopax minor</i> Louisiana Waterthrush – <i>Seiurus motacilla</i>
Mammals	Masked Shrew/ <i>Sorex cinereus cinereus</i>
Reptiles	Timber Rattlesnake/ <i>Crotalus horridus</i> Northern Coal Skink/ <i>Eumeces antracinus anthracinus</i> Southeastern Crowned Snake/ <i>Tantilla coronata</i> Eastern Ribbon Snake/ <i>Thamnophis sauritus sauritus</i>
Snails	Delicate vertigo/ <i>Vertigo bollesiana</i>
PLANTS	
Dicots	Yellow Screwstem/ <i>Bartonia virginica</i> Brook Saxifrage/ <i>Boykinia acontifolia</i> Shaggy Hedge-hyssop/ <i>Gratiola pilosa</i> American Water-pennywort/ <i>Hydrocotyle americana</i> Kidney-leaf Grass-of-Parnassus/ <i>Parnassia asarifolia</i> Cross-leaf Milkwort/ <i>Polygala cruciata</i> var. <i>cruciata</i> Slender Marsh-pink/ <i>Sabatia campanulata</i> New York Ironweed/ <i>Vernonia noveboracensis</i>
Ferns	Engelmann's Quillwort/ <i>Isoetes englemannii</i>

Class	Common Name/ Species
Liverworts	A Liverwort/ <i>Telerania nematodes</i>
Monocots	Cane/ <i>Arundinaria gigantea</i> Atlantic Caric Sedge/ <i>Carex atlantica</i> Cypress-swamp Caric Sedge/ <i>Carex jooarii</i> Caric Sedge/ <i>Carex seorsa</i> Uptight Caric Sedge/ <i>Carex stricta</i> Grass-pink/ <i>Calopogon tuberosus</i> Appalachian Spreading Pogonia/ <i>Cleistes bifaria</i> Pink Lady's-slipper – <i>Cypripedium acaule</i> Small Yellow Lady's-slipper – <i>Cypripedium parviflorum</i> var. <i>parviflorum</i> Loesel's Twayblade/ <i>Liparis loeselii</i> Rose Pogonia/ <i>Pogonia ophioglossoides</i> Goldenclub/ <i>Orontium aquaticum</i> Clubspur Orchid/ <i>Platanthera clavellata</i> Yellow-crested Orchid/ <i>Platanthera cristata</i> White Fringeless Orchid/ <i>Platanthera integrilabia</i> Small Purple-fringed Orchid/ <i>Platanthera psycodes</i> Rose Pogonia/ <i>Pogonia ophioglossoides</i> Yellow-eyed Grass/ <i>Xyris caroliniana</i> Yellow-eyed Grass/ <i>Xyris difformis</i> Yellow-eyed Grass/ <i>Xyris torta</i>
Mosses	Sphagnum Moss/ <i>Sphagnum bartlettianum</i> Sphagnum Moss/ <i>Sphagnum magellanicum</i> Large-leaved Sphagnum Moss/ <i>Sphagnum macrophyllum</i> Swamp Sphagnum Moss/ <i>Sphagnum palustre</i>

Attachment B.

Seeps/Swamps Species/Habitat Relationships with References

ANIMALS

Amphibians

Jefferson Salamander -- *Ambystoma jeffersonianum* -- Jefferson salamander is found primarily in shady deciduous forests or mixed woods, low woods and bottomlands. This salamander requires abundant leaf litter, rocks, decomposing logs and stumps. During breeding season, the Jefferson salamander requires temporary ponds, ideally with a pH between 5 and 6 (DeGraff and Rudis, 1986). This salamander is an opportunistic feeder consuming small invertebrates. (Wilson, 1995).

Marbled Salamander -- *Ambystoma opacum* -- The marbled salamander occupies a variety of habitats, ranging from pine forests to mixed pine-hardwoods and apparently does best in areas where abundant leaf litter and fallen logs provide shelter. This salamander will spend much of its' time in burrows, leaf litter or under bark and logs. During late fall, the marbled salamander moves into bottomland hardwoods and deposits its' eggs terrestrially. This salamander requires areas subject to fluctuating water levels for breeding and larvae development. The marbled salamander will eat a variety of food items such as insects, other small arthropods, earthworms, snails, and slugs. (Wilson, 1995).

Mountain Dusky Salamander -- *Desmognathus ochrophaeus* -- The mountain dusky salamander has the broadest altitudinal distribution of any desmognathine salamander, reaching the highest elevations in the eastern United States. These salamanders become more terrestrial at higher elevations, apparently in response to increased humidity. (Hairston, 1949; Tilley, 1973c). At high elevations, the mountain dusky salamander prefers cool, moist floors of conifer forests (USGS, 2001); at low elevations, this species occurs primarily under rocks, logs or leaves near stream margins, springs, or seepage areas, where the ground is water saturated. Adults will often move far into the adjacent woodlands, particularly during rains. The mountain dusky salamander requires mesic woodlands, usually hardwoods or mixed pine-hardwood, with springs, seeps or rocky streams. In winter, this salamander is known to congregate in springs or seepage areas. (USGS, 2001). Wet, mossy, rock faces are preferred by this species. The mountain dusky salamander's diet includes small arthropods and earthworms. (Wilson, 1995)

Black Mountain Salamander -- *Desmognathus walteri* -- The type locality for the Black Mountain Salamander is Black Mountain, Harlan County, Kentucky. The range extends through the southeastern two thirds of Kentucky and adjacent Virginia and Tennessee. The Black Mountain Salamander is found in and around mountain streams with moderate to weak current. Occasionally it is found associated with wet, rocky seeps. The black mountain salamander is primarily a nocturnal feeder, which preys on worms, arthropods and crustaceans. The black mountain salamander requires silt-free streams with rocky bottoms. They spend most of the daylight hours concealed under rocks. (Wilson, 1995)

Green Frog – *Rana clamitans* – This frog is a semi-aquatic species occupying many of the same habitats as the large bullfrog, e.g. permanent bodies of water. The green frog can be observed in shallow water, such as springs, seeps, ponds, reservoirs, creeks, beaver ponds, ditches, bogs, floodplain pools, and swamps. The green frog requires semi-permanent water and is an opportunistic feeder. The green frog's diet includes arthropods, snails and worms (Martof et al., 1980). The green frog prefers ponds, floodplain swamps or marshy habitat with grassy edges and emergent vegetation. (Wilson, 1995)

Wood Frog -- *Rana sylvatica* -- The wood frog lives in or near moist woods, hardwood valleys and occasionally white pine-hemlock, and upland pine forest types. The wood frog breeds in open-water ponds, slow-moving portions of streams and roadside ditches. The wood frog's diet consists mainly of insects. Adults require upland forest areas with logs, stumps and rocks for overwintering and moist woods with standing water during the late winter months. (Wilson, 1995)

Birds

Wood Duck – *Aix sponsa* – These birds live around a variety of aquatic habitats that have cavities available for nesting. Swamps, wooded streams, lakes, ponds, reservoirs, and marshes provide suitable habitat. Nesting is in live or dead trees, within cavities, hollow limbs, and even abandoned pileated woodpecker holes. Trees utilized are usually near or above water—often in Sycamore and maples (Mengel 1965). Artificial nest boxes are widely used. Birds forage in shallow water for aquatic plants, insects, and small fish. In the winter, Wood ducks often eat acorns. Within the seep habitat association, wood ducks would be particularly attracted to wooded wetlands and swamps and other areas with standing water and mature trees with cavities.

Northern Harrier – *Circus cyaneus* – This is a species of open country, weedy fields, and marshes. Wooded habitats are not used. Northern Harriers were more prevalent in Kentucky in the past, before the destruction of native prairies. Harriers have bred in small numbers on reclaimed surface mines in the state, nesting amid dense cover of tall grasses. When trees are planted during reclamation...the harriers probably use the mines only for a limited number of years (Palmer-Ball 1996). On the DBNF, this species has been observed over Anco strip mines on the Somerset Ranger District and over large hayfields on the Stearns R.D. (L.Perry, pers. obs.). The northern harrier would be expected to forage over large wetlands with no overstory and a grassy understory.

Sedge Wren – *Cistothorus platensis* – This is a species of low, wet grasslands. Moist meadows and the grassy margins of marshes and bogs are favored. In Kentucky, the birds also inhabit hayfields, overgrown pastures and fallow fields; areas that provide the thick, herbaceous cover the birds require (Palmer-Ball 1996). Nests are in grasses and sedges of weedy fields and in dense clumps of sedges growing in moist spots (Mengel 1965). Larger streamhead wetlands and bogs may be utilized by this species.

Least Bittern – *Ixobrychus exilis* – This bittern species is found around aquatic habitats that have tall vegetation, such as cattails and rushes, in which to conceal themselves and their nests. Swamps, marshes, and pond edges are commonly used. In Kentucky, least bitterns have also

been found nesting in artificial situations, including reservoirs, waterfowl management impoundments, and fish hatchery brood ponds (Palmer-Ball 1996). Foraging is in shallow water, mud, and aquatic vegetation (Hamel 1992). This species would be expected to utilize swamps and wetlands within this habitat association.

Swainson's Warbler – *Limnothlypis swainsonii* – This forest interior species is found within tracts of moist, extensive forest that have dense understory (Palmer-Ball, 1996). Hemlock ravines, having dense growths of rhododendron and laurel, and bottomland forest, with a well-developed understory and/or thickets of small trees, are favored locations. Dense cane breaks are also used. On the DBNF, this bird is often observed in damp, shady hemlock ravines with an understory of rhododendron, near small streams (L.Perry, pers. obs.). The Swainson's warbler would be expected to utilize the wooded wetlands and swamps for breeding provided that a dense understory of shrubs is present.

Hooded Merganser – *Lophodytes cucullatus* – This species of waterfowl requires wooded areas with clear water streams, rivers, swamps, ponds, and lakes with cavity trees present (DeGraaf et al., 1991). Usually forages in freshwater situations such as swamps, ponds or lakes (Hamel, 1992). This species is seldom found far from floodplain situations and usually requires a good stand of fairly mature forest nearby for nest sites (Palmer-Ball, 1996). They require cavities for nesting and may utilize artificial cavities originally constructed for wood ducks (Bellrose, 1980). Within the seep habitat association, hooded mergansers would be particularly attracted to wooded wetlands and swamps and other areas with standing water and mature trees with cavities.

Pied-billed Grebe – *Podilymbus podiceps* – The destruction of wetland habitat has led to a decrease in numbers of this species. Marshes, water impoundments, and shallow edges of lakes and ponds provide habitat for these birds. Marshy, shallow water with abundant emergent vegetation in which to nest is required during the breeding season. During winter, the birds use similar habitat, but with an increased use of open water. On 13 June 2000, an MSU grad student observed a pied-billed grebe and four young on an USFS-built wetland near Beaver Creek, on the Morehead R.D. (Biebighauser 2001).

Prothonotary Warbler – *Protonotaria citrea* – This species is found in standing water habitats within areas of extensive forest (Hamel, 1992). When birds are seen, they are almost always near the water. Swamps, riparian corridors, bottomlands and floodplains, willow thickets around lakes and ponds, and reservoir margins that contain snags at least 6" dbh provide potential habitat for these cavity-nesters. Somewhat open swamps, with scattered dead stumps or dead trees with cavities, are favored nesting sites. Within the seep habitat association, prothonotary warblers would be particularly attracted to wooded wetlands and swamps and other areas with standing water and mature trees with cavities.

American Woodcock – *Scolopax minor* – This species typically requires moist woodlands in early stages of succession. It may use open fields, cultivated land, pastures and clearings at least ¼ acre in size (DeGraaf et al., 1991). It generally requires poorly drained soils with an abundance of earthworms for feeding, nearby fields or small forest openings for courtship and roost site (DeGraaf et al., 1991) and is largely absent from extensive areas of mature forest (Palmer-Ball, 1996). The presences of edge habitat and a high shrub stem density may be

important for nest site selection in some areas (NatureServe, 2001). Appears to be partial to sheltered wet thickets along meandering streams (Barbour et. al., 1973). This species would be attracted to brushy seeps and bogs within the general forest environment.

Louisiana Waterthrush – *Seiurus motacilla* – This forest interior breeding bird frequents rather steep, wooded slopes in riparian areas: especially the banks of rocky, rushing streams. Nests are usually near the water--commonly in crevices at the base of rocks under bank overhangs in heavily shaded areas (Mengel 1965). On the DBNF, the birds are nearly always found where a dense understory of rhododendron or other shrubs shades the stream (L. Perry, pers. obs.). Hamel gives the minimum tract size necessary for the species as 875 ha (1992).

Mammals

Masked Shrew – *Sorex cinereus cinereus* – The masked shrew is associated with higher elevations of the conifer-northern hardwood habitat association. They are found in deep, moist woodlands and prefer areas of thick leaf mold and decaying fallen logs. Masked shrews may occur in small populations on the Redbird Ranger District, DBNF. The species may occur in other forested habitats, particularly near stream head seeps, that have the right conditions to support numerous invertebrate food species and moisture conditions. The dens of masked shrews are located in cavities in logs or snags, under logs or in shallow burrows. In streamside areas they may be found in communities dominated by hemlock/rhododendron. The diet of this species consists of a variety of invertebrates and small vertebrate animals. They prefer moist habitats and access to free water may be important.

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, rocky ridge 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.

Southeastern Crowned Snake (*Tantilla coronata*) The southeastern crowned snake ranges from south-central Virginia and southern Illinois to the Florida panhandle and eastern Louisiana. This secretive snake is an excellent burrower, spending much of its time concealed in rotting logs, under bark, stones, leaf litter, pine needles, or burrowed in the soil. The southeastern crowned snake apparently prefers relatively xeric, well-drained soils in pine flatwoods, sandhills and dry hillsides. This snake requires dry habitats with friable soil and sufficient debris for shelter. Females deposit eggs in rotting logs or sawdust piles. The southeastern crowned snake's diet consists of centipedes, spiders, termites, and other small, soft-bodied arthropods. (Wilson, 1995).

Eastern Ribbon Snake – *Thamnophis sauritus sauritus* – This is a semiaquatic species almost always found close to the shallow water of bogs, marshes, swamps, ponds, streams, and weedy lake shorelines. Other low, wet places in which it is encountered include meadows and grassy roadside ditches. Occupied areas tend to be open, but with an abundance of ground cover, such as grasses and sedges, and bushes in which the snakes can sun themselves. These snakes often climb into low vegetation, although rarely more than 4 feet off the ground (Barbour 1971). When startled, they swim on the surface of the water. Deep water is normally avoided, and fleeing Ribbon Snakes skirt the shore, threading their way through vegetation and getting lost from sight with amazing rapidity (Conant and Collins 1991). Their diet consists of small fish and amphibians.

Snails

Delicate Vertigo — *Vertigo bollesiana* — is restricted to Bell and Harlan Counties. It can be found in leaf litter and moss on wooded hillsides within the general forest. *V. bollesiana* has also been recorded from marshes.

PLANTS

Dicots

Yellow Screwstem – *Bartonia virginica* – is a coastal plain species commonly found in moist to wet pine savannas. On the DBNF, it occurs, if at all, in streamhead wetlands and slope seeps. It requires constantly moist conditions and no more than moderate shade. There is some taxonomic confusion between this species and *B. paniculata*, which is more common and which definitely occurs on the forest in the habitat described above.

Brook Saxifrage – *Boykinia acontifolia* – is found throughout its range associated with stream banks. It may also grow in wet meadows. It grows on continually wet, sandy or rocky banks just above summer water levels. It is usually found in moderate shade.

Shaggy Hedge-hyssop – *Gratiola pilosa* – is a coastal plain species which extends interior to the Appalachian Mountains and Arkansas. In Kentucky is known only from the southern portion of the DBNF area. Here it occurs on pond margins, wet meadows and seeps along rivers.

American Water-pennywort – *Hydrocotyle americana* – is a northern species that extends south along the Appalachian Mountains. It grows on usually damp sandy soil, often along streams. On the DBNF, it occurs in only one area, on the sandy floodplain of a stream. The overstory is oak-

yellow pine and the midstory is sparse.

Kidney-leaf Grass-of-Parnassus – *Parnassia asarifolia* – is a species of the Appalachian and Ozarkian provinces. It is commonly found on stream banks and in boggy habitat. On the DBNF, the few locations are from streamhead wetlands in open yellow pine-oak forest. The species requires constantly moist soil and moderate light.

Cross-leaf Milkwort – *Polygala cruciata* var. *cruciata* – is coastal plain species with inland records along the Appalachian Plateaus and in midwestern prairie states. It is known from damp to wet meadows, yellow pine savannas, and bogs. On the DBNF, it is known from wet meadows and open, wet non-forested areas such as warm season grassland.

Slender Marsh-pink – *Sabatia campanulata* – is coastal plain species found in salt or brackish marshes. It occurs inland in a few areas. The DBNF sites are from wet meadows.

New York Ironweed – *Vernonia noveboracensis* – is a coastal plain species with scattered interior stations. It is found in open floodplain forest, roadside ditches, marshes, and other wet places. On the DBNF, the species is found in streamhead wetlands and occasionally in roadside ditches. A canopy may be present, but if so, the midstory and shrub layers are sparse.

Ferns

Engelmann's Quillwort – *Isoetes engelmannii* – is a semi-aquatic species. The plants can survive entirely submerged, or for several months out of water if the soil remains moist. At the time spores are released, the leaf bases must be submerged for sexual reproduction to be successful. The plants are generally in shallow water (under 2 feet deep) and are found in both permanent and seasonal water including ruts, roadside ditches, ponds, lake margins, and occasionally in streamhead wetlands and streams.

Liverworts

Liverwort – *Telarania nematodes* – is associated with wetlands throughout its range. On the DBNF, it is known from only a few slope seeps, but probably occurs in others and streamhead seeps. The species grows in and on top of other bryophytes, in particular sphagnum mosses. It requires constant moisture, high humidity and moderate shade, which may be provided by the sphagnum or herbaceous plants growing in the wetlands.

Monocots

Cane – *Arundinaria gigantea* – is a riparian species that also grow in upland habitats. It often forms extensive monocultures (or nearly so) called cane brakes. These areas were maintained in part by fire. Cane brakes are most common along open riparian areas subject to infrequent flooding, but do occasionally occur in upland areas.

Atlantic Caric Sedge – *Carex atlantica* (ssp. *atlantica*) – is a coastal plain species that grows in areas that remain wet throughout the year such as swamps and bogs. On the DBNF, it is associated with streamhead wetlands, slope seeps and swamps. It may also occur in wet

meadows. It grows in clumps forming thick to thin mats of vegetation. Shade is usually moderate to light.

Pond Caric Sedge – *Carex jorii* – is a coastal plain species found associated with areas that remain wet throughout its range, primarily swamps and wet woods. On the DBNF, it is a semi-aquatic species found only in and at the edge of, a few, apparently natural, ponds. These ponds occasionally dry, but the soil remains saturated.

Caric Sedge – *Carex seorsa* – is a wet forest species with a range over much of the eastern US. It grows in areas that remain wet throughout the year. On the DBNF, it is associated with a few streamhead wetlands and slope seeps. It grows in clumps forming thick to thin mats of vegetation. Shade is usually moderate to light.

Upright Caric Sedge – *Carex stricta* – is similar to and easily confused with streamside caric sedge. Its range is primarily the northern US, but with extensions into the Appalachian Mountains. This species may grow along streamsides in gravel or mud bars subjected to flooding, but is more commonly found in swamps. It forms tight clumps, which are usually in several inches of standing water. The water is often stagnant. The canopy provides moderate to heavy shade. The DBNF stations are in swamps.

Grass-pink – *Calopogon tuberosus* – is a coastal plain species found in wet to moist pine savannas, roadside ditches, pitcher plant bogs, and other open, wetland habitats. A few historic Kentucky stations occurred in dry, sandy soil on ridgetops under open oak or oak-yellow pine forest. On the DBNF, a few extant stations are known from streamhead wetlands, slope seeps or wet warm season grassland. It may have occurred on drier sites in the past. The species requires constant moisture and more or less open conditions.

Appalachian Spreading Pogonia – *Cleistes bifaria* – ranges from the Appalachian Plateaus to the Piedmont. It is found in a variety of sites ranging from glades to open forest to warm season grassland to streamhead wetlands. It occurs on well-drained substrates (on hummocks in wetlands) usually in open or partially open conditions. The plants can be single or occur in colonies. On the DBNF, it is known from glades, streamhead wetlands, seep slopes, and on road cuts in upland oak forest. Fire enhances flowering and total numbers of plants. Fire probably helps to maintain habitat as well.

Pink Lady's-slipper – *Cypripedium acaule* – across its range, occurs in acid forests or wetlands (usually sphagnum bogs). On the DBNF, pink lady-slipper is found in upland oak and mixed pine-oak woods, and occasionally on hummocks within seeps and streamhead wetlands. It occurs in light to heavy shade, but does not seem to flower unless in somewhat open conditions. This species responds well to burning. It is not uncommon to find 3-4 dozen plants in flower and as many more in vegetation condition following a fire where only a dozen or so were found before. The species is experiencing collection pressure from root diggers. Digging of this species is not permitted on the DBNF.

Small Yellow Lady's-slipper – *Cypripedium parviflorum var. parviflorum* – ranges from Canada to the southern Appalachian Mountains. It is most common to the north. It grows in sphagnum

bogs and hemlock- white pine woods northward. On the DBNF, a few sites are known, all from open oak forest on lower slopes.

Loesel's Twayblade – *Liparis loeselii* – is a northern and midwestern 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.

Goldenclub – *Orontium aquaticum* – is a coastal plain species with scattered stations inland on the Cumberland Plateau. It is found in shallow water slow water and swamps. On the DBNF, it is found in quiet backwater along rivers and streams at the southern end of the forest.

Clubspur Orchid – *Platanthera clavellata* – orchid occurs in a wide variety of habitats across its range. On the DBNF, it occurs in streamhead wetlands, in seeps, on streambanks, and in swamps. It is usually found in mucky soil under moderate to heavy shade. The soil in which it occurs is always damp or wet. This species is an alternative host to the endophyte fungus that is the sole fungal associate for white fringeless orchid (*P. integrilabia*). Maintaining this orchid helps to maintain a diverse stock for the fungal symbiont.

Yellow Crested Orchid – *Platanthera cristata* – occurs in a wide variety of habitats across its range. On the DBNF, it occurs in streamhead wetlands, seeps, and in permanently damp to wet areas in warm season grassland. It occurs in low to moderate shade conditions. This species is an alternative host to the endophyte fungus that is the sole fungal associate for white fringeless orchid (*P. integrilabia*). Maintaining this orchid helps to maintain a diverse stock for the fungal symbiont

White Fringeless Orchid – *Platanthera integrilabia*– on the DBNF is found in streamhead seeps, or rarely streambanks in the vicinity of streamhead wetlands. This species requires the sterile, constantly wet to moist sandy soil found in this habitat. Water in these seeps is always flowing at least below the surface, and is never stagnant. It is possible that this helps keep the species endophyte fungus associate from damaging the plant. The species almost always grows in mats of *Sphagnum* mosses, but occasionally is associated with leaf litter or a thin layer of organic muck. It is probable *Sphagnum* helps to maintain moisture and soil pH. It is also known to serve as a nursery for seed germination. The canopy associated with these seeps ranges from open to closed. The open conditions encourage butterfly-attracting species such as *Eupatorium fistulosum*, which in turn increase the chances of pollination of the orchid flowers. The closed canopy condition may improve germination and establishment of seedlings.

Small Purple-fringed Orchid – *Platanthera psycodes* – is a northern species with a range extension south along the Appalachian Mountains. It is found in wet meadows and wet, open forest. On the DBNF, there are tentative records for this species from wet stream terraces under high canopy closed forest. The identity of the plants in question is not certain.

Rose Pogonia – *Pogonia ophioglossoides* – is found in open, boggy ground, scattered through the eastern US. In the DBNF area, it is known from one, maybe two sites. One is open, wet warm season grassland under a powerline right-of-way. The other site is a sphagnum slope seep.

Yellow-eyed grass – *Xyris caroliniana* – is not found in the state. It is a misidentification which has been tracked erroneously. The specimens are referable to *X. torta* (Medley, 1993)

Yellow-eyed Grass – *Xyris difformis* var. *difformis* – is a coastal plain and lake state species found in bogs and saturated sandy shores. The one Kentucky record, in the DBNF area, is from a wet, sandy meadow.

Yellow-eyed Grass – *Xyris torta* – is a coastal plain and lake state species found in bogs and wet, sandy soil of open yellow pine forest and grasslands. The DBNF records are from streamhead wetlands, slope seeps, and wet warm season grasslands and meadows.

Mosses

Sphagnum Moss – *Sphagnum bartlettianum* – is a coastal plain species where it is common. On the DBNF, it is uncommon and is found only associated with streamhead wetlands and slope seeps. It requires constantly moist conditions, although is somewhat tolerant of short term drying. The species sometimes serves as a growing substrate or substrate moderator for *Telarania nematodes* and *Platanthera* species.

Sphagnum Moss – *Sphagnum magellanicum* – is a coastal plain species where it is common. On the DBNF, it is uncommon and is found only associated with streamhead wetlands and slope seeps. It requires constantly moist conditions, although is somewhat tolerant of short term drying. The species sometimes serves as a growing substrate or substrate moderator for *Telarania nematodes* and *Platanthera* species.

Sphagnum Moss – *Sphagnum macrophyllum* – is a coastal plain species ranging from Newfoundland to Florida then west to Texas. It is known from the Cumberland Plateau in Tennessee and Kentucky. The Kentucky site is on the Morehead District of the DBNF. Throughout its range it is found in shallow, quiet water in lakes, ponds, roadside ditches, and southward in gum-cypress swamps. On the DBNF, it is known from one small pond near Cave Run Lake, where it covers much of the surface.

Sphagnum Moss – *Sphagnum palustre* – is widespread. Throughout its range it is found in sites which are constantly moist. It does tolerate periodic drying, but portions may die. On the DBNF, it is found in streamhead wetlands, swamps, slope seeps, and along stream margins. The latter habitat is the least common. This species is important as it helps maintain moisture and pH regimes in wetland sites where other plant and animal species find habitat. The species sometimes serves as a growing substrate or substrate moderator for *Telarania nematodes* and *Platanthera* species.

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07/15/2003

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07/15/2003

Attachment C.

Seeps/Swamps Habitat Association Matrix

Association	Habitat	Modifier	Class	Common/Species
14-Seeps/ Swamps	Seeps/Bogs-including slopes, not streamhead	(blank)	GASTR	Delicate vertigo/ <i>Vertigo bollesiana</i>
			P-DIC	Slender Marsh-pink/ <i>Sabatia campanulata</i>
			P-MOS	Large-leaved sphagnum/ <i>Sphagnum macrophyllum</i>
		Acidic Substrate		Magellan's Sphagnum Moss/ <i>Sphagnum magellanicum</i>
		Dense shrub understory	BIRD	Louisiana Waterthrush/ <i>Seiurus motacilla</i>
				Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
		Downed Logs	REPT	Northern Coal Skink/ <i>Eumeces antracinus anthracinus</i>
		Forb/Grass Condition	BIRD	American Woodcock/ <i>Scolopax minor</i>
		Forest Interior (Minimal Edge)		Louisiana Waterthrush/ <i>Seiurus motacilla</i>
				Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
		High Shade		Louisiana Waterthrush/ <i>Seiurus motacilla</i>
				Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
		Low (wet, i.e. subject to holding water)		Northern Harrier/ <i>Circus cyaneus</i>
				Sedge Wren/ <i>Cistothorus platensis</i>
		Moderate Shade	P-MOS	Sphagnum Moss/ <i>Sphagnum palustre</i>
				Streamhead sphagnum/ <i>Sphagnum palustre</i>
		Moist	BIRD	American Woodcock/ <i>Scolopax minor</i>
				Sedge Wren/ <i>Cistothorus platensis</i>
				Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
			P-MON	Loesel's Twayblade/ <i>Liparis loeselii</i>
		Open (Little or No Shade)	BIRD	Northern Harrier/ <i>Circus cyaneus</i>
			P-DIC	Shaggy Hedge-hyssop/ <i>Gratiola pilosa</i>
		Rich Soil	BIRD	American Woodcock/ <i>Scolopax minor</i>
		Riparian		Louisiana Waterthrush/ <i>Seiurus motacilla</i>
		Rocky/Rocks	AMPHI	Mountain Dusky Salamander/ <i>Desmognathus ochrophaeus</i>
			BIRD	Louisiana Waterthrush/ <i>Seiurus motacilla</i>
			P-MOS	Magellan's Sphagnum Moss/ <i>Sphagnum magellanicum</i>
			REPT	Northern Coal Skink/ <i>Eumeces antracinus anthracinus</i>
		Shrub/Sapling Condition	BIRD	American Woodcock/ <i>Scolopax minor</i>
		Slope (hillside, steepness)		Louisiana Waterthrush/ <i>Seiurus motacilla</i>
		Soil (bare)	P-MOS	Sphagnum Moss/ <i>Sphagnum palustre</i>
				Streamhead sphagnum/ <i>Sphagnum palustre</i>
		Sphagnum Associate	P-MON	Rose Pogonia/ <i>Pogonia ophioglossoides</i>
		Tract Size (Area Sensitive)	BIRD	Louisiana Waterthrush/ <i>Seiurus motacilla</i>
				Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
		Water (Distance Sensitive)		Louisiana Waterthrush/ <i>Seiurus motacilla</i>
			REPT	Northern Coal Skink/ <i>Eumeces antracinus anthracinus</i>

07/15/2003

Association	Habitat	Modifier	Class	Common/Species
	Streamhead Seeps and Wetlands	(blank)	AMPHI	Wood Frog/ <i>Rana sylvestris</i>
			P-DIC	American Water-pennywort/ <i>Hydrocotyle americana</i>
				Brook Saxifrage/ <i>Boykinia acontifolia</i>
				Cross-leaf Milkwort/ <i>Polygala cruciata</i> var. <i>cruciata</i>
				Kidney-leaf Grass-of-Parnassus/ <i>Parnassia asarifolia</i>
				New York Ironweed/ <i>Vernonia noveboracensis</i>
			P-MON	Appalachian Spreading Pogonia/ <i>Cleistes bifaria</i>
				Caric Sedge/ <i>Carex atlantica</i>
				Clubspur Orchid/ <i>Platanthera clavellata</i>
				Grass-pink/ <i>Calopogon tuberosus</i>
				Rose Pogonia/ <i>Pogonia ophioglossoides</i>
				Small Purple-fringed Orchid/ <i>Platanthera psycodes</i>
				White Fringeless Orchid/ <i>Platanthera integrilabia</i>
				Yellow-crested Orchid/ <i>Platanthera cristata</i>
			P-MOS	Large-leaved sphagnum/ <i>Sphagnum macrophyllum</i>
			REPT	Eastern Ribbon Snake/ <i>Thamnophis sauritus sauritus</i>
		Acidic Substrate	P-DIC	Brook Saxifrage/ <i>Boykinia acontifolia</i>
				Cross-leaf Milkwort/ <i>Polygala cruciata</i> var. <i>cruciata</i>
				Yellow Screwstem/ <i>Bartonia virginica</i>
			P-MON	Grass-pink/ <i>Calopogon tuberosus</i>
				Pink Lady-slipper/ <i>Cypripedium acaule</i>
				Yellow-crested Orchid/ <i>Platanthera cristata</i>
			P-MOS	Magellan's Sphagnum Moss/ <i>Sphagnum magellanicum</i>
		Cool Temperatures	P-MON	Small Purple-fringed Orchid/ <i>Platanthera psycodes</i>
		Dense shrub understory	BIRD	Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
		Downed Logs	MAMM	Masked Shrew/ <i>Sorex cinereus cinereus</i>
		Forb/Grass Condition	BIRD	American Woodcock/ <i>Scolopax minor</i>
		Forest Interior (Minimal Edge)		Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
		High Shade		Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
			P-MON	Clubspur Orchid/ <i>Platanthera clavellata</i>
		High/Constant Humidity (Microclimate)	P-LIV	A Liverwort/ <i>Telermania nematodes</i>
		Low (wet, i.e. subject to holding water)	AMPHI	Mountain Dusky Salamander/ <i>Desmognathus ochrophaeus</i>
			BIRD	Northern Harrier/ <i>Circus cyaneus</i>
				Sedge Wren/ <i>Cistothorus platensis</i>
		Moderate Shade	P-DIC	Kidney-leaf Grass-of-Parnassus/ <i>Parnassia asarifolia</i>
			P-FER	Quillwort/ <i>Isoetes englemannii</i>
			P-MON	Caric Sedge/ <i>Carex seorsa</i>
				Small Purple-fringed Orchid/ <i>Platanthera psycodes</i>
				White Fringeless Orchid/ <i>Platanthera integrilabia</i>
				Yellow-crested Orchid/ <i>Platanthera cristata</i>
			P-MOS	Sphagnum Moss/ <i>Sphagnum palustre</i>
				Streamhead sphagnum/ <i>Sphagnum palustre</i>
		Moist	BIRD	American Woodcock/ <i>Scolopax minor</i>

07/15/2003

Association	Habitat	Modifier	Class	Common/Species
				Sedge Wren/ <i>Cistothorus platensis</i>
				Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
		Open (Little or No Shade)	BIRD	Northern Harrier/ <i>Circus cyaneus</i>
			P-MON	Cypress-swamp Caric Sedge/ <i>Carex jorii</i>
				Small Yellow Lady's-slipper/ <i>Cypripedium parviflorum</i> var. <i>parviflorum</i>
				Uptight Caric Sedge/ <i>Carex stricta</i>
		Rich Soil	BIRD	American Woodcock/ <i>Scolopax minor</i>
		Rocky/Rocks	AMPHI	Black Mountain Salamander/ <i>Desmognathus welteri</i>
			P-MOS	Magellan's Sphagnum Moss/ <i>Sphagnum magellanicum</i>
				Sphagnum Moss/ <i>Sphagnum palustre</i>
				Streamhead sphagnum/ <i>Sphagnum palustre</i>
		Sandy Soil	P-MON	White Fringeless Orchid/ <i>Platanthera integrilabia</i>
			P-MOS	Bartlett's Sphagnum Moss/ <i>Sphagnum bartlettianum</i>
				Red Sphagnum/ <i>Sphagnum bartlettianum</i>
		Seasonal (water)	REPT	Eastern Ribbon Snake/ <i>Thamnophis sauritus sauritus</i>
		Seep/Constant Water	AMPHI	Green Frog/ <i>Rana clamitans</i>
			P-FER	Quillwort/ <i>Isoetes englemannii</i>
			P-MON	Goldenclub/ <i>Orontium aquaticum</i>
		Shrub/Sapling Condition	BIRD	American Woodcock/ <i>Scolopax minor</i>
		Sphagnum Associate	P-MON	Pink Lady-slipper/ <i>Cypripedium acaule</i>
				White Fringeless Orchid/ <i>Platanthera integrilabia</i>
				Yellow-eyed Grass/ <i>Xyris caroliniana</i>
		Tract Size (Area Sensitive)	BIRD	Swainson's Warbler/ <i>Limnothlypis swainsonii</i>
	Swamp (wooded wetland)	(blank)	AMPHI	Green Frog/ <i>Rana clamitans</i>
			BIRD	Hooded Merganser/ <i>Lophodytes cucullatus</i>
				Least bittern/ <i>Ixobrychus exilis</i>
			P-DIC	American Water-pennywort/ <i>Hydrocotyle americana</i>
				Slender Marsh-pink/ <i>Sabatia campanulata</i>
				Small-flowered Thoroughwort/ <i>Eupatorium semiserratum</i>
				Yucca-leaved Rattlesnake Master/ <i>Eryngium yuccifolium</i>
			P-MON	Appalachian Spreading Pogonia/ <i>Cleistes bifaria</i>
				Cane/ <i>Arundinaria gigantea</i>
				Caric Sedge/ <i>Carex atlantica</i>
				Caric Sedge/ <i>Carex seorsa</i>
				Clubspur Orchid/ <i>Platanthera clavellata</i>
				Small Purple-fringed Orchid/ <i>Platanthera psycodes</i>
				Uptight Caric Sedge/ <i>Carex stricta</i>
				Yellow-crested Orchid/ <i>Platanthera cristata</i>
				Yellow-eyed Grass/ <i>Xyris caroliniana</i>
				Yellow-eyed Grass/ <i>Xyris difformis</i>
				Yellow-eyed Grass/ <i>Xyris tortula</i>
			REPT	Timber Rattlesnake/ <i>Crotalus horridus</i>
		Acidic Substrate	P-MON	Caric Sedge/ <i>Carex seorsa</i>

07/15/2003

Association	Habitat	Modifier	Class	Common/Species
		Burrows, Holes, Tunnels (Secondary Users)	AMPHI	Marbled Salamander/ <i>Ambystoma opacum</i>
		Downed Logs	AMPHI	Jefferson Salamander/ <i>Ambystoma jeffersonianum</i>
			REPT	Southeastern Crowned Snake/ <i>Tantilla coronata</i>
		Forest Interior (Minimal Edge)	BIRD	Prothonotary warbler/ <i>Protonotaria citrea</i>
		High Shade	P-MON	Clubspur Orchid/ <i>Platanthera clavellata</i>
		Low (wet, i.e. subject to holding water)	AMPHI	Marbled Salamander/ <i>Ambystoma opacum</i>
		Moderate Shade	P-MON	Clubspur Orchid/ <i>Platanthera clavellata</i>
		Open (Little or No Shade)	REPT	Eastern Ribbon Snake/ <i>Thamnophis sauritus sauritus</i>
		Rocky/Rocks	AMPHI	Marbled Salamander/ <i>Ambystoma opacum</i>
			REPT	Northern Coal Skink/ <i>Eumeces antracinus anthracinus</i>
				Southeastern Crowned Snake/ <i>Tantilla coronata</i>
		Sandy Soil	P-MOS	Bartlett's Sphagnum Moss/ <i>Sphagnum bartlettianum</i>
				Red Sphagnum/ <i>Sphagnum bartlettianum</i>
		Seasonal (water)	AMPHI	Marbled Salamander/ <i>Ambystoma opacum</i>
		Seep/Constant Water	P-FER	Quillwort/ <i>Isoetes englemannii</i>
			P-MON	Uptight Caric Sedge/ <i>Carex stricta</i>
		Snags > 6" dbh	BIRD	Prothonotary warbler/ <i>Protonotaria citrea</i>
				Wood Duck/ <i>Aix sponsa</i>
		Tract Size (Area Sensitive)		Prothonotary warbler/ <i>Protonotaria citrea</i>
		Tree and Snags (Cavity Nesters)		Hooded Merganser/ <i>Lophodytes cucullatus</i>
				Prothonotary warbler/ <i>Protonotaria citrea</i>
				Wood Duck/ <i>Aix sponsa</i>
		Water (Distance Sensitive)	BIRD	Hooded Merganser/ <i>Lophodytes cucullatus</i>
				Least bittern/ <i>Ixobrychus exilis</i>
				Pied-billed Grebe/ <i>Podilymbus podiceps</i>
				Prothonotary warbler/ <i>Protonotaria citrea</i>
				Wood Duck/ <i>Aix sponsa</i>
			REPT	Northern Coal Skink/ <i>Eumeces antracinus anthracinus</i>