Powell Mountain Karst Preserve:

Biological Inventory of Vegetation Communities, Vascular Plants, and Selected Animal Groups

Final Report

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For:

The Cave Conservancy of the Virginias

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COMMONWEALTH of VIRGINIA

Biological Inventory of Vegetation Communities, Vascular Plants, and Selected Animal Groups

Virginia Department of Conservation and Recreation
Division of Natural Heritage
Natural Heritage Technical Report 10-12
April 2010

DCR
Department of Conservation & Recreation
CONSERVING VIRGINIA'S NATURAL AND RECREATIONAL RESOURCES

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Introduction

The Cave Conservancy of the Virginias contracted with the Virginia Department of Conservation and Recreation, Division of Natural Heritage in 2008 to conduct a biological inventory of vegetation communities, vascular plants, and selected animal groups within the Powell Mountain Karst Preserve located in Wise County, Virginia. The preserve consists of 174 acres of mostly hardwood forest, with five known caves (Franklin Pit, Omega (Blowing) Cave, Parson's Cave, Rascal Pit, Solomon's Seal Cave), and several sinkholes. The approximate boundary of the preserve is shown in Figure 1.

The project period began in January 2009, and continued through March 2010, when final field surveys were conducted. The scope of work set forth in the contract called for a number of tasks to be completed during the contract period including field surveys of bat hibernacula, mist netting, cave invertebrate sampling, general non-cave invertebrate sampling, botanical survey, and vegetation community classification.

This report summarizes the results of field work conducted and specimen identifications made through the final report date of April 15, 2010.

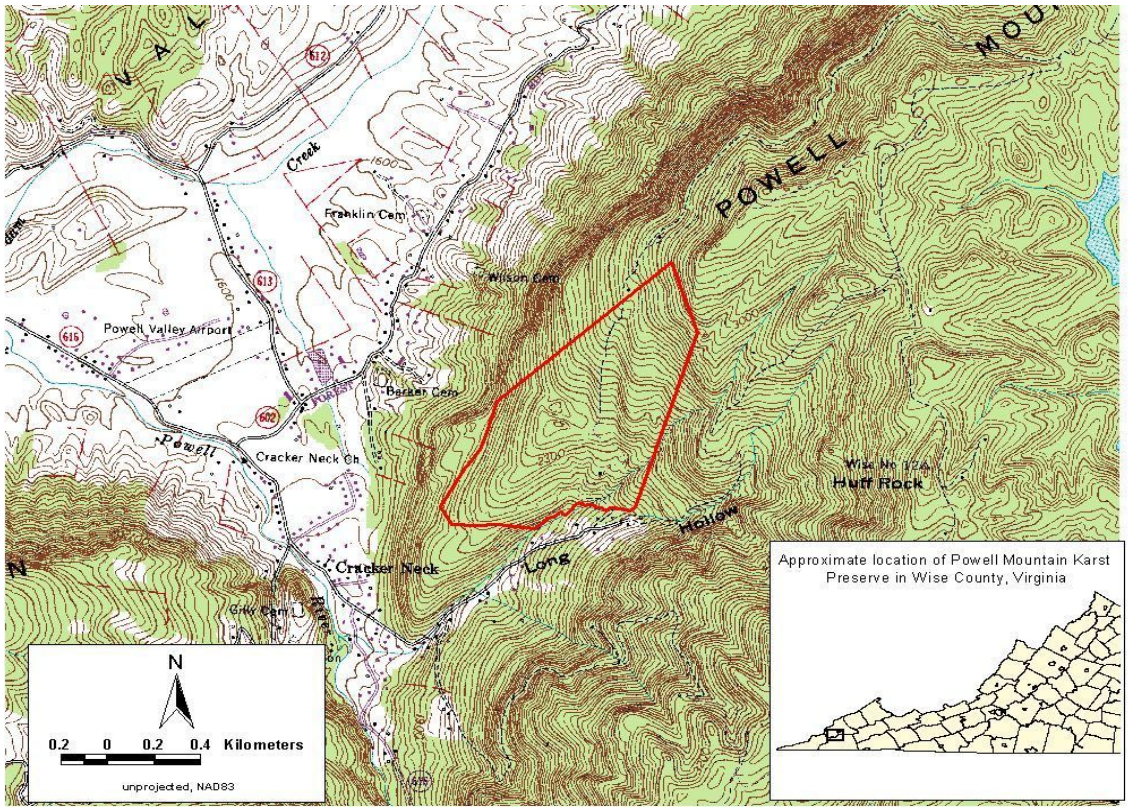

Figure 1. Approximate boundary of Powell Mountain Karst Preserve, Wise County, Virginia

Geology

The Powell Mountain Karst Preserve is underlain by Mississippian-aged bedrock of the Greenbrier and Bluefield Formations (Henika, 1988). These units strike northeast and dip moderately (10-15 degree to the southeast). The Greenbrier Formation is dominantly limestone, and hosts the large caves of Powell Mountain. It crops out on the western (lower) half of the preserve. The Bluefield Formation is dominantly shale with thin limestone and sandstone interlayers, and crops out on the eastern half of the preserve. The Bluefield Formation includes an approximately 40' thick limestone sequence known as the "Little lime." This unit hosts the Solomon Seal dig on the east side of the property, and is documented to be of great hydrological significance (Schwartz and Orndorff, 2009). The bedrock units are covered in the extreme southern portion of the preserve along Long Hollow by coarse-grained alluvial deposits consisting largely of sandstone cobbles derived from overlying sandstone units exposed much higher on the mountain.

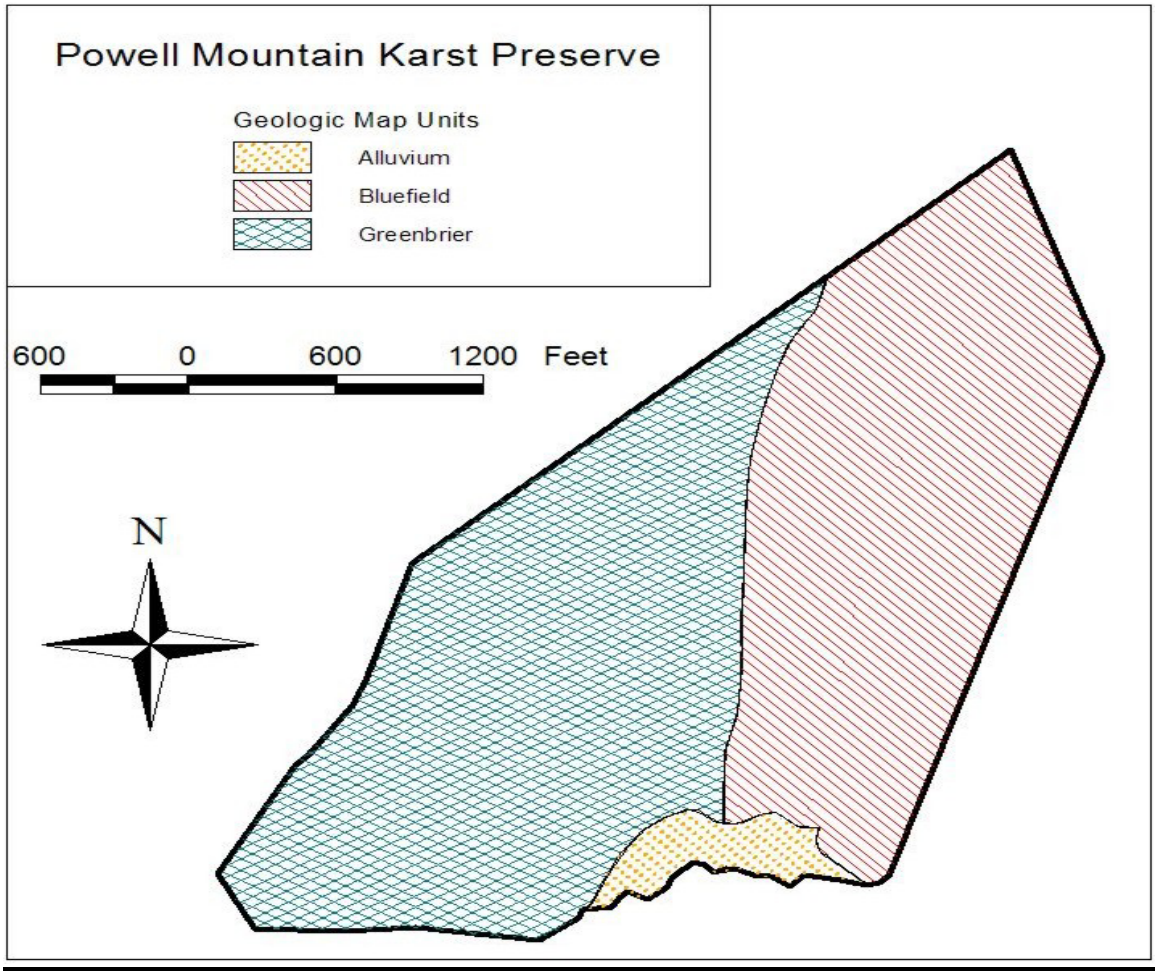

Figure 2. Geologic map of Powell Mountain Karst Preserve, Wise County, Virginia showing approximate limits of Alluvium, Bluefield, and Greenbrier units

EXPLANATION OF THE NATURAL HERITAGE RANKING SYSTEM

Each of the significant natural features (species, community type, etc.) monitored by DCR-DNH is considered an element of natural diversity, or simply an **element**. Each element is assigned a rank that indicates its relative rarity on a five-point scale (1 = extremely rare; 5 = abundant). The primary criterion for ranking plant and animal elements is the number of occurrences, i.e., the number of known distinct localities or populations. Also of great importance is the number of individuals at each locality or, for highly mobile organisms, the total number of individuals. Other considerations include the condition of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of occurrences, so that ranks essentially are an index of known biological rarity. These ranks are assigned both in terms of the element's rarity within Virginia (its state or S-rank) and the element's rarity over its entire range (its global or G-rank). Subspecies and varieties are assigned a taxonomic (T-) rank in addition to their G-rank. Taken together, these ranks give an instant picture of an element's rarity. For example, a designated rank of G5/S1 indicates an element which is abundant and secure range-wide, but extremely rare in Virginia. Ranks for community types are provisional, or in many cases lacking, due to ongoing efforts by the natural heritage network to classify community taxa. Rarity ranks used by DCR-DNH are not legal designations, and they are continuously updated to reflect new information.

The primary ranking factors used in assessing the appropriate conservation status rank for a community element are: 1) the total number of occurrences and (2) the total area (acreage) of the element. Secondary factors such as the level of threats to the occurrences and the viability of existing occurrences also affect the rank. Additional factors that have been used to arrive at an assessment of a community's rangewide (global) rank include the geographic range over which the type occurs, the long-term decline of the type across the range, the degree of site specificity exhibited by the type, and the rarity across the range based on state ranks assigned by state Natural Heritage Programs. Current global ranks for community types are provided in the U.S. National Vegetation Classification (USNVC, Grossman et al. 1998, NatureServe 2008a, NatureServe 2008b), and are constantly reviewed and updated through ongoing collaborative efforts by ecologists throughout the NatureServe / Natural Heritage Network.

Global Ranks

Global ranks are assigned by a consensus of the network of natural heritage programs, scientific experts, and NatureServe to designate a rarity rank based on the range-wide status of a species or variety. This system was developed by The Nature Conservancy and is widely used by other agencies and organizations as the best available scientific and objective assessment of a taxon's rarity and level of threat to its existence. The ranks are assigned after considering a suite of factors, including number of occurrences, number of individuals, and severity of threats. These ranks should not be interpreted as legal designations. The global ranks are defined in Table 1 as follows:

Table 1. Global ranks for natural heritage elements.

Global Rarity Rank	Global Conservation Status	Definition
G1	Critically Imperiled	At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	Imperiled	At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	Vulnerable	At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors
G4	Apparently Secure	Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	Secure	Common, widespread and abundant.
GH	Possibly Extinct (species)**:** **=** Presumed Eliminated (Historical ecological communities)	Missing; known from only historical occurrences but still some hope of rediscovery. Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American Chestnut Forest.
GX	Presumed Extinct (species)**:** = Eliminated (ecological communities):	Not located despite intensive searches and virtually no likelihood of rediscovery. Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species
G#G#	Range Rank	A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community.
GU	Unrankable	Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express minor uncertainty, or a range rank (e.g., G2G3) is used to delineate the range of uncertainty
G_?	Inexact Numeric Rank	Denotes inexact numeric rank (e.g., G3?).
G_Q	Questionable taxonomy	Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower conservation priority (e.g., G3Q).
G_T_	Infraspecific Taxa**:**	Signifies the rank of a subspecies or variety. For example, the rank G5T1 would be assigned to a very rare and localized variety of an otherwise widespread and common taxon.
GNR	Unranked	Global rank not yet assessed
GNA	Not applicable	Species is not suitable for conservation activities.

State Ranks

State ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Virginia. For example, whereas a species which is endemic to Virginia will have the same global and state ranks, a species which may be common in the northeastern United States, but only known from a few occurrences in Virginia will have different global and state ranks. By comparing the global and state ranks, the status, rarity, and the urgency of conservation needs can be ascertained. DCR-DNH maintains lists of rare and watchlist plant and animal taxa (Townsend 2007; Roble 2006). Plant and animal taxa designated as rare in Virginia include those having a state rank of S1, S1S2, S2, S2S3, or SH. Plant taxa placed on the watchlist include those taxa with uncommon status, including those ranked S3 and S?. (A separate review list contains plant taxa of uncertain status, including those taxa ranked SU, SNR, SNA, and SE?.) Animal taxa designated as watchlist taxa include those with ranks of S3, S3?, S3S4, and SU. State ranks are defined in Table 2 as follows:

Table 2. State ranks for natural heritage elements.

State Rarity Rank	State Conservation Status	Definition
S1	Critically Imperiled	For plants and animals: at very high risk of extirpation from the state due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors. For communities: generally with 5 or fewer occurrences state-wide, and/or covering < 50 ha (124 ac) in aggregate; or covering a larger area but highly threatened with destruction or modification
S2	Imperiled	For plants and animals: at high risk of extirpation from the state due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors. For communities: generally with 6 to 20 occurrences state-wide, and /or covering < 250 ha (618 ac) in aggregate; or covering a larger area but threatened with destruction or modification.
S3	Vulnerable.	For plants and animals: at moderate risk of extirpation from the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. For communities: generally with 21 to 100 occurrences, or a larger number subject to higher levels of threat; may be relatively frequent in specific localities or habitats.
S4	Apparently Secure	For plants and animals: at moderate risk of extirpation from the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. For communities: generally with 21 to 100 occurrences, or a larger number subject to higher levels of threat; may be relatively frequent in specific localities or habitats
S5	Secure	For plants, animals, and communities: common, widespread and abundant.
SH	Possibly Extirpated (Historical)	Species or community occurred historically in the nation or state, some possibility that it may be rediscovered.

SX	Presumed Extirpated	Species or community is believed to be extirpated from the nation or state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered
SU	Unrankable	Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
S# S#	Range Rank	A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community.
S_?	Inexact Numeric Rank	Denotes inexact numeric rank (e.g., S3?).
SNR	Unranked	State conservation status not yet assessed
SNA	Not Applicable	A conservation status rank is not applicable because the species is not a suitable target for conservation activities
S_B	Breeding Status	Breeding status of an animal (primarily used for birds) in Virginia; these species typically inhabit Virginia only during the breeding season.
S_B/S_N	Breeding/Non-Breeding	Breeding and nonbreeding status of an animal (primarily used for birds) in Virginia, when they differ.

The U.S. Fish and Wildlife Service (USFWS) is responsible for the listing of endangered and threatened species under the Endangered Species Act of 1973, as amended. Federal listed species (including subspecific taxa) are afforded a degree of legal protection under the Act, and, therefore, sites supporting these species need to be identified. USFWS also maintains a review listing of potential candidate endangered and threatened taxa. Table 3 illustrates the various status categories used by USFWS and followed in this report. The status category of candidate species is based largely on the Service's current knowledge about the biological vulnerability and threats to a species.

Table 3. U.S. Fish and Wildlife Service species status codes, with abbreviated definitions.

Species Status Code	**Defintion (abbreviated)**
LE	Listed endangered
LT	Listed threatened
PE	Proposed to be listed as endangered
PT	Proposed to be listed as threatened
S	Synonyms
C	Candidate (formerly C1 (Candidate category 1))
E (S/A)	treat as endangered because of similarity of appearance
T(S/A)	treat as threatened because of similarity of appearance
SOC	species that merit special concern (**not a regulatory category**)

In Virginia, two acts have authorized the creation of official state endangered and threatened species lists. The Virginia Endangered Species Act (§29.1-563 through 570, *Code of Virginia*), administered by the Virginia Department of Game and Inland Fisheries (DGIF), authorizes listing of fish and wildlife species, not including insects. The Virginia Endangered Plant and Insect Species Act (§3.1-1020 through 1030, *Code of Virginia*), administered by the Virginia Department of Agriculture and Consumer Services (VDACS), allows for listing of plant and insect species. In general, these acts prohibit or regulate taking, possessing, buying, selling, transporting, exporting, or shipping of any endangered or threatened species appearing on the official lists. Table 4 lists the categories for state legal status. DGIF has also created an informal category of Special Concern (SC) for animals that merit special attention. This is a non-regulatory category that affords no legal protection.

Table 4. State legal status.

Species Status Code	Definition
LE	Listed Endangered
LT	Listed Threatened
PE	Proposed Endangered
PT	Proposed Threatened
SC	- Special Concern - animals that merit special concern according to VDGIF (not a regulatory category)
C	Candidate for listing as threatened or endangered

Methods and Results

Natural Community Inventory

Natural Heritage vegetation ecologists Gary Fleming and Karen Patterson conducted field work on 11-12 May, 2009. A reconnaissance inventory of the entire property was conducted and four plots of representative vegetation types were sampled. Within each 400 m^2 plot, all plant species were recorded, along with their estimated cover, stem measurements of all woody plants ≥ 2.5 cm diameter at breast height, and various standard environmental measurements. Soil samples were also collected from each plot for later laboratory analysis. Additional field notes and species lists were recorded from other locations on the preserve. These data were recorded on standard DNH ecology data forms, then transferred to Access database form, and are presented in Appendix 3. Photographs documenting ecological communities at PMKP can be seen in Figures 4-6.

Three natural communities (1-3) and one semi-natural / modified community (4) were documented during this fieldwork:

1) Dry-Mesic Calcareous Forest (Sugar Maple – Northern Red Oak Type) (G4 / S4) – this is the predominant community type on the steeper western and southern slopes of the property. Stands observed were medium-aged, probably about 60-80 years old, and were variably co-dominated by sugar maple (*Acer saccharum*), northern red oak (*Quercus rubra*), shag bark hickory (*Carya ovata*), pignut hickory (*Carya glabra*), and tuliptree. Black oak (*Quercus velutina*), white ash, and cucumber magnolia (*Magnolia acuminata*) are common associates. Redbud (*Cercis canadensis*) and hophornbeam (*Ostrya virginiana*) are common understory trees. The herb layer is moderately rich but is sparse in places. This community was sampled at two locations (see plots WISE002 and WISE003). More information on this natural community can be found on the VADNH website, following the link:
http://www.dcr.virginia.gov/natural_heritage/ncTIIIa.shtml

2) Appalachian Sugar Maple - Chinkapin Oak Dry Calcareous Forest (G4? / S4?) – this dry, open forest occupies the rocky crest and upper southeast slope of the spur ridge in the southern part of the property. It is characterized by a stunted canopy of eastern red-cedar (*Juniperus virginiana*), chinkapin oak (*Quercus muhlenbergii*), white oak (*Quercus alba*), shagbark hickory, and white ash. Post oak (*Quercus stellata*), and sugar maple are occasional associates. A large number of drought-tolerant shrubs and herbs occur in the stand. This forest is probably as old as, or older than, the Dry-Mesic Calcareous Forest of adjacent steeper slopes. This community was sampled at one location (see plot WISE001). The 19 ac (7.8 ha) stand on the Preserve was of sufficient quality to document as an exemplary element occurrence (Fig 2). It is part of a larger element occurrence that is found intermittently along the western flanks of Powell Mountain, in dry, rocky areas. More information on this natural community can be found on the VADNH website, following the link:
http://www.dcr.virginia.gov/natural_heritage/ncTIIIm.shtml

3) Southern Appalachian Limestone Rich Cove Forest (G3G4 / S3)– a single small patch of this community type was found on the slopes of the large sinkhole around and below Parsons Cave. This lush forest occupies deep, bouldery, colluvial soils. The principal trees are sugar maple, white basswood (*Tilia americana* var. *heterophylla*), hickories, white ash, and slippery elm (*Ulmus rubra*). Pawpaw (*Asimina triloba*) and spicebush (*Lindera benzoin*) are common shrubs. The herb layer is dense and contains many moisture- and nutrient-demanding species, e.g., wild ginger (*Asarum canadense*), wood nettle (*Laportea canadensis*), sweet cicely (*Osmorhiza claytonii*). Bulblet fern (*Cystopteris bulbifera*) is abundant on the moist mossy boulders and rock faces. This community was sampled at one location (see plot WISE004). More information on this natural community can be found on the VADNH website, following the link: http://www.dcr.virginia.gov/natural_heritage/ncTIIa.shtml

4) Successional Tuliptree Forest (GNA / SNA) – this type occupies much of the eastern and northern parts of the property which were cut over fairly recently. It is a young forest characterized by coppice sprouts from cut trees and dense sapling and pole-sized regeneration. Tuliptree (*Liriodendron tulipifera*) is abundant and characteristic, but a number of other trees occur, including oaks (*Quercus* spp.), hickories (*Carya* spp.), maples (*Acer* spp.), and white ash (*Fraxinus americana*). The shrub and herb layers are fairly rich, but are sparse in some areas where sapling or coppice density is very high. Small patches of older forest and individual large trees are scattered in the stand. This vegetation was observed, but not quantitatively sampled.

*** Numbers 1-4 above correlate with community association values in plant and animal lists presented in appendices.**

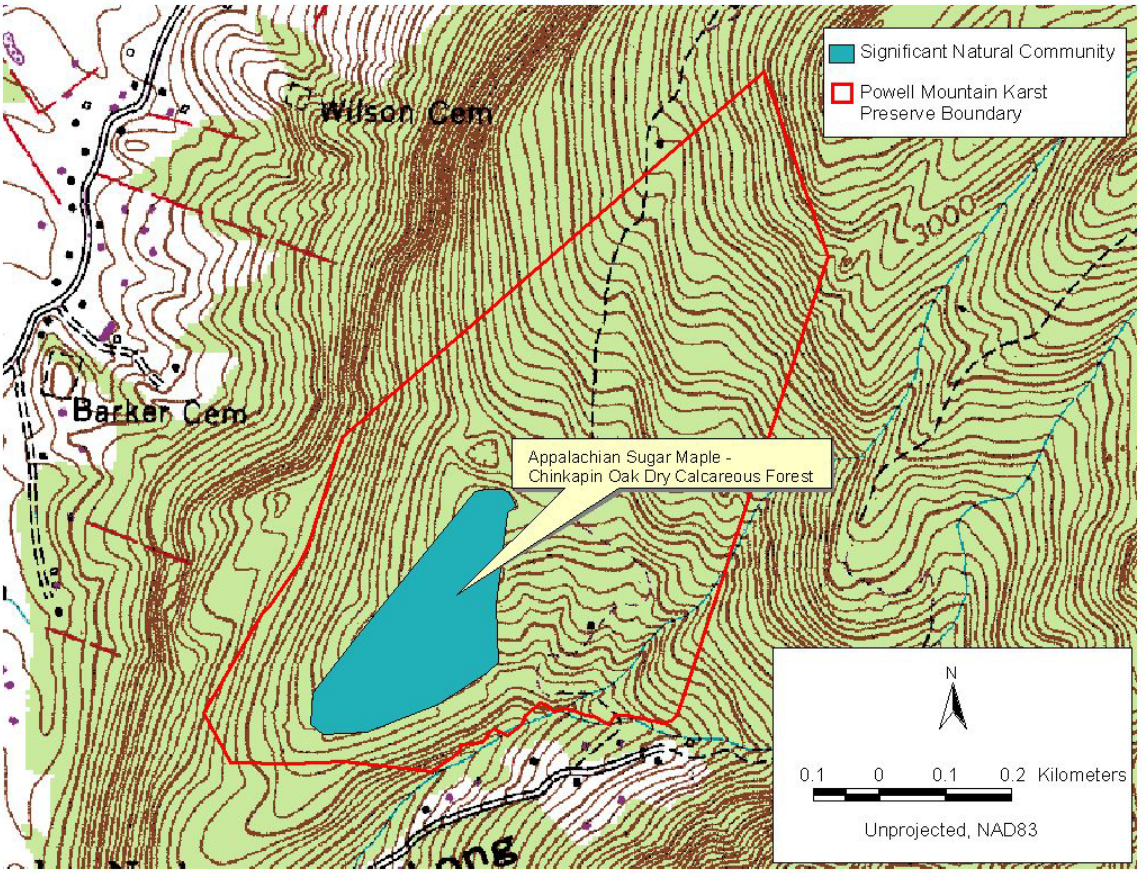

Figure 3. Location of 19 ac (7.8 ha) stand of Appalachian Sugar Maple - Chinkapin Oak Dry Calcareous Forest at Powell Mountain Karst Preserve, Wise County, Virginia. This occurrence is part of a larger element occurrence found intermittently, in dry, rocky areas, along the western flanks of Powell Mountain.

Figure 4. Southern Appalachian Limestone Rich Cove Forest at Powell Mountain Karst Preserve, Wise County, Virginia 2010 (photo G.P. Fleming)

Figure 5. Dry-Mesic Calcareous Forest (Sugar Maple – Northern Red Oak Type) at Powell Mountain Karst Preserve, Wise County, Virginia 2010 (photo G. P. Fleming)

Figure 6. Appalachian Sugar Maple - Chinkapin Oak Dry Calcareous Forest at Powell Mountain Karst Preserve, Wise County, Virginia 2010 (Photo G. P. Fleming)

Botanical Inventory

Natural Heritage botanist John Townsend conducted field work on 26-29 May, 30 June-1 July, as well as 28-29 September, 2009 in order to cover the spring, summer and fall flowering periods on the PMKP property. During these time periods, the entire property was searched on foot with the aid of 1:24,000 scale topographic maps and 2007 aerial photographs. Particular attention was paid to novel habitats when encountered, including those too small to be included in the list of natural community types given in the section on Natural Community Inventory. A list of all observed plant taxa was recorded, and occasional specimens were collected (usually only one) to verify problematic identifications. This list of 418 taxa is presented in Appendix 4. Voucher specimens were collected for taxa listed on the DCR-DNH Rare Vascular Plants list (see http://www.dcr.virginia.gov/natural_heritage/documents/plantlist09.pdf) and will be deposited at the Virginia Tech Herbarium (VPI). A very small number of plants could not be positively identified to the specific or infraspecific level due to lack of reproductive material, discovery at an improper stage of development, or in the case of one cultivated species persisting on the site (*Rosa sp.*), due to the need for comparative herbarium material and horticulural references. Names of these taxa will be updated in the future if possible.

Two rare vascular plant species were confirmed from the PMKP property. Several species found on the DCR-DNH Watchlist and Review List were also located but only those found on the rare list are discussed below:

***Crataegus mollis* (Downy Hawthorn; G5/S1)** Three specimens of this state-rare shrub/small tree were located near the opening to Omega Cave (one fruiting individual several meters tall located ca. 3-5m south of cave entrance; two smaller sterile individuals ca. 20m north of cave entrance). See Figure 7 for an image that shows the characteristic large, wide, hairy leaves of this species and Figure 9 for a map showing the location of the population.

Downy Hawthorn is primarily a midwestern taxon, with its traditional haunts being rich lowlands of the Ohio Valley and beyond. The few populations known in Virginia have few individuals and come mostly from mesic to dry upland sites. Unlike most species of *Crataegus* in Virginia, *Crataegus mollis* has the potential to reach 10-12 m in height and have a trunk measuring 3+dm in diameter. This species, like most other hawthorns, reaches its greatest size and reproductive potential in well-lit areas and is therefore favored by periodic natural or man-made disturbances. The PMKP population occurs in an area of young, even-aged forest and was perhaps more abundant and produced more fruit immediately after clearcutting occurred. The population has likely declined in number of individuals and plant vigor since the canopy closed.

***Crataegus calpodendron* (Pear Hawthorn; G5/S1)** Approximately 10 specimens of this state-rare shrub/small tree were located near the opening to Omega Cave (three 2.5-3m tall individuals within ca. 5m radius from the large *Crataegus mollis* individual and scattered individuals seen in woods north of cave entrance). These shrubs easily blend in

with the rest of the broadleaf vegetation in the area so exact numbers are not known. See Figure 8 for an image showing the leaves of this species which have impressed veins and blades which taper along the length of the petiole. Figure 9 shows the location of the population, which is coincident with that of *Crataegus mollis*.

Pear Hawthorn is primarily a species of northeastern and midwestern states and is known to inhabit open woodlands in various landscape positions. As with the species discussed above, *Crataegus calpodendron* thrives best in areas with scattered trees or full sun and may be declining on PMKP due to closure of the canopy following clearcutting.

Figure 7. *Crataegous mollis* (Downy Hawthorn G5 S1) from Powell Mountain Karst Preserve,Wise County, Virginia

Figure 8. *Crataegous calpodendron* (Pear Hawthorn G5 S1) from Powell Mountain Karst Preserve, Wise County, Virginia

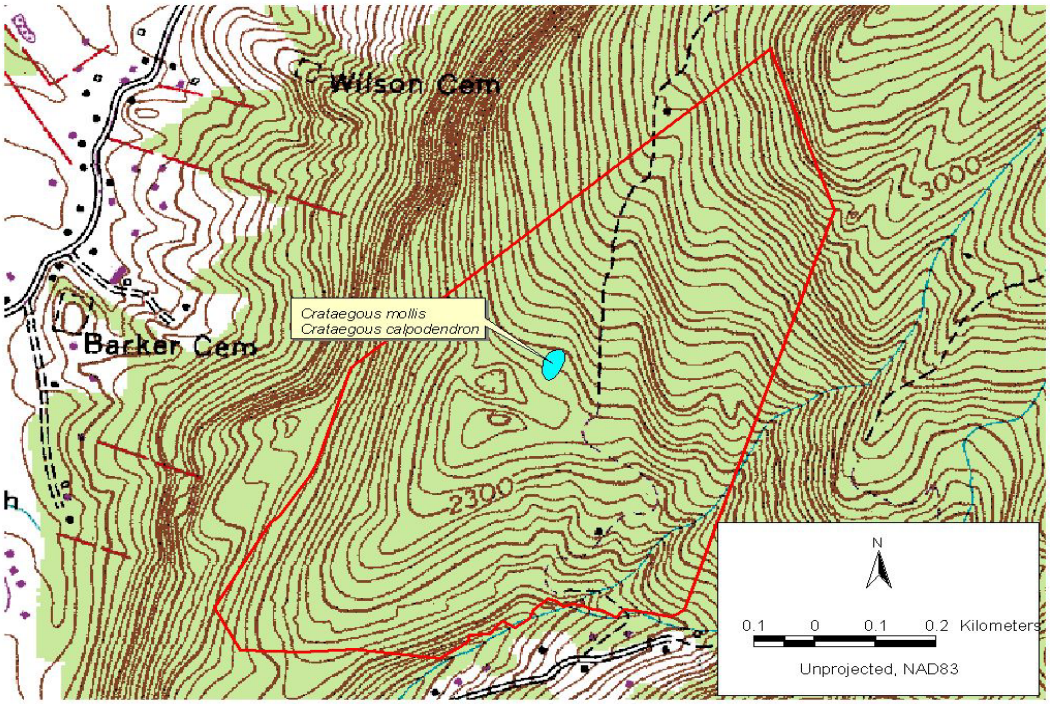

Figure 9. Locations for *Crataegous mollis* (Downy Hawthorn), and *Crataegous calpodendron* (Pear Hawthorn) at Powell Mountain Karst Preserve, Wise County, Virginia

Summer Bat Inventory

Mist netting for bats was conducted on 9-11 June, 30-31 June, 22-23 September, and on 22 October. During the 9-11 June, 30-31 June and 22-23 September surveys, a single 2 x 6 m net was placed just downslope of the Blowing entrance of Omega Cave, and two additional nets (Camp net 18 x 18 ft, and Parson's net 6 m x 9 m) were placed along the road on either side of the "camp" area. A harp trap was also used during 22-23 September surveys, during which the entrance of Omega (Blowing) Cave was sealed off with nylon netting to funnel bats into the trap. The harp trap was largely unsuccessful, and few bats were seen actually trying to leave the cave. On 22 October, only two 2 x 6 m nets were set just downslope of the Blowing entrance of Omega Cave.

Mist netting around the Blowing entrance was the most productive. A majority of bats captured at PMKP were of the genus *Myotis*. By far, the most abundant bat captured was *M. septentrionalis* (68), followed by *Perimyotis subflavus* (19), *M. lucifugus* (17), *M. leibii* (9), *Eptesicus fuscus* (2) and *M. sodalis* (1). Table 5 shows the number of bats by species and sex for each survey period. Except for *M. sodalis*, all bats were banded using colored, individually numbered plastic arm bands. The *M. sodalis* was fitted with a green metal band (DGIF-00506). Additional information, including band numbers, and tabulated data collected during bat surveys can be found in Appendix 5.

Table 5. Number of bats by species and sex for each mist net survey period, June-October 2009 at Powell Mountain Karst Preserve, Wise County, Virginia

	M. septentrionalis	*M. lucifugus*	*M. sodalis*	*Myotis leibii*	*Eptesicus fuscus*	*Perimyotis subflavus*
9-10 June 2009	45 m, 1 f	4 m	1 m	5 m	1 m	1 m
30-31 June 2009	9 m	3 m, 1 f	0	0	1 escaped	0
22-23 September 2009	12 m, 7 f	8 m, 1 f	0	3 m	0	12 m, 6 f
22 October 2009	4 m	0	0	1 m	0	0
Totals	**60 m, 8 f**	**15 m, 2 f**	**1 m**	**9 m**	**2**	**13 m, 6 f**

m=male f=female

Cave invertebrate inventory

Invertebrate inventory for cave species was scheduled to begin in early spring 2009; however, due to concerns related to the spread of White Nose Syndrome, this work was delayed. Invertebrate surveys began in Parson's Cave on 27 May 2009, when a thorough search of aquatic and terrestrial habitats resulted in several discoveries. Wil Orndorff and Bill Balfour conducted an additional survey in Parson's Cave on 20 August, and placed 3 pitfall traps (8 oz. plastic cups) in two different areas of the cave. Trap 1 was placed

along a mud bank at approximately the halfway mark in the main cave passage. Traps 2 and 3 were placed near the back of the cave in mud and gravelly substrates. The pitfalls were baited with cheese and/or canned cat food. The traps were checked on 21 August, and again on 25 August by Chris Hobson, Bill Balfour, and Rocky Parsons. Pitfall traps were removed on 23 September.

The globally rare epikarstic amphipod *Stygobromus cumberlandus* (Cumberland Cave amphipod; G3G4 S1S2) was found in drip pools at the base of flowstone columns near the entrance of Parson's Cave. Despite previous inventories of Parson's Cave, and other caves on the property, this is the first record of *S. cumberlandus* from the PMKP. No specimens of the common amphipod *Stygobromus mackini* were detected during our surveys, despite previous collections of this species at PMKP. Aquatic isopods that appear to be the watchlisted *Caecidotea recurvata* were collected from drip pools in several areas, and this species has been previously reported from caves at PMKP.

Franklin's Pit was surveyed on 11 June 2009, and again on 11 March 2010. The surveys were conducted by Wil Orndorff, Bill Balfour, and Shane Hanlon. Several cave beetles of the genus *Pseudanophthalmus* were collected as well as other taxa including troglobitic diplurans. According to Dr. Thomas Barr, the cave beetle is the same globally rare species (*P. cordicollis*; Little Kennedy Cave Beetle G1 S1) known from other caves in the area. The two troglobitic diplurans are likely the same new (undescribed) *Litocampa* sp. nov nr. *cookei* previously recorded in Omega Cave. Per Dr. Lynn Ferguson (pers. communication to W. Orndorff in 2004) the diplurans on the east side of Crackers Neck vary significantly from those on the west (Hairy Hole) side.

Among the other invertebrates collected or observed were stygobitic flatworms, diplurans, spiders, cave crickets, flies, fungus gnats, and millipedes. Millipedes collected in Parson's Cave were identified by Dr. Richard Hoffmann as *Pseudotremia* sp. nov near *stupefactor*. Hoffman claims that specimens collected by David Hubbard in 1996 may be this or perhaps another new species; however, an undescribed species of *Pseudotremia* identified by Bill Shear is present at caves on PMKP, and is tracked by DNH as *Pseudotremia* sp. 16. To clarify if there is one or two undescribed new *Pseudotremia* at PMKP caves will involve additional investigation and collaboration amongst taxonomic experts.

Two species of cave crickets were identified from pitfall samples taken near Franklin Pit and Parson's Cave. *Euhadenoecus fragilis* is considered a troglophile, but may be found occasionally on the surface in proximity to known caves (Hubbell and Norton 1978). *Euhadenoecus puteanus* is more of a trogloxenic species, and typically inhabits cave entrances and surrounding surface habitats (Hubbell and Norton 1978).

Identifications of other invertebrates collected are pending expert review, and will be provided as they are confirmed. No specimens of stygobitic flatworms were taken due to the difficulty in obtaining identifications from taxonomic experts.

Bat hibernacula survey

Due to concerns over the potential spread of White Nose Syndrome to bats hibernating in caves at PMKP, winter surveys were postponed from 2009 to 2010. Inclement weather during January-February 2010 pushed winter inventory back until March 11, 2010, at which time both Parson's Cave and Franklin Pit Cave were surveyed. Chris Hobson and Bill Balfour conducted surveys in Parson's, while Wil Orndorff and Shane Hanlon surveyed Franklin Pit Cave. The results of these surveys are as follows:

Parson's Cave- this cave was found to harbor a total of 79 *Perimyotis subflavus*, 2 *Myotis lucifugus*, 1 *Eptesicus fuscus*, and 7 *M. sodalis*. The small colony of *M. sodalis* represents a new hibernation site for this federally endangered species in Virginia. Six of the *M. sodalis* were clustered together, including one male that was banded during mist netting at PMKP on 10 June 2009. A single female was found ca. 40 meters further into the cave. All of the *M. sodalis* were found within sight of the entrance, as were the *E. fuscus* and *M. lucifugus*. In contrast, *P. subflavus* was distributed throughout the extent of the cave. The discovery of the banded male and other *M. sodalis* during this inventory suggests that this species utilizes habitats at PMKP year round. This should be considered carefully when planning management activities on the site, and the placement of a cave gate at the entrance to Parson's Cave should be considered. During the invertebrate inventory of Parson's Cave on 27 May 2009, a small number (<10) of tri-colored bats (*Perimyotis subflavus*) were found using the cave, suggesting this species likely uses cave habitats at PMKP year round.

Franklin Pit Cave- this cave supported a total of 44 *P. subflavus*, 6-9 *E. fuscus*, 149-153 *M.lucifugus*, 3-7 *M.leibii*, 1-3 *M. septentrionalis*, and 1 *M.sodalis*. This cave is more complex than Parson's and presents opportunities for hibernating bats to use multiple passages, and levels within the cave. Some bats were located in high ceilings, or in cracks, and could not be positively identified to species. Like Parson's, this cave had a number of *P. subflavus* located throughout the extent of the cave. Most of the *M. lucifugus* were located between the dig area, and the second drop, with a couple of dozen individuals scattered in the Saltpetre room and adjacent upper level passages. The single *M. sodalis* was identified within a cluster of *M. lucifugus* between the dig area and the second drop. Like the Parson's colony, this record represents a new hibernation site for this federally endangered species. *Myotis leibii* and *M. septentrionalis* were found in several areas in small numbers.

Table 6. Number of bats hibernating by species in Parson's and Franklin Pit caves on 11 March 2010 at Powell Mountain Karst Preserve, Wise County, Virginia

	M.leibii	*M.lucifugus*	*M.septentrionalis*	*M.sodalis*	*E.fuscus*	*P.subflavus*
Parson's Cave	0	2	0	7	1	79
Franklin Pit	3-7	153	1-3	1	6-9	44

Figure 10. Indiana bat (*Myotis sodalis*) with mouth open, hibernating amongst a cluster of little brown bats (*Myotis lucifugus*) on 11 March 2010 at Franklin Pit Cave, Powell Mountain Karst Preserve, Wise County, Virginia (photo W. Orndorff)

Bird/herp/millipede/butterfly inventory

Zoologists Chris Hobson (CSH), Anne Chazal (ACC), Steve Roble (SMR), and Art Evans (AVE) conducted surveys for these animal groups from April 6-9 (CSH, ACC), April 27-30 (CSH, ACC), April 27-29 (CSH, AVE), May 11-14 (CSH, ACC), and May 26-29 (CSH). Summer surveys continued on June 29-31 (CSH), July 28-30 (ACC), August 20-21 (CSH), and 25 August (CSH). Two later trips in September 22-23 (CSH,SMR), and October 21-23 (CSH,SMR) completed surveys for general faunal groups.

Hand collection, pitfall traps (Fig. 15), snap traps, audio surveys, sweep netting, and visual observations allowed us to compile lists of birds, reptiles, amphibians, millipedes, butterflies, and a variety of terrestrial invertebrates. The results of these surveys are summarized below:

Birds

A total of 56 bird species was recorded at PMKP, including several species of neotropical migrant songbirds that are likely to breed at the preserve, including Black-throated Green Warbler, Cerulean Warbler, Worm-eating Warbler, Ovenbird, American Redstart, Hooded Warbler, Black and White Warbler, White-eyed Vireo, Yellow-throated Vireo, and Blue-headed Vireo.

Two species were documented by observation of nests or young birds as confirmed breeding on site, including Wood Thrush (fledgling observed), and Eastern Phoebe (nest in Parson's Cave entrance). Purple Finch and Hermit Thrush were both observed, and are considered rare breeding birds in Virginia, but we found no evidence of breeding for these two species at PMKP, and all sightings were during winter or migratory periods. No rare bird species were documented breeding on the site.

Overall, the list of birds found represents a typical fauna for a forested site in the Appalachians. A list of all bird species encountered is presented in Appendix 1.

Reptiles and Amphibians

Ten species of salamanders were documented on site, including the watchlisted Cumberland Plateau salamander (*Plethodon kentucki* G4 S3), and Green salamander (*Aneides aeneus* G3G4 S3). The green salamander is typically found on sandstone rock outcrops, and is known from relatively few sites where it inhabits limestone, including the rock outcrops above Parson's Cave. This species has also been documented on limestone in "The Cedars" area of Lee County, Virginia. Several additional sightings of this species were documented at PMKP from August-October, also in association with Parson's Cave rock outcrops.

The Cumberland Plateau salamander was seen at several locations within PMKP, including rock outcrops above Parson's Cave, and under cover objects near Solomon's Seal Cave. This species is known from extreme southwestern Virginia, and is very similar to the larger, more widespread, Slimy salamander, *Plethodon glutinosus* that also occurs on the PMKP. The two species can be distinguished by the white throat of the *P. kentucki*, in contrast to the blackish throat of *P. glutinosus*.

Five frog species were documented at PMKP, including spring peeper (*Pseudacris crucifer*), green frog (*Lithobates clamitans*), Cope's gray treefrog (*Hyla chrysoscelis*), wood frog (*Lithobates sylvatica*), and mountain chorus frog (*Pseudacris brachyphona*). Unidentified tadpoles were found in a small wetland pool near the eastern edge of PMKP proximal to UV trap 4 (Figure 16).

Reptiles documented included the Northern fence lizard (*Sceloporus undulatus*), Eastern box turtle (*Terrapene carolina*), Eastern milk snake (*Lampropeltis triangulum*), Eastern garter snake (*Thamnophis sirtalis*), Northern black racer (*Coluber constrictor*), Eastern ring-necked snake (*Diadophis punctatus*), and the Black rat snake (*Elaphe alleghaniensis*). Although local residents have reported seeing both copperheads (*Agkistrodon contortrix mokasen*) and rattlesnakes (*Crotalus horridus*) in the area, neither has been observed at PMKP during our surveys.

No rare amphibians or reptiles were found during our surveys. A list of all reptiles and amphibians documented at PMKP is presented in Appendix 1.

Figure 11. Cumberland Plateau salamander (*Plethodon kentucki*) from Powell Mountain Karst Preserve,Wise County, Virginia (photo Chris Hobson)

Figure 12. The Mountain chorus frog (*Pseudacris brachyphona*) from Powell Mountain Karst Preserve, Wise County, Virginia (photo Steve Roble)

Millipeds and Centipedes

Collections of the terrestrial millipede fauna have provided some interesting results. Dr. Richard Hoffman of the Virginia Museum of Natural History, has identified a total of 21 species, from 11 families, including *Apheloria virginiensis tesselatum* (unpublished species name), *Abacion magnum*, and the watchlisted *A. tesselatum*, among others such

as the common *Narceus americanus* that appears to be widespread and abundant throughout the property, and a less common congener *Narceus annularis*.

One of the more exciting finds was that of the Cedar millipede *Brachoria cedra* (G2G3 S2S3), that was until recently, thought to be endemic to "The Cedars" in Lee County, Virginia. A recent record from High Knob in Wise County extended the known range, and the presence of this species at PMKP represents only the third known recorded locality for this Virginia endemic. The state rare millipede *Petaserpes rosalbus* (G5 S2) was found at all three pitfall trap sites. The presence of *Abacion magnum* and *A. tesselatum* at the same site has not been documented before according to Dr. Hoffman.

Of particular importance is the discovery of several new, undescribed species of millipedes, one of the genus *Brachoria*. The *Brachoria* species is known from a single individual collected at PMKP. Dr. Hoffman is continuing to examine collections from PMKP in hopes of finding additional specimens of this new species. There were also two new species of *Cleidogona*, and one new *Pseudotremia* recorded from our samples. These undescribed species will remain as such until taxonomic experts provide an adequate scientific description.

Figure 13. A common millipede (*Pseudopolydesmus canadensis*) at the Powell Mountain Karst Preserve,Wise County, Virginia (photo Steve Roble)

Butterflies

The butterfly fauna of the preserve includes a list of species that are typical for the region in which PMKP lies. A total of 29 species have been verified, including the Great spangled fritillary (*Speyeria cybele*), Gemmed satyr (*Cyllopsis gemma*), Cloudless sulphur (*Phoebis sennae*), Banded hairstreak (*Satyrium calanus*), and Eastern Comma (*Polygonia comma*). No rare butterflies were found, however, the watchlisted Diana

fritillary (*Speyeria diana* G3G4 S3), and West Virginia white (*Pieris virginiensis*; G3G4 S3) were both documented. A list of all butterfly species observed or collected is provided in Appendix 2.

Figure 14. A newly emerged Henry's Elfin (*Callophrys henrici*) from Powell Mountain Karst Preserve, Wise County, Virginia (photo Anne Chazal)

Mammals

Two lines of "museum special" snap traps (10 per line, 20 total), were set overnight on 7 and 8 April, 2009. These traps were set along logs, inside downed trees, and in rockpiles around the sinkholes adjacent to Parson's Cave. These traps produced two taxa, *Peromyscus* sp. (Deer mouse or White-footed mouse), and *Blarina brevicauda* (Short-tailed shrew). The use of snap traps was discontinued due to the inefficiency of the traps in providing specimens of small mammals, particularly those not typically trapped in snap traps.

Pitfalls proved to be much more effective in capturing small shrews, and there were three species documented, the most numerous was the Masked shrew (*Sorex cinereus*), followed by the Short-tailed shrew (*Blarina brevicauda*), with only one specimen of the Pygmy shrew (*Sorex hoyi*). In addition, the pitfalls captured Eastern chipmunk (*Tamias striatus*), Pine vole (*Microtus pinetorum*), Meadow jumping mouse (*Zapus hudsonius*), and Woodland jumping mouse (*Napeozapus insignis*). Other mammal species documented include Gray squirrel (*Sciurus carolinensis*), Southern flying squirrel (*Glaucomys volans*), White-tailed deer (*Odocoileus virginiensis*), and Raccoon (*Procyon lotor*). Evidence of previous occupation by the Alleghany woodrat (*Neotoma magister*) was reported in Parson's Cave, and extensive evidence of woodrat use was noted in the dry crawlway at the bottom of the entrance drop into Franklin's Pit.

Two rare bats, the Indiana bat (*Myotis sodalis*), and Eastern small-footed bat (*M. leibii*) were documented during mist netting and cave inventory. No other rare mammals were

documented at PMKP. A list of all mammal species observed and captured can be found in Appendix 1.

General invertebrate trapping

Various techniques including pitfall traps, sweep netting, black light bucket traps, yellow bowl traps, Malaise trap, and Lindgren funnels (baited with 50% turpentine and 50% ethanol) were utilized during our surveys. These methods resulted in the capture of hundreds of specimens of beetles, moths, and other invertebrate taxa. Figure 15 shows the locations of pitfall traps used.

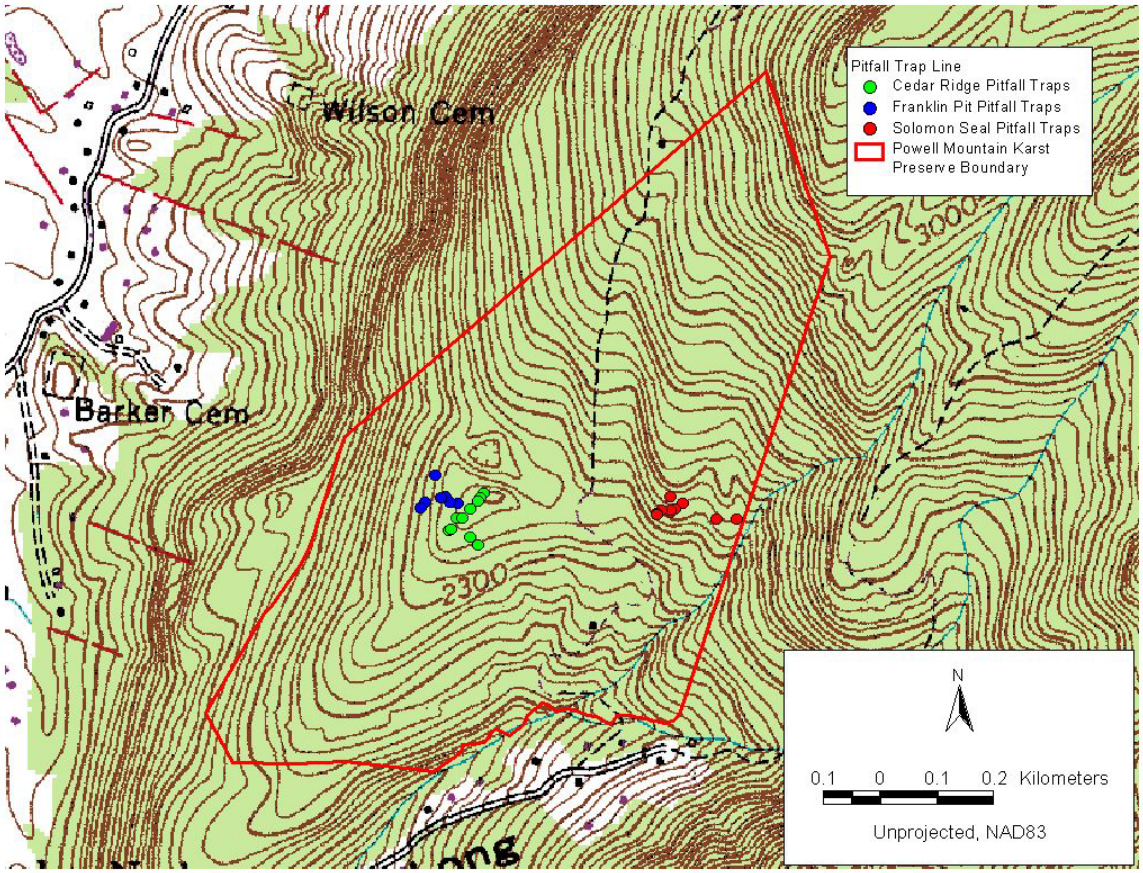

Figure 15. Locations of pitfall traps utilized at Powell Mountain Karst Preserve, Wise County, Virginia during 2009 field season.

Black light bucket traps (UV traps 1-4) were placed in 4 stationary positions (Fig. 16) for sampling during each field visit to the PMKP. In addition to the 4 stationary traps, 1 or 2 additional traps (floaters) were occasionally used to trap different micro habitats, and to capture additional specimens.

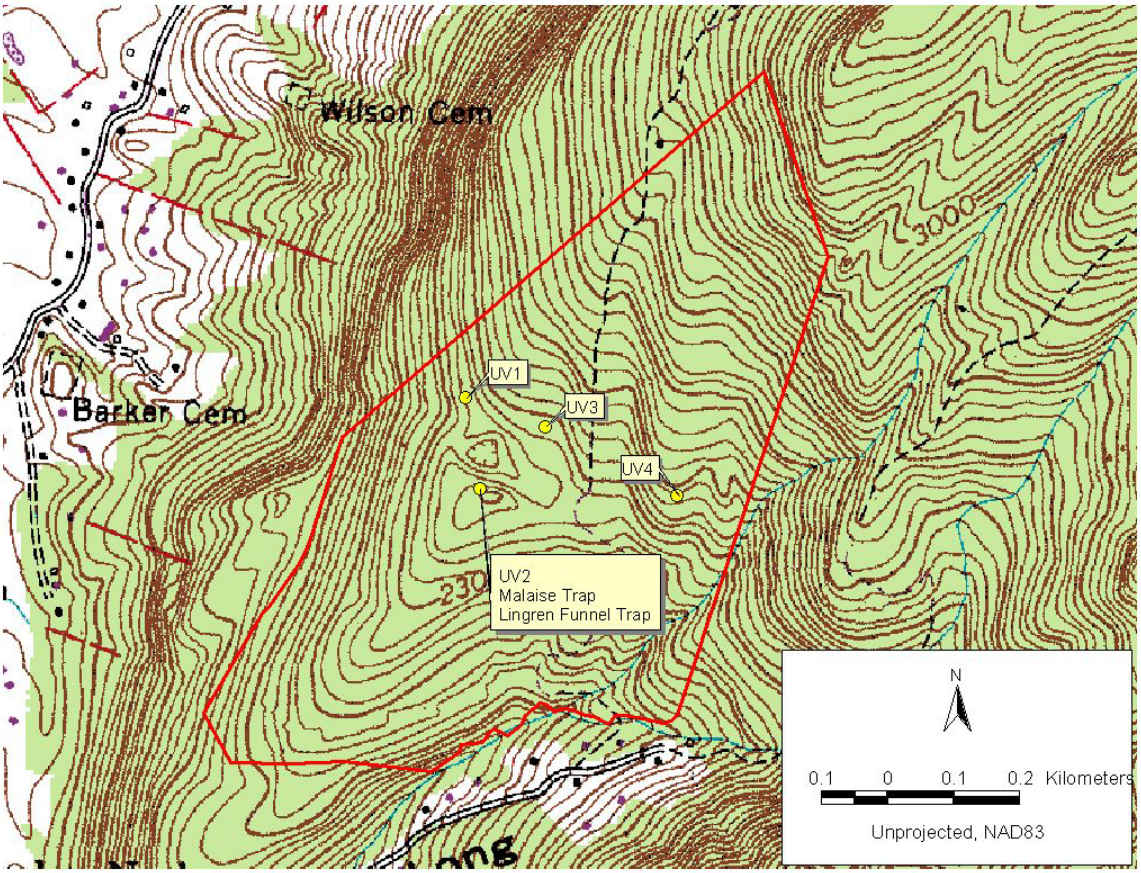

Figure 16. Location of 4 stationary UV light traps, Malaise trap, and Lindgren Funnel Trap at Powell Mountain Karst Preserve, Wise County, Virginia, during 2009 field surveys.

Examination of the moth captures has resulted in the identification of two rare species, the Dark stoneroot borer moth (*Papaipema duplicatus* G2G4 S2) and a geometrid moth (*Lytrosis permagnaria* G3G4 S2), and several watchlisted species (*Acronicta radcliffei* G5 S2S4; *Apamea sordens* G5 S1S3; *Catocala serena* G5 S2S4; *Eulithis explanata* G5 S2S4; *Papaipema impecuniosa* G5 S2S4; *Psaphida thaxterianus* G4 S2S4; *Xanthorhoe labradorensis* G4 S2S4). A total of 338 species of macromoths, and 29 species of micromoths were identified from samples collected between April-October 2009. A complete list of all moth species identified from PMKP can be found in Appendix 2.

Figure 17. Ultraviolet light trap used for invertebrate sampling at Powell Mountain Karst Preserve, Wise County, Virginia

Although there are no permanent pond habitats, and no major streams on the property, there are several dragonflies and damselflies utilizing roads and trails on the property. The Common whitetail (*Libellula lydia*), Ashy clubtail (*Gomphus lividus*), Common baskettail (*Epitheca cynosura*), Powdered dancer (*Argia moesta*), Common green darner (*Anax junius*), Blue dasher (*Pachydiplax longipennis*), and Azure bluet (*Enallagma aspersum*) were all recorded on the property. A list of all Odonata documented at PMKP is contained in Appendix 2.

Beetles at PMKP proved to be both numerous, and diverse, including 218 species representing 44 different families. Despite this diversity and abundance, only one rare beetle was documented. The Little Kennedy cave beetle (*Pseudanophthalmus cordicollis* G1 S1) found in Franklin Pit Cave, is considered globally rare, and is restricted to only a few caves in close proximity to PMKP. This rare cave beetle is known from a previous collection at PMKP within Omega Cave.

There were no other rare or watchlisted beetles recorded from PMKP. However, Dr. Art Evans noted that 24 beetle species captured at PMKP had not been previously documented in the scientific literature as occurring in Virginia. Some of these species may have been collected at other sites in the state previously, or may exist in academic or museum collections, but those records have not been published, and are therefore undocumented in pertinent literature. These species include *Alobates morio*, *Anaspis rufa*, *Anelaphus villosus*, *Athous rufifrons*, *Aulonothroscus texetrius*, *Centrodara*

decolorata, *Clytus ruricola*, *Dictyoptera munda*, *Ellychnia autumnalis*, *Eucinetus strigosus*, *Eurymycter fasciatus*, *Falsomordellistena discolor*, *Hadrobregmus notatus*, *Lecontella cancellata*, *Limonius basillaris*, *Mordellaria borealis*, *Obrium rubidum*, *Osphya varians*, *Paria pratensis*, *Pedilus terminalis*, *Ptilinus pruinosus*, *Sachodes pulchella*, *Tritoma mimetica*, and *Tymnes chrysis*.

Roads and trails also provide habitat for several species of predatory tiger beetles, including the common and widespread Six-spotted tiger beetle (*Cicindela sexguttata*), the nearly flightless One-spotted tiger beetle (*Cicindela unipunctata*), and the Red-bellied tiger beetle (*Cicindela rufiventris*). A list of all identified beetle species is contained in Appendix 2.

Spiders were primarily collected in pitfall traps, and by hand collection. At least 49 species have been identified to date, and identification of several spider taxa is still pending. Two rare species were found at PMKP, the Southeastern wandering spider (*Anahita punctulata* G4 S2), and Pocock's lampshade-web spider (*Hypochilus pococki* G4G5 S2S3). *Hypochilus pococki* was found only beneath rock overhangs in the rock outcrops around Parson's Cave, where they construct their lampshade-shaped webs. *Anahita punctulata* was discovered in pitfall traps near Solomon's Seal Cave and along the Cedar Ridge pitfall line (Figure 15). Hoffman (2006) mentions three Virginia records for this spider, including one from Wise County. Also, two watchlist spider species *Gnaphosa fontinalis* (G4? S3), and *Sphodros niger* (G4F5 S3) were documented, both were found in pitfall trap samples near Franklin Pit, and along the Cedar Ridge pitfall line (Figure 15).

The true bug fauna (Heteroptera) includes at least 23 species from 11 different families, including one new state record Mirid bug *Polymerus punctipes* according to R. Hoffman. Thirty species from the Order Hymenoptera were identified, including 21 ants (Formicidae), and several bees, and wasps, although no rare species have been recorded. Additional species are likely to be added to these fauna as taxonomic experts complete examination of specimens.

The invertebrate portion of the inventory is by far the most time consuming non-field part of the inventory, and required many hours in the laboratory where specimens were sorted, prepared, and identified. Much of this work was done by Dr. Art Evans and Dr. Richard Hoffmann, with significant contributions from Anne Chazal and Steve Roble. Appendix 2 contains a list of all invertebrate species identified from PMKP. Some specimens will require additional taxonomic study, and identifications were not available in time for final report submission.

Rare species summary

A number of rare species were encountered during this project. Locations of rare species are presented in Figure 18-19, and these species are presented in the following table which includes DNH rank, as well as state and federal status if appropriate:

Table 7. Rare plants and animals found at Powell Mountain Karst Preserve, with DNH rank, Federal, and State Status

Species	DNH rank	Federal Status	State Status
Crataegus mollis	G5 S1		
Crataegus calpodendron	G5 S1		
Myotis sodalis	G2 S1	FE	SE
Myotis leibii	G3 S2		
Brachoria cedra	G2G3 S2S3		
Petaserpes rosalbus	G5 S2		
Papaipema duplicatus	G2G4 S2		
Lytrosis permagnaria	G3G4 S2		
Hypochilus pococki	G4G5 S2S3		
Anahita punctulata	G4 S2		
Stygobromus cumberlandus	G3G4 S1S2		
Pseudanophthalmus cordicollis	G1 S1		
Pseudotremia sp. nov. nr. stupefactor	To be determined		
Litocampa sp. nov. nr. cookei	To be determined		

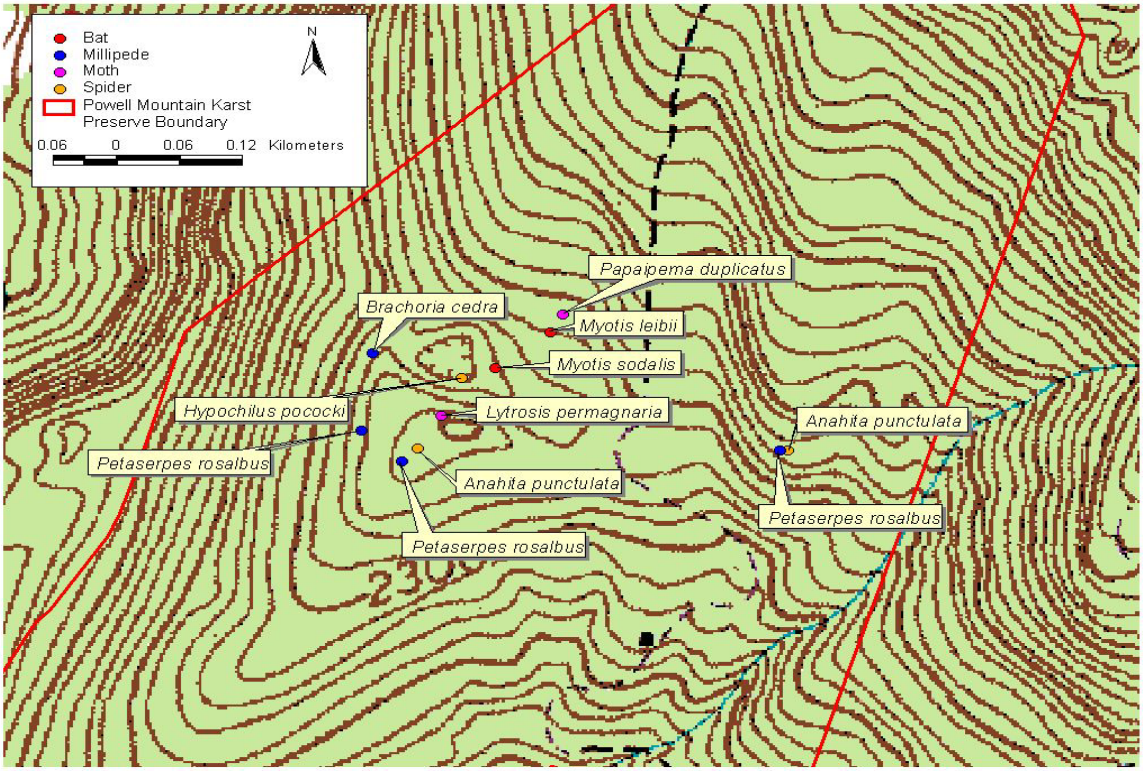

Figure 18. Locations of non-cave rare animal occurrences at Powell Mountain Karst Preserve, Wise County, Virginia

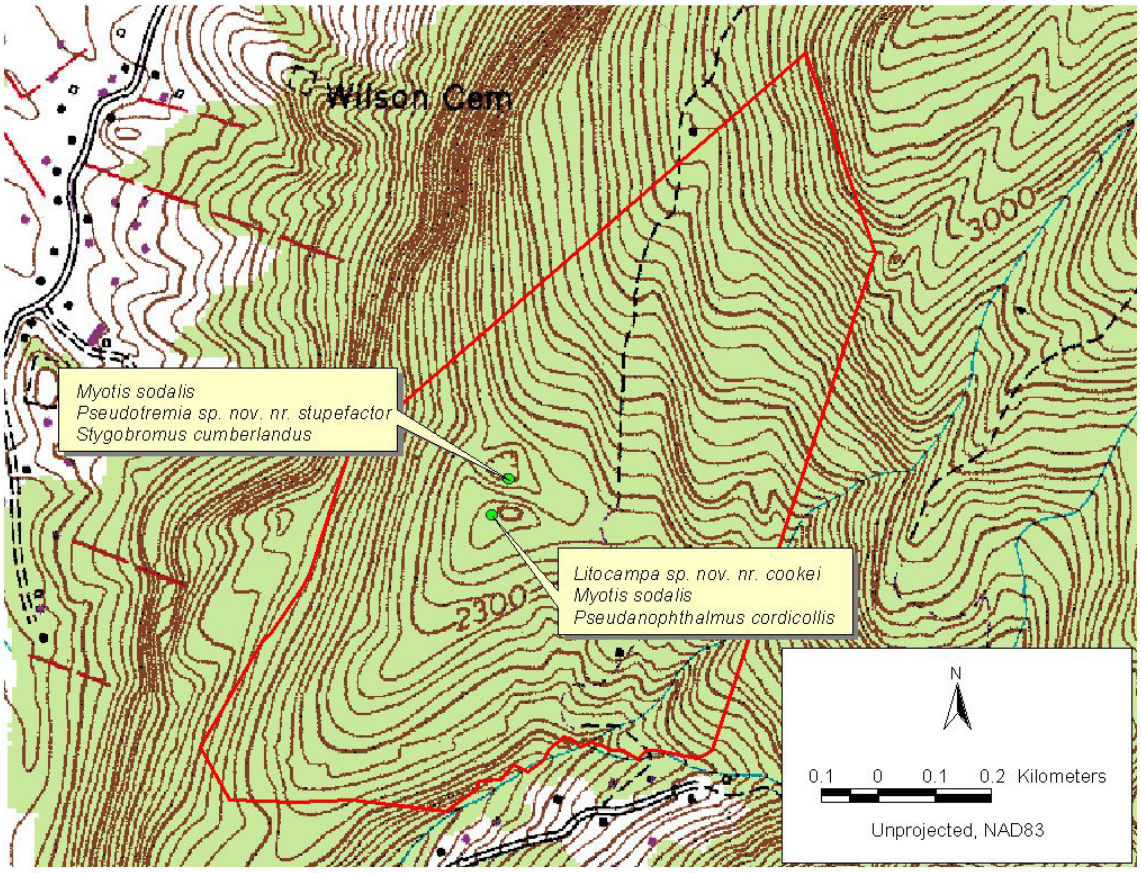

Figure 19. Locations of rare cave species at Powell Mountain Karst Preserve, Wise County, Virginia

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Literature Cited and References

Capinera, J.L., R.D. Scott, and T.J. Walker. 2004. Field Guide to Grasshoppers, Katydids, and Crickets of the United States. Comstock Publishing Associates, Ithaca. 249 pp.

Covell, C.V. 2005. A Field Guide to Moths of Eastern North America. Virginia Museum of Natural History Special Publication Number 12. 496 pp.

Evans, A.V. 2007. Field Guide to Insects and Spiders of North America. Sterling Publishing Company, Inc., New York. 496 pp.

Helfer, J.R. 1987. How to Know the Grasshoppers, Crickets, Cockroaches and Their Allies. Dover Publications, Inc., New York. 363 pp.

Henika, William S., 1988, Geology of the East Stone Gap Quadrangle, Virginia. Virginia Division of Mineral Resources Publication 79, Charlottesville.

Hoffman, R.L. 1971. Shield Bugs (Hemiptera; Scutelleroidea: Scutelleridae, Corimelaenidae, Cydnidae, Pentatomidae). The Insects of Virginia: No. 4. Research Division Bulletin 67. Virginia Polytechnic Institute and State University, Blacksburg.

Hoffman, R.L. 1975. Squash, Broad-headed, and Scentless Plant Bugs of Virginia (Hemiptera: Coreoidea: Coreidae, Alydidae, Rhopalidae). The Insects of Virginia: No. 9. Research Division Bulletin 105. Virginia Polytechnic Institute and State University, Blacksburg.

Hoffman, R.L. 2006. Anahita punctulata (Hentz), A Species, Genus, and Family of Spiders New to the Fauna of the Virginias and Ohio. Banisteria 27: 46-47.

Holsinger, J.R. and D.C. Culver. 1988. The Invertebrate Cave Fauna of Virginia and a Part of Eastern Tennessee: Zoogeography and Ecology. Brimleyana 14: 1-162

Hubbell, T.H., and R. M. Norton. 1978. The Systematics and Biology of the Cave-Crickets of the North American Tribe Hadenoecini (Orthoptera Saltatoria: Ensifera: Rhaphidophoridae: Dolichopodinae). Miscellaneous Publications, Museum of Zoology, University of Michigan, No. 156. Museum of Zoology, University of Michigan, Ann Arbor.

Opler, P.A. 1998. A Field Guide to Eastern Butterflies. Houghton Mifflin Company, New York. 486 pp.

Pechuman, L.L. 1973. Horse Flies and Deer Flies of Virginia (Diptera: Tabanidae). The Insects of Virginia: No. 6. Research Division Bulletin 81. Virginia Polytechnic Institute and State University, Blacksburg.

Roble, S.M. 2010. Natural Heritage Resources of Virginia: Rare Animals. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. Natural Heritage Technical Report 10-12.

Schwartz, B. and W. Orndorff, 2009, Hydrogeology of the Mississippian scarp-slope karst system, Powell Mountain, Virginia. Journal of Cave and Karst Studies 71(3): 168-179.

Appendix 1. Vertebrate species list for Powell Mountain Karst Preserve, Wise County, Virginia

PMKP vertebrate species lists

Common name	*Scientific name*	Community association	Rare/watchlist rank
Birds			
Acadian Flycatcher	*Empidonax virescens*	1,2,3,4	
American Crow	*Corvus brachyrhynchos*	1,2,3,4	
American Goldfinch	*Carduelis tristis*	1,2,3,4	
American Redstart	*Setophaga ruticilla*	1,2,3,4	
American Robin	*Turdus migratorius*	1,2,3,4	
American Woodcock	*Scolopax minor*	1,2,3,4	
Baltimore Oriole	*Icterus galbula*	1,2,3,4	
Barred Owl	*Strix varia*	1,2,3,4	
Black and White Warbler	*Mniotilta varia*	1,2,3,4	
Black-capped Chickadee	*Parus atricapillus*	1,2,3,4	
Black-throated Green Warbler	*Dendroica virens*	1,2,3,4	
Blue Jay	*Cyanocitta cristata*	1,2,3,4	
Blue-gray Gnatcatcher	*Polioptila caerulea*	1,2,3,4	
Blue-headed Vireo	*Vireo solitarius*	1,2,3,4	
Broad-winged Hawk	*Buteo platypturus*	1,2,3,4	
Brown Thrasher	*Toxostoma rufum*	1,2,3,4	
Brown-headed Cowbird	*Molothrus ater*	1,2,3,4	
Carolina Chickadee	*Parus carolinensis*	1,2,3,4	
Carolina Wren	*Thryothaurus ludovicianus*	1,2,3,4	
Cedar Waxwing	*Bombycilla cedrorum*	1,2,3,4	
Cerulean Warbler	*Dendroica cerulea*	1,2,3,4	G4 S3S4B
Chimney Swift	*Chaetura pelagica*	1,2,3,4	
Common Flicker	*Colaptes auratus*	1,2,3,4	
Common Screech Owl	*Otus asio*	1,2,3,4	
Cooper's Hawk	*Accipiter cooperii*	1,2,3,4	G5 S3B/S3N
Dark-eyed Junco	*Junco hyemalis*	1,2,3,4	
Downy Woodpecker	*Picoides pubescens*	1,2,3,4	
Eastern Phoebe	*Sayornis phoebe*	1,2,3,4	
Eastern Towhee	*Pipilo erythrophthalmus*	1,2,3,4	
Eastern Wood Pewee	*Contopus virens*	1,2,3,4	
Golden-crowned Kinglet	*Regulus satrapa*	1,2,3,4	
Gray Catbird	*Dumetella carolinensis*	1,2,3,4	
Hairy Woodpecker	*Picoides villosus*	1,2,3,4	
Hermit Thrush	*Catharus guttatus*	1,2,3,4	G5 S1B/S5N
Hooded Warbler	*Wilsonia citrina*	1,2,3,4	
Indigo Bunting	*Passerina cyanea*	1,2,3,4	
Mourning Dove	*Zenaida macroura*	1,2,3,4	
Northern Cardinal	*Cardinalis cardinalis*	1,2,3,4	
Northern Raven	*Corvus corax*	1,2,3,4	
Ovenbird	*Seiurus aurocapillus*	1,2,3,4	
Pileated Woodpecker	*Dryocopus pileatus*	1,2,3,4	

Vertebrate species list cont'd

Birds

Purple Finch	*Carpodacus purpureus*	1,2,3,4	G5 S1B/S5N
Red-bellied woodpecker	*Melanerpes carolinus*	1,2,3,4	
Red-eyed Vireo	*Vireo olivaceous*	1,2,3,4	
Red-tailed Hawk	*Buteo jamaicensis*	1,2,3,4	
Ruby-crowned Kinglet	*Regulus calendula*	1,2,3,4	
Ruby-throated Hummingbird	*Archilochus colubris*	1,2,3,4	
Ruffed Grouse	*Bonasa umbellus*	1,2,3,4	
Scarlet Tanager	*Piranga olivacea*	1,2,3,4	
Tufted Titmouse	*Parus bicolor*	1,2,3,4	
Turkey Vulture	*Cathartes aura*	1,2,3,4	
White eyed Vireo	*Vireo griseus*	1,2,3,4	
White-breasted Nuthatch	*Sitta carolinensis*	1,2,3,4	
White-throated Sparrow	*Zonotrichia albicollis*	1,2,3,4	
Wild Turkey	*Meleagris gallopavo*	1,2,3,4	
Wood Thrush	*Hylocichla mustelina*	1,2,3,4	
Worm-eating Warbler	*Helmitheros vermivorus*	1,2,3,4	
Yellow-billed Cuckoo	*Coccyzus americanus*	1,2,3,4	
Yellow-throated Vireo	*Vireo flavifrons*	1,2,3,4	

Reptiles and Amphibians

Green salamander	*Aneides aeneus*	3,4	G3G4 S3
Cumberland salamander	*Plethodon kentucki*	1,3,4	G4 S3
Red-spotted newt	*Notophthalmus viridescens*	1,2,3,4	
Mountain dusky salamander	*Desmognathus ochrophaeus*	1,3,4	
Cave salamander	*Eurycea lucifuga*	1,2,4,5	
Long-tailed salamander	*Eurycea longicauda*	1,3,4	
Slimy salamander	*Plethodon glutinosus*	1,2,3,4	
Spring salamander	*Gyrinophilis porphyriticus*	1,3,4,5	
Green frog	*Lithobates clamitans*	1,3,4	
Spring peeper	*Pseudacris crucifer*	1,3,4	
Cope's gray treefrog	*Hyla chrysoscelis*	1,2,3,4	
Eastern milk snake	*Lampropeltis trangulum*	1,2,3,4	
Eastern garter snake	*Thamnophis sirtalis*	1,2,3,4	
Northern black racer	*Coluber constrictor*	1,2,3,4	
Mountain chorus frog	*Pseudacris brachyphona*	1,3,4	
Black ratsnake	*Elaphe alleghaniensis*	1,2,3,4	
Wood Frog	*Lithobates sylvatica*	1,3,4	
Fence lizard	*Sceloporus undulatus*	1,2,3,4	
Ravine salamander	*Plethodon richmondi*	1,3,4	

Mammals

Big brown bat	*Eptesicus fuscus*	1,2,3,4,5	
Cottontail	*Sylvilagus sp.*	1,2,3,4	
Coyote	*Canis latrans*	1,2,3,4	

Vertebrate species list cont'd

Mammals

Eastern small-footed myotis	*Myotis leibii*	1,2,3,4,5	G3 S2
Indiana bat	*Myotis sodalis*	1,2,3,4,5	G2 S1
Meadow jumping mouse	*Zapus hudsonius*	1,2,3,4	
Woodland jumping mouse	*Napeozapus insignis*	1,2,3,4	
Little brown bat	*Myotis lucifugus*	1,2,3,4,5	
Masked shrew	*Sorex cinereus*	1,2,3,4	
Northern long-eared bat	*Myotis septentrionalis*	1,2,3,4	
Northern short-tailed shrew	*Blarina brevicauda*	1,2,3,4	
Pine vole	*Microtus pinetorum*	1,2,3,4	
Pygmy shrew	*Sorex hoyi*	1,2,3,4	
Raccoon	*Procyon lotor*	1,2,3,4	
Southern flying squirrel	*Glaucomys volans*	1,2,3,4	
Tricolored bat	*Perimyotis subflavus*	1,2,3,4,5	
White-footed mouse	*Peromyscus sp.*	1,2,3,4,5	
White-tailed deer	*Odocoileus virginianus*	1,2,3,4	
Neotoma magister	*Alleghany woodrat*	1,2,3,4,5	

Appendix 2. Invertebrate species lists for Powell Mountain Karst Preserve, Wise County, Virginia

Lepidoptera species list for PMKP

Common name	Scientific name	Rare/watchlist rank	Community association
Butterflies			
American lady	*Vanessa virginiensis*		1,2,3,4
Appalachian azure	*Celastrina neglectamajor*		1,2,3,4
Banded hairstreak	*Satyrium calanus*		1,2,3,4
Diana fritillary	*Speyeria diana*	G3G4 S3	1,2.3,4
Dreamy duskywing	*Erynnis icelus*		1,2,3,4
Eastern comma	*Polygonia comma*		1,2,3,4
Eastern tailed blue	*Everes comyntas*		1,2,3,4
Gemmed satyr	*Cyllopsis gemma*		1,2,3,4
Great spangled fritillary	*Speyeria cybele*		1,2,3,4
Hackberry emperor	*Asterocampa celtis*		1,2,3,4
Henry's elfin	*Callophrys henrici*		1,2,3,4
Juvenal's skipper	*Erynnis juvenalis*		1,2,3,4
Little wood satyr	*Megisto cymela*		1,2,3,4
Mourning cloak	*Nymphalis antiopa*		1,2,3,4
Orange sulphur	*Colia eurytheme*		1,2,3,4
Pearl crescent	*Phyciodes tharos*		1,2,3,4
Pipevine swallowtail	*Battus philenor*		1,2,3,4
Question mark	*Polygonia interrogationis*		1,2,3,4
Red-banded hairstreak	*Calycopis cecrops*		1,2,3,4
Red-spotted purple	*Limenitis astyanax*		1,2,3,4
Silver spotted skipper	*Epargyreus clarus*		1,2,3,4
Silvery blue	*Glaucopsyche lygdamus*		1,2,3,4
Silvery checkerspot	*Chlosyne nycteis*		1,2,3,4
Spicebush swallowtail	*Papilio troilus*		1,2,3,4
Spring azure	*Celastrina ladon*		1,2,3,4
Tiger swallowtail	*Papilio glaucus*		1,2,3,4
West Virginia White	*Pieris virginiensis*	G3G4 S3	1,2,3,4
Zabulon skipper	*Poanes zabulon*		1,2,3,4
Zebra swallowtail	*Eurytides marcellus*		1,2,3,4

Appendix 2 (cont'd). Invertebrate species lists for Powell Mountain Karst Preserve, Wise County, Virginia

Macrolepidopteran moth species list for PMKP

Family	Species	Rare/watchlist rank	Community association
Apatelodidae	*Apatelodes torrefacta*		1,2,3,4
Apatelodidae	*Olceclostera angelica*		1,2,3,4
Drepanidae	*Drepana arcuata*		1,2,3,4
Drepanidae	*Euthyatira pudens*		1,2,3,4
Drepanidae	*Oreta rosea*		1,2,3,4
Erebidae	*Apantesis nais*		1,2,3,4
Erebidae	*Catocala amica*		1,2,3,4
Erebidae	*Catocala blandula*		1,2,3,4
Erebidae	*Catocala cerogama?*		1,2,3,4
Erebidae	*Catocala dejecta*		1,2,3,4
Erebidae	*Catocala habilis*		1,2,3,4
Erebidae	*Catocala ilia*		1,2,3,4
Erebidae	*Catocala judith*		1,2,3,4
Erebidae	*Catocala lacrymosa*		1,2,3,4
Erebidae	*Catocala lineella*		1,2,3,4
Erebidae	*Catocala nebulosa*		1,2,3,4
Erebidae	*Catocala neogama*		1,2,3,4
Erebidae	*Catocala obscura ?*		1,2,3,4
Erebidae	*Catocala paleogama*		1,2,3,4
Erebidae	*Catocala residua ?*		1,2,3,4
Erebidae	*Catocala retecta*		1,2,3,4
Erebidae	*Catocala serena*	G5 S2S4	1,2,3,4
Erebidae	*Catocala sordida*		1,2,3,4
Erebidae	*Catocala subnata*		1,2,3,4
Erebidae	*Catocala ultronia*		1,2,3,4
Erebidae	*Catocala vidua*		1,2,3,4
Erebidae	*Cisthene packardii*		1,2,3,4
Erebidae	*Cisthene plumbea*		1,2,3,4
Erebidae	*Clemensia albata*		1,2,3,4
Erebidae	*Crambidia pallida*		1,2,3,4
Erebidae	*Crambidia uniformis*		1,2,3,4
Erebidae	*Ecpantheria scribonia*		1,2,3,4
Erebidae	*Euchaetes egle*		1,2,3,4
Erebidae	*Grammia anna*		1,2,3,4
Erebidae	*Halysidota tessellaris*		1,2,3,4
Erebidae	*Haploa clymene*		1,2,3,4
Erebidae	*Haploa contigua*		1,2,3,4
Erebidae	*Haploa lecontei*		1,2,3,4

Macro moth	cont'd		
Erebidae	*Hyphantria cunea*		1,2,3,4
Erebidae	*Hypoprepia fucosa*		1,2,3,4
Erebidae	*Hypoprepia miniata*		1,2,3,4
Erebidae	*Idia aemula*		1,2,3,4
Erebidae	*Idia americalis*		1,2,3,4
Erebidae	*Idia forbesi*		1,2,3,4
Erebidae	*Idia laurenti ?*		1,2,3,4
Erebidae	*Idia lubricalis*		1,2,3,4
Erebidae	*Idia rotundalis*		1,2,3,4
Erebidae	*Idia scobialis*		1,2,3,4
Erebidae	*Lophocampa caryae*		1,2,3,4
Erebidae	*Pyrrharctia isabella*		1,2,3,4
Erebidae	*Spilosoma congrua*		1,2,3,4
Erebidae	*Spilosoma latipennis*		1,2,3,4
Erebidae	*Spilosoma virginica*		1,2,3,4
Erebidae	*Virbia aurantiaca*		1,2,3,4
Erebidae	*Virbia opella*		1,2,3,4
Erebidae	*Dasychira basiflava ?*		1,2,3,4
Erebidae	*Dasychira tephra*		1,2,3,4
Erebidae	*Chytolita morbidalis*		1,2,3,4
Erebidae	*Chytolita petrealis*		1,2,3,4
Erebidae	*Hypena baltimoralis*		1,2,3,4
Erebidae	*Hypena deceptalis*		1,2,3,4
Erebidae	*Hypena edictalis*		1,2,3,4
Erebidae	*Hypena manalis*		1,2,3,4
Erebidae	*Hypena madefactalis*		1,2,3,4
Erebidae	*Hypena scabra*		1,2,3,4
Erebidae	*Orgyia definita*		1,2,3,4
Erebidae	*Orgyia leucostigma*		1,2,3,4
Erebidae	*Renia factiosalis*		1,2,3,4
Erebidae	*Renia nemoralis*		1,2,3,4
Erebidae	*Renia sobrialis*		1,2,3,4
Erebidae	*Renia sp. nr discoloralis*		1,2,3,4
Erebidae	*Scoliopteryx libatrix*		1,2,3,4,5
Euteliidae	*Paectes abrostoloides*		1,2,3,4
Euteliidae	*Paectes oculatrix*		1,2,3,4
Euteliidae	*Paectes pygmaea*		1,2,3,4
Euteliidae	*Marathyssa basalis*		1,2,3,4
Geometridae	*Anagoga occiduaria*		1,2,3,4
Geometridae	*Anavitrinella pampinaria*		1,2,3,4
Geometridae	*Antepione thisoaria*		1,2,3,4
Geometridae	*Anticlea vasiliata*		1,2,3,4
Geometridae	*Besma endropiaria*		1,2,3,4
Geometridae	*Besma quercivoraria*		1,2,3,4
Geometridae	*Biston betularia*		1,2,3,4

Macro moth	cont'd		
Geometridae	*Cabera erythemaria*		1,2,3,4
Geometridae	*Campaea perlata*		1,2,3,4
Geometridae	*Cepphis armataria*		1,2,3,4
Geometridae	*Cladara atroliturata*		1,2,3,4
Geometridae	*Cladara limitaria*		1,2,3,4
Geometridae	*Coryphista meadii*		1,2,3,4
Geometridae	*Costaconvexa centrostrigaria*		1,2,3,4
Geometridae	*Dichorda iridaria*		1,2,3,4
Geometridae	*Digrammia ocellinata*		1,2,3,4
Geometridae	*Dyspteris abortivaria*		1,2,3,4
Geometridae	*Dysstroma hersiliata*		1,2,3,4
Geometridae	*Ectropis crepuscularia*		1,2,3,4
Geometridae	*Ennomos magnaria*		1,2,3,4
Geometridae	*Epimecis hortaria*		1,2,3,4
Geometridae	*Eubaphe mendica*		1,2,3,4
Geometridae	*Euchlaena amoenaria*		1,2,3,4
Geometridae	*Euchlaena irraria*		1,2,3,4
Geometridae	*Euchlaena obtusaria*		1,2,3,4
Geometridae	*Euchlaena tigrinaria*		1,2,3,4
Geometridae	*Eugonobapta nivosaria*		1,2,3,4
Geometridae	*Eulithis diversilineata*		1,2,3,4
Geometridae	*Eulithis gracilineata*		1,2,3,4
Geometridae	*Eulithis atricolorata*		1,2,3,4
Geometridae	*Eulithis explanata*	G5 S2S4	1,2,3,4
Geometridae	*Euphyia unangulata*		1,2,3,4
Geometridae	*Eupithecia miserulata*		1,2,3,4
Geometridae	*Eusarca confusaria*		1,2,3,4
Geometridae	*Eutrapela clemataria*		1,2,3,4
Geometridae	*Glena plumosaria*		1,2,3,4
Geometridae	*Glenoides texanaria*		1,2,3,4
Geometridae	*Heliomata cycladata*		1,2,3,4
Geometridae	*Heterophleps triguttaria*		1,2,3,4
Geometridae	*Horisme intestinata*		1,2,3,4
Geometridae	*Hydriomena transfigurata*		1,2,3,4
Geometridae	*Hypagyrtis unipunctata*		1,2,3,4
Geometridae	*Idaea furciferata*		1,2,3,4
Geometridae	*Iridopsis larvaria*		1,2,3,4
Geometridae	*Speranza (Itame) pustularia*		1,2,3,4
Geometridae	*Speranza (Itame) subcessaria*		1,2,3,4
Geometridae	*Lambdina athosaria*		1,2,3,4
Geometridae	*Lomographa vestaliata*		1,2,3,4
Geometridae	*Lobocleta ossularia*		1,2,3,4
Geometridae	*Lytrosis permagnaria*	G3G4 S2	3,4

Macro moth	cont'd		
Geometridae	*Lytrosis unitaria*		1,2,3,4
Geometridae	*Macaria multilineata*		1,2,3,4
Geometridae	*Macaria pinistrobata*		1,2,3,4
Geometridae	*Macaria promiscuata*		1,2,3,4
Geometridae	*Melanolophia canadaria*		1,2,3,4
Geometridae	*Metarranthis homuraria*		1,2,3,4
Geometridae	*Metarranthis hypochraria*		1,2,3,4
Geometridae	*Metarranthis mestusata*		1,2,3,4
Geometridae	*Nemoria bistriaria*		1,2,3,4
Geometridae	*Orthonama obstipata*		1,2,3,4
Geometridae	*Patalene olyzonaria puber*		1,2,3,4
Geometridae	*Pero ancetaria*		1,2,3,4
Geometridae	*Phaeoura quernaria*		1,2,3,4
Geometridae	*Plagodis alcoolaria*		1,2,3,4
Geometridae	*Plagodis fervidaria*		1,2,3,4
Geometridae	*Plagodis kuetzingi*		1,2,3,4
Geometridae	*Plagodis phlogosaria*		1,2,3,4
Geometridae	*Probole alienaria*		1,2,3,4
Geometridae	*Probole amicaria*		1,2,3,4
Geometridae	*Prochoerodes lineola*		1,2,3,4
Geometridae	*Rheumaptera prunivorata*		1,2,3,4
Geometridae	*Scopula limboundata*		1,2,3,4
Geometridae	*Selenia alciphearia*		1,2,3,4
Geometridae	*Selenia kentaria*		1,2,3,4
Geometridae	*Sicya macularia*		1,2,3,4
Geometridae	*Tetracis cachexiata*		1,2,3,4
Geometridae	*Tetracis crocallata*		1,2,3,4
Geometridae	*Thysanopyga intractata*		1,2,3,4
Geometridae	*Trigrammia quadrinotaria*		1,2,3,4
Geometridae	*Xanthorhoe labradorensis*	G4 S2S4	1,2,3,4
Geometridae	*Xanthorhoe lacustrata*		1,2,3,4
Geometridae	*Xanthotype urticaria*		1,2,3,4
Lasiocampidae	*Artace cribraria*		1,2,3,4
Lasiocampidae	*Malacosoma americanum*		1,2,3,4
Lasiocampidae	*Phyllodesma americana*		1,2,3,4
Lasiocampidae	*Tolype velleda*		1,2,3,4
Noctuidae	*Abagrotis alternata*		1,2,3,4
Noctuidae	*Abagrotis anchocelioides*		1,2,3,4
Noctuidae	*Achatia distincta*		1,2,3,4
Noctuidae	*Acronicta afflicta*		1,2,3,4
Noctuidae	*Acronicta americana*		1,2,3,4
Noctuidae	*Acronicta hasta*		1,2,3,4
Noctuidae	*Acronicta impleta*		1,2,3,4
Noctuidae	*Acronicta inclara*		1,2,3,4
Noctuidae	*Acronicta interrupta*		1,2,3,4

Macro moth	cont'd		
Noctuidae	*Acronicta lobeliae*		1,2,3,4
Noctuidae	*Acronicta modica*		1,2,3,4
Noctuidae	*Acronicta noctivagans*		1,2,3,4
Noctuidae	*Acronicta radcliffei*	G5 S2S4	1,2
Noctuidae	*Acronicta retardata*		1,2,3,4
Noctuidae	*Acronicta spinigera*		1,2,3,4
Noctuidae	*Agnorisma badinodis*		1,2,3,4
Noctuidae	*Agriopodes fallax*		1,2,3,4
Noctuidae	*Agrochola bicolorago*		1,2,3,4
Noctuidae	*Agrotis ipsilon*		1,2,3,4
Noctuidae	*Allotria elonympha*		1,2,3,4
Noctuidae	*Anathix ralla*		1,2,3,4
Noctuidae	*Anicla infecta*		1,2,3,4
Noctuidae	*Anorthodes tarda*		1,2,3,4
Noctuidae	*Apamea cristata*		1,2,3,4
Noctuidae	*Apamea sordens*	G5 S1S3	1,2,3,4
Noctuidae	*Balsa labecula*		1,2,3,4
Noctuidae	*Caenurgina crassiuscula*		1,2,3,4
Noctuidae	*Callopistria mollissima*		1,2,3,4
Noctuidae	*Calocasia flavicornis*		1,2,3,4
Noctuidae	*Calocasia propinquilinea*		1,2,3,4
Noctuidae	*Calyptera canadensis*		1,2,3,4
Noctuidae	*Celiptera frustulum*		1,2,3,4
Noctuidae	*Cerma cerintha*		1,2,3,4
Noctuidae	*Charadra deridens*		1,2,3,4
Noctuidae	*Choephora fungorum*		1,2,3,4
Noctuidae	*Chrysonympha formosa*		1,2,3,4
Noctuidae	*Condica mobilis*		1,2,3,4
Noctuidae	*Copivaleria grotei*		1,2,3,4
Noctuidae	*Crocigrapha normani*		1,2,3,4
Noctuidae	*Egira alternans*		1,2,3,4
Noctuidae	*Elaphria alapallida/cornutinis*		1,2,3,4
Noctuidae	*Elaphria grata*		1,2,3,4
Noctuidae	*Elaphria versicolor*		1,2,3,4
Noctuidae	*Eosphoropteryx thyatyroides*		1,2,3,4
Noctuidae	*Epiglaea decliva*		1,2,3,4
Noctuidae	*Euclidea cuspidea*		1,2,3,4
Noctuidae	*Eudryas grata*		1,2,3,4
Noctuidae	*Euparthenos nubilis*		1,2,3,4
Noctuidae	*Euplexia benesimilis*		1,2,3,4
Noctuidae	*Eupsilia cirripalea*		1,2,3,4
Noctuidae	*Feltia herilis*		1,2,3,4
Noctuidae	*Feltia jaculifera*		1,2,3,4
Noctuidae	*Galgula partita*		1,2,3,4

Macro moth	cont'd		
Noctuidae	*Helicoverpa zea*		1,2,3,4
Noctuidae	*Homorthodes lindseyi*		1,2,3,4
Noctuidae	*Hyperstrotia secta*		1,2,3,4
Noctuidae	*Lacinipolia lorea*		1,2,3,4
Noctuidae	*Lacinipolia meditata*		1,2,3,4
Noctuidae	*Lacinipolia renigera*		1,2,3,4
Noctuidae	*Lacinipolia teligera*		1,2,3,4
Noctuidae	*Lascoria ambigualis*		1,2,3,4
Noctuidae	*Leucania ursula*		1,2,3,4
Noctuidae	*Leuconycta diphteroides*		1,2,3,4
Noctuidae	*Leuconycta lepidula*		1,2,3,4
Noctuidae	*Maliattha concinnimacula*		1,2,3,4
Noctuidae	*Maliattha muscosula*		1,2,3,4
Noctuidae	*Lithophane bethunei*		1,2,3,4
Noctuidae	*Lithophane hemina*		1,2,3,4
Noctuidae	*Lithophane querquera*		1,2,3,4
Noctuidae	*Lithophane unimoda*		1,2,3,4
Noctuidae	*Loscopia velata*		1,2,3,4
Noctuidae	*Macrochilo litophora*		1,2,3,4
Noctuidae	*Marimatha (Thioptera) nigrofimbria*		1,2,3,4
Noctuidae	*Metalectra discalis*		1,2,3,4
Noctuidae	*Metaxaglaea inulta*		1,2,3,4
Noctuidae	*Morrisonia confusa*		1,2,3,4
Noctuidae	*Morrisonia latex*		1,2,3,4
Noctuidae	*Nephelodes minians*		1,2,3,4
Noctuidae	*Noctua pronuba*	exotic	1,2,3,4
Noctuidae	*Oligia mactata*		1,2,3,4
Noctuidae	*Orthodes cynica*		1,2,3,4
Noctuidae	*Orthodes detracta*		1,2,3,4
Noctuidae	*Orthodes goodelli*		1,2,3,4
Noctuidae	*Orthodes majuscula*		1,2,3,4
Noctuidae	*Palthis asopialis*		1,2,3,4
Noctuidae	*Pangrapta decoralis*		1,2,3,4
Noctuidae	*Panopoda carneicosta*		1,2,3,4
Noctuidae	*Panopoda rufimargo*		1,2,3,4
Noctuidae	*Papaipema cataphracta*		1,2,3,4
Noctuidae	*Papaipema duplicatus*	G2G4 S2	1,3,4
Noctuidae	*Papaipema furcata*		1,2,3,4
Noctuidae	*Papaipema impecuniosa*	G5 S2S4	1,2,3,4
Noctuidae	*Papaipema rigida*		1,2,3,4
Noctuidae	*Parallelia bistriaris*		1,2,3,4
Noctuidae	*Perigea xanthioides*		1,2,3,4
Noctuidae	*Phlogophora periculosa*		1,2,3,4
Noctuidae	*Phoberia atomeris?*		1,2,3,4
Noctuidae	*Phoberia ingenua*		1,2,3,4

Macro moth	cont'd	
Noctuidae	*Phosphila miselioides*	1,2,3,4
Noctuidae	*Phosphila turbulenta*	1,2,3,4
Noctuidae	*Polia imbrifera*	1,2,3,4
Noctuidae	*Polygrammate hebraeicum*	1,2,3,4
Noctuidae	*Protolampra brunneicollis*	1,2,3,4
Noctuidae	*Psaphida electilis*	1,2,3,4
Noctuidae	*Psaphida resumens*	1,2,3,4
Noctuidae	*Psaphida thaxterianus*	1,2,3,4
Noctuidae	*Pseudeustrotia carneola*	1,2,3,4
Noctuidae	*Pseudoplusia includens*	1,2,3,4
Noctuidae	*Pseudorthodes vecors*	1,2,3,4
Noctuidae	*Pyrrhia exprimens*	1,2,3,4
Noctuidae	*Raphia frater*	1,2,3,4
Noctuidae	*Schinia arcigera*	1,2,3,4
Noctuidae	*Scolecocampa liburna*	1,2,3,4
Noctuidae	*Spargaloma sexpunctatus*	1,2,3,4
Noctuidae	*Spodoptera ornithogalli*	1,2,3,4
Noctuidae	*Sympistis infixa*	1,2,3,4
Noctuidae	*Tetanolita mynesalis*	1,2,3,4
Noctuidae	*Tricholita signata*	1,2,3,4
Noctuidae	*Tripudia rectangula*	1,2,3,4
Noctuidae	*Ulolonche culea*	1,2,3,4
Noctuidae	*Xestia dolosa*	1,2,3,4
Noctuidae	*Xestia normanianus*	1,2,3,4
Noctuidae	*Xestia smithii*	1,2,3,4
Noctuidae	*Zale aeruginosa*	1,2,3,4
Noctuidae	*Zale horrida*	1,2,3,4
Noctuidae	*Zale intenta*	1,2,3,4
Noctuidae	*Zale lunata*	1,2,3,4
Noctuidae	*Zale minerea*	1,2,3,4
Noctuidae	*Zale phaeocapna*	1,2,3,4
Noctuidae	*Zale undulata*	1,2,3,4
Noctuidae	*Zale unilineata*	1,2,3,4
Noctuidae	*Zanclognatha cruralis*	1,2,3,4
Noctuidae	*Zanclognatha jacchusalis*	1,2,3,4
Noctuidae	*Zanclognatha laevigata*	1,2,3,4
Noctuidae	*Zanclognatha lituralis*	1,2,3,4
Noctuidae	*Zanclognatha ochreipennis*	1,2,3,4
Noctuidae	*Zanclognatha protumnusalis?*	1,2,3,4
Nolidae	*Baileya australis*	1,2,3,4
Nolidae	*Baileya dormitans*	1,2,3,4
Nolidae	*Baileya levitans*	1,2,3,4
Nolidae	*Baileya ophthalmica*	1,2,3,4
Nolidae	*Meganola minuscula*	1,2,3,4

Macro moth	cont'd	
Notodontidae	*Datana angusii*	1,2,3,4
Notodontidae	*Datana drexelii*	1,2,3,4
Notodontidae	*Datana major*	1,2,3,4
Notodontidae	*Ellida caniplaga*	1,2,3,4
Notodontidae	*Heterocampa biundata*	1,2,3,4
Notodontidae	*Heterocampa obliqua*	1,2,3,4
Notodontidae	*Heterocampa umbrata*	1,2,3,4
Notodontidae	*Hyperaeschra georgica*	1,2,3,4
Notodontidae	*Lochmaeus bilineata*	1,2,3,4
Notodontidae	*Lochmaeus manteo*	1,2,3,4
Notodontidae	*Macrurocampa marthesia*	1,2,3,4
Notodontidae	*Nadata gibbosa*	1,2,3,4
Notodontidae	*Nerice bidentata*	1,2,3,4
Notodontidae	*Oligocentria lignicolor*	1,2,3,4
Notodontidae	*Oligocentria semirufescens*	1,2,3,4
Notodontidae	*Peridea angulosa*	1,2,3,4
Notodontidae	*Peridea basitriens*	1,2,3,4
Notodontidae	*Peridea ferruginea*	1,2,3,4
Notodontidae	*Schizura ipomoeae*	1,2,3,4
Notodontidae	*Schizura leptinoides*	1,2,3,4
Notodontidae	*Symmerista albifrons*	1,2,3,4
Notodontidae	*Symmerista canicosta*	1,2,3,4
Notodontidae	*Symmerista leucitys*	1,2,3,4
Saturniidae	*Actias luna*	1,2,3,4
Saturniidae	*Automeris io*	1,2,3,4
Saturniidae	*Callosamia promethea*	1,2,3,4
Saturniidae	*Dryocampa rubicunda*	1,2,3,4
Saturniidae	*Eacles imperialis*	1,2,3,4
Sphingidae	*Darapsa myron*	1,2,3,4
Sphingidae	*Deidamia inscripta*	1,2,3,4
Sphingidae	*Hemaris diffinis*	1,2,3,4
Sphingidae	*Laothoe juglandis*	1,2,3,4
Sphingidae	*Paonias excaecatus*	1,2,3,4
Sphingidae	*Paonias myops*	1,2,3,4

Appendix 2 (cont'd). Invertebrate species lists for Powell Mountain Karst Preserve, Wise County, Virginia

Microlepidopteran moth species list for PMKP

Family	Species	Rare/watchlist rank	Community association
Amphisbatidae	*Machimia tentoriferella*		1,2,3,4
Crambidae	*Pantographa limata*		1,2,3,4
Crambidae	*Desmia funeralis*		1,2,3,4
Crambidae	*Desmia maculalis*		1,2,3,4
Crambidae	*Herpetogramma thestialis*		1,2,3,4
Crambidae	*Hymenia perspectalis*		1,2,3,4
Crambidae	*Ostrinia nubilalis*		1,2,3,4
Crambidae	*Palpita magniferalis*		1,2,3,4
Crambidae	*Polygrammodes flavidalis*		1,2,3,4
Crambidae	*Udea rubigalis*		1,2,3,4
Elachistidae	*Ethmia zelleriella*		1,2,3,4
Limacodidae	*Adoneta spinuloides*		1,2,3,4
Limacodidae	*Apoda biguttata*		1,2,3,4
Limacodidae	*Apoda y-inversum*		1,2,3,4
Limacodidae	*Euclea delphinii*		1,2,3,4
Limacodidae	*Isa textula*		1,2,3,4
Limacodidae	*Lithacodes fasciola*		1,2,3,4
Limacodidae	*Natada nasoni*		1,2,3,4
Limacodidae	*Parasa chloris*		1,2,3,4
Limacodidae	*Prolimacodes badia*		1,2,3,4
Limacodidae	*Tortricidia testacea*		1,2,3,4
Megalopygidae	*Lagoa crispata*		1,2,3,4
Pyralidae	*Aglossa cuprina*		1,2,3,4
Pyralidae	*Euzophera ostricolorella*		1,2,3,4
Pyralidae	*Herculia olinalis*		1,2,3,4
Thyrididae	*Thyris sepulchralis*		1,2,3,4
Tortricidae	*Amorbia humerosana*		1,2,3,4
Yponomeutidae	*Atteva punctella*		1,2,3,4
Zygaenidae	*Pyromorpha dimidiata*		1,2,3,4

Appendix 2 (cont'd). Invertebrate species lists for Powell Mountain Karst Preserve, Wise County, Virginia

Miscellaneous invertebrate Orders

Species	Family	rare/watchlist rank	Community association
Collembola			
Neanura sp. Indet	Hypogastruidae		1,2,3,4
Mecoptera			
Bittacus strigosus	Bittacidae		1,2,3,4
Hylobittacus apicalis	Bittacidae		1,2,3,4
Merope tuber	Meropeidae		1,2,3,4
Panorpa helena	Panorpidae		1,2,3,4
Panorpa nebulosa	Panorpidae		1,2,3,4
Panorpa subulifera	Panorpidae		1,2,3,4
Blattodea			
Parcoblatta pennsylvanica	Blattellidae		1,2,3,4
Parcoblatta americana?	Blattellidae		1,2,3,4
Parcoblatta virginica?	Blattellidae		1,2,3,4
Neuroptera			
Lomamyia banksi	Berothidae		1,2,3,4
Chrysopa nigricornis	Chrysopidae		1,2,3,4
Chrysopa oculata	Chrysopidae		1,2,3,4
Chrysopa quadripunctata	Chrysopidae		1,2,3,4
Chrysoperla rufilabris	Chrysopidae		1,2,3,4
Chrysopodes placita	Chrysopidae		1,2,3,4
Leucochrysa insularis	Chrysopidae		1,2,3,4
Hemerobius humulinus	Hemerobiidae		1,2,3,4
Hemerobius pinidumus	Hemerobiidae		1,2,3,4
Hemerobius stigmaterus	Hemerobiidae		1,2,3,4
Megalomus fidelis	Hemerobiidae		1,2,3,4
Micromus posticus	Hemerobiidae		1,2,3,4
Micromus subanticus	Hemerobiidae		1,2,3,4
Zeugomantispa minuta	Mantispidae		1,2,3,4
Dendroleon obsoletus	Myrmeleontidae		1,2,3,4

Megaloptera

Chauliodes pectinicornis	Corydalidae		1,2,3,4

Trichoptera

Hydropsyche cheilonis	Hydropsychidae		1,2,3,4
Hydropsyche slossonae	Hydropsychidae		1,2,3,4
Hydropsyche sparna	Hydropsychidae		1,2,3,4
Rhyacophila carolina	Rhyacophilidae		1,2,3,4
Rhyacophila glaberrima	Rhyacophilidae		1,2,3,4
Pseudostenophylax uniformis	Limnephilidae		1,2,3,4
Pycnopsyche gentilis	Limnephilidae		1,2,3,4
Pycnopsyche luculenta	Limnephilidae		1,2,3,4
Pycnopsyche scabripennis	Limnephilidae		1,2,3,4
Ironoquia punctatissima	Limnephilidae		1,2,3,4
Neophylax aniqua	Uenoidae		1,2,3,4
Neophylax etnieri	Uenoidae		1,2,3,4
Neophylax stolus	Uenoidae		1,2,3,4

Diplopoda

Abacion magnum	Abacionidae		1,2,3,4
Abacion tesselatum	Abacionidae	G5 S3	1,2,3,4
Brachycybe lecontii	Andrognathidae	G5 S3	1,2,3,4
Cambala annulata	Cambalidae		1,2,3,4
Cleidogona major	Cleidogonidae		1,2,3,4
Cleidogona n. sp. nr *jocassee* & *hoffmani*	Cleidogonidae		1,2,3,4
***Cleidogona* n. sp.? small**	Cleidogonidae		1,2,3,4
Pseudotremia sp. nov. nr *stupefactor*	Cleidogonidae		5
Euryurus leachii	Euryuridae		1,2,3,4
Ophyiulus pilosus	Julidae		1,2,3,4
Ptyoiulus impressus	Parajulidae		1,2,3,4
Uroblaniulus sp. indet., apparently new	Parajulidae		1,2,3,4
Pseudopolydesmus canadensis	Polydesmidae		1,2,3,4
Pseudopolydesmus serratus	Polydesmidae		1,2,3,4
Scytonotus granulatus	Polydesmidae		1,2,3,4
Petaserpes rosalbus	Polyzoniidae	G5 S2	1,2,3,4
Narceus americanus	Spirobolidae		1,2,3,4
Narceus annularis	Spirobolidae		1,2,3,4
Apheloria montana flavissima	Xystodesmidae		1,2,3,4
Brachoria cedra	Xystodesmidae	G2G3 S2S3	1,2
Brachoria sp. nov	Xystodesmidae		1,2,3,4

Chilopoda

Scolopocryptops nigridius	Cryptopidae		1,2,3,4
Scolopocryptops sexspinosus	Cryptopidae		1,2,3,4
Theatops posticus	Cryptopidae		1,2,3,4
***Strigamia* sp.**	Dignathodontidae		1,2,3,4
Arenobius manegitus	Gosibiidae		1,2,3,4
Zygethobius pontis	Henicopidae		1,2,3,4
Bothropolys multidentatus	Lithobiidae		1,2,3,4
***Nampabius* sp. indet**	Lithobiidae		1,2,3,4
Hemiscolopendra marginata	Scolopendridae		1,2,3,4

Mantodea

Stagmomantis carolina	Mantidae		1,2,3,4

Arachnida

Agelenopsis kastoni	Agelenidae		1,2,3,4
Agelenopsis ?	Agelenidae		1,2,3,4
Agelenopsis emertoni	Agelenidae		1,2,3,4
Agelenopsis naevia	Agelenidae		1,2,3,4
Callobius bennetti	Amaurobiidae		1,2,3,4
Watodes calcaratus	Amaurobiidae		1,2,3,4
Watodes hybridus	Amaurobiidae		1,2,3,4
Antrodiaetus unicolor	Antrodiaetidae		1,2,3,4
Antrodiaetus* sp. apparently not *unicolor	Antrodiaetidae		1,2,3,4
Anyphaena fraterna	Anyphaenidae		1,2,3,4
Micrathena mitrata	Araneidae		1,2,3,4
Ocrepeira ectypa	Araneidae		1,2,3,4
Sphodros niger	Atypidae	G4G5 S3	1,2,3,4
Elaver excepta	Clubionidae		1,2,3,4
Castianeira cingulata	Corinnidae		1,2,3,4
Castianeira descripta-crocata	Corinnidae		1,2,3,4
Castianeira longipalpus	Corinnidae		1,2,3,4
Castianeira variata	Corinnidae		1,2,3,4
Anahita punctulata	Ctenidae	G4 S2	1,2,3,4
Cybaeus giganteus	Cybaeidae		1,2,3,4
Myrmekiaphilia foliata	Cyrtaucheniidae		1,2,3,4
Cesonia bilineata	Gnaphosidae		1,2,3,4
Drassyllus aprilinus	Gnaphosidae		1,2,3,4

<u>Arachnida</u> cont'd

Drassyllus covensis	Gnaphosidae		1,2,3,4
Drassyllus novus	Gnaphosidae		1,2,3,4
Gnaphosa fontinalis	Gnaphosidae	G4? S3	1,2,3,4
Litopyllus temporarius	Gnaphosidae		1,2,3,4
Sergiolus capulatus	Gnaphosidae		1,2,3,4
Zelotes duplex	Gnaphosidae		1,2,3,4
Zelotes hentzi	Gnaphosidae		1,2,3,4
Calymmaria cf. *persica*	Hahniidae		1,2,3,4
Hypochilus pococki	Hypochilidae	G4G5 S2S3	1,3
Neriene variabilis	Linyphiidae		1,2,3,4
Allocosa sublata	Lycosidae		1,2,3,4
Gladicosa gulosa	Lycosidae		1,2,3,4
Lycosa aspersa	Lycosidae		1,2,3,4
***Pirata* sp. indet.**	Lycosidae		1,2,3,4
Rabidosa rabida	Lycosidae		1,2,3,4
***Schizocosa* ?humilis**	Lycosidae		1,2,3,4
Schizocosa ?ochreata	Lycosidae		1,2,3,4
***Schizocosa* ?saltatrix**	Lycosidae		1,2,3,4
Schizocosa sp.?	Lycosidae		1,2,3,4
Philodromus cf. *infuscatus*	Philodromidae		1,2,3,4
Philodromus rufus	Philodromidae		1,2,3,4
Dolomedes albineus	Pisauridae		1,2,3,4
Pisaurina mira	Pisauridae		1,2,3,4
Thiodina ?puerpa	Salticidae		1,2,3,4
Ariadna bicolor	Segestriidae		1,2,3,4
Tmarus cf. *angulatus*	Thomisidae		1,2,3,4
Xysticus elegans	Thomisidae		1,2,3,4
Xysticus fraternus	Thomisidae		1,2,3,4
Xysticus transversatus	Thomisidae		1,2,3,4

<u>Opiolones</u>

Vonones sayi	Cosmetidae		1,2,3,4

<u>Thysanura</u>

Machilis sp. indet	Machilidae		1,2,3,4

Coleoptera

Necrophilus pettiti	Agyrtidae		1,2,3,4
Hadrobregmus notatus	Anobiidae	state record	1,2,3,4
Ptilinus pruinosus	Anobiidae	state record	1,2,3,4
Trichodesma gibbosa	Anobiidae		1,2,3,4
Euparius marmoreus	Anthribidae		1,2,3,4
Eurymycter fasciatus	Anthribidae	state record	1,2,3,4
Eurypogon niger	Artematopodidae		1,2,3,4
Eugnamptus angustatus	Attelabidae		1,2,3,4
Lichenophanes bicornis	Bostrichidae		1,2,3,4
Xylobiops basilaris	Bostrichidae		1,2,3,4
Arrenodes minutus	Brentidae		1,2,3,4
Atalantycha bilineata	Cantharidae		1,2,3,4
Atalantycha dentigera	Cantharidae		1,2,3,4
Ditemnus bidentatus	Cantharidae		1,2,3,4
Podabrus limbatus	Cantharidae		1,2,3,4
Podabrus tricostatus	Cantharidae		1,2,3,4
Carabus goryi	Carabidae		1,2,3,4
Cicindela rufiventris	Carabidae		1,2,3,4
Cicindela sexguttata	Carabidae		1,2,3,4
Cicindela unipunctata	Carabidae		1,2,3,4
Cyclotrachelus sigillatus	Carabidae		1,2,3,4
Cymindis limbatus	Carabidae		1,2,3,4
Dicaelus dilatatus	Carabidae		1,2,3,4
Dicaelus sculptilis intricatus	Carabidae		1,2,3,4
Galerita bicolor	Carabidae		1,2,3,4
Lebia analis	Carabidae		1,2,3,4
Lebia fuscata	Carabidae		1,2,3,4
Lebia grandis	Carabidae		1,2,3,4
Lebia tricolor	Carabidae		1,2,3,4
Pseudanophthalmus cordicollis	Carabidae	G1 S1	5
Scaphinotus andrewsii germari	Carabidae		1,2,3,4
Scarites subterraneus	Carabidae		1,2,3,4
Sphaeroderus canadensis	Carabidae		1,2,3,4
Trichotichnus dichrous	Carabidae		1,2,3,4
Trichotichnus vulpeculus	Carabidae		1,2,3,4
Aegomorphus modestus	Cerambycidae		1,2,3,4
Analeptura lineola	Cerambycidae		1,2,3,4
Anelaphus villosus	Cerambycidae	state record	1,2,3,4
Astylopsis macula	Cerambycidae		1,2,3,4
Atimia confusa	Cerambycidae		1,2,3,4

Coleoptera cont'd

Centrodera decolorata	Cerambycidae	state record	1,2,3,4
Clytus ruricola	Cerambycidae	state record	1,2,3,4
Cyrtophorus verrucosus	Cerambycidae		1,2,3,4
Eubulus bisginatus	Cerambycidae		1,2,3,4
Goes pulcher	Cerambycidae		1,2,3,4
Leptorhabdium pictum	Cerambycidae		1,2,3,4
Metacmaeops vittata	Cerambycidae		1,2,3,4
Obrium rubidum	Cerambycidae	state record	1,2,3,4
Onicideres cingulata	Cerambycidae		1,2,3,4
Orthosoma brunneum	Cerambycidae		1,2,3,4
Parelaphidion aspersum	Cerambycidae		1,2,3,4
Prionus laticollis	Cerambycidae		1,2,3,4
Saperda imitans	Cerambycidae		1,2,3,4
Saperda lateralis	Cerambycidae		1,2,3,4
Saperda vestita	Cerambycidae		1,2,3,4
Stenocorus cinnamopterus	Cerambycidae		1,2,3,4
Strangalepta abbreviata	Cerambycidae		1,2,3,4
Strangalia bicolor	Cerambycidae		1,2,3,4
Strangalia luteicornis	Cerambycidae		1,2,3,4
Strophiona nitens	Cerambycidae		1,2,3,4
Trigonarthris minnesotana	Cerambycidae		1,2,3,4
Typocerus lugubris	Cerambycidae		1,2,3,4
Urgleptes querci	Cerambycidae		1,2,3,4
Urographis despectus	Cerambycidae		1,2,3,4
Urographis fasciatus	Cerambycidae		1,2,3,4
Xylotrechus colonus	Cerambycidae		1,2,3,4
Ceratophytum pulsator	Ceratophytidae		1,2,3,4
Calligrapha scalaris	Chrysomelidae		1,2,3,4
Capraita subvittata	Chrysomelidae		1,2,3,4
Gibbobruchus mimus	Chrysomelidae		1,2,3,4
Glyptina brunnea	Chrysomelidae		1,2,3,4
Lupraea picta	Chrysomelidae		1,2,3,4
Odontota dorsalis	Chrysomelidae		1,2,3,4
Paria pratensis	Chrysomelidae	state record	1,2,3,4
Paria thoracica	Chrysomelidae		1,2,3,4
Phyllotreta bipustulata	Chrysomelidae		1,2,3,4
Phyllotreta striolata	Chrysomelidae		1,2,3,4
Tymnes chrysis	Chrysomelidae	state record	1,2,3,4
Tymnes tricolor	Chrysomelidae		1,2,3,4
Xanthonia decemnotata	Chrysomelidae		1,2,3,4

Coleoptera cont'd

Xanthonia striata	Chrysomelidae		1,2,3,4
Xanthonia villosula	Chrysomelidae		1,2,3,4
Cymatodera bicolor	Cleridae		1,2,3,4
Cymatodera inornata	Cleridae		1,2,3,4
Enoclerus ichneumoneus	Cleridae		1,2,3,4
Lecontella cancellata	Cleridae	state record	1,2,3,4
Madoniella dislocatus	Cleridae		1,2,3,4
Zenodosus sanquineus	Cleridae		1,2,3,4
Anatis labiculata	Coccinellidae		1,2,3,4
Chilocorus stigma	Coccinellidae		1,2,3,4
Harmonia axyridis	Coccinellidae		1,2,3,4
Clypastraea fasciata	Corylophidae		1,2,3,4
Conotrachelus affinis	Curculionidae		1,2,3,4
Conotrachelus anaglypticus	Curculionidae		1,2,3,4
Cyrtepistomus castaneus	Curculionidae		1,2,3,4
Lechriops oculata	Curculionidae		1,2,3,4
Leptostylus asperatus	Curculionidae		1,2,3,4
Otiorhynchus rugostriatus	Curculionidae		1,2,3,4
Pandeleteius hilaris	Curculionidae		1,2,3,4
Rhantus calidus	Dytiscidae		1,2,3,4
Ampedus collaris	Elateridae		1,2,3,4
Ampedus linteus	Elateridae		1,2,3,4
Argiotes oblongicollis	Elateridae		1,2,3,4
Athous cucullatus	Elateridae		1,2,3,4
Athous orvus	Elateridae		1,2,3,4
Athous rufifrons	Elateridae	state record	1,2,3,4
Hemicrepidus memnonius	Elateridae		1,2,3,4
Limonius aurifer	Elateridae		1,2,3,4
Limonius basillaris	Elateridae	state record	1,2,3,4
Limonius ectypus	Elateridae		1,2,3,4
Limonius griseus	Elateridae		1,2,3,4
Ludius pyrrhos	Elateridae		1,2,3,4
Orthostethus infuscatus	Elateridae		1,2,3,4
Aphorista perpulchra	Endomychidae		1,2,3,4
Clemmus minor	Endomychidae		1,2,3,4
Danae testacea	Endomychidae		1,2,3,4
Lycoperdina ferruginea	Endomychidae		1,2,3,4
Phymaphora puchella	Endomychidae		1,2,3,4
Phymaphora pulchella	Endomychidae		1,2,3,4
Acropteroxys gracilis	Erotylidae		1,2,3,4

Coleoptera cont'd

Ischyrus quadripunctatus	Erotylidae		1,2,3,4
Tritoma biguttata	Erotylidae		1,2,3,4
Tritoma humeralis	Erotylidae		1,2,3,4
Tritoma mimetica	Erotylidae	state record	1,2,3,4
Tritoma sanguinipennis	Erotylidae		1,2,3,4
Eucinetus morio	Eucinetidae		1,2,3,4
Eucinetus strigosus	Eucinetidae	state record	1,2,3,4
Isorhipis obliqua	Eucnemidae		1,2,3,4
Bolboceras liebecki	Geotrupidae		1,2,3,4
Bolboceras thoracicornis	Geotrupidae		1,2,3,4
Eucanthus lazarus	Geotrupidae		1,2,3,4
Geotrupes splendidus	Geotrupidae		1,2,3,4
Dineutus americanus	Gyrinidae		1,2,3,4
Ellychnia autumnalis	Lampyridae	state record	1,2,3,4
Ellychnia corrusca	Lampyridae		1,2,3,4
Lucidota atra	Lampyridae		1,2,3,4
Lucidota punctata	Lampyridae		1,2,3,4
Phausis reticulata	Lampyridae		1,2,3,4
Ceruchus piceus	Lucanidae		1,2,3,4
Dorcus parallelus	Lucanidae		1,2,3,4
Dictyoptera munda	Lycidae	state record	1,2,3,4
Anaspis flavipennis	Melandryidae		1,2,3,4
Anaspis rufa	Melandryidae	state record	1,2,3,4
Dircaea liturata	Melandryidae		1,2,3,4
Microtonus sericans	Melandryidae		1,2,3,4
Osphya varians	Melandryidae	state record	1,2,3,4
Falsomordellistena bihamata	Mordellidae		1,2,3,4
Falsomordellistena discolor	Mordellidae	state record	1,2,3,4
Falsomordellistena pubescens	Mordellidae		1,2,3,4
Hoshihananomia octopunctata	Mordellidae		1,2,3,4
Mordellaria borealis	Mordellidae	state record	1,2,3,4
Mordellistana masoni	Mordellidae		1,2,3,4
Mordellistena ancilla	Mordellidae		1,2,3,4
Mordellistena attenuata	Mordellidae		1,2,3,4
Mordellistena convicta	Mordellidae		1,2,3,4
Mordellistena sexnotata	Mordellidae		1,2,3,4
Mordellochroa scapularis	Mordellidae		1,2,3,4
Cryptarcha ampla	Nitidulidae		1,2,3,4
Glisrochilus obtusus	Nitidulidae		1,2,3,4
Glisrochilus quadrisignatus	Nitidulidae		1,2,3,4

Coleoptera cont'd

Phenolia grossa	Nitidulidae		1,2,3,4
Xenochodaeus musculus	Ochodaeidae		1,2,3,4
Asclera ruficollis	Oedemeridae		1,2,3,4
Phengodes laticollis	Phengodidae		1,2,3,4
Ptilodactyla angustata	Ptilodactylidae		1,2,3,4
Ptilodactyla serricollis	Ptilodactylidae		1,2,3,4
Dendroides canadensis	Pyrochoridae		1,2,3,4
Neopyrochroa femoralis	Pyrochoridae		1,2,3,4
Neopyrochroa flabellata	Pyrochoridae		1,2,3,4
Pedilus terminalis	Pyrochroidae	state record	1,2,3,4
Sandalus niger	Rhipiceridae		1,2,3,4
Acrossus rufipes	Scarabaeidae		1,2,3,4
Aphodius fimetarius	Scarabaeidae		1,2,3,4
Ateuchus histeroides	Scarabaeidae		1,2,3,4
Callistethus marginatus	Scarabaeidae		1,2,3,4
Copris fricator	Scarabaeidae		1,2,3,4
Dialytes striatulus	Scarabaeidae		1,2,3,4
Dialytes ulkei	Scarabaeidae		1,2,3,4
Dichelonyx linearis	Scarabaeidae		1,2,3,4
Dichelonyx subvittata	Scarabaeidae		1,2,3,4
Diplotaxis harperi	Scarabaeidae		1,2,3,4
Euphoria inda	Scarabaeidae		1,2,3,4
Onthophagus hecate	Scarabaeidae		1,2,3,4
Onthophagus taurus	Scarabaeidae		1,2,3,4
Pelidnota punctata	Scarabaeidae		1,2,3,4
Phyllophaga anxia	Scarabaeidae		1,2,3,4
Phyllophaga drakii	Scarabaeidae		1,2,3,4
Phyllophaga fusca	Scarabaeidae		1,2,3,4
Phyllophaga hirsuta	Scarabaeidae		1,2,3,4
Phyllophaga hornii	Scarabaeidae		1,2,3,4
Phyllophaga marginalis	Scarabaeidae		1,2,3,4
Phyllophaga quercus	Scarabaeidae		1,2,3,4
Phyllophaga spreta	Scarabaeidae		1,2,3,4
Phyllophaga vilifrons	Scarabaeidae		1,2,3,4
Serica atricapilla	Scarabaeidae		1,2,3,4
Serica georgiana	Scarabaeidae		1,2,3,4
Serica sericea	Scarabaeidae		1,2,3,4
Serica sponsa	Scarabaeidae		1,2,3,4
Valgus seticollis	Scarabaeidae		1,2,3,4
Sacodes pulchella	Scirtidae	state record	1,2,3,4

Coleoptera cont'd

Necrophila americana	Silphidae		1,2,3,4
Nicrophorus orbicollis	Silphidae		1,2,3,4
Nicrophorus pustulatus	Silphidae		1,2,3,4
Nicrophorus sayi	Silphidae		1,2,3,4
Nicrophorus tomentosus	Silphidae		1,2,3,4
Oiceoptoma inaequale	Silphidae		1,2,3,4
Oiceoptoma noveboracense	Silphidae		1,2,3,4
Ontholestes cingulatus	Staphylinidae		1,2,3,4
Philonthus caeruleipennis	Staphylinidae		1,2,3,4
Platydracus maculosus	Staphylinidae		1,2,3,4
Cephaloon lepturides	Stenotrachelidae		1,2,3,4
Alobates morio	Tenebrionidae	state record	1,2,3,4
Anaedus brunneus	Tenebrionidae		1,2,3,4
Isomira sericea	Tenebrionidae		1,2,3,4
Neomida bicornis	Tenebrionidae		1,2,3,4
Penthe obliquata	Tetratomidae		1,2,3,4
Aulonothroscus teretrius	Throscidae	state record	1,2,3,4
Trox variolatus	Trogidae		1,2,3,4
Tenebroides corticalis	Trogossitidae		1,2,3,4

Hymenoptera

Bombus andersoni	Apidae		1,2,3,4
Bombus impatiens	Apidae		1,2,3,4
Xylocopa virginica	Apidae		1,2,3,4
Acrotapha wiltii	Ichneumonidae		1,2,3,4
Pelicinus polyturator	Pelecinidae		1,2,3,4
Chalybion californicum	Sphecidae		1,2,3,4
Polistes fuscatus	Vespidae		1,2,3,4
Pseudodynerus quadrisectus	Vespidae		1,2,3,4
Vespa crabro	Vespidae		1,2,3,4
Vespula maculifrons	Vespidae		1,2,3,4

Orthoptera

Neoxabea bipunctata	Gryllidae		1,2,3,4
Microcentrum rhombifolium	Gryllidae		1,2,3,4
Ceuthophilus sp.	Rhaphidophoridae		1,2,3,4,5
Euhadenoecus fragilis	Rhaphidophoridae		1,2,3,4,5
Euhadenoecus puteanus	Rhaphidophoridae		1,2,3,4,5

Orthoptera cont'd

Myrmecophila pergandei	Myrmechophilidae		1,2,3,4
Atlanticus monticola	Tettigoniidae		1,2,3,4
Atlanticus testaceus	Tettigoniidae		1,2,3,4

Diptera

Trichopoda pennipes	Tachinidae		1,2,3,4
Milesia virginiensis	Syrphidae		1,2,3,4
Chrysopilus thoracicus	Rhagionidae		1,2,3,4
Tabanus stygius	Tabanidae		1,2,3,4
Tabanus superjumentarius	Tabanidae		1,2,3,4

Heteroptera

Jalysus spinosus	Berytidae		1,2,3,4
Neoneides muticus	Berytidae		1,2,3,4
Philaenus spumarius	Circopidae		1,2,3,4
Anormenis chloris	Flatidae		1,2,3,4
Metcalfa pruinosa	Flatidae		1,2,3,4
Lygus vanduzeei	Miridae		1,2,3,4
Poecilocapsus lineolatus	Miridae		1,2,3,4
Polymerus punctipes	Miridae	state record	1,2,3,4
Prepops insitiuus ????	Miridae		1,2,3,4
Stenotus binotatus	Miridae		1,2,3,4
Hoplistoscelis sordidus	Nabidae		1,2,3,4
Acanthocephala terminalis	Coreidae		1,2,3,4
Alphina glauca	Fulgoridae		1,2,3,4
Archasia belfragei	Membracidae		1,2,3,4
Atymna helena	Membracidae		1,2,3,4
Atymna querci	Membracidae		1,2,3,4
Telamona unicolor	Membracidae		1,2,3,4
Acrosternum hilare	Pentatomidae		1,2,3,4
Banasa sordida	Pentatomidae		1,2,3,4
Menecles insertus	Pentatomidae		1,2,3,4
Oebalus pugnax	Pentatomidae		1,2,3,4
Parabrochymena arborea	Pentatomidae		1,2,3,4
Boisea trivittata	Rhopalidae		1,2,3,4
Myadocha serripes	Rhyparochromidae		1,2,3,4

Amphipoda			
Stygobromus cumberlandus	Crangonyctidae	G3G4 S1S2	5
Isopoda			
Caecidotea recurvata	Asellidae	G5 S3	5
Diplura			
Litocampa sp. nov?	Litocampidae		5
Odonata			
Anax junius	Aeshnidae		1,2,3,4
Argia moesta	Coenagrionidae		1,2,3,4
Enallagma aspersum	Coenagrionidae		1,2,3,4
Gomphus lividus	Gomphidae		1,2,3,4
Epitheca cynosura	Libellulidae		1,2,3,4
Libellula lydia	Libellulidae		1,2,3,4
Pachydiplax longipennis	Libellulidae		1,2,3,4

POWELL MOUNTAIN KARST PRESERVE VASCULAR PLANT SPECIES LIST

Total number of taxa: 418

This list is first divided into the following major groups:

1) Ferns and Fern Allies

2) Gymnosperms

3) Angiosperms, Part 1: Dicotyledons

4) Angiosperms, Part 2: Monocotyledons

The list is further subdivided alphabetically by family, genus, species, and subspecies/variety

Rarity ranks are only provided for taxa on the DCR-DNH Rare Vascular Plant List, Vascular Plant Watchlist, or Review List. See appendix for definitions of these abbreviations

Community associations of plants are indicated as follows:

1= Dry-Mesic Calcareous Forest (Sugar Maple – Northern Red Oak Type)

2= Appalachian Sugar Maple - Chinkapin Oak Dry Calcareous Forest

3= Southern Appalachian Limestone Rich Cove Forest

4= Successional Tuliptree Forest

Synonyms are given for selected scientific names where generic alignments are unlikely to be familiar to the user

FERNS AND FERN ALLIES

FAMILY	SCIENTIFIC NAME	COMMON NAME	Community Association	DNH Rarity Rank/ Status/ Comments
Aspleniaceae				
	Asplenium platyneuron	Ebony Spleenwort	1,4	
	Asplenium resiliens	Blackstem Spleenwort	2,3	
	Asplenium rhizophyllum	Walking Fern	2,3	
Dryopteridaceae				
	Dryopteris marginalis	Marginal Shield Fern	1,4	
	Polystichum acrostichoides	Christmas Fern	1,4	
Lycopodiaceae				
	Diphasiastrum digitatum	Running-Cedar	1,4	
Ophioglossaceae				
	Botrychium virginianum	Rattlesnake Fern	1,2,4	

FERNS AND FERN ALLIES cont'd

FAMILY	SCIENTIFIC NAME	COMMON NAME	Community Association	DNH Rarity Rank
Pteridaceae				
	Adiantum pedatum	Maidenhair Fern	3	
	Pellaea atropurpurea	Purple Cliff-Brake	2	
	Pteridium aquilinum var. latiusculum	Bracken Fern	2	
Thelypteridaceae				
	Phegopteris hexagonoptera	Broad Beech Fern	1,3,4	
Woodsiaceae				
	Cystopteris bulbifera	Bulblet Fern	2,3	
	Diplazium pycnocarpon	Glade Fern	3	

GYMNOSPERMS

FAMILY	SCIENTIFIC NAME	COMMON NAME	Community Association	DNH Rarity Rank
Cupressaceae				
	Juniperus virginiana	Eastern Redcedar	2	
Pinaceae				
	Pinus strobus	White Pine	1,4	
	Pinus virginiana	Virginia Pine	1,4	
	Tsuga canadensis	Eastern Hemlock	1	

ANGIOSPERMS, PART 1: DICOTYLEDONS

FAMILY	SCIENTIFIC NAME	COMMON NAME	Community Association	DNH Rarity Rank
Acanthaceae				
	Ruellia caroliniensis	Carolina Wild-Petunia	2	
	Ruellia purshiana	Pursh's Wild-Petunia	2	G3/S3
Adoxaceae				
	Sambucus canadensis	Common Elderberry	1,4	
	Sambucus racemosa var. pubens	Red Elderberry	1	
	Viburnum prunifolium	Black Haw	1,2,4	
Anacardiaceae				
	Rhus aromatica var. aromatica	Fragrant Sumac	1,2	
	Rhus copallinum var. latifolium	Eastern Winged Sumac	1,2	
	Rhus glabra	Smooth Sumac	1,2	
	Toxicodendron radicans	Poison Ivy	1,2,3,4	

ANGIOSPERMS, PART 1: DICOTYLEDONS cont'd

Annonaceae				
	Asimina triloba	Common Pawpaw	1,2,3,4	
Apiaceae				
	Angelica venenosa	Hairy Angelica	1,2,3	
	Cryptotaenia canadensis	Honewort	1,2,3,4	
	Daucus carota	Wild Carrot	2,4	
	Osmorhiza claytonii	Hairy Sweet Cicely	1,2,3,4	
	Sanicula canadensis	Black Snakeroot	1,2,3,4	
	Sanicula smallii	Small's Sanicle	2	
	Sanicula trifoliata	Large-Fruited Sanicle	3	G4/S3
	Taenidia integerrima	Yellow Pimpernel	1,2	
	Thalictrum dioicum	Early Meadowrue	1,2,3	
	Thalictrum revolutum	Skunk Meadowrue	2	
	Thaspium barbinode	A Meadow-Parsnip	1,2,3	
	Zizia aptera	Heartleaf Golden-Alexanders	2	
Apocynaceae				
	Apocynum cannabinum	Indian-Hemp	1,2,4	
	Asclepias exaltata	Tall Milkweed	1,2	
	Asclepias quadrifolia	Fourleaf Milkweed	1,2,4	
	Asclepias syriaca	Common Milkweed	4	
	Asclepias tuberosa var. tuberosa	Common Butterfly-weed	2,4	
Aquifoliaceae				
	Ilex opaca var. opaca	American Holly	1,2,4	
Araliaceae				
	Panax quinquefolius	Ginseng	2	G3G4/S3S4 - State Endangered
Aristolochiaceae				
	Asarum canadense	Wild Ginger	1,2,3	
	Endodeca serpentaria (=*Aristolochia serpentaria*)	Dutchman's Pipe, Turpentine-Root	1,2	
	Isotrema macrophylla(=*Aristolochia macrophylla*)	Dutchman's Pipe	1,4	
Asteraceae				
	Achillea millefolium	Yarrow	1,2,4	
	Agertatina altissima var. altissima	Common White Snakeroot	1,2,3,4	
	Ambrosia artemisiifolia	Ragweed	2,4	
	Ambrosia trifida	Giant Ragweed	2,4	

ANGIOSPERMS, PART 1: DICOTYLEDONS
Asteraceae cont'd

Antennaria parlinii ssp. parlinii	Parlin's Pussytoes	2
Antennaria plantaginifolia	Plantain Pussytoes	2
Antennaria solitaria	Single-Head Pussytoes	2
Arctium minus	Common Burdock	1,4
Arnoglossum atriplicifolium	Pale Indian Plantain	1,2,4
Bidens frondosa	Devil's Beggar-Ticks	2,4
Carduus nutans ssp. macrolepis	Musk Thistle	2,4
Cirsium discolor	Field Thistle	2,4
Conyza canadensis var. canadensis	Common Horseweed	2,4
Coreopsis major	Woodland Coreopsis	2,4
Crepis cf. capillaris	Smooth Hawksbeard	2
Elephantopus carolinianus	Southern Elephant's Foot	1,2,4
Erechtites hieraciifolius	Fireweed	1,2,4
Erigeron annuus	Annual Fleabane	1,2,4
Erigeron pulchellus	Robin's Plantain	1,3,4
Erigeron strigosus	Rough Fleabane	2,4
Eupatorium perfoliatum	Boneset	4
Eupatorium pubescens	Inland Roundleaf Eupatorium	2,4
Eupatorium serotinum	Late Eupatorium	4
Eurybia divaricata	Common White Heart-Leaved Aster	1,2,3
Eutrochium fistulosum	Hollow-Stem Joe-Pye-Weed	4
Eutrochium steelei	Appalachian Joe-Pye_weed	1,4
Helenium autumnale	Common Sneezeweed	2,4
Helianthus divaricatus	Spreading Sunflower	2,4
Helianthus microcephalus	Small-Headed Sunflower	2,4
Helianthus strumosus	Roughleaf Sunflower	2
Heliopsis helianthoides var. helianthoides	Eastern Oxeye	1,2
Hieracium caespitosum	Yellow King-Devil	2,4
Hypochaeris radicata	Spotted Cat's-Ear	2,4
Krigia cf. biflora	Orange Dwarf-Dandelion	1
Lactuca biennis	Tall Blue Lettucec	4
Lactuca canadensis	Wild Lettuce	4
Leucanthemum vulgare	Oxeye Daisy	4
Packera aurea	Golden Ragwort	3,4
Packera obovata	Roundleaf Ragwort	2

*Packera paupercula var. appalachiana**	A Ragwort	2
Polymnia canadensis	White-Flowered Leafcup	2,3
Prenanthes altissima	Tall Rattlesnake-Root	2,4,
Prenanthes trifoliolata	Gall-of -the-Earth	2,4
Pseudognaphalium obtusifolium	Fragrant Rabbit Tobacco	2,4
Rudbeckia fulgida	A Black-Eyed-Susan	1,2,4
Rudbeckia hirta var. hirta	Woodland Black-Eyed-Susan	4
Rudbeckia laciniata	Cutleaf Coneflower	2,4
Smallanthus uvedalius	Bearsfoot	2,4
Solidago altissima	Tall Goldenrod	2,4
Solidago arguta	Forest Goldenrod	1,2
Solidago caesia	Axillary Goldenrod	1,2,3,4
Solidago canadensis	Canada Goldenrod	2,4
Solidago curtisii	Curtis's Goldenrod	1,2,3,4
Solidago flexicaulis	Zigzag Goldenrod	1,2,3
Solidago nemoralis	Old-Field Goldenrod	2,4
Solidago rugosa var. rugosa	Wrinkle-Leaf Goldenrod	2,4
Solidago ulmifolia	Elmleaf Goldenrod	1,2,4
Sonchus asper	Prickly Sow-Thistle	2,4
Symphyotrichum cordifolium	An Aster	1,2,3,4
Symphyotrichum laeve	Smooth Aster	1,2,3
Symphyotrichum lateriflorum	Starved Aster	2,4
Symphyotrichum novae-angliae	New England Aster	2,4
Symphyotrichum phlogifolium	Appalachian Clasping Aster	1,2,4
Symphyotrichum pilosum	Frost Aster	4
Symphyotrichum undulatum	An Aster	2,4
Symphyotrichum urophyllum	White Arrowleaf Aster	2
Taraxacum officinale	Common Dandelion	2,4
Tussilago farafara	Colt's-Foot	4
Verbesina alternifolia	Common Wingstem	1,2,3,4
Verbesina occidentalis	Southern Crownbeard	3
Vernonia glauca	An Ironweed	2,3
Vernonia noveboracensis	New York Ironweed	3,4

**P. paupercula var. appalchiana is the most appropriate name based on recent publications*

ANGIOSPERMS, PART 1: DICOTYLEDONS cont'd

Balsaminaceae				
	Impatiens pallida	Yellow Jewelweed	3	
Berberidaceae				
	Berberis thunbergii	Japanese Barberry	2,4	
	Caulophyllum thalictroides	Blue Cohosh	3,4	
	Podophyllum peltatum	May-Apple	1,3,4	
Betulaceae				
	Betula lenta	Sweet Birch	1,3,4	
	Carpinus caroliniana	American Hornbeam	1,4	
	Ostrya virginiana	American Hop-hornbeam	1,3,4	
Boraginaceae				
	Cynoglossum virginanum	Wild Comfrey	1,2,4	
	Lithospermum latifolium	Broadleaf Gromwell	3	G5/S3
Brassicaceae				
	Barbarea verna	Early Winter-Cress	2,4	
	Boechera canadensis (=*Arabis canadensis*)	Canada Rockcress	1	
	Boechera laevigata(=Arabis laevigata)	Smooth Rockcress	1,2,4	
	Cardamine concatenata	Cutleaf Toothwort	1,4	
	Cardamine diphylla	Crinkleroot	1,4	
	Cardamine parviflora var. arenicola	Sand Bittercess	4	
Campanulaceae				
	Lobelia inflata	Indian-Tobacco	1,2,4	
	Lobelia puberula	A Lobelia	1,2,4	
	Lobelia spicata	Spiked Lobelia	1,3,4	
	Lobelia syphyllitica	Giant Lobelia	1,4	
Caprifoliaceae				
	Lonicera japonica	Japanese Honeysuckle	1,2,3,4	
	Symphoricarpos orbiculatus	Coralberry	2,4	
	Triosteum aurantiacum	Horse-Gentian	1,3	
Caryophyllaceae				
	Cerastium glomeratum	Mouse-Ear Chickweed	2,4	
	Silene virginica	Fire-Pink	1,2	
	Stellaria pubera	Giant Chickweed	1,2,3,4	
Celastraceae				
	Celastrus orbiculatus	Oriental Bittersweet	1	
	Celastrus scandens	American Bittersweet	1	
	Euonymus americanus	Strawberry-Bush	1,2,4	

ANGIOSPERMS, PART 1: DICOTYLEDONS cont'd

Colchicaceae				
	Uvularia perfoliata	Perfoliated Bellwort	1,3,4	
Convolvulaceae				
	Ipomoea pandurata	Wild Sweet Potato	2,4	
	Ipomoea purpurea	Common Morning Glory	2,4	
Cornaceae				
	Cornus florida	Flowering Dogwood	1,2,3,4	
Crassulaceae				
	Sedum ternatum	Mountain Stonecrop	1,2,3,4	
Elaeagnaceae				
	Elaeagnus umbellata	Russian-Olive, Spring Silverberry	2,4	
Ericaceae				
	Chimaphila maculata	Spotted Wintergreen	1,2,4	
	Oxydendrum arboreum	Sourwood	1,2,4	
	Rhododendron cumberlandense	Cumberland Azalea	4	G4?/S3
	Vaccinium stamineum	Deerberry	1,2,4	
Euphorbiaceae				
	Acalypha virginica	Virginia Copperleaf	2,4	
	Euphorbia pubentissima	Southeastern Flowering Spurge	2,4	G5/SU - Review List
Fabaceae				
	Amphicarpaea bracteata	Hog-Peanut	1,2,3,4	
	Cercis canadensis	Redbud	1,2,3,4	
	Coronilla varia	Crown-Vetch	2,4	
	Desmodium glutinosum	Heartleaf Tick-trefoil	1,2,4	
	Desmodium marilandicum	Beggar's-Lice	2	
	Desmodium nudiflorum	Naked-Flowered Tick-trefoil	1,2,4	
	Desmodium nuttallii	Beggar's-Lice	1,2,4	
	Desmodium paniculatum	Beggar's-Lice	2,4	
	Desmodium perplexum	Beggar's-Lice	2,4	
	Desmodium rotundifolium	Roundleaf Tick-trefoil	2,4	
	Kummerowia stipulacea	Korean Clover, Korean Lespedeza	4	
	Lespedeza cuneata	Sericea Lespedeza	2,4	
	Lespedeza frutescens	Violet Lespedeza	2	
	Lespedeza hirta	Hairy Lespedeza	2	
	Lespedeza repens	Smooth Trailing Lespedeza	2	
	Medicago lupulina	Black Medic	2,4	

	Melilotus albus	White Sweetclover	4
	Melilotus officinalis	Yellow Sweetclover	4
	Robinia pseudo-acacia	Black Locust	1,2,4
	Trifolium arvense	Rabbitfoot Clover	2,4
	Trifolium aureum	Yellow Clover	4
	Trifolium pratense	Red Clover	2,4
	Vicia caroliniana	Carolina Vetch	2,4
Fagaceae			
	Fagus grandifolia	American Beech	1,2,3,4
	Quercus alba	White Oak	1,2,3,4
	Quercus coccinea	Scarlet Oak	2,4
	Quercus montana	Chestnut Oak	2
	Quercus muhlenbergii	Chinkapin Oak	2
	Quercus rubra	Northern Red Oak	1,2,3,4
	Quercus stellata	Post Oak	2
	Quercus velutina	Black Oak	1,2,4
Gentianaceae			
	Obolaria virginica	Pennywort	1
	Sabatia angularis	Common Marsh Pink	2
Geraniaceae			
	Geranium carolinianum	Carolina Geranium	4
	Geranium maculatum	Wild Geranium	1,2,3
Grossulariaceae			
	Ribes cynosbati	Prickly Gooseberry	2,3
	Ribes rotundifolium	Appalachian Gooseberry	2,3
Hydrangeaceae			
	Hydrangea arborescens	Wild Hydrangea	1,3
Hydrophyllaceae			
	Phacelia bipinnatifida	Fernleaf Phacelia	3,4
Hypericaceae			
	Hypericum perforatum	European St. John's-wort	2,4
	Hypericum prolificum	Shrubby St. John's-wort	2
	Hypericum punctatum	Spotted St. John's-wort	1,2,4
	Hypericum stragulum	A St. John's-wort	2,4
Juglandaceae			
	Carya alba	Mockernut Hickory	1,2,4
	Carya cordiformis	Bitternut Hickory	1,2,3,4
	Carya glabra	Pignut Hickory	1,2,3,4

	Carya ovalis	Red Hickory	1,2,4	
	Carya ovata	Shagbark Hickory	1,2,3,4	
	Juglans cinerea	Butternut	1	G4/S3?
	Juglans nigra	Black Walnut	1,4	
Lamiaceae				
	Clinopodium vulgare	Wild Basil	4	
	Collinsonia canadensis	Northern Horse-balm	1,3,4	
	Hedeoma pulegioides	Bugleweed	2,4	
	Monarda clinopodia	Basil Bergamot	3	
	Monarda media	Purple Bee-Balm	3	
	Prunella vulgaris	Self-heal	2,4	
	Pycnanthemum beadlei	Beadle's Mountain Mint	2,4	G2G4/SU - Review List. This taxon has a very restricted range in VA and may be added to the Rare List soon.
	Pycnanthemum loomisii/pycnanthemoides		2,4	not possible to differentiate btwn these 2 taxa w/o more specimens
	Pycnanthemum tenuifolium	A Mountain Mint	2	
	Salvia lyrata	Lyre-leaved Sage	4	
	Scutellaria elliptica	A Skullcap	2,4	
	Stachys cordata	Heart-Leaved Hedge-Nettle	3	
	Trichostema dichotomum	Blue-curls	2	
Lauraceae				
	Lindera benzoin	Spicebush	1,2,3,4	
	Sassafras albidum	Sassafras	1,2,4	
Linaceae				
	Linum striatum	Ridgestem Yellow Flax	2	
	Linum virginianum	Virginia Yellow Flax	2	
Magnoliaceae				
	Liriodendron tulipifera	Yellow-poplar	1,2,3,4	
	Magnolia acuminata	Cucumber Tree	1,3	
Malvaceae				
	Tilia americana var. americana	Northern Basswood	1,3	
	Tilia americana var. heterophylla	White Basswood	1,3	
Menispermaceae				
	Menispermum canadense	Moonseed	1,2,3,4	

ANGIOSPERMS, PART 1: DICOTYLEDONS cont'd

Moraceae			
	Morus rubra	Red Mulberry	1,2,4
Nyssaceae			
	Nyssa sylvatica	Black Gum	1,2,4
Oleaceae			
	Fraxinus americana	White Ash	1,2,3,4
Onagraceae			
	Circaea lutetiana ssp. canadensis	Enchanter's Nightshade	1,3,4
	Ludwigia alternifolia	Alternate-leaf Seedbox	4
	Oenothera biennis	Common Evening-Primrose	4
Orobanchaceae			
	Conopholis americana	Squaw-Root	1,4
Oxalidaceae			
	Oxalis grandis	Great Yellow Woodsorrel	1,3
	Oxalis stricta	Comon Yellow Woodsorrel	2,4
	Oxalis violacea	Violet Woodsorrel	1,2,3
Papaveraceae			
	Sanguinaria canadensis	Bloodroot	3
Passifloraceae			
	Passiflora lutea	Yellow Passionflower	2,4
Paulowniaceae			
	Paulownia tomentosa	Princess Tree	4
Phrymaceae			
	Mimulus ringens	Monkeyflower	4
	Phryma leptostachya	Lopseed	1,2,3,4
Phytolaccaceae			
	Phytolacca americana	Pokeweed	2,4
Plantaginaceae			
	Plantago rugellii	Broad-Leaved Plantain	2,4
	Veronica officinalis	Common Speedwell	4
Platanaceae			
	Platanus occidentalis	Sycamore	1,3,4
Polygalaceae			
	Polygala senega	Seneca Snakeroot	1,2
	Polygala verticillata	Whorled Milkwort	2

ANGIOSPERMS, PART 1: DICOTYLEDONS cont'd

Polygonaceae				
	Fallopia convolvulus (=*Polygonum convolvulus*)	Climbing Buckwheat	1,2,4	
	Fallopia scandens (=*Polygonum scandens*)	Crested Climbing Buckwheat	2	
	Rumex crispus	Curly Dock	2,4	
	Tovara virginiana	Jumpseed	1,3,4	
Ranunculaceae				
	Anemone quinquefolia	Wood Anemone	1,2,3,4	
	Anemone virginiana	Thimbleweed	2,3	
	Anemonella thalictroides	Rue Anemone	1,2,3,4	
	Cimicifuga racemosa	Black Cohosh	1,3,4	
	Clematis virginiana	Virgin's Bower	2,4	
	Ranunculus allegheniensis	Allegheny Buttercup	1,3,4	
	Ranunculus recurvatus	Hooked Buttercup	1,3,4	
Rhamnaceae				
	Frangula caroliniana	Carolina Buckthorn	2	
Rosaceae				
	Agrimonia pubescens	Downy Agrimony	1,3,4	
	Agrimonia rostellata	Common Agrimony	1,3,4	
	Amelanchier arborea	Downy Serviceberry	1,2,4	
	Crataegus biltmoreana	Biltmore Hawthorn	2	
	Crataegus calpodendron	Pear Hawthorn	4	G5/S1
	Crataegus mollis	Downy Hawthorn	4	G5/S1
	Fragaria virginiana	Wild Strawberry	1,2,4	
	Geum canadense	Avens	1,2,3,4	
	Malus coronaria	Wild Crab Apple	4	
	Potentilla canadensis	Five-Fingers	2,4	
	Potentilla simplex	Old-Field Five-Fingers	2,4	
	Prunus americana	Wild Plum	4	
	Prunus serotina	Black Cherry	1,2,4	
	Rosa carolina	Carolina Rose	2	
	Rosa multiflora	Multiflora Rose	2,4	
	Rosa sp. (unidentified cultivar)	A Rose	4	
	Rubus allegheniensis	Allegheny Blackberry	1,4	
	Rubus enslenii	Southern Dewberry	1,4	
	Rubus flagellaris	Northern Dewberry	1	
	Rubus occidentalis	Black Raspberry	1,4	

ANGIOSPERMS, PART 1: DICOTYLEDONS
Rosaceae cont'd

	Rubus pensilvanicus	Pennsylania Blackberry	1,4
	Rubus phoenicolasius	Wineberry	1,4
Rubiaceae			
	Galium aparine	Cleavers	4
	Galium circaezans	Forest Bedstraw	1,2,3,4
	Galium lanceolatum	Wild-licorice	1,2,3,4
	Galium pilosum	A Bedstraw	2,4
	Galium triflorum	Sweet-Scented Bedstraw	1,2,3,4
	Houstonia longifolia	Longleaf Bluet	1,2,3,4
	Houstonia purpurea	Summer Bluet	1,2,3,4
Salicaceae			
	Populus grandidentata	Bigtooth Aspen	4
	Salix nigra	Black Willow	4
Sapindaceae			
	Acer rubrum	Red Maple	1,3,4
	Acer saccharum	Sugar Maple	1,2,3,4
	Aesculus octandra	Yellow Buckeye	3,4
Saxifragaceae			
	Heuchera longiflora	Long-Flowered Alumroot	1,3
Scrophulariaceae			
	Verbascum blattaria	Moth Mullein	4
	Verbascum thapsus	Wooly Mullein	4
Simaroubaceae			
	Ailanthus altissima	Tree of Heaven	4
Solanaceae			
	Physalis heterophylla	Clammy Ground-Cherry	2
	Physalis virginiana	Virginia Ground-Cherry	2
	Solanum carolinense	Horse-Nettle	4
	Solanum ptychanthum	American Black Nightshade	2,4
Staphyleaceae			
	Staphylea trifolia	Bladdernut	2,4
Ulmaceae			
	Celtis occidentalis	Northern Hackberry	2,4
	Celtis tenuifolia	Dwarf Hackberry	2
	Ulmus rubra	Slippery Elm	2,4
Urticaceae			
	Laportea canadensis	Wood-Nettle	3,4
	Pilea pumila	Clearweed	3,4

ANGIOSPERMS, PART 1: DICOTYLEDONS cont'd

Verbenaceae			
	Verbena urticifolia	Velvetleaf Vervain	2
Violaceae			
	Hybanthus concolor	Green-Violet	3
	Viola hirsutula	A Violet	2,4
	Viola palmata var. palmata	Wood Violet	1,2,3,4
	Viola pubescens var. leiocarpon	Smooth Yellow Forest Violet	3
	Viola rostrata	Long-Spurred Violet	3,4
	Viola sororia	Common Blue Violet	2,4
Vitaceae			
	Parthenocissus quinquefolia	Virginia Creeper	1,2,3,4
	Vitis aestivalis var. aestivalis	Summer Grape	2,4
	Vitis aestivalis var. bicolor	Silverleaf Grape	2,4
	Vitis cinerea var. baileyana	Possum Grape	2,4
	Vitis vulpina	Fox Grape	2,4

ANGIOSPERMS, PART 2: MONCOTYLEDONS

FAMILY	SCIENTIFIC NAME	COMMON NAME	Community Association	DNH Rarity Rank
Alliaceae (split from traditional Liliaceae)				
	Allium vineale	Field Garlic	2,4	
Araceae				
	Arisaema triphyllum ssp. pusillum	Small Jack-in the-pulpit	3,4	
Cyperaceae				
	Carex aestivalis	Summer Sedge	1,3	
	Carex aggregata	A Sedge	1,4	
	Carex albicans	A Sedge	2,4	
	Carex albursina	White Bear Sedge	3,4	
	Carex amphibola	A Sedge	3,4	
	Carex blanda	A Sedge	3,4	
	Carex cephalophora	A Sedge	2,3,4	
	Carex communis var. communis	A Sedge	2,3,4	
	Carex crebriflora	A Sedge	3,4	
	Carex cumberlandensis	Cumberland Sedge	2,3,4	
	Carex digitalis	A Sedge	2,3,4	

ANGIOSPERMS, PART 2: MONCOTYLEDONS
Cyperaceae cont'd

	Carex gracillima	Graceful Sedge	1,3,4	
	Carex granularis	A Sedge	3,4	
	Carex hirsutella	A Sedge	2,4	
	Carex hirtifolia	A Sedge	4	
	Carex laxiculmis var. copulata	A Sedge	3,4	
	Carex laxiflora	A Sedge	1,3,4	
	Carex oligocarpa	Few-Fruited Sedge	3,4	
	Carex cf. pensylvanica	A Sedge	2	
	Carex platyphylla	Broadleaf Sedge	3,4	
	Carex prasina	A Sedge	4	
	Carex rosea	Rosy Sedge	1,3,4	
	Carex swanii	A Sedge	2,4	
	Carex umbellata complex	A Sedge	2	*material inadequate to distinguish between Carex umbellata and its close relatives*
	Carex vulpinoidea	Fox Sedge	2,4	
	Cyperus odoratus	A Nutsedge	4	
	Scirpus cyperinus	Woolrush	4	
	Scirpus georgianus	Georgia Bulrush	4	
	Scleria oligantha	Few-Flowered Nutrush	2	
Dioscoreaceae				
	Dioscorea quaternata	Whorled Wild Yam	1,2,4	
Iridaceae				
	Iris sp. - domesticated, vegetative	An Iris	4	
	Sisyrinchium angustifolium	A Blue-Eyed Grass	2,4	
	Sisyrinchium mucronatum	A Blue-Eyed Grass	2,4	
Juncaceae				
	Juncus acuminatus	A Rush	4	
	Juncus cf. filipendulus	Texas Plains Rush	4	** Potential state record (I.D. confirmation pending). If confirmed, this species would be ranked G5/S1
	Juncus dichotomus	A Rush	4	
	Juncus diffusissimus	Diffuse Rush	4	
	Juncus effusus	Soft Rush	4	

Liliaceae (see also Alliaceae, Ruscaceae, Smilacaceae, Trilliaceae)

	Prosartes lanuginosa	Yellow Mandarin	1,3	
Orchidaceae				
	Aplectrum hyemale	Adam and Eve Orchid	1,2,4	
	Galearis spectabilis (=*Orchis spectabilis*)	Showy Orchis	1,3	
	Goodyera pubescens	Rattlesnake Plantain Orchid	1,2,4	
	Liparis lilifolia	Lily-Leaved Twayblade	1,3,4	
Poaceae				
	Agrostis capillaris	Colonial Bentgrass	4	
	Avena fatua	Wild Oats	4	
	Brachyelytrum erectum	Common Shorthusk	1,4	
	Bromus pubescens	Common Brome Grass	1,2,4	
	Dactylis glomerata	Orchard Grass	2,4	
	Danthonia compressa	Mountain Oat Grass	1,2,4	
	Danthonia spicata	Poverty Oat Grass	2,4	
	Diarrhena americana	Eastern Beakgrain	1,3	G4G5/S3
	Dichanthelium acuminatum var. acuminatum	Wooly Witch-Grass	2,4	
	Dichanthelium acuminatum var. fasciculatum	Slender-Stemmed Witch Grass	2,4	
	Dichanthelium boscii	Bosc's Witch-Grass	1,2,3,4	
	Dichanthelium clandestinum	Deer-Tounge Witch Grass	2,4	
	Dichanthelium commutatum var. commutatum	Variable Witch Grass	1,2,3,4	
	Dichanthelium dichotomum var. dichotomum	Ashe's Witch Grass	1,2,3,4	
	Dichanthelium laxiflorum	Open-Flower Witch Grass	2,4	
	Dichanthelium polyanthes	Small-Fruited Witch Grass	2,4	
	Dichanthelium sphaerocarpon	Round-Fruited Witch Grass	2,4	
	Dichanthelium yadkinense	Spotted-Sheath Witch Grass	4	
	Digitaria ischaemum	Smooth Crabgrass	4	
	Elymus hystrix	Bottlebrush Grass	2,4	
	Festuca subverticillata	Nodding Fescue	2,3,4	
	Glyceria striata var. striata	Fowl Mannagrass	4	
	Leersia virginica	Rice Cutgrass	4	
	Lolium perenne var. perenne	Perennial Rye-grass	4	
	Melica mutica	Two-Flower Melic	1,4	

ANGIOSPERMS, PART 2: MONCOTYLEDONS
Poaceae cont'd

	Microstegium vimineum	Japanese Stiltgrass	4
	Muhlenbergia sobolifera	Rock Muhly	1,2
	Muhlenbergia tenuiflora	Slender Muhly	1,2
	Panicum anceps	Beaked Panic Grass	1,2,4
	Panicum flexile	Wiry Panic Grass	2,4
	Phleum pratense	Timothy	4
	Poa annua	Annual Bluegrass	4
	Poa compressa	Canada Bluegrass	1,2,4
	Poa pratensis	Kentucky Bluegrass	2,4
	Poa sylvestris	Forest Bluegrass	1,2,4
	Schedonorus arundinaceus (=*Festuca arundinacea*)	Tall Fescue	4
	Schizachyrium scoparium	Little Bluestem	2
	Sphenopholis nitida	Wedgegrass	2,3,4
	Sporobolus vaginiflorus	Poverty Dropseed	2
	Tridens flavus	Redtop	2,4
Ruscaceae (split from traditional Liliaceae)			
	Maianthemum racemosum	False Solomon's Seal	1,2,3,4
	Polygonatum biflorum var. biflorum	Solomon's Seal	1,3,4
Smilacaceae (split from traditional Liliaceae)			
	Smilax glauca	Whiteleaf Greenbrier	2,4
	Smilax herbacea	Common Carrionflower	1,2,3,4
	Smilax hispida	Bristly Greenbrier	2,3,4
	Smilax rotundifolia	Common Greenbrier	2,3,4
Trilliaceae (split from traditional Liliaceae)			
	Trillium grandiflorum	Large-Flowered Trillium	3,4