

***Conservation Assessment  
For  
The Mid-Appalachian Shale Barrens***



Little Fork Shale Barren, Pendleton Co., WV

***U.S. Forest Service, Eastern Region***

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*This Conservation Assessment was prepared to compile the published and unpublished information and serves as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject community, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.*

**Table Of Contents**

**EXECUTIVE SUMMARY ..... 4**  
**ACKNOWLEDGEMENTS ..... 4**  
**DESCRIPTION OF SHALE BARRENS ..... 5**  
**COMMUNITY CLASSIFICATION AND SYNONYMS..... 9**  
**COMMUNITY ECOLOGY / ENVIRONMENTAL CONDITIONS... 14**  
**PRE-EUROPEAN SETTLEMENT: COMMUNITY DISTRIBUTION  
AND CONDITIONS ..... 15**  
**REGIONAL FORESTER SENSITIVE SPECIES ASSESSMENT ..... 16**  
**OTHER SHALE BARREN PLANTS..... 27**  
**CURRENT COMMUNITY CONDITION, DISTRIBUTION AND  
ABUNDANCE..... 33**  
**POPULATION BIOLOGY AND VIABILITY OF SHALE BARREN  
SPECIES..... 33**  
**PRESENT AND POTENTIAL THREATS TO HABITAT, AND  
MONITORING ..... 34**  
**SUMMARY OF LAND OWNERSHIP AND EXISTING  
PROTECTION..... 37**  
**OWNERSHIP..... 37**  
**SUMMARY OF EXISTING MANAGEMENT ACTIVITIES..... 38**  
**PAST AND CURRENT CONSERVATION ACTIVITIES ..... 38**  
**RESEARCH AND MONITORING ..... 39**  
**REFERENCES..... 42**

## EXECUTIVE SUMMARY

Mid-Appalachian shale barrens are sparsely-vegetated areas on steep, shaley slopes that face southeast to west. They occur mostly on Braillier shales in the Ridge and Valley Province from southern VA and WV through western MD into south-central PA. The characteristic sparseness of vegetation is due primarily to the difficulty of most plant seedlings in becoming established in the hot, dry surface layer of shale fragments. Many of the thousand or so known shale barrens support one or more endemic plant species, including *Arabis serotina*, shale barren rockcress, federally listed as Endangered. Other rare endemic or characteristic shale barren plants are on the Regional Forester's Sensitive Species list: *Allium oxyphilum* (Lillydale onion), *Asplenium bradleyi* (Bradley's spleenwort), *Liatris turgida* (Appalachian blazing star), *Phlox buckleyi* (swordleaf phlox), *Scutellaria ovata* (heart-leaved skullcap), and *Trifolium virginicum* (Kates Mountain clover). These and 10 other shale barren plants are described and discussed in some detail. Though poorly known, there is also a characteristic invertebrate fauna that probably includes several rare species. The principle threats to these habitats and their flora and fauna include road construction, excessive deer browsing, spraying for gypsy moth, invasive exotic plants, and trampling by researchers and other human visitors. Despite a plethora of shale barren literature, there has been far more speculation than substantial ecological research and observation. Much remains to be learned about the taxonomic status and life history of shale barren plants, vegetation structure and natural communities, and the fundamental ecological processes that create and maintain barrens. A fundamental need is to determine and map the locations of all shale barrens and classify them as to community types present.

## ACKNOWLEDGEMENTS

The primary source for this document was a hundred years of published and unpublished literature. Appreciation is due to those many workers cited in References. The most valuable source of recent information, especially current status of shale barrens and their species and research and monitoring, have been the files and personnel of the Natural Heritage Programs of PA, VA, WV and especially MD. Rodney Bartgis and Ashton Berdine of The Nature Conservancy's Elkins office are particularly knowledgeable and experienced with shale barrens and shared their expertise. Al Wheeler was quick to answer questions about the insects associated with shale barren plants. Dan Arling and Jan Garrett of Monongahela National Forest worked with us in determining the form of this project. Thanks are extended to Brian McDonald for many suggestions along the way and to others of the WV Wildlife Diversity Program (Natural Heritage) - James Vanderhorst, P. J. Harmon, Tim Brake, Barbara Sargent, Jennifer Wykle, Donna Mitchell - for substantial contributions and assistance. Walt Kordek read the manuscript and suggested improvements. Thanks also to Angela McWilliams for her cheerful answers to incessant word-processing questions. Paul Redfearn of Ozarks Regional Herbarium kindly granted permission to use his excellent photo of *Asplenium bradleyi*. This work was done under a Participating Agreement between the Monongahela National Forest and the West Virginia Division of Natural Resources, Wildlife Resources Section. Final responsibility for errors and omissions lies with the senior author.

## DESCRIPTION OF SHALE BARRENS

The mid-Appalachian shale barrens are sparsely vegetated, steep shaley slopes, with a generally southern aspect (see photos in Appendix F). They occur primarily in the Ridge and Valley Physiographic Province from southwestern Virginia and adjacent West Virginia north through western Maryland into south-central Pennsylvania. They may be characterized in terms of geology/topography, soils, climate/microclimate, and vegetation.

### Geology and Topography

Shale strata that form barrens are mostly Brallier Formation of Upper Devonian age, but the barrens of Massanutten Mountain are on calcareous Martinsburg shales of the Ordovician (Allard & Leonard 1946). A typical barren has been found in Maryland on Silurian strata (Morse 1983), and Rawinski *et al.* (1996) found similar habitat, with endemic plants (*Packera* [= *Senecio*] *antennariifolia* and *Clematis coactilis*), on metamorphic shale of the Cambrian age Harper Shale Formation in the Blue Ridge, forcing us to expand, or at least re-examine, our classic concept of shale barrens.

Slopes are generally more than 20% with a southeastern to western exposure. Often a barren is undercut by a stream that carries away eroded material as it reaches the bottom of the slope, frequently maintaining a convex surface.

### Soils

Loose shale fragments cover the surface of the ground to a depth of up to a few dm (ca. 1 ft.), except where bedrock outcrops. There is little or no organic litter unless held by an occasional log or perennial plant stems. “On the true barrens, the soil is little more than a so-called ‘skeletal soil’ comprised of unstable fragments of the underlying rock . . . there is no hint of the profile of a mature soil” (Allard & Leonard 1946).

Soil chemistry on barrens is not very different from the surrounding area, except for the paucity of organic matter. Braunsweig, *et al.* (1999) note that

. . . while soil profile development may be less than that occurring on non-shale barren sites, aspects of the soil chemistry are not notably different. The pH of shale barren soil (4.0 to 5.0) and availability of some inorganic nutrients . . . are comparable to that found in soil supporting nonbarrens vegetation on north and south slopes on various geologic formations in southwestern Virginia (Platt 1951; Schiffman 1990). Nevertheless, the reported availability of inorganic nutrients is extremely low and if availability of nitrogen is related to soil organic matter, as it is in other soils, soil nutrients may play a role in limiting nonendemic plant growth on shale barrens.

## **Climate and Microclimate.**

The Ridge and Valley Province lies within the “rain shadow” of the Allegheny Front. Prevailing westerly winds bring moisture from the Gulf of Mexico, but adiabatic cooling as the air rises to cross the highest mountains results in most of this moisture being dumped as rain and snow on the western slopes. The difference in precipitation between Pickens and Upper Tract, WV, 120 km (75 mi.) apart, is about 75 cm (30 in.). Still, there is adequate rainfall throughout the region. Average annual precipitation in the shale barren region varies from about 85 cm (33.4 in.) at Upper Tract to 107 cm (42.2 in.) at Hot Springs, VA. January average low temperature for the region is about 7.2 °C (19 °F) and average July high is about 28.3 °C (83 °F). (Records and averages from The Weather Channel 2002.) According to Platt (1951), “the climate of the shale barren region . . . is fairly uniform in all respects . . . a warm temperate, rainy climate, with no distinct dry season.”

However, in terms of solar irradiance and temperatures, the microclimate on barrens differs greatly from non-barren sites, with 20 times more sunlight reaching the ground, raising surface temperatures to as much as 63 °C (145 °F) (Platt 1951, Braunschweig *et al.* 1999).

## **Vegetation and Flora.**

The sparseness of vegetation is the most obvious feature of mid-Appalachian shale barrens, varying from bare shale soils and bedrock outcrops supporting lichens and occasional herbs to patchy herbaceous cover and scattered shrubs under open-canopy woodland.

Woody species composition is generally similar throughout the shale barrens, though dominance varies (Platt 1951). Dominant trees are usually one or more of the following: *Pinus virginiana*, *Juniperus virginiana*, *Quercus prinus*, *Q. rubra*, *Q. alba*, *Fraxinus americana*, and *Carya* spp. (mostly *glabra*). Dominants in the shrub layer may include *Rhus copallinum*, *R. aromatica*, *Celtis tenuifolia*, *Amelanchier sanguinea*, *A. arborea*, *Quercus ilicifolia*, *Vaccinium stamineum*, *Gaylussacia baccata*, and *Rosa carolina*. (Braunschweig 1993, Berdine 1999, Fleming and Coulling 2001, NatureServe 2002.)

Composition of the herbaceous layer is far more diverse and varies greatly from north to south in the shale barren range as well as from barren to barren and from community to community within a barren. While endemic and near endemic plants help to define shale barrens, there are additional characteristic species, not so narrow in their habitat requirements, that show a preference for barrens. Of the 128 taxa listed by Platt (1951) for the open barrens, 79 are vascular herbs. Among those species frequently reported from shale barrens are *Phlox subulata*, *Carex pensylvanica*, *Allium cernuum*, *Cheilanthes lanosa*, *Deschampsia flexuosa*, *Draba ramosissima*, *Cunila origanoides*, *Danthonia spicata*, *Ambrosia artemisiifolia*, *Houstonia longifolia*, *Woodsia scopulina*, *Selaginella rupestris*, *Antennaria virginica*, *Opuntia compressa* and *Viola pedata*. (Braunschweig *et al.* 1999, NatureServe 2002.) Some barrens have been invaded by such exotic species as

*Centaurea biebersteinii* (= *C. maculosa*), *Bromus sterilis*, and *B. japonicus*. Invasive plants are discussed in Present and Potential Threats to Habitat. Calcareous shale barrens may support, in addition to the typical endemics, a flora more characteristic of cedar glades (e.g., *Delphinium exaltatum* and *Linum lewisii*) and may indeed grade into cedar glades (Bartgis 1984).

The several endemic herbs are the source of our fascination with shale barrens. Numerous lists have been compiled (e.g., Wherry 1935, Core 1966, Bodkin 1973, Keener 1983, Braunschweig *et al.* 1999), but all differ to some extent. The difficulty is in arriving at two definitions: “shale barrens” and “endemic”. Shale barrens are often defined by the presence of endemics, while those same species may occasionally occur in other habitats, and there are many typical barrens where no endemics can be found. Are there endemics on such barrens that have been overlooked? Will this barren be colonized by such species at some future time? We do not know the answers to these questions.

The southern West Virginia-Virginia border area has the largest concentration of shale barrens, and all the endemic plant species are found within 10 km (6.2 mi.) of Alleghany County, VA (Belden, *et al.* 1999). See Keener (1983) for a detailed discussion of shale barren endemics and their classification based on evolutionary history and relying on cytotaxonomy. He lists in this paper 18 taxa, eight “strict endemics” (*Eriogonum allenii*, *Clematis albicoma*, *C. coactilis*, *C. viticaulis*, *Arabis serotina*, *Trifolium virginicum*, *Oenothera argillicola*, and *Packera antennariifolia*), nine “preferential endemics” (*Allium oxyphilum*, *Paronychia montana*, *Pseudotaenidia montana*, *Calystegia spithamea* ssp. *purshiana*, *Phlox buckleyi*, *Antennaria virginica*, *Aster schistosus*, *Helianthus laevigatus*, and *Solidago arguta* var. *harrisii*), and one “disjunct ‘racial’ endemic” (*Astragalus distortus*). But as pointed out by Wherry (1953), shale barren endemics grow where they do because they cannot compete with the abundant vegetation on more favorable sites. Thus, most endemics have also been reported from other sites where competition is low due to disturbance, very thin soil, rock outcrops, or very dry conditions. *Solidago arguta* var. *harrisii*, *Antennaria virginica*, *Paronychia montana*, *Oenothera argillicola*, *Helianthus laevigatus*, and even *Trifolium virginicum* occur outside the range of shale barrens in other dry habitats (See Regional Forester Sensitive Species Assessment below). Braunschweig *et al.* (1999) follow Keener’s list with the addition of *Arabis laevigata* var. *burkii*, *Scutellaria ovata* ssp. *rugosa*, and *Hieracium traillii* (as “near endemics”) and dropping *Helianthus laevigatus* (widespread in dry open habitats) and *Aster schistosus* (a hybrid whose parents are widespread).

A number of species with a generally western distribution have disjunct populations on mid-Appalachian shale barrens, including *Astragalus distortus*, *Scutellaria ovata* ssp. *rugosa* (also in the southern Appalachians), *Erysimum capitatum*, and the ferns *Cheilanthes castanea*, *Asplenium septentrionale*, and *Woodsia scopulina* (as ssp. *appalachiana*).

Bryophytes and lichens are two important but neglected groups in shale barren communities. Platt (1951) listed four mosses and 24 lichens as “characteristic of the more exposed areas of the shale barrens,” and Morse (1993) noted that “at some sites,

lichen cover is significant.” Ammons (1943) described the results of a collecting trip to a shale barren near Petersburg, Grant Co., WV where she found two liverworts and 21 mosses, but nine of the species were from “mud” “in a somewhat swampy area” near the base of the barren.

Even more neglected are the fungi, which are abundant at the appropriate seasons, given adequate rainfall. Mycorrhizal species appear to be those typical of the surrounding forest, but there may well be interesting finds to be made among the decomposers, especially gasteromycetes, a group that is particularly well represented in xeric environments. Some incidental collecting has been done in WV, especially in Pendleton County, but there has been no effort to specifically survey shale barrens (D. Mitchell pers. comm.).

### **Animals.**

Vertebrates that occupy shale barrens habitat are, as far as we know, the same as those in the surrounding forest, though it seems likely that some species of birds would prefer these openings for nesting, e.g., brown-headed cowbirds.

The invertebrate fauna of shale barrens have not been studied much, but there are apparently some species that prefer barrens. Wheeler (1995) remarked that several plant bugs (Heteroptera: Miridae) “are as characteristic of shale barrens as are the endemic plant species” and went on to say that the barrens support “a diverse fauna of phytophagous insects . . . although entomologists have paid relatively little attention to insect-plant relationships in these communities.” A WV Natural Heritage Program pit trap survey of Little Fork Shale Barren, Pendleton Co., WV in 2001 took, among other animals, an undescribed spider species (Hahniidae), another possible new species (Araniidae), and four additional spiders previously unrecorded from the state (Arnold 2002).

Two butterflies should be mentioned. *Euchloe olympia* (Olympia marble) is widespread but discontinuous over much of central and northeastern North America. The eastern population known as the “Appalachian isolate”, is small and very local, occurring on shale barrens and similar dry openings. The larval food plant is *Arabis*, including *A. serotina*. (Clench and Opler 1983, Opler 1985.) Heritage Ranks are G4G5, MD S2, PA S1, VA S2S3, WV S2S3. *Pyrgus wyandot* (Appalachian grizzled skipper) was previously commonly treated as a subspecies of the more widespread *P. centaureae*, but there appear to be sufficient differences in morphology and ecology to warrant recognition at the species level. It formerly ranged (discontinuously) from NY to NC and west to MI and KY, but it has been extirpated from much of that range, largely as a result of spraying for gypsy moth. It occupies shale barrens and other dry openings that support *Potentilla canadensis*, the larval host plant. (Schweitzer 1991, Chazal and Roble 2001.) Heritage Ranks are G2, MD S1, PA S1, VA S1S2, WV S1.

## COMMUNITY CLASSIFICATION AND SYNONYMS

Botanists had been collecting unusual plants from shale slopes in southern West Virginia and adjacent Virginia for many years before Edward Steele recognized their habitat as a unique natural community:

Several of the species considered are inhabitants of a type of land widely distributed through the mountains of middle Virginia which might well be denominated “shale barrens.” This land is made up of exposures of shale in different stages of disintegration . . . The formations are so open that over large areas they can be penetrated on foot with no great difficulty. The barrenness is perhaps largely due to the constant washing away of the finer particles of soil, but in some cases it seems as if it must be chargeable to chemical composition. The plant covering, I should say, is mildly xerophytic, but there is no evidence of extreme drought. On the contrary, the vegetation maintains itself through the season, even on sunbeaten slopes as well as that on other soils similarly situated. The variety of plant life is very considerable, and together with many plants well known on other strata, these barrens possess a number of species peculiar to themselves (Steele 1911).

Although there is little consensus on a precise definition of “shale barren”, the term has persisted to the present day, because it is well understood to denote a fairly recognizable habitat that supports a characteristic flora, including several endemics. Some of these barrens are less well-delineated than others, so that their boundaries (or even their existence) become debatable. Many workers consider the presence of some indicator species (endemic) necessary to the designation. Of course, such plants are occasionally found in an uncharacteristic habitat or well out of normal range, raising questions about the meaning of “endemic” and the definition of “shale barren.”

Our shale barrens are best termed “mid-Appalachian” or “central Appalachian” to avoid confusion with other natural communities that are also called “shale barrens,” e.g., in South Dakota, Colorado, Wyoming, Illinois, and along the Delaware River in Pennsylvania.

Attempts in recent years to create a nomenclature and classification of natural communities has led to description of several community types within what we call “shale barren”. This work has been done primarily by The Nature Conservancy (TNC) and state Natural Heritage Programs, and now NatureServe (formerly The Association for Biodiversity Information). While much remains to be done in perfecting and merging these classifications, a discussion of the current state of affairs follows. More complete information can be found in Appendix C.

**MARYLAND** Heritage ecologists recognize five natural community types within the shale barrens of Allegheny and Washington Counties (Berdine 1999).

**Rich Shale Barren Woodland** (*Juniperus virginiana* - *Fraxinus americana* - *Carya glabra* / *Carex pensylvanica* Woodland) is open woodland dominated by these species on relatively richer soils derived from calcareous shales and having high species diversity and high herbaceous cover (> 20%). Characteristic shale barren species include *Trifolium virginicum*, *Packera antennariifolia*, *Oenothera argillicola*, *Calystegia spithamea*, *Taenidia montana*, *Solidago arguta* var. *harrisii*, *Astragalus distortus*, and *Prunus alleghaniensis*.

**Sterile Shale Barren Pine/Oak Woodland** (*Pinus virginiana* - *Quercus prinus* / *Deschampsia flexuosa* Woodland) is open woodland on thinner, more acid soils, dominated by the named trees and with the grass *Deschampsia flexuosa* in the herbaceous layer. Diversity is low and herbaceous cover is low (< 5%). Characteristic shale barren plants include the same species listed for Rich Shale Barren Woodland. This is the most common community type on the shale barrens of MD.

**Sterile Shale Barren Pine/Cedar Woodland** (*Pinus virginiana* - *Juniperus virginiana* Woodland) is similar to Sterile Shale Barren Pine/Oak woodland, but it has a greater amount and more even mix of *Juniperus virginiana*, and no *Deschampsia*. The only characteristic shale barren species known to occur here is *Solidago arguta* var. *harrisii*.

**Shale Barren Glade/Prairie** (*Carex pensylvanica* - *Danthonia spicata* / *Juniperus virginiana* - *Ostrya virginiana* Herbaceous Vegetation) is an opening or “glade” of 200-1000 square meters (2150-10,750 square feet) within a larger shale barren woodland. There is extensive bare soil and bedrock, with vegetation cover of 30-90%, with *Carex pensylvanica* predominant and scattered *Juniperus*. The characteristic shale barren species listed for Rich Shale Barren Woodland are also found here.

**Shale Barren Shortgrass Prairie** (*Carex pensylvanica* - *Schizachyrium scoparium* / *Quercus stellata* Herbaceous Vegetation) differs from Shale Barren Glade/Prairie in having significant amounts of *Schizachyrium* and *Bouteloua curtipendula* codominant with the *Carex pensylvanica*. There is also typically scattered *Quercus stellata* and *Carya glabra*, and in some cases 20-70% cover of shrubs, including *Rhus aromatica*, *Rosa carolina*, *Viburnum rafinesquianum*, *Hypericum prolificum*, and *Prunus alleghaniensis*. This is the community most commonly having *Trifolium virginicum* in MD. It also supports *Packera antennariifolia*, *Calystegia spithamea*, *Taenidia montana*, *Solidago arguta* var. *harrisii*, and *Astragalus distortus*.

In PENNSYLVANIA, Fike (1999) defined two shale woodlands, not separating the herbaceous openings within them.

**Red-cedar - Mixed Hardwood Rich Shale Woodland** typically occurs on calcareous shale and is dominated by *Juniperus virginiana*, *Fraxinus americana*, *Quercus* spp. and *Carya* spp. “Although the overall aspect is that of a woodland, there may be herbaceous openings and sparsely vegetated areas within the woodland matrix.” This community has most of PA’s shale barren endemics, including *Oenothera argillicola*, *Calystegia spithamea* ssp. *purshiana*, *Packera antennariifolia*, and *Trifolium virginicum*.

**Virginia Pine - Mixed Hardwood Shale Woodland** is generally less open, with a sparser herbaceous layer and fewer endemics. It is typically on acidic shales, with *Pinus virginiana* dominating.

**VIRGINIA Heritage** uses a hierarchical community classification in which Central Appalachian Shale Barrens Ecological Community Group includes three community types (Fleming and Coulling 2001).

**Central Appalachian Shale Barren (Northern Type)** (*Pinus virginiana* - *Quercus prinus* / *Deschampsia flexuosa* - *Cunila origanoides* - *Packera antennariifolia* Woodland) is dominated in the canopy layer by *Pinus virginiana* and *Quercus prinus* and includes herbaceous openings dominated by *Deschampsia flexuosa* and *Phlox subulata*. Other characteristic herbs include *Packera antennariifolia*, *Clematis coactilis*, and *Eriogonum allenii*. It occurs on acid shales.

**Central Appalachian Shale Barren (Southern Type)** (*Pinus virginiana* - *Quercus prinus* - *Carya glabra* / *Phlox subulata* - *Packera antennariifolia* Woodland) occurs on a variety of shales, mostly in the Ridge and Valley province, but also very locally in the Northern Blue Ridge on metamorphic Cambrian rock. Soils are strongly acid and poorly developed. Woody cover is sparse, of stunted trees and shrubs: *Pinus virginiana*, *Quercus prinus*, *Carya glabra*, and *Amelanchier arborea*. Herbaceous cover is low (typically 25-40%) and dominated by *Carex pennsylvanica*, *Danthonia spicata*, *Schizachyrium scoparium*, *Phlox subulata*, *Potentilla canadensis*, and *Packera antennariifolia*. Other endemic or near endemic shale barren species found here are *Trifolium virginicum*, *Arabis serotina*, *Clematis albicoma*, and *Eriogonum allenii*. This is the classic mid-Appalachian shale barren.

**Central Appalachian Shale Barren (Shale Ridge Bald / Prairie Type)** (*Pinus virginiana*, *Juniperus virginiana*] / *Schizachyrium scoparium* - *Eriogonum allenii* Wooded Herbaceous Vegetation) is a grassland with or without a sparse tree layer that occurs on or near ridgetops. Soils are more stable, better developed, and more fertile. Dominant trees are *Pinus virginiana* and/or *Juniperus virginiana*, and *Carex pennsylvanica*, *Schizachyrium scoparium* and other warm season

tussock grasses dominate the herbaceous layer. *Eriogonum allenii* is common, and other endemics/near endemics likely to be present are *Packera antennariifolia*, *Trifolium virginicum*, *Scutellaria ovata*, *Arabis serotina*, *Clematis viticaulis*, and *Oenothera argillicola*. Fleming and Coulling (2001) give more detailed descriptions of these community types.

**WEST VIRGINIA**'s state community classification (Vanderhorst 2002) currently recognizes five shale barren community types.

**South-central Appalachian Shale Barren Woodland** (*Pinus virginiana*-[*Quercus alba*]/[*Carya ovata*, *Quercus alba*]/*Carex pensylvanica*-*Antennaria virginica* Shale Barren Woodland) is limited to Greenbrier Co. on steep slopes with southern to western aspects. Soils are shallow, strongly acid, with low fertility and low moisture capacity, and with higher leaf litter cover than other WV types. This community is dominated by *Pinus virginiana* with a high component of deciduous trees in the canopy and subcanopy and high cover and diversity in the herbaceous layer. Commonly occurring species include *Carya* and *Quercus* spp., *Ostrya virginica*, *Quercus ilicifolia*, *Robinia pseudoacacia*, *Rhus aromatica*, *Crataegus* spp., *Viburnum prunifolium*, *Vaccinium pallidum*, *V. stamineum*, *Carex pensylvanica*, *Antennaria virginica*, *Danthonia spicata*, *Allium cernuum*, *A. oxyphilum*, *Galium pilosum*, *Houstonia longifolia*, *Paronychia montana*, *Phlox subulata*, *Potentilla canadensis*, *Rosa carolina*, *Silene caroliniana*, *Uvularia puberula*, and *Viola pedata*. Endemics and near endemics include *Arabis serotina*, *Clematis albicoma*, *Packera antennariifolia*, *Trifolium virginicum*, *Scutellaria ovata* ssp. *rugosa*.

**Central Appalachian Shale Barren Woodland** (*Pinus virginiana*-*Quercus prinus*/*Carex pensylvanica*-[*Arabis serotina*, *Clematis albicoma*] Shale Barren Woodland) is the "classic" shale barren described above as VA's Central Appalachian Shale Barren (Southern Type), differing from the VA concept chiefly in the lesser importance of *Packera antennariifolia*.

**North-central Appalachian Dry Shale Barren Woodland** (*Pinus virginiana*-*Juniperus virginiana*-[*Quercus stellata*]/[*Opuntia humifusa*, *Viola pedata*] Shale Barren Woodland) is dominated by stunted *Pinus virginiana* and *Juniperus virginiana* with *Quercus stellata* often codominant. Other *Quercus* spp., *Carya* spp., and *Fraxinus americana* are frequently present. The subcanopy and shrub layers are sparse to nonexistent and may include *Celtis* spp., *Hypericum prolificum*, *Quercus muhlenbergii*, and *Rhus aromatica*, in addition to the canopy species. The sparse herb layer is likely to include *Carex pensylvanica*, *Danthonia spicata*, *Opuntia humifusa*, *Packera antennariifolia*, and *Viola pedata*. Endemics and near endemics may include *Clematis albicoma*, *Oenothera argillicola*, *Trifolium virginicum*, *Scutellaria ovata* ssp. *rugosa*, and *Solidago arguta* var. *harrisii*.

**Steep Rock Outcrop Shale Barren** (*Pinus virginiana-Quercus prinus/Oenothera argillicola-Solidago arguta* var. *harrisii* Shale Barren Sparse Woodland) is similar to MD's Sterile Shale Barren Pine/Oak Woodland. It is characterized by high cover percentages of bedrock and bare shale fragments.

**Shale Barren Herbaceous Opening** (*Carex pensylvanica-Dichantherium depauperatum-Paronychia montana* Shale Barren Herbaceous Vegetation) includes open areas with less than 5% cover in each of the woody strata. It is a relatively artificial grouping based on four plots and most closely resembles MD's Shale Barren Glade/Prairie. Dominants are graminoids, including *Carex pensylvanica*, *Danthonia spicata*, and *Dichantherium depauperatum*. Other frequent herbs include *Ambrosia artemisiifolia*, *Houstonia longifolia*, *Paronychia montana*, *Phlox subulata*, *Potentilla canadensis*, and *Viola pedata*. Endemics found in these openings are *Clematis albicoma*, *Arabis serotina*, *Calystegia spithamea* ssp. *purshiana*, *Scutellaria ovata* ssp. *rugosa*, and *Trifolium virginicum*.

A **NATIONAL CLASSIFICATION** of natural communities is being developed by NatureServe (formerly The Association for Biodiversity Information) in cooperation with Natural Heritage Programs. The current version includes one grassland and five woodland communities or "elements" that would fall within our concept of shale barren.

**Chestnut Oak – Virginia Pine / Ragwort Acidic Shale Woodland (Southern Type)** (*Pinus virginiana - Quercus [pinus, velutina] / Packera antennariifolia - Phlox subulata* Woodland [Provisional]) is probably the equivalent of VA's Central Appalachian Shale Barren (Southern Type) and WV's Central Appalachian Shale Barren Woodland.

**Virginia Pine - Red Cedar / Pennsylvania Sedge Shale Woodland (Northern Type)** (*Pinus virginiana - Juniperus virginiana / Carex pensylvanica* Woodland [Provisional]) differs chiefly in having *Juniperus virginiana* as a dominant species.

**Central Appalachian Circumneutral Shale Woodland** (*Juniperus virginiana - Fraxinus americana - Carya glabra / Carex pensylvanica - Cheilanthes lanosa* Woodland) has circumneutral to basic soils and relatively high herbaceous diversity.

**Central Appalachian Acidic Shale Woodland** (*Pinus virginiana - Quercus prinus / Deschampsia flexuosa - Cunila origanoides* Woodland) apparently equals VA's Central Appalachian Shale Barren (Northern Type) and WV's Steep Rock Outcrop Shale Barren.

**Virginia Pine / Ragwort / Houstonia Shale Woodland (Southern Type)** (*Pinus virginiana / Packera antennariifolia - Houstonia longifolia* Woodland [Provisional]) is dominated by *Pinus virginiana*, with sparse shrub and herb

layers. It may be limited to extremely dry, shallow soils of the southern half of WV (Pendleton, Greenbrier, and Monroe Counties).

**Pennsylvania Sedge - Poverty Grass Acidic Shale Opening** (*Carex pensylvanica* - *Danthonia spicata* - *Cheilanthes lanosa* Herbaceous Vegetation [Provisional]) represents graminoid openings dominated by *Carex pensylvanica*. It is not yet well defined. (NatureServe 2002.)

## COMMUNITY ECOLOGY / ENVIRONMENTAL CONDITIONS

Brallier shales are remarkably uniform in character through most of their range (Woodward 1943). Brallier and similar shales break up into small fragments that are resistant to further weathering. Three conditions tend to increase the steepness of slopes. Hard sandstones may cap the shale ridges (a common situation in the Massanutten region), and streams may undercut the shale slopes. (In some places the streams have been replaced by roads, and loose shale fragments that accumulate at the base are carried away not by floodwaters, but by road crews with heavy equipment.) But the critical factor in barren formation is, according to Platt (1951), hardness of the shale and consequent resistance to erosion. There is some variation from place to place in hardness of the Brallier formation, and shale barrens are associated with the harder shales. Regions of softer shale have mostly weathered to gentler slopes. The presence of an undercutting stream is often cited as characteristic of barrens, and is certainly a factor in the maintenance of lower slope barrens, but could hardly be important to conditions higher on the hillside.

Steep slopes (in excess of 20<sup>o</sup>) with generally southerly exposures allow barrens to form. Platt (1951) demonstrated that this is principally due to maximized insolation raising temperatures and lowering moisture on the bare shale surface. Southerly exposure, steep slope approaching perpendicular to the incidence of sunlight, and sparse plant cover allow far more sunlight to penetrate to the ground. Air temperatures over barrens can reach 34 to 47 °C (93 to 117 °F), and soil surface temperatures may be 50 to 60 °C (122 to 140 °F) (Platt 1951, Braunschweig 1993). According to Braunschweig *et al.* (1999):

During the growing season, photosynthetically active radiation (PAR) in the subcanopy of a non-shale barren slope can reach a maximum of approximately 50  $\mu\text{mol}/\text{m}^2/\text{s}$  (ca. 2.5% full sun). On a shale barren, however, light intensity commonly remains above 1000  $\mu\text{mol}/\text{m}^2/\text{s}$  PAR (50% full sun) during a summer day.

Platt (1951) found that of an estimated 35,000 seedlings of various species present in a 225 square meter (2,422 square foot) area in April, only 9 survived to mid-June.

From seed germination studies, it is clear that unusual limitations on the amount of vegetation are not imposed either by the number, distribution, and viability of seed produced or by the climatic conditions required to break the various kinds of

seed dormancy represented. However, the high temperature and low moisture conditions of the surface layer are so severe as to sharply curtail seedling establishment. This then constitutes the critical point in plant growth, and is the factor responsible for the sparsity of plant life on the barrens (Platt 1951).

Shale barren endemic plants are mostly herbaceous perennials with remarkably well developed root systems. Artz (1937b) described an *Eriogonum allenii* with a 2.5 cm (1 in.) stem and roots reaching 37 cm (15 in.) long. Subsurface conditions are not extreme in terms of either temperature or moisture, and once established, plants are able to survive even periods of severe drought.

These endemics are obligate heliophytes, adapted to high light levels and unable to acclimate to low light. They are also tolerant of temperature extremes (Braunschweig *et al.* 1999). Platt (1951) noted that shale barren endemics

... are obligate upon 1) high light intensity, 2) an edaphic medium adequate for their extensive root systems, and 3) a low level of competition. They are restricted to the shale barrens because no other habitat in the whole region possesses this unique combination of soil and light conditions which permits them, but does not permit stifling competitors to grow.

An extensive band of Brallier shale comes to the surface in Randolph County, WV without the formation of barrens. It is not known to what degree this is due to the lithologic character of the shale or to heavier rainfall. Much has been made of the fact that the Ridge and Valley lies in a “rain shadow” with consequently diminished precipitation, but we know that root-zone moisture is normally adequate on barrens. However, it seems probable that abundant cloud cover in summer would allow the survival of a higher number and diversity of plants, preventing the formation of barrens. Even occasional wet summers would be enough, because vegetation cover, once established, would prevent high soil surface temperatures – one of the most important factors in maintenance of barrens.

## **PRE-EUROPEAN SETTLEMENT: COMMUNITY DISTRIBUTION AND CONDITIONS**

No references to what might be identified as shale barrens could be found in early (18<sup>th</sup> and 19<sup>th</sup> century) literature. Later studies attempting to elucidate regional floristic history are too general to be of much relevance. Allard and Leonard (1946) speculated that the barrens were perhaps more restricted in pre-settlement times:

There would be a natural tendency for the forest to ascend the shale mountains by a very gradual extension since with every foot of ground captured at the base of a steep, denuded shale slope, obstruction and accumulation of the downward moving soils would advance a little higher and still further restrict the barrens as we know them at the present time.

In view of the existence of several endemic species that probably have limited ability to disperse and establish themselves, it seems likely that individual barrens have persisted with little change over long periods of time.

## REGIONAL FORESTER SENSITIVE SPECIES ASSESSMENT

In the following species accounts, these are the most important sources and will not be repeatedly cited: Nomenclature from Harmon and Ford-Werntz 2002, Kartesz 1994; descriptions from Gleason and Cronquist 1991, Strausbaugh and Core 1977; distribution, abundance and current status from unpublished Natural Heritage Program data from Maryland, Pennsylvania, Virginia, and West Virginia and from NatureServe 2001. The Nature Conservancy's Heritage Status Ranks are explained in Appendix D. State Heritage Ranks are given only for the four states in the shale barrens range. Appendix E contains photographs of six of these Sensitive Species. A photograph of *Liatris turgida* could not be found.

### *Allium oxyphilum*

#### Nomenclature and Taxonomy

**Scientific name:** *Allium oxyphilum* Wherry

**Synonyms:** *Allium cernuum* Roth (in part)

**Common names:** Nodding onion, Lillydale onion, wild onion

**Family:** Liliaceae

**Remarks:** There is some doubt as to whether this taxon is distinct from *A. cernuum*, though the name is currently accepted by Kartesz (1994) and Harmon and Ford-Werntz (2002). Gleason and Cronquist (1991) include it under *A. cernuum* but note that it "may merit some recognition."

#### Description

An herb with flat, linear basal leaves and an umbel of white flowers, arising from a perennial bulb. The bulb is slenderly conic, tapering to the stem, its skin not strongly reticulated. Leaves are 2-8 mm (0.08-0.31 in.) wide. Scape is slender, erect, 3-6 dm (1-2 ft.) tall, exceeding the leaves, bearing a nodding umbel subtended by 2 or 3 bracts. Pedicels are 2-4 cm (0.8-1.6 in.) long. The perianth is campanulate, 6-parted, the segments obtuse. The ovary is subsessile and three-celled, the style persistent and thread-like. The fruit is a capsule. The entire plant is onion-scented. Chromosome number  $2n = 14$ .

*Allium oxyphilum* is most similar to *A. cernuum*, and is distinguished from that common species by the more slender and longer pedicels (2-4 cm [0.8-1.6 in.] instead of 1.6-3 cm[0.6-1.2 in.]), the obtuse, rather than acute, perianth segments, and the crests on the capsule which are shorter and more broadly deltoid. *A. cernuum* may also have white flowers, but they are commonly pink or rose. *A. oxyphilum* generally blooms 2-3 weeks later.

### **Ecology and Life History**

This onion occurs mostly on shale barrens, often on bare shale, but also in xeric woodland with grass and sedge, on shale and sandstone outcrops and atop boulders. Most sites are acidic, but it has also been reported from calcareous soils. It shows a preference for the more sparsely vegetated areas.

*Allium oxyphilum* flowers in August, generally 2-3 weeks later than *A. cernuum* in the same locality. It produces viable seed, and bumblebees have been observed pollinating the flowers (R. Bartgis, pers. comm.).

### **Distribution**

Endemic to Greenbrier, Mercer, Monroe and Summers counties in southeastern WV. Reports of its occurrence in adjacent VA have been erroneous, although it may well be found there (T. Wieboldt, pers. comm.).

### **Abundance and Current Status**

The 18 occurrences of *Allium oxyphilum* consist mostly of 100 to 400 plants, but the largest is 18,000 plants. Total population is estimated at 33,000. Most populations appear stable. Heritage Ranks: G2Q, WV S2.

### ***Arabis serotina***

#### **Nomenclature and Taxonomy**

**Scientific name:** *Arabis serotina* Steele

**Synonyms:** *Arabis laevigata* (Muhl. ex. Willd.) Poir. var. *burkii* Porter (in part)

**Common names:** Shale barren rock cress

**Family:** Brassicaceae (Cruciferae)

## Description

An erect, much-branched, facultative biennial herb with inconspicuous flowers. Flowering stems rise to about 4-10 dm (1-3 ft.) from small basal rosettes that wither and disappear as the stem develops. Basal leaves are spatulate, lobed, and form rosettes about 15-35 mm (0.6-1.4 in.) across. Thin rhizomes may spread from the rosette producing additional rosettes (Rouse 1990). Stem leaves are 5-15 cm (2-6 in.), narrowly lanceolate, entire to serrate, not clasping at the base, often early deciduous. Flowers are small (4-8 mm [0.2-0.3 in.]) and whitish, the calyx 2-3.3 mm (0.08-0.13 in.) long. Fruit is a nearly straight silique, 4-8 cm (1.6-3.2 in.) in length, containing yellowish-brown, flattened seeds with very narrow wings. The seed is 1-2 mm (0.04-0.08 in.) long, with a narrowly elliptic body. (Ludwig & Van Alstine 1991, Wieboldt 1987.)

*Arabis serotina* was long confused with *A. laevigata* var. *burkii*, which is very similar and also found on shale barrens. However, *A. serotina* differs in being restricted to shale barrens, flowering 8-10 weeks later, being freely branched with a paniculate inflorescence, having a shorter calyx (av. 2.55 mm [0.10 in.] vs. 3.83 mm [0.15 in.]) and seeds that are broadly elliptic (rather than ovate) with a more narrowly winged margin (0.1-0.2 mm [0.004-0.008 in.] vs. 0.25-0.5 mm [0.01-0.02 in.]). *A. serotina* also averages about 12 cm (4.7 in.) taller. (Wieboldt 1987.)

## Ecology and Life History

A strict shale barren endemic with small populations (up to several hundred individuals, but most with fewer than 20) that may fluctuate widely from year to year. Although there were two populations reported on the Martinsburg Formation of VA, now believed extirpated, all extant populations are on Devonian shale. In WV *Arabis serotina* usually occurs within 1 m (3 ft.) of the base of a tree, or otherwise in large stands of sedge (usually *Carex pensylvanica*) or grass (*Danthonia* sp.). Associated plants are those characteristic of shale barrens (see Description of Shale Barrens above), but species vary considerably between sites. (WV Heritage Program, unpublished data.)

If the population fluctuations are indeed real, and not the result of inconsistency in counting, the causes could be several. Flowering plants are commonly browsed, probably mostly by deer, as well as fed on by some insects. Drought probably adversely affects seed production, seed germination, and plant establishment. Little if anything is known of the seed bank on shale barrens.

*Arabis serotina* is a facultative biennial, that is, the rosette may persist for a number of years before producing a flower stem. Flowering is from mid-July until killing frost. Additional rosettes may be produced on short rhizomes. Most *Arabis* species are pollinated by insects. A flower fly (Syrphidae) has been observed visiting the flowers (Lipford 1987). Rouse has estimated seed production to range from 12-730 per plant, while one WV specimen with 455 siliques was estimated to have 13,000-14,000 seeds (Ludwig & Van Alstine 1991).

This species is known to serve as food for the larva of the rare (in the east) *Olympia* marble butterfly (*Euchloe olympia*) (Clench & Opler 1983).

### **Distribution**

The known present range of *Arabis serotina* includes these 9 counties: Greenbrier, Pocahontas, Pendleton and Hardy of WV, and Allegheny, Bath, Rockbridge, Highland, and Augusta of VA. This is roughly the southern half of the shale barren range. Two populations were reported from the Massanutten Mountain area of VA (in 1935 and 1991), but are now believed extirpated (Ludwig & Van Alstine 1991, C. Ludwig pers. com.).

### **Abundance and Current Status**

About 33 populations are known from 5 VA and 4 WV counties. Populations are small, mostly fewer than 50 plants, many fewer than 20. The total number of plants may be less than 1000. The number of plants on a given barren may fluctuate greatly from year to year, due to causes that are poorly understood but may include variation in rainfall or deer browsing. Heritage Ranks: G2, VA S2, WV S2. Listed Endangered under the U. S. Endangered Species Act.

## ***Asplenium bradleyi***

### **Nomenclature and Taxonomy**

**Scientific name:** *Asplenium bradleyi* D. C. Eaton

**Synonyms:** *Asplenium x stotleri* Wherry

**Common names:** Bradley's spleenwort, cliff spleenwort

**Family:** Aspleniaceae

### **Description**

A small fern with tufted evergreen fronds. The short, sometimes branched rootstock, 1-1.5 mm (0.04-0.06 in.) thick, bears numerous narrowly lanceolate, blackish scales, 2-4.5 mm (0.08-0.18 in.) long. The numerous spreading leaves are 7-25 cm (3-10 in.) long. The stipe is about "½ as long as the blade, lustrous dark brown, this coloration extending to middle of rachis" (Wherry 1961), becoming green distally. The blade is "narrowly lanceolate-oblong, pinnate-pinnatifid to commonly bipinnate, 2-17 cm (0.8-6.7 in.) long by 1-6 cm (0.4-2.4 in.) wide, sparsely pubescent; pinnae distinct, 5-15 pairs, variable in shape but mostly lanceolate-ovate, margins dentate-denticulate; sori 3 or more per pinna" (Rhoads & Block 2000). The 8-15 pairs of pinnae are alternate or the basal nearly opposite. The sori are medial and mature to a blackish brown. "Name applied to both

the sterile hybrid ( $2n = 72$ ) [between *A. montanum* and *A. platyneuron*] and to the fertile allopolyploid ( $2n = 144$ ) derived from it” (Gleason and Cronquist 1991).

*Asplenium bradleyi* is one of a confusing complex of Appalachian spleenworts that frequently hybridize. As noted above, it is believed to have originated as a hybrid between two common species, *A. platyneuron* (L.) Oakes and *A. montanum* Willd. It in turn is a parent to two named hybrids: *A. x gravesii* Maxon (*A. bradleyi* x *A. pinnatifidum*) and *A. x wherryi* D. M. Sm. (*A. bradleyi* x *A. montanum*). This fern is most likely to be confused with *A. pinnatifidum*, but differs in that its frond is divided into distinct pinnae (pinnate) while the frond of *A. pinnatifidum* is merely deeply lobed (pinnatifid). They are often found in the same habitat. *A. bradleyi* is distinguished from *A. montanum* and *A. ruta-muraria* by narrower fronds and the continuation of the dark brown or maroon color of the stem base halfway up the rachis of the blade.

### **Ecology and Life History**

This species grows from crevices in dry acidic rocks, sometimes high on cliff faces, in exposed, often sunny, locations. It may occur on shale barrens, but is not limited to them, nor to shale. It occurs on granite, sandstone and quartzite. Gleason and Cronquist (1991) also attribute it to “acid soil.”

Little is known of reproduction, establishment and ecology. While its habitat (as we understand it) is common and its distribution is broad, it remains a rare species.

As mentioned above, hybridization and polyploidy are common in the genus *Asplenium*. This species appears to have arisen from hybridization several times in its history and exhibits broad variation in genotype (Werth, *et al.* 1985).

### **Distribution**

Southern NY and NJ and southeastern PA to the uplands of GA and AL, west to OH, southern IL and OK.

### **Abundance and Current Status**

The greatest numbers of plants are found in the Ozark Mountains, but *Asplenium bradleyi* is rare to uncommon throughout its range. Heritage Ranks: G4, MD SH, PA S1, VA S2, WV S?.

## *Liatris turgida*

### Nomenclature and Taxonomy

**Scientific name:** *Liatris turgida* Gaiser

**Synonyms:** *Lacinaria pilosa* auct. non (Ait.) Heller

**Common names:** Appalachian blazing star, robust blazing star, turgid gay feather

**Family:** Asteraceae (Compositae)

### Description

An erect perennial herb with narrow leaves and a spike of pink-purple flower heads. The thickened, roundish, corm-like rootstock gives rise to an unbranched stem 2-9 dm (8 in.-3 ft.) tall, glabrous or hirsute. The leaves are alternate, linear-lanceolate, the lowest oblanceolate, 0.7-2 cm (0.3-0.8 in.) wide by 7-30 cm (3-12 in.) long. Leaves are usually irregularly ciliate-margined near the base and weakly or scarcely punctate. The inflorescence is a spike or raceme of 5-40 heads, sessile or on peduncles up to 3 cm (1.2 in.), closely ascending. The involucre is turbinate, its bracts appressed, broadly rounded, with ciliate scarious margins, not strongly punctate, and generally purplish above. There are about 13 flowers per head (range 8-20). The corolla is rose purple and pubescent inside near the base. The fruit is an achene with about 10 ribs and a pappus of barbellate bristles. Chromosome number  $2n = 20$ .

*Liatris* is a problematic genus, but *L. turgida* is reasonably well defined, being distinguished by the combination of finely barbed pappus (rather than plumose), closely ascending heads of mostly more than 8 flowers and less than 20, larger leaves more than 1 cm (0.4 in.) wide, and involucral bracts appressed and with entire to slightly erose (rather than lacerate) scarious margins.

### Ecology and Life History

*Liatris turgida* grows in dry open woods, on shallow soils over outcropping granite, and on shale barrens. It may also colonize rocky road banks. It occurs on eastern, southern and western aspects at elevations from 700 to 1300 m (2300-4250 ft.) Commonly associated species include *Nyssa sylvatica*, *Quercus coccinea*, *Q. prinus*, *Oxydendrum arboreum*, *Sassafras albidum*, *Pinus virginiana*, *Kalmia latifolia*, *Vaccinium pallidum*, and *Epigaea repens*.

*L. turgida* blooms in late summer (August-September) and produces wind-dispersed seeds, but nothing is known of their germination and establishment, longevity, etc. Pollinators have not been recorded, but it is presumed to be insect pollinated.

## Distribution

Mountains of WV and VA south through western NC to northern GA and northeastern AL (Cronquist 1980). Once known from MD, but perhaps extirpated there.

## Abundance and Current Status

Occurs in 5 WV counties (Greenbrier, McDowell, Mineral, Monroe, and Nicholas), 20 VA counties, and 6 NC counties. Its status in AL and GA is uncertain. Currently considered rare and tracked by WV and NC Heritage Programs, but apparently of less concern in VA. No longer known to occur in MD. Heritage Ranks: G3, MD SH, VA SR, WV S1.

## *Phlox buckleyi*

### Nomenclature and Taxonomy

**Scientific name:** *Phlox buckleyi* Wherry

**Synonyms:** None

**Common names:** Swordleaf phlox, sword-leaved phlox, shale-barren phlox

**Family:** Polemoniaceae

### Description

A mostly unbranched, partially evergreen, perennial herb with narrow leaves and purple flowers. The decumbent slender stem is terminated by a rosette of firm linear to lanceolate or ensiform (sword-shaped) leaves up to 12 cm (5 in.) long and 5-10 mm (0.2-0.4 in.) wide. These leaves persist for about a year but wither and die as they are replaced. From these leaves arise an erect stem of 3 to 7 nodes, to 4 dm (16 in.) tall, with sessile lanceolate leaves similar to the lower ones, and terminated by a rather dense, glandular corymbiform cyme of bright purple flowers. The calyx is 7-13 mm (0.3-0.5 in.) long, glandular, its short-awned lobes about 1/3 the length of the tube. The corolla is 15-25 mm (0.6-1.0 in.) wide, its glandular tube 17-23 mm (0.7-0.9 in.) long. Flowers are slightly fragrant. Chromosome number  $2n=28$ .

*Phlox buckleyi* may be distinguished from other members of the genus by this combination of characters: Style obviously longer than the ovary or stigmas, corolla lobes not conspicuously notched, inflorescence evidently glandular, and leaves linear to lanceolate – never typically spatulate.

## Ecology and Life History

Although sometimes described as occurring there (Gleason and Cronquist 1991), *Phlox buckleyi* seldom, if ever, occupies shale barrens. Braunschweig, *et al.* (1999) refer to this species as “transitional”, saying “A few individuals of a few of the more frequent endemics or near endemics may occur with *Phlox buckleyi* in these marginal or transitional habitats.” In the paper in which he named this species, Wherry (1930a) says, “The normal habitat . . . is a thinly wooded slope toward the base of a hill of Devonian shale, the soil being usually a humus-rich gravel of subacid reaction,” and in his monograph *The Genus Phlox* (Wherry 1955), he gives the habitat as “Open woods on slopes of Devonian shale and margins of barrens.” Strausbaugh and Core (1977) attribute it to “shaly slopes in open woods.” All the occurrences presently known in WV are associated with roads or trails, except for a recently-found population on the top of Allegheny Mountain, Greenbrier Co., WV (R. Bartgis, pers. comm.). In an unpublished memo, Dobberpuhl (1982) wrote of a population in Greenbrier State Forest, Greenbrier County, WV:

Nearly all of the hundreds of plants which we observed were located within 10 feet of either side of the mowed jeep trail. Only a few (about 20) plants were found to have dried flower stalks or fruiting capsules from this season. All of those which did were located in the relatively sunny spots where other vegetative cover was minimal . . . We searched the forest quite thoroughly several hundred yards in from the trail and did not find further representatives of the phlox.

The picture of habitat that emerges from unpublished element occurrence records and notes indicates a preference for open canopy (sun to partial shade), and for more organic soil than is usual on shale barrens. This combination must have been exceedingly rare in pre-settlement times, and this phlox apparently now takes advantage of human disturbance – canopy-opening roadways, mowing, etc.

Associated plant species that have been noted include: *Quercus* spp., *Acer rubrum*, *Pinus strobus*, *P. virginiana*, *Prunus serotina*, *Nyssa sylvatica*, *Castanea dentata*, *Hydrangea arborescens*, *Hamamelis virginiana*, *Vitis* sp., *Rosa multiflora*, *Toxicodendron radicans*, *Vaccinium* spp., *Gaylussacia baccata*, *Rubus* sp., *Pteridium aquilinum*, *Epigea repens*, *Viola pedata*, *Hieraceum venosum*, *H. floribundum*, *Festuca elatior*, other grass spp., *Carex* spp., *Hypoxis hirsuta*, *Polystichum acrostichoides*, *Geranium maculatum*, *Asclepias quadrifolia*, *Pedicularis canadensis*, *Waldensteinia fragarioides*, and *Pyrola rotundifolia*. Not surprisingly, some of these are species typical of disturbed areas.

Flowering seems to be limited by availability of light. Blooming period is late spring – May and June. Nothing is known of pollinators, but we may assume insect pollination, as in other phloxes. Apparently, reproduction is more commonly asexual, by slender rhizomes or stolons, resulting in clonal colonies (Dobberpuhl 1982, Wherry 1955).

## Distribution

Southeastern WV and adjacent VA. Extant populations are known from Greenbrier and Pocahontas Counties, WV and 10 counties in VA.

## Abundance and Current Status

Most WV populations are very small (5-20 plants) and three are believed extirpated. The species is probably very vulnerable to shading if forest growth closes the canopy.  
Heritage Ranks: G2, VA S2, WV S2.

## *Scutellaria ovata*

### Note

This variable species has been divided into numerous subspecies and varieties (e.g., Epling 1942). Recent study (Ewing and Evans 1995) has revealed three rather distinct groups in the OH-WV-VA region: *S. ovata* var. *rugosa* (including *S. ovata* var. *pseudoarguta*), *S. ovata* var. *virginiana*, and *S. ovata* ssp. *ovata*. There is no consensus regarding taxonomy and classification of the many proposed subtaxa within this species. We will consider here that segment of *Scutellaria ovata* that is commonly found on shale barrens. It consists of *S. ovata* ssp. *pseudoarguta* Epling (or *S. ovata* var. *pseudoarguta* (Epling) Core) and *S. ovata* ssp. *rugosa* (Wood) Epling (or *S. ovata* var. *rugosa* (Wood) Fern. No other *Scutellaria* except *S. parvula* var. *leonardii* (very different in appearance) is apt to be found on shale barrens.

Many collections and records have not been identified below the level of species, and those that have must remain in some doubt because of the difficulty inherent in identification of this complex. Errors probably abound, limiting confidence in our knowledge of distribution and status.

## Nomenclature and Taxonomy

- Scientific name:** *Scutellaria ovata* Hill
- Synonyms:** *Scutellaria cordifolia* Muhl.
- Common names:** Heart-leaved skullcap, forest skullcap
- Subspecific taxa:** *Scutellaria ovata* Hill ssp. *rugosa* (Wood) Epling (= *S. ovata* var. *rugosa* (Wood) Fern.)  
*Scutellaria ovata* Hill ssp. *pseudoarguta* Epling (= *S. ovata* var. *pseudoarguta* Epling (Core))
- Family:** Lamiaceae (Labiatae)

## Description

Epling (1942) used the following key to separate these forms:

Plants erect, with the habit of *S. arguta*; leaves acuminate, the upper surfaces glabrate; petioles usually longer than the internodes they subtend.....ssp. *pseudoarguta*

Plants decumbent or lax; leaves usually obtuse or rounded at the apex, the upper surfaces hirsute; petioles about equaling the internodes.....ssp. *rugosa*

But after comparing measurements of 19 characters, Evans and Ewing (1995) concluded that “*S. ovata* var. *pseudoarguta* and *S. ovata* var. *rugosa* were found to be morphologically inseparable”, so no attempt will be made to separate them here.

This is a small, pubescent, branching herbaceous perennial, with blue-violet flowers. Plants are usually less than 30 cm (12 in.) tall, from very slender rootstocks. The decumbent to erect stems are glandular pubescent throughout with spreading, capitate hairs. Largest leaf blades are less than 5 cm (2 in.) long, ovate to round ovate, crenate, rounded to slightly cordate at the base. They may be pubescent or glabrate. Flowers in racemes, subtended by much-reduced, entire bracts. Corolla 10-24 mm (0.4-0.9 in.), without an internal ring of hairs. Nutlets are brown and covered with conical, decurved papillae. (Epling 1942, Gleason and Cronquist 1991.)

These taxa could be confused with *Scutellaria arguta*, but the latter has mostly dentate bracts, not much different from the upper leaves.

## Ecology and Life History

These plants are quite characteristic of shale barrens. Braunschweig, *et al.* (1999) note that *S. ovata* ssp. *rugosa*

...is a species that previously has not appeared on lists of endemics but is a regular member of the midsummer flora of the barrens. As shown by Pittman (1988), it occupies an Appalachian range coincident with other near-endemic taxa and, being disjunct from the Ozarks, fits the pattern of having an affinity with a more western flora.

It also occupies a variety of other dry, rocky openings. *S. ovata* ssp. *pseudoarguta*, as conceived by Epling, is limited to shale barrens.

*Scutellaria ovata* flowers June through August. It is presumably insect pollinated, but specific pollinators are not known. Epling (1942) suggested a hybrid origin for this species involving *S. lateriflora*. Colonies spread by means of very slender rhizomes, and this is probably an important means of reproduction.

## Distribution

*S. ovata* ssp. *rugosa* ranges in the middle and southern Appalachians from western MD through WV, VA, TN, and NC to northern AL. It is disjunct in the Ozarks of MO and southern IL. *S. ovata* ssp. *pseudoarguta* was recorded from a few WV shale barrens (the type locality is Kates Mountain), but there are no current occurrences known.

## Abundance and Current Status

Occurrences are local, but numbers of plants may be high. To what extent these “individuals” may be clones is not known. If ssp. *pseudoarguta* is regarded as a distinct taxon, it is probably very rare. Heritage Ranks for ssp. *pseudoarguta*: G5THQ, WV S1TH; for ssp. *rugosa*: G5T?, MD SR, VA SR, WV S1T?.

## *Trifolium virginicum*

### Nomenclature and Taxonomy

**Scientific name:** *Trifolium virginicum* Small ex Small & Vail

**Synonyms:** *Trifolium reflexum* L. var. *virginicum* (Small ex Small & Vail) McDermott

**Common names:** Kates Mountain clover

**Family:** Fabaceae (Leguminosae)

### Description

A prostrate perennial herb, 10-15 cm (4-6 in.) tall, with trifoliate leaves and globose clusters of whitish flowers. The short, sparsely hairy stems grow from a stout, deep taproot. Leaflets are distinctive, linear to oblanceolate, 1.5-6 cm (0.6-2.4 in.) long, 3-7 times as long as wide, slightly silky beneath. Lower stipules are scarious and quite or nearly clasping. The inflorescence is umbellate, globose, 2-3 cm (0.8-1.2 in.) in diameter, on a 4-10 cm (1.6-3.9 in.) peduncle. The hairy pedicels are first ascending, then becoming reflexed. Corollas are 10-12 mm (0.4-0.5 in.) long, white to yellow-pink. Legume is ovoid-oblong with 1-3 seeds. (Davison 1985, Isley 1990, Gleason and Cronquist 1991.) Chromosome number  $2n = 16$ .

The leaves of *Trifolium virginicum* are distinctive, making it unlikely that it would be confused with anything else.

## Ecology and Life History

*Trifolium virginicum* grows mostly on shale barrens and is usually considered endemic to that specific habitat, but it also occurs in cedar glades and other dry limestone woodlands in MD, where it prefers sites with 20-30% woody cover, south-to-west aspect, and circumneutral shale substrate (NatureServe 2002). Braunschweig, *et al.* (1999) report that it “recently has been found on diabase and ultramafic substrates on the northern and central Piedmont in VA, respectively.” On shale barrens, a preference is shown for the more open areas, including crevices in shale outcrops.

Populations are generally small (fewer than 30), with scattered plants.

Flowering is in May and June. Pollination is presumed to be by insects, but specific pollinators have not been reported. Platt (1951) reported variation in seed color with locality, suggesting genetic variation, but there seems to have been no work done on the genetics of *T. virginicum*.

## Distribution

The shale barren areas of PA (Bedford, Fulton, and Huntingdon counties), MD, VA, and WV. Also the northern and central Piedmont of VA (see Ecology and Life History above).

## Abundance and Current Status

Although there are many occurrences – over 100 – numbers of plants are usually very small. Most sites have less than 30 plants, and the total range probably supports only a few thousand. Nevertheless, the permanence of occurrences is illustrated by the fact that of 52 occurrences in WV, all but one have been seen in the last 20 years. Heritage Ranks: G3, MD S2S3, PA S1, VA S3, WV S3.

## OTHER SHALE BARREN PLANTS

Several other characteristic shale barren plant species are more or less rare, or of very limited distribution. Although not currently on the Regional Forester Sensitive Species List, these are discussed briefly below.

***Astragalus distortus* Torr. & Gray var. *distortus***, (= *Holcophacos distortus* (Torr. & Gray) (Fabaceae), bent milk-vetch or Ozark milk-vetch, is a branching low perennial herb with irregular lavender flowers. It is decumbent to ascending (1-4 dm [4-16 in.]) from a stout taproot and caudex, glabrate or sparsely pubescent, with alternate pinnately compound leaves and free stipules. The 10-25 leaflets are broadly obovate to elliptic, 3-12 mm (0.1-0.5 in.) long, obtuse or emarginate. Racemes exceed the leaves, of 8 to numerous flowers. Corolla 8-15 mm (0.3-0.6 in.) long and usually lavender-white with a spotted keel. The legume is 1.2-2.5 cm (0.5-1 in.) long, sulcate along both upper and lower sutures, and bent at ca. 90 degrees. While commonly occurring on limestone

elsewhere, in VA and WV it is “apparently restricted to shale slopes” (Isely 1990). This includes shale barrens, poor shaley fields and pastures, and road banks. Flowering occurs March – June. The population in the shale barren region of WV, VA and MD is disjunct from the midwest range of AR, LA, MS, OK, MO, and IL, “but no exomorphic differentiation seems to exist” (Isely 1990). This species is common in the midwest, but rare in Appalachia. Heritage Ranks: G5T5?, VA S1, WV S2 (although it is more abundant in VA!).

***Calystegia spithamea* (L.) Pursh ssp. *purshiana* (Wherry) Brummitt**, (= *C. sepium* (L.) R. Br. var. *pubescens* Gray, *C. spithamea* var. *pubescens* (Gray) C. F. Reed, *Convolvulus purshianus* Wherry, *C. sepium* L. var. *pubescens* (Gray) Fern., *C. spithameus* L. var. *pubescens* (Gray) Fern.) (Convolvulaceae), shale barren bindweed, is a short, erect, densely pubescent, perennial herb with simple alternate leaves and white flowers. Stems 1-4 dm (4-16 in.) high arise from spreading rhizomes forming colonies. The plant is densely velvety-pubescent. Leaves are oblong- or elliptic-sagittate with distinct basal auricles, blades 3-6 cm (1.2-2.4 in.) long. Floral bracts are ovate to cordate and keeled. The funnellform flower is 4-7 cm (1.6-2.8 in.) long. Similar to the typical variety, but differing in the dense pubescence and cordate leaf base. Treated in much of the literature as *Convolvulus purshianus*. Commonly on shale barrens and adjacent roadbanks. Flowering May and June. WV Heritage lists 63 recent occurrences. Heritage Ranks: G4G5T4, MD S3, PA S?, VA SR, WV S3. Considering its clonal nature, numbers of individuals are probably greatly overestimated. The species and its varieties/subspecies are in need of taxonomic study.

***Clematis albicoma* Wherry** (= *Coriflora albicoma* (Wherry) W. A. Weber), white-haired leatherflower ***Clematis coactilis* (Fern.) Keener** (= *Clematis albicoma* var. *coactilis* Fern.), and ***Clematis viticaulis* Steele** (= *Coriflora viticaulis* (Steele) W. A. Weber), Millboro leatherflower, are three similar shale barren endemic (or near-endemic) species in the Ranunculaceae. They are erect, not vining, perennial herbs, 2-6 dm (8-24 in.) high, with simple, opposite leaves and purple flowers. The leaves of *C. coactilis* are wooly pubescent beneath, while those of the other two are nearly or quite glabrous. The hairs on the achenes of *C. viticaulis* are erect or ascending, while the upper ones of *C. albicoma* are spreading or reflexed. All three species are found on shale in western VA and *C. albicoma* is also in adjacent WV. *C. coactilis* also occurs on limestone in the southwestern part of its range and on metamorphic shales and sandstones of the Blue Ridge barrens (Rawinski *et al.* 1996). All flower April – June. *C. viticaulis* is ranked G2, VA S2; *C. coactilis* is G2G3, VA S3; and *C. albicoma* is G4, VA S3S4, WV S3. In WV there are 47 occurrences of *C. albicoma* – 37 on private property, 8 on USFS lands, 2 on a U.S. Navy base.

***Eriogonum allenii* S. Wats.** (Polygonaceae), yellow buckwheat, is an erect (3-5 dm [12-20 in.] tall), dichotomously branched, perennial herb, floccose-tomentose throughout, with whorled leaves and bright yellow flowers. Leaves are entire, ovate-oblong, obtuse at base and apex, in whorls of 3-5. Inflorescence is rather flat topped and broad, with many calyx-like involucre that are 5-toothed. The yellow tepals are broad, obtuse, ca. 3

mm (0.1 in.) long. Restricted to shale barrens of WV and adjacent VA. Flowers in July and August. Heritage Ranks: G4, VA S3, WV S2.

***Helianthus laevigatus* T. & G.** (= *H. reindutus* (Steele) E. E. Wats.) (Asteraceae), smooth sunflower or shale-barren sunflower, is an erect perennial herb, essentially glabrous, 1-2 m (3-6 ft.) tall, from a short rhizome with fibrous roots. Leaves are mostly lanceolate, serrulate to entire, narrowed to a short-petiolate or sessile base. Heads are small, with involucre bracts glabrous but sometimes ciliolate. Disk is yellow, 1-1.5 cm (0.4-0.6 in.) wide. The 5-10 rays are yellow, 1-2 cm (0.4-0.8 in.) long. (Cronquist 1980.) Mostly on shale barrens in the northern part of its range, but commonly in other dry openings to the south (Braunschweig, *et al.* 1999). Flowers August-October. Heritage Ranks: G4, MD S1, PA SR, VA S4, WV S2.

***Hieraceum traillii* Greene** (= *H. greenii* Porter & Britton, a preoccupied name) (Asteraceae), shale-barren hawkweed or Green's hawkweed, is a perennial herb with a basal tuft of leaves and a 2-7 dm (8-28 in.) scape bearing heads of yellow flowers. Leaves spatulate to obovate, long-setose, especially beneath, not purple-veined. Stem naked or with 1-2 leaves near base, peduncles densely stellate-tomentose and with spreading blackish gland-tipped hairs. Involucre to 12 mm (0.5 in.), with 3 types of pubescence: long eglandular setae, blackish gland-tipped hairs, stellate hairs. The similar *H. venosum* has leaves with reddish-purple main veins above, and often all purple underneath, involucre 7-10 mm (0.3-0.4 in.), glabrous to stipitate-glandular but without long glandless setae. Shaley, open woods, often on shale barrens. Flowers May-August. Range is shale barren region of southern PA, MD, WV, VA. This species is in need of study to understand its status. Heritage Ranks: G4, MD SR, PA S1, VA S4, WV S?.

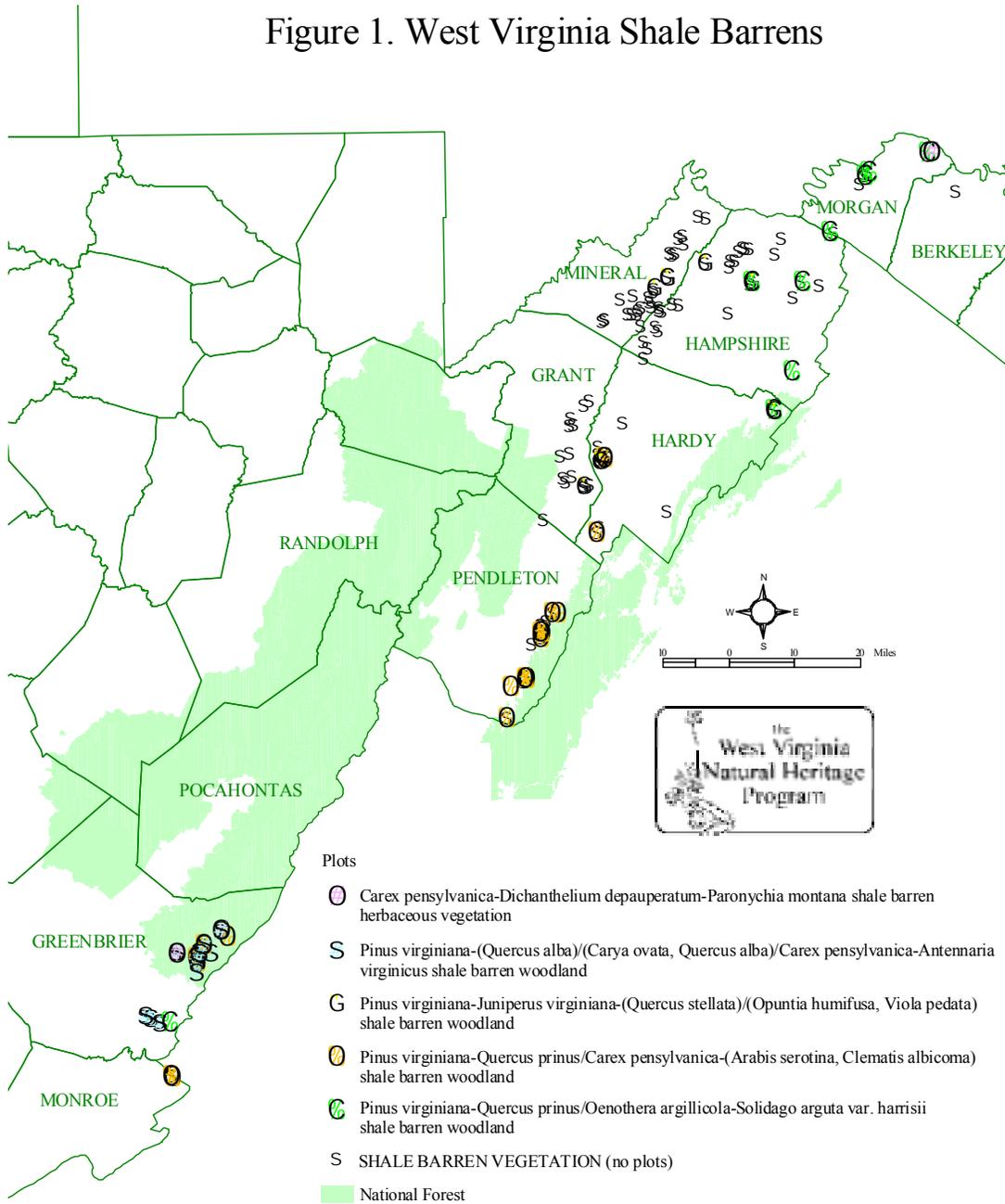
***Oenothera argillicola* Mackenzie** (incl. *O. argillicola* var. *pubescens* Core & Davis) (Onagraceae), shale-barren evening-primrose, is a suberect leafy biennial or short-lived perennial with showy yellow flowers. Stems to 14 dm (5 ft.) tall, often with red color, rise from a taproot and basal rosette of leaves 7-25 cm (2.8-10 in.) long, narrowly oblanceolate, with remotely dentate margins. Cauline leaves 6-13 cm (2.4-5 in.) long, narrow, margins remotely dentate, sinuate-dentate, or subentire, apex and base acute (Dietrich, *et al.* 1997). Near glabrous or somewhat hairy in inflorescence or puberulent on leaves. Inflorescence spicate, leafy bracted, nodding at tip, buds erect. Sepal appendages subterminal, the actual tip represented by a small lobe or ridge. Petals 2.5-4 cm (1-1.6 in.) long, anthers 8-12 mm (0.3-0.8 in.) long. Fruit near terete, roundly 4-angled, thickest near the base, seeds horizontal and prismatic angular. Most closely resembles *O. parviflora* L., which sometimes may also be found on shale barrens, but has significantly larger flowers. Var. *pubescens* Core & Davis (Core & Davis 1953) is generally considered a taxonomically insignificant form. Throughout the shale barren region on barrens, shale outcrops and adjacent road banks. Has also been collected in Randolph and Tucker Counties, WV. (Strausbaugh and Core 1977). Flowering July – October, insect pollinated, seeds germinate easily. Regularly hybridizes with *O. parviflora* (Dietrich, *et al.* 1997). Heritage Ranks: G3G4, MD S3, PA S2, VA S3, WV S3.

***Packera antennariifolia* (Britt.) W. A. Weber & A. Love** (= *Senecio antennariifolius* Britt.) (Asteraceae), cat's paw ragwort or pussytoes ragwort, is a conspicuously pubescent perennial herb arising from a well-developed caudex with rhizomes. Stem 1.5-4 dm (6-16 in.) tall, white tomentose. Leaves densely white tomentose beneath and glabrate above. Basal leaves in a dense rosette, elliptic to ovate, shallowly and remotely dentate, 1-3.5 cm (0.4-1.4 in.) long. Cauline leaves few and much reduced, linear, entire or pinnatifid. Heads 3-12, involucre 5-8 mm (0.20-0.31 in.) high, rays yellow, 5-10 mm (0.2-0.4 in.) long. (Cronquist 1980.) On the more open parts of shale barrens, including the Blue Ridge barrens. Flowers from mid-April to early June. Reproduction is both by wind- and water-dispersed seeds and by spreading and fragmenting rhizomes (Walck 1994). Heritage Ranks: G4, MD S3, PA S1, VA S3, WV S3.

***Solidago arguta* Ait. var. *harrisii* (Steele) Cronq.** (= *S. harrisii* Steele) (Asteraceae), shale-barren goldenrod, is a 5-15 dm (20-60 in.) tall herb from a stout perennial caudex, essentially glabrous except for the puberulent inflorescence. Basal leaves coriaceous, broadly elliptic to ovate, truncate at the base, long petiolate, toothed to subentire, to 30 cm (12 in.) long. Cauline leaves smaller and narrower. Inflorescence narrow or divergent, the branches recurved-secund. Involucre 4-5 mm (0.16-0.20 in.), bearing 9-15 disc flowers and about 5 rays. Achenes hairy. (Fernald 1950, Cronquist 1980.) *S. arguta* var. *harrisii* is a distinctive shale barren ecotype of a more common and widespread species. There is probably sufficient reason to recognize this taxon at the species level (Morton 1973). Flowers June – August. Heritage Ranks: G5T4, MD S3, PA S1, VA S3, WV S3.

***Taenidia montana* (Mackenzie) Cronq.** (= *Pseudotaenidia montana* Mackenzie) (Apiaceae), mountain parsley, shale-barren pimpinell, or mountain pimpinell, is a smooth, perennial herb to 8 dm (30 in.) tall, with a “heavy, rather unpleasant, somewhat anise-like odor” (Cronquist 1991). Leaves are ternately or pinnately compound, with broad, clasping petioles and ovate or elliptic leaflets 1-4 cm (0.4-1.6 in.) long. The small yellow flowers are in compound umbels, generally without bracts. Fruit dorsally compressed, 4-7 mm (0.16-0.28 in.) long, with narrow, lateral wings. Very similar to *T. integerrima*, which differs in having fruits laterally compressed and not winged, and having a light celery-like scent. *T. montana* occurs on shale barrens, dry limestone woodlands and rock outcrops throughout the shale barren range. Flowers April – May. Heritage Ranks: G4, MD S2, PA S1, VA S3, WV S3.

Figure 1. West Virginia Shale Barrens



**Figure 2.** The mid-Appalachian Shale Barrens Region.



Figure 2. The mid-Appalachian shale barren region.

## **CURRENT COMMUNITY CONDITION, DISTRIBUTION AND ABUNDANCE**

As a natural community type, shale barrens seem to be quite stable and long lived (Braunschweig, *et al.* 1999). Their total destruction usually involves heavy equipment and considerable effort and is seldom considered worthwhile. The rare species that inhabit them are undoubtedly more vulnerable. While some barrens have been destroyed over the years by road and railroad construction, most remain in a near-natural condition. Some are threatened by exotic invasive plants, especially where disturbance is excessive. See Present and Potential Threats to Habitat and Monitoring below.

Mid-Appalachian shale barrens occur primarily in the Ridge and Valley Physiographic Province from southwestern VA (Montgomery County) and adjacent WV (Monroe County) north through western MD (Allegany and Washington counties) into south-central PA (Bedford, Fulton, Franklin, Huntington, Mifflin, and Perry counties). VA has most of the known shale barren habitat – more than the other three states combined. Massanutten Mountain in Shenandoah Valley has many barrens, and barrens of the “Blue Ridge sub-type” are found in the Blue Ridge Physiographic Province of western VA. (See maps, Figures 1 and 2.)

While the total number of known barrens continues to increase with additional field work, and there remains some vagueness over what constitutes a shale barren, these numbers from Heritage Program data are an approximation of current known abundance: Pennsylvania, 25; Maryland, 35; Virginia, 800; West Virginia, 100.

## **POPULATION BIOLOGY AND VIABILITY OF SHALE BARREN SPECIES**

What little is known about the population biology of the characteristic shale barren species has been discussed under Regional Forester Sensitive Species Assessment.

Populations of these plants are generally remarkably small. Although some, such as *Allium oxyphilum* and *Astragalus distortus* may number in the thousands, others do not exceed a few hundred per population, and populations are commonly less than a few dozen. Although the perennials seem to be fairly stable in numbers in the absence of disturbance, *Arabis serotina* populations are believed to fluctuate greatly from year to year.

Even within the apparently suitable habitat available to them, shale barren plants are generally very sparse. This suggests problems with reproduction or dispersal, or perhaps unrecognized microhabitat factors. The sparseness of any kind of vegetation on the more open barrens indicates that competition is not limiting there, but herbivory could be a factor.

Shale barrens are effective islands, and small ones at that. Essentially nothing is known about movement of endemics between barrens, but it seems likely that dispersal of these plants beyond the bounds of a given barren occurs very infrequently.

Baskin and Baskin (1988) show that shale barren endemics, like those of other southeastern U.S. rock outcrop habitats, tend to exhibit considerable genetic variability. Several authors have noted infraspecific variation in morphology of these species: *Eriogonum allenii* (Bellmer 1968), the three *Clematis* spp. (Platt 1951, Keener 1967), *Trifolium virginicum* (Platt 1951), and *Oenothera argillicola* (Core & Davis 1953, Dietrich, *et al.* 1997).

## **PRESENT AND POTENTIAL THREATS TO HABITAT, AND MONITORING**

Threats to shale barrens can be divided into natural and anthropogenic causes. The most important natural threats are probably erosion of the shaley slope by rainfall and over-browsing by deer. Feeding by larval lepidoptera may have a detrimental effect on the rare endemic *Arabis serotina*. Fire is not a major threat to the barrens because of the lack of accumulated debris needed to fuel a devastating fire (Allard and Leonard 1946). A forest fire that thins the surrounding woodland may create more open conditions, but revegetation probably occurs before endemic plant populations are able to expand.

Anthropogenic – human-induced – threats to shale barrens are less numerous than to most other types of habitats due to the topography and geology of the sites. The steep slope creates difficult access, which generally tends to discourage human activities and traffic. Nevertheless, several barrens have been destroyed by road, railroad and dam construction and by the removal of shale to resurface roads.

Monitoring for threats is generally incidental to the monitoring of rare species (see Research and Monitoring below). There is some ongoing monitoring (and management) for invasive plants in MD (D. Keech, pers. comm.).

### **Commercial, Recreational, Scientific or Educational Over-utilization**

Shale barrens have little commercial value. Their steep slopes make them poor sites for residential or business construction. Grazing potential is poor, and what little timber is present is not usually of commercial value (although the cutting of red cedar fence posts is a possibility on some barrens). Their value for recreation is limited for the same reasons. Even hikers and hunters are apt to avoid such steep slopes of slippery, loose shale – often threatening a drop into a stream below! However, a number of examples exist (e.g., High Germany Hill, Outdoor Club, and Carroll Road Shale Barrens in MD and Slaty Mountain, Monroe Co., WV) where development on the ridge above a barren resulted in trash dumping, introduction of weeds, etc.

Those visiting for scientific or educational purposes may unwittingly cause significant damage. The WV Heritage Program receives a few inquiries every year from teachers,

researchers and naturalists who want to visit one or more barrens. Some want to bring a class or other group. Towson University plant ecology classes regularly include trips to western MD barrens. Displacement of the substrate and plants by human feet is the main problem, but over-collecting may also have an impact. Many of the rare plant species are present in very small numbers. A hundred years of over-collecting on Kates Mountain, Greenbrier Co., WV, is believed to have extirpated some species there.

There seems to be a consensus among shale barren researchers that walking and climbing on the barrens may be seriously damaging and should be minimized. Some programs have simplified or discontinued monitoring, citing “observer impact,” “trampling,” and “slide damage” (J. Dunscomb, pers. comm., WV Heritage files). R. Bartgis, (pers. comm.) has suggested using photo points as a low-impact method, but apparently this has not been implemented.

Impacts from human visitors might be reduced by the construction on selected shale barrens of board walks such as are used in heavily visited wetlands (e.g., Cranesville Swamp in Preston Co., WV and Cranberry Glades in Pocahontas Co., WV). These barrens should be selected for proximity to a road and parking as well as for their ecological quality.

Several shale barren plant species have horticultural potential, including such endemics as *Eriogonum allenii*, *Trifolium virginicum*, and *Phlox buckleyi* (Oliver 2000). Allard & Leonard in their classic paper on the Massanutten barrens (1946) used 1½ pages to expound on the beauty of the barrens wildflowers. Collecting for the garden is not known to have been a problem in the past, but could become one. The New England Wildflower Society Native Plant Nursery (the largest in New England) has listed *Eriogonum allenii* plants for sale in the past and currently lists *Clematis albicoma*, *Oenothera argillicola*, and *Phlox buckleyi*. Plant Delights Nursery on their web site (<http://www.plantdelights.com>) mention that “we have once again spent the year traveling around the country on plant expeditions . . . one into the Shale Barrens of Virginia and West Virginia. . . . Seed from many of the expeditions are already sprouting.” Of course, responsible collecting and subsequent introduction into the nursery trade could help to insure survival of some of these species. The Edith J. Carrier Arboretum at James Madison University in Harrisonburg, VA boasts the country’s only artificial shale barren, with seven endemic plants (James Madison University Arboretum 2001).

### **Disease or Predation**

No incidence of disease has been reported for shale barren plants or animals. Extensive defoliation of individuals of *Arabis serotina* and *Clematis albicoma* by unidentified insects has been observed, but whether this may impact the population is unknown. Various herbivores such as rabbits and woodchucks doubtless graze the barrens, but probably the only one causing much impact is the whitetail deer. The current overpopulation of deer in the shale barrens region is probably adversely affecting many plant species. Speaking of MD’s barrens, Ed Thompson recently said, “We have noticed

an increase in deer browsing on rare plants such as Kates Mountain clover in recent years,” and *Arabis serotina* has been subject to heavy browsing in WV for several years (Bartgis 1987 and WV Heritage data).

### **Inadequacy of Existing Regulatory Mechanisms**

Laws or regulations to protect shale barrens as communities do not exist on state or federal levels. There is protection for some of the endemic plant species, however, and this affords incidental protection to the barren habitat where such plants are present. *Arabis serotina* is federally listed as endangered, and some other species are protected under state law in PA, MD, and VA. By this means, many barrens on public lands are afforded a degree of protection. Those barrens on which protected species have not yet been found, and those on private land are vulnerable. Any legal protection assumes that enforcement will be adequate, and enforcement varies with local and national political climate.

### **Other Natural or Human Factors Affecting Continued Existence**

Spraying of pesticides is a potential threat to invertebrate and plant species of shale barrens. The widespread use of Dimilin, Gypchek, and Btk (*Bacillus thuringiensis* var. *kurstaki*) in an attempt to control gypsy moth (*Lymantria* [= *Porthetria*] *dispar*) has had a detrimental effect on shale barrens lepidoptera such as the rare butterfly *Pyrgus wyandot*. In 1990 the Larenim Park shale barren (Mineral Co., WV) was sprayed with Dimilin under a cooperative state-county-landowner program (Dean 1990). The WV Department of Agriculture plans to spray 74,388 acres in 2002, including much of the state’s northern shale barren area (WV Dept. of Agriculture 2002). Although no example is known, roadside or powerline spraying of herbicides could potentially damage barrens plants.

Exotic invasive plants, i.e., “weeds”, are a potentially serious threat to native species and natural communities (Chester, *et al.* 2001, Wilcove *et al.*, 1998), and shale barrens are not immune. Weed seeds are often accidentally carried by humans, their equipment, and domestic animals, and human-caused disturbance to the substrate or soil encourages their establishment. Roadways, pipeline and powerline right-of-ways, and hiking trails are often corridors along which weeds enter natural communities. Weeds seem not to be a problem on relatively undisturbed barrens. Keech (1996) reviewed literature and visited shale barrens in MD, PA, and WV and determined the 10 most seriously threatening weeds to be *Ailanthus altissima*, *Alliaria petiolata*, *Bromus sterilis* (and probably other *Bromus* spp.), *Centaurea biebersteinii*, *Coronilla varia*, *Linaria vulgaris*, *Lonicera morrowi*, *L. japonica*, *Polygonum convolvulus*, and *Verbascum thapsus*. Of these, she considers *Centaurea*, *Bromus*, and *Lonicera morrowi* to be the worst (D. Keech, pers. comm.). *Bromus* is a very serious problem on West Virginia barrens, especially in the Potomac drainage (R. Bartgis, pers. comm.), and it is a significant problem on Boy Scout Barren, Carroll Road Barren, Oldtown/Romney Barren, and Country Club Barren in MD. *Centaurea biebersteinii* is probably the most important weed on VA’s barrens (C. Ludwig, pers. comm.) Most of these species are tolerant of hot, dry conditions, produce

abundant seeds that easily germinate and establish new plants, and have the potential to build large populations that could out compete native plants.

## **SUMMARY OF LAND OWNERSHIP AND EXISTING PROTECTION**

Sufficient data are not available for MD and VA to discuss private versus public land ownership, except to say that a great majority of the shale barrens are on private land. Of Pennsylvania’s 23 barrens, five are owned by the Army Corps of Engineers and one is on a TNC preserve.

An inventory of current ownership of land with shale barrens in West Virginia revealed that the majority of the barrens within the state are privately owned. The following table is a summary of known ownership. It should be noted that we are aware of many existing barrens for which there is no data, but these numbers will give an indication of relative distribution of ownership.

<b>Number of Shale Barrens</b>	<b>Ownership</b>
78	Private Property
9	Monongahela National Forest, US Forest Service
2	Shared ownership between Private Property and Monongahela National Forest
3	The Nature Conservancy
2	US Navy
2	Grant and Mineral County Governments
1	George Washington National Forest

Approximately 11 percent of the known shale barrens in West Virginia are entirely or partly on the Monongahela National Forest. An additional 6 percent are on other government lands, including George Washington National Forest, the U. S. Navy base at Sugar Grove, and two county properties. Barrens owned by the U. S. Forest Service are presumed to be afforded some degree of protection if they support Endangered or Sensitive Species. The U. S. Navy is aware of its barrens and is preserving them. Larenim County Park, Mineral County, is protected from gross destruction such as road building, etc., but is abused and overused by the public. The other county property has no more protection than private land. The Nature Conservancy’s three shale barrens make another 3 percent, and they are owned for the express purpose of preserving them. Eighty percent of the known shale barrens are on private property, and may or may not be protected by the landowners.

The two shale barrens that are owned partly by Monongahela National Forest and are partly in private ownership are Blue Bend and Upper Whites Draft, both in Greenbrier County southwest of Neola. Blue Bend Shale Barren is reached by going 6 miles southwest of Neola on Rt. 92, then west on Little Creek/Blue Bend Rd. about 3.3 miles. It occurs on a narrow band of calcareous shale. Vegetation consists of scattered *Quercus*,

*Carya*, *Cercis*, *Celtis*, and *Prunus allegheniensis* trees and sparse herbs. Sensitive species present are *Arabis serotina*, *Trifolium virginicum*, and *Scutellaria ovata*. The private owner is K. M. Gillespie, 7 Salesbury Ave., White Sulphur Springs, WV 24986. (Walton 1995.)

Upper Whites Draft Shale Barren is 5.9 miles southwest from Neola on Rt. 92, then east 1.5 miles on Whites Draft Road. It is a wide band of sparse, stunted *Pinus*, with *Carya*, *Quercus*, and *Ptelea*. Herbs are scattered throughout, but are more common in the openings. Sensitive species present are *Arabis serotina*, *Trifolium virginicum* and *Scutellaria ovata*. The private portion is owned by Melvin Dixon, 2580 Crane Schoolhouse Rd., Bethel OH 41506. (Walton 1995.)

## **SUMMARY OF EXISTING MANAGEMENT ACTIVITIES**

Some shale barrens are managed as preserves by The Nature Conservancy or state agencies, while others fall under the general management practices of National Forests. One is within a county park and a few are in state forests. Managed areas and activities are discussed by state.

**Maryland.** The barrens on Green Ridge State Forest lands are included in the Forest Management Plan as Sensitive Management Zones or Wildlands – a legislative designation (E. Thompson, pers. comm.). Two invasive plant management projects are currently underway on MD shale barrens (D. Keech, pers. comm.).

**Pennsylvania.** Five shale barrens are on Army Corps of Engineers lands and one is a Western Pennsylvania Conservancy preserve. There is no active management of the shale barren communities at present (C. Bier, pers. comm.).

**Virginia.** Johnson’s Creek Natural Area Preserve (NAP) is the only shale barren in the NAP system. Management “is focused on maintaining and enhancing the natural values of land to conserve biological diversity” (Va. Dept. of Conservation and Recreation, Div. of Natural Heritage 2002a). No specific active management is being done (M. Leahy, pers. comm.). In 1994 there was a project to remove *Ailanthus* from Potts Creek TNC Preserve, using cutting and herbicide application.

**West Virginia.** Twelve WV barrens are on U. S. Forest Service land, and eight of these support Endangered and Sensitive Species. Three barrens are TNC preserves, two are on a Navy base, and one is a county park. None of these are actively managed for the qualities that make them shale barrens, except for occasional attempts on TNC preserves to suppress exotic vegetation.

## **PAST AND CURRENT CONSERVATION ACTIVITIES**

Conservation has consisted of acquisition and protection of shale barrens by government and private organizations.

Several barrens on private land in **Maryland** have been bought by The Nature Conservancy (E. Thompson, pers. comm.).

The Western **Pennsylvania** Conservancy has one shale barren preserve.

In **Virginia**, Potts Creek and Ironto Shale Barrens are TNC preserves, while Johnson's Creek Shale Barren is in the state Natural Area Preserve system. VA Heritage has also proposed many barrens on the George Washington and Jefferson National Forests to be designated as Special Biological Areas. Thus far, the U.S. Forest Service has not acted on this recommendation (C. Ludwig, pers. comm.).

In **West Virginia**, Monongahela National Forest has two candidate Research Natural Areas – Meadow Creek and Whites Draft – that include shale barrens. Larenim Park, a county park near Keyser, has a shale barren, and barrens are included in Sugar Grove Naval Security Group Activity ownership and three TNC preserves – Brushy Mountain, Cacapon River and Slaty Mountain.

North Carolina Botanical Garden, as part of the Member Network of the Center for Plant Conservation (<http://ridgwaydb.mobot.org/cpcweb/>), is growing and maintaining *Arabis serotina*. This is part of the living National Collection of Endangered Plants.

In an effort to encourage awareness and voluntary conservation activity on the part of the public, Virginia Cooperative Extension Service has included shale barrens in a recent publication as one example of “unique and special areas” that should be considered in planning management activities on private forest land (Walters and Johnson 2000).

## **RESEARCH AND MONITORING**

### **Existing Surveys, Monitoring and Research.**

Heritage Programs in the four shale barren states have all done vegetation analysis on shale barrens with the purpose of defining natural communities. The results are discussed under Community Classification and Synonyms. And there have, of course, been efforts to map all known shale barrens in the Heritage databases. Virginia Heritage Program surveyed George Washington National Forest for shale barrens in 1994-97 using aerial photographs and field surveys (Belden, *et al.* 1999). Of 809 potential barrens delineated on the photos, 166 were checked on the ground, leading to the discovery of 85 new “significant barrens”. Rare plant species were found on 65 (76%) of these. Field work in 1998 on the New Castle Ranger District of Jefferson National Forest discovered another 20 barrens, of which 19 (95%) had rare species.

*Arabis serotina*, being federally listed as endangered, has been the subject of several studies and extensive monitoring, and has insured that other species have been monitored incidentally. A three-year life history study was undertaken by Rouse and Milner (1993) in VA and WV and a similar study (Harmon and Ford-Werntz 2002) was ongoing at Little Fork Shale Barren, Pendleton Co., WV for the years 1994 - 1995. Research on the

germination of *A. serotina* seeds is currently being done by David Wing at Shepherd College, Shepherdstown, WV.

There is no monitoring of shale barrens ongoing in PA (J. Wagner, pers. comm.). At the present, The Nature Conservancy in VA does some presence/absence survey for rare species on their preserves (Ironto and Potts Creek) that include barrens, but have abandoned more complex monitoring protocols because of observer impact and time required (J. Dunscomb pers. comm.). VA Heritage monitored *Arabis serotina*, *Clematis* spp., and *Eriogonum allenii* in the 1990's, but are doing no shale barren monitoring at present (C. Ludwig pers. comm., M. Leahy pers. comm.). E. Thompson (pers. comm.) reports that MD Heritage has likewise discontinued routine monitoring on barrens, mostly because of concerns about the impact of visitors, but is currently monitoring some rare butterfly populations. Some MD barrens will also be monitored with a crew of volunteers for invasive plants beginning this year (D. Keech, pers. comm.). Other than *Arabis serotina* monitoring and vegetation plot sampling for community classification, WV Heritage currently has no organized effort to survey for or monitor shale barrens.

In spring of 2002, for the first time point count surveys for breeding birds are being established on shale barrens in WV (D. Mitchell pers. com.). Most shale barrens are smaller than the area apt to be covered by a point count, making this method less than ideal for determining use of barrens by birds, but the results of these efforts may prove interesting.

John M. Matter of Juniata College has an ongoing study of the northern fence lizard, at Raystown Field Station, Huntingdon, PA (<http://faculty.juniata.edu/matter/spiny.htm>). He is evaluating population size, age structure, longevity, territoriality, and thermoregulatory biology. The study site is predominately shale barren.

The Pennsylvania Natural Diversity Inventory undertook an intensive survey of invertebrates on barrens in 1996-97. Specimens that were trapped and collected are presently being identified at Carnegie Museum of Natural History, and a report is due out in the summer of 2002. (C. Bier, pers. comm.).

### **Survey Protocol**

Protocol for survey and monitoring of rare shale barren species usually calls for the counting of individual plants and some estimate of the proportion of mature or flowering stems. For several years the protocol used by the WV Natural Heritage Program for monitoring *Arabis serotina* required counting individual plants (as rosettes or bolting plants) on two barrens, Brandywine and Little Fork, every year and for each of the other known populations every five years. Starting in 2002, Brandywine and Little Fork barrens will be monitored every two years, while the others will continue to be monitored every five years. This decrease is due mainly to concern about possible adverse impacts from frequent visits.

## Research Priorities

Examination of the literature of shale barren ecology reveals abundant contradictions and the persistence of hypotheses (usually presented as fact) that were disproved by Robert Platt over 50 years ago. Even the most recent writings cling to the myths of an exceedingly dry habitat with nutrient-poor substrate and an unstable, rapidly eroding surface maintained by the obligatory undercutting stream. Braunschweig, *et al.* (1999) say, “According to Platt (1951), a surface layer of rock fragments and its rapid erosion are important in maintaining shale barrens.” Platt actually noted that “several lines of evidence . . . demonstrate that shale barrens are not the subject of extreme erosion,” and described the correlation of barrens with areas of exceptionally hard, erosion-resistant shales. There is almost universal mention of the undercutting stream (e.g., Ludwig & Van Alstine 1991, Morse 1993, Walton & Harmon 1995), and the action of such a stream doubtless serves to maintain many bottom-slope barrens, but as Platt pointed out, there are “a greater number of barrens away from streams than along their course,” and it seems obvious that the erosive influence of a stream would, in most cases, reach only a short distance upslope. Original observations and experimental work are far scarcer than speculation and restating of old ideas. Clearly, much valuable research remains to be done.

Low-impact methods need to be developed for the monitoring of rare species on shale barrens, perhaps involving photo points or limited sampling at infrequent intervals. In view of the impact of trampling by well-intentioned researchers, this may be the most pressing need.

Much remains to be learned about the ecology and life history of shale barren plants, including pollination, seed viability and germination, vegetative reproduction, and dispersal. Especially interesting from a conservation standpoint is the question of how endemics may move between barrens (if indeed they do). Work is still needed to clarify the taxonomic status of some endemics or near endemics, including *Scutellaria ovata* (does var. *pseudoarguta* = var. *rugosa*?), *Calystegia spithamea* ssp. *purshiana* (questions remain about subspecific variation), *Allium oxyphilum* (distinct from *A. cernuum*?), *Solidago arguta* var. *harrisii* (should *harrisii* be elevated to species?), and *Astragalus distortus* (are there morphological differences in this disjunct population?). The distributions and habitat preferences of *Allium oxyphilum* and *Hieraceum traillii* need study.

A fundamental need is to determine and map the locations of all shale barrens. This is a large task that could be approached one area at a time. It has already been done rather thoroughly for George Washington National Forest (Belden, *et al.* 1999), and covering Monongahela National Forest would be a logical next step. An experienced photo-interpreter could delineate probable barrens on aerial photographs, using existing site-specific data to establish signatures. This would be followed by checking these delineations on the ground to assure their accuracy. Newly discovered barrens could be examined for rare species, etc. at the same time.

Eventually, barrens should be classified as to community types present. Distribution and protection status should be considered for these communities, and conservation needs determined. How many barrens with each community type are needed to assure viability?

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## **APPENDIX A: List Of Contacts**

### **Information Requests**

Dan Arling, biologist, Monongahela National Forest, West Virginia  
James Arnold, WV Arachnological Survey, Huntington, West Virginia  
Ashton Berdine, Joint Central Appalachians Program, TNC, West Virginia  
Charles Bier, Heritage Program zoologist PNDI West, Pennsylvania  
Judy Dunscomb, TNC, Virginia  
Dan Evans, plant taxonomist, Marshall University, West Virginia  
Jean Fike, community ecologist, PNDI Central, Pennsylvania  
Jan Garrett, botanist/ecologist, Monongahela National Forest, West Virginia  
Kevin Heffernan, Heritage Program biologist, DCR, Virginia  
Fred Huber, biologist, George Washington and Jefferson National Forests, Virginia  
Curtis Hutto, natural areas steward, DCR, Virginia  
Donnelle Keech, Allegany Forest Project Manager, TNC, Maryland  
Mike Leahy, preserve manager, Johnson's Creek NAP, DCR, Virginia  
Chris Ludwig, Heritage Program biologist, DCR, Virginia  
Donna Mitchell, DNR, West Virginia  
Greg Podniesinski, ecologist, PNDI East, Pennsylvania  
Steve Roble, Heritage Program zoologist, DCR, Virginia  
Megan Rollins, Heritage Program database manager, DCR, Virginia  
Ed Thompson, Heritage Program ecologist, DNR, Maryland  
Johnny Townsend, Heritage Program botanist, DCR, Virginia  
James Vanderhorst, Heritage Program community ecologist, DNR, West Virginia  
Jeff Wagner, Heritage Program ecologist, PNDI West, Pennsylvania  
Dean Walton, Heritage Program ecologist, DCR, Virginia  
Alfred Wheeler, entomologist, Clemson University, South Carolina  
Jennifer Wykle, Heritage Program zoologist, DNR, West Virginia

### **Review Requests**

**APPENDIX B:** scientific and common names of organisms mentioned in text

**Plants**

<i>Acer Rubrum</i>	RED MAPLE
<i>Ailanthus Altissima</i>	TREE OF HEAVEN
<i>Alliaria Petiolata</i>	GARLIC MUSTARD
<i>Allium Cernuum</i>	WILD ONION
<i>Allium Oxyphilum</i>	LILLYDALE ONION
<i>Ambrosia Artemisiifolia</i>	COMMON RAGWEED
<i>Amelanchier Arborea</i>	COMMON SERVICEBERRY
<i>Amelanchier Sanguinea</i>	ROUNDLEAF SERVICEBERRY
<i>Antennaria Virginica</i>	SHALEBARREN PUSSYTOES
<i>Arabis Laevigata</i>	SMOOTH ROCKCRESS
<i>Arabis Serotina</i>	SHALE BARREN ROCKCRESS
<i>Asclepias Quadrifolia</i>	FOUR-LEAVED MILKWEED
<i>Asplenium Bradleyi</i>	BRADLEY'S SPLEENWORT
<i>Asplenium Montanum</i>	MOUNTAIN SPLEENWORT
<i>Asplenium Pinnatifidum</i>	PINNATIFID SPLEENWORT
<i>Asplenium Platyneuron</i>	EBONY SPLEENWORT
<i>Asplenium Ruta-Muraria</i>	RUE SPLEENWORT
<i>Asplenium Septentrionale</i>	FORKED SPLEENWORT
<i>Asplenium X Gravesii</i>	GRAVE'S SPLEENWORT
<i>Asplenium X Wherryi</i>	WHERRY'S SPLEENWORT
<i>Aster Schistosus</i>	AN ASTER
<i>Astragalus Distortus</i>	BENT MILKVETCH
<i>Bouteloua Curtipendula</i>	SIDE-OATS GRAMA
<i>Bromus Japonicus</i>	JAPANESE BROMEGRASS
<i>Bromus Sterilis</i>	BARREN BROMEGRASS
<i>Calestegia Spithamea</i>	LOW BINDWEED
<i>Calestegia Spithamea Ssp. Purshiana</i>	SHALE BINDWEED
<i>Carex Communis</i>	A SEDGE
<i>Carex Pensylvanica</i>	PENNSYLVANIA SEDGE
<i>Carya Glabra</i>	PIGNUT HICKORY
<i>Carya Ovata</i>	SHAGBARK HICKORY
<i>Castanea Dentata</i>	AMERICAN CHESTNUT
<i>Celtis Tenuifolia</i>	DWARF HACKBERRY
<i>Centaurea Maculosa</i>	SPOTTED KNAPWEED
<i>Cheilanthes Castanea</i>	CHESTNUT LIPFERN
<i>Cheilanthes Lanosa</i>	HAIRY LIPFERN
<i>Clematis Albicoma</i>	WHITE-HAIRED LEATHERFLOWER
<i>Clematis Coactilis</i>	VIRGINIA WHITE-HAIRED LEATHERFLOWER

*Clematis Viticaulis*  
*Coronilla Varia*  
*Crataegus Spp.*  
*Cunila Origanoides*  
*Danthonia Spicata*  
*Delphinium Exaltatum*  
*Deschampsia Flexuosa*  
*Dichanthelium Depauperatum*  
*Draba Ramosissima*  
*Epigaea Repens*  
*Eriogonum Allenii*  
*Erysimum Capitatum*  
*Festuca Elatior*  
*Fraxinus Americana*  
*Galium Pilosum*  
*Gaylussacia Baccata*  
*Geranium Maculatum*  
*Hamamelis Virginiana*  
*Helianthus Laevigatus*  
*Hieraceum Floribundum*  
*Hieraceum Venosum*  
*Hieracium Traillii*  
*Houstonia Longifolia*  
*Hydrangea Arborescens*  
*Hypericum Prolificum*  
*Hypoxis Hirsuta*  
*Juniperus Virginiana*  
*Kalmia Latifolia*  
*Liatris Turgida*  
*Linaria Vulgaris*  
*Linum Lewisii*  
*Lonicera Japonica*  
*Lonicera Morrowii*  
*Nyssa Sylvatica*  
*Oenothera Argillicola*  
*Oenothera Parviflora*  
*Opuntia Humifusa* (Incl. *O. Compressa*)  
*Ostrya Virginiana*  
*Oxydendrum Arboreum*  
*Packera (=Senecio) Antennariifolius*  
*Paronychia Montana*  
*Pedicularis Canadensis*  
*Phlox Buckleyi*  
*Phlox Subulata*  
*Pinus Strobus*  
*Pinus Virginiana*

MILLBORO LEATHERFLOWER  
CROWN VETCH  
HAWTHORN  
DITTANY  
POVERTY OAT-GRASS  
TALL LARKSPUR  
CRINKLED HAIRGRASS  
STARVED PANIC GRASS  
ROCKTWIST  
TRAILING ARBUTUS  
YELLOW BUCKWHEAT  
WESTERN WALLFLOWER  
MEADOW OR TALL FESCUE  
WHITE ASH  
HAIRY BEDSTRAW  
BLACK HUCKLEBERRY  
WILD CRANESBILL  
WITCH-HAZEL  
SMOOTH SUNFLOWER  
SMOOTH HAWKWEED  
RATTLESNAKE-WEED  
GREEN'S HAWKWEED  
LONG-LEAVED BLUETS  
WILD HYDRANGEA  
SHRUBBY ST. JOHN'S-WORT  
YELLOW STARGRASS  
RED CEDAR  
MOUNTAIN LAUREL  
APPALACHIAN BLAZING STAR  
TOADFLAX  
PRAIRIE FLAX  
JAPANESE HONEYSUCKLE  
MORROW'S HONEYSUCKLE  
BLACK GUM  
SHALE EVENING-PRIMROSE  
NORTHERN EVENING-PRIMROSE  
PRICKLY-PEAR  
IRONWOOD  
SOURWOOD  
PUSSYTOES RAGWORT  
MOUNTAIN NAILWORT  
COMMON LOUSEWORT  
SWORDLEAF PHLOX  
MOSS PHLOX  
WHITE PINE  
SCRUB PINE

<i>Polygonum Convolvulus</i>	BLACK BINDWEED
<i>Polystichum Acrostichoides</i>	CHRISTMAS FERN
<i>Potentilla Canadensis</i>	CANADA CINQUEFOIL
<i>Prunus Alleghaniensis</i>	ALLEGHENY PLUM
<i>Prunus Serotina</i>	WILD BLACK CHERRY
<i>Pseudotaenidia Montana</i>	MOUNTAIN PIMPERNEL
<i>Pteridium Aquilinum</i>	BRACKEN FERN
<i>Pyrola Rotundifolia</i>	ROUND-LEAVED AMERICAN WINTERGREEN
<i>Quercus Alba</i>	WHITE OAK
<i>Quercus Coccinea</i>	SCARLET OAK
<i>Quercus Illicifolia</i>	SCRUB OAK
<i>Quercus Muhlenbergii</i>	CHINQUAPIN OAK
<i>Quercus Prinus</i>	CHESTNUT OAK
<i>Quercus Rubra</i>	RED OAK
<i>Quercus Stellata</i>	POST OAK
<i>Quercus Velutina</i>	BLACK OAK
<i>Rhus Aromatica</i>	FRAGRANT SUMAC
<i>Rhus Copallinum</i>	WINGED SUMAC
<i>Robinia Pseudoacacia</i>	BLACK LOCUST
<i>Rosa Carolina</i>	PASTURE ROSE
<i>Rosa Multiflora</i>	MULTIFLORA ROSE
<i>Rubus Sp.</i>	BLACKBERRY OR RASPBERRY
<i>Sassafras Albidum</i>	SASSAFRAS
<i>Schizachyrium Scoparium</i>	LITTLE BLUESTEM
<i>Scutellaria Arguta</i>	APPALACHIAN SKULLCAP
<i>Scutellaria Lateriflora</i>	MAD-DOG SKULLCAP
<i>Scutellaria Ovata</i>	HEART-LEAVED SKULLCAP
<i>Scutellaria Ovata Spp. Ovata</i>	HEART-LEAVED SKULLCAP
<i>Scutellaria Parvula Var. Leonardii</i>	SHALE SKULLCAP
<i>Selaginella Rupestris</i>	ROCK SPIKEMOSS
<i>Silene Caroliniana</i>	WILD PINK
<i>Solidago Arguta Var. Harrisii</i>	SHALE BARREN GOLDENROD
<i>Taenidia Montana</i>	MOUNTAIN PIMPERNEL
<i>Toxicodendron Radicans</i>	POISON IVY
<i>Trifolium Virginicum</i>	KATES MOUNTAIN CLOVER
<i>Uvularia Puberula</i>	MOUNTAIN BELLWORT
<i>Vaccinium Pallidum</i>	UPLAND LOW BLUEBERRY
<i>Vaccinium Stamineum</i>	SQUAW HUCKLEBERRY OR DEERBERRY
<i>Verbascum Thapsus</i>	GREAT MULLEIN
<i>Viburnum Prunifolium</i>	BLACK HAW
<i>Viburnum Rafinesquianum</i>	DOWNY ARROWWOOD
<i>Viola Pedata</i>	BIRD-FOOT VIOLET
<i>Vitis Sp.</i>	GRAPE
<i>Waldensteinia Fragarioides</i>	BARREN STRAWBERRY

*Woodsia Scopulina*

ALLEGHENY CLIFF FERN

**Invertebrates**

*Euchloe Olympia*

*Lymantria [=Portheria] Dispar*

*Pyrgus Wyandot*

OLYMPIA MARBLE BUTTERFLY

GYPSY MOTH

APPALACHIAN GRIZZLED SKIPPER

**Vertebrates**

BROWN-HEADED COWBIRD

NORTHERN FENCE LIZARD

RABBIT

WHITETAIL DEER

WOODCHUCK

*Molothrus Ater*

*Sceloporus Undulatus Hyacinthinus*

*Sylvilagus Sp.*

*Odocoileus Virginianus*

*Marmota Monax*

## APPENDIX C: Detailed Descriptions Of Shale Barren Communities

### Classification of West Virginia Shale Barrens

Draft Report  
Jim Vanderhorst  
WV Natural Heritage Program  
April 3, 2002

The classification of West Virginia shale barrens presented here is based on data from 56 plots. Fifty-two were sampled in 1994 and 1995 by Chris Jesse with occasional help from various others. These were scattered throughout the range of shale barrens in the state (Figure 1). A large percentage of known shale barrens in the central and southern counties (Pendleton, Greenbrier, and Monroe) were sampled, but a smaller percentage of known shale barrens in the northern counties (Grant Hardy, Mineral, Hampshire, Morgan, and Berkeley) were sampled, reflecting the prevalence of private ownership in the north. Four plots were sampled in September 2001 by Jim Vanderhorst at Sugar Grove Naval Base in Pendleton County.

Standard form 3 (quantitative community characterization) developed by The Nature Conservancy (Sneddon 1993) was filled out in the field for each plot. Data recorded included information on location, environment (elevation, topographic position, slope, aspect, soil profile, moisture regime, drainage, soil pH, soil texture, stoniness, and unvegetated ground cover), community physiognomy and structure, and floristic composition. Percentage cover was estimated for total cover by each strata (tree canopy, tree subcanopy, tall shrub, short shrub, and herbaceous) and for each species in each strata.

All plot data were entered in the Plots Database System, an Access 2.0 application developed by The Nature Conservancy for the USGS/NPS Vegetation Mapping Program. Nomenclature for plant taxa were standardized for the entire set to be consistent with Harmon and Ford-Werntz (2002) which generally follows Kartesz (1999).

Multivariate analysis of the plot data was performed using PC-Ord version 4 (McCune and Mefford 1999). Prior to analysis, most plant taxa identified only to the generic level were deleted from the data set but a few taxa thought to have ecological diagnostic value at this level (eg. *Crataegus*, *Cladina*) were left in. Two plots were removed from the analysis because they did not contain any shale barren endemics or near endemics (Braunschweig et al. 1999) and thus do not conform to the definition of shale barren vegetation. Analyses included two way indicator species analysis (TWINSPAN), cluster analysis, and indicator species analysis (Dufrene and Legendre 1997). TWINSPAN was performed on raw data of species abundance (% cover) with pseudospecies cut levels of 0.4, 0.9, 1.9, 4.9, 9.9, 19.9, and 39.9. Cluster analysis was performed on data relativized by site totals and by species maxima using the Sorensen (Bray-Cutis) distance measure and the flexible beta linkage method with beta value of .25. Cluster analysis follows the

methods found to result in the most interpretable classification of most plot data from a Virginia study (Fleming and Coulling 2001).

Although all of these analyses provided insight into classification of WV shale barrens at various levels, none alone resulted in a satisfactory complete classification of the plots. The classification presented here is derived from the statistical analyses but some plots were subjectively placed in groups and some groups are more "artificial" than others. For example, a small number of plots having herbaceous physiognomy are placed together despite a high level of heterogeneity. Likewise, extremely steep shale slopes with high proportion of exposed bedrock are placed together. Herbaceous communities are thought to be under-represented in the data set and additional sampling of these types as well as all other types in the northeastern panhandle of WV would probably allow a more "natural" classification.

Five shale barren types were classified and are described in the following sections. They include four woodland types and one herbaceous type. The community names are based on dominant and diagnostic species with species of taller strata listed first separated by a forward slash from those of lower strata. Species in parentheses indicate variation in the type and reflect a lower classification confidence for the type. An attempt was made to "crosswalk" the community types to the National Vegetation Classification (NatureServe 2002) and to compare them to shale barren types described from Maryland (Berdine 1999), Pennsylvania (Fike 1999) and Virginia (Flemming and Coulling 2001).

*Pinus virginiana*-(*Quercus alba*)/(*Carya ovata*, *Quercus alba*)/*Carex pensylvanica*-*Antennaria virginicus* shale barren woodland

Common name: Virginia pine-(white oak)/(shagbark hickory, white oak)/Pennsylvania sedge-shale barren pussy-toes shale barren woodland

Descriptive name: South-central Appalachian shale barren woodland

National Vegetation Classification

Class: Woodland

Subclass: Mixed evergreen-deciduous woodland

Group: Mixed needle-leaved evergreen-cold deciduous woodland

Formation: Mixed needle-leaved evergreen-cold deciduous woodland

Alliance: *Pinus (rigida, pungens, virginiana)*-*Quercus prinus* woodland

Association: not described

Range: This community appears to be endemic to Greenbrier County, in southeastern West Virginia. It is known from Blue Bend, Humphrey's Draft, Lower White's Draft, Upper White's Draft, Middle Mountain, Turkey Pen Run, and Waid's Draft shale barrens on the Monongahela National Forest, and from Greenbrier Airport, Greenbrier Mountain, and Kate's Mountain shale barrens on private land.

Environment: This small patch community occupies steep shale slopes with southern to western aspects. Known occurrences are confined to Devonian shales of the Brallier Formation and Chemung Group (WV Geological and Economic Survey 1968). Elevations of the sampled plots range from 1,920 to 2,500 feet. Soils are mapped as Weikert shaley silt loams (USDA Soil Conservation Service 1972). These are described as shallow, strongly acid soils with low fertility and low moisture capacity. There is higher ground cover by leaf litter (~ = 42% in 11 sampled plots) and less exposed small shale fragments (~ = 15%) and bedrock (~ = 0.5%) compared to other shale barren types in WV.

Vegetation: This is a woodland or sparse forest community (46.3% mean canopy cover) dominated by *Pinus virginiana* (Virginia pine) with a relatively high component of deciduous trees in the canopy and subcanopy and high cover in the herb layer compared to other shale barren types. *Juniperus virginiana* (eastern red cedar), *Pinus strobus* (white pine) and *Pinus pungens* (table mountain pine) are additional conifers in the canopy of a few stands. Deciduous canopy species include *Quercus alba* (white oak), *Carya ovata* (shagbark hickory), *Fraxinus americana* (white ash), *Carya glabra* (pignut hickory), *Quercus prinus* (chestnut oak), and *Quercus rubra* (red oak). There is relatively high cover (~ = 33.3%) and diversity (26 species) in the subcanopy. The most common in addition to the canopy species are *Carya alba* (mockernut hickory), *Ostrya virginica* (ironwood), *Quercus ilicifolia* (scrub oak), and *Robinia pseudoacacia* (black locust). Cover in the shrub strata is relatively sparse (~ = 6.8% in each of the tall and short shrub layers). Shrubs having 5% or more cover in individual plots include *Rhus aromatica* (fragrant sumac), *Quercus ilicifolia*, *Crataegus* sp. (hawthorn), *Viburnum prunifolium* (black haw), *Vaccinium pallidum* (upland low blueberry) and *Vaccinium stamineum* (deer berry). The herb layer has high cover (~ = 34.5%) and diversity (124 species including tree and shrub seedlings and small saplings). The most abundant species by far is *Carex pensylvanica* (Pennsylvania sedge) which has mean cover of 16.7%. *Antennaria virginica* (shale barren pussy-toes), *Danthonia spicata* (poverty oatgrass), and *Allium cernuum* (nodding onion, see note under classification comments) are less abundant, but are also constant in the plots. Additional taxa with greater than 50% constancy include *Crataegus* sp. (hawthorn), *Galium pilosum* (hairy bedstraw), *Houstonia longifolia* (long-leaved bluets), *Paronychia montana* (mountain nailwort), *Phlox subulata* (moss phlox), *Potentilla canadensis* (Canada cinquefoil), *Rosa carolina* (pasture rose), *Silene caroliniana* ssp. *pensylvanica* (wild pink), *Uvularia puberula* (mountain bellwort), and *Viola pedata* (birdfoot violet). Shale barren endemics (Braunschweig et al. 1999) found in the plots include *Arabis serotina* (shale barren rockcress), *Clematis albicoma* (whitehaired leatherflower), *Packeria antennariifolia* (pussy-toes ragwort), and *Trifolium virginicum* (Kate's Mountain clover). Near endemics include *Antennaria virginica*, *Paronychia montana*, *Scutellaria ovata* ssp. *rugosa* (heart-leaved skullcap), and *Taenidia montana* (mountain pimpernel). Nonvascular taxa with high constancy include species of the moss genera *Leucobryum* and *Polytrichum* and the lichen genus *Cladina*.

Classification comments: The distinctiveness of this community is supported by hierarchical agglomerative cluster analysis of the West Virginia shale barren data set. The dendrogram produced by this analysis can be "pruned" at different levels such that a

different number of groups are classified. Ten plots of this community are maintained as a single group when as many as 14 groups are recognized. This indicates that this community is a distinct and internally cohesive unit. One plot (SHALE.3) identified as an outlier to this group by cluster analysis is included in this description due to similar physiognomy dominated by deciduous canopy species (but *Quercus rubra* is dominant instead of *Quercus alba*) and similar herbaceous composition. The distinctiveness of this community type may be attributed to its occurrence at relatively high elevations near the southwestern extent of the range of shale barrens in the Appalachians and/or it may be due to successional status of these stands. It has not been described as an association in the National Vegetation Classification.

Note: *Allium oxyphilum* (nodding wild onion), a state rare species and shale barren endemic, is known from many of the shale barrens where plots of this community were sampled but was not identified in any plots. It resembles and is sometimes considered synonymous with *Allium cernuum* (e.g. Gleason and Cronquist 1991) which is constant in plots of this community. It is probable that some or all of the plants identified as *Allium cernuum* in the plots were in fact *Allium oxyphilum*.

Management concerns: Seven of the ten plots of this type are from shale barrens on the Monongahela National Forest and it appears to be the most common shale barren type on the Forest. Conservation of this globally rare type is thus dependent on Forest Service policy and management.

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

Plots: 3, 23, 24, 27, 28, 31, 34, 47, 48, 49, 51 (n=11)

*Pinus virginiana-Quercus prinus/Carex pensylvanica-(Arabis serotina, Clematis albicoma)* shalebarren woodland

Common name: Virginia pine-chestnut oak/Pennsylvania sedge-(shalebarren rockcress, whitehaired leatherflower) shalebarren woodland

Descriptive name: Central Appalachian shale barren woodland

## National Vegetation Classification

Class: Woodland

Subclass: Mixed evergreen-deciduous woodland

Group: Mixed needle-leaved evergreen-cold deciduous woodland

Formation: Mixed needle-leaved evergreen-cold deciduous woodland

Alliance: *Pinus (rigida, pungens, virginiana)-Quercus prinus* woodland

Association: *Pinus virginiana-Quercus (prinus, velutina)/Packera antennariifolia-Phlox subulata* woodland

Range: This community is endemic to the Ridge and Valley Province of the Central Appalachian Region in west-central Virginia and eastern West Virginia (Fleming and Coulling 2001). West Virginia occurrences are centered in Pendleton County but are also found further south in Greenbrier and Monroe counties and further north in Hardy County. It is found on public lands on the Monongahela National Forest, the George Washington/Jefferson National Forest, and Sugar Grove Naval Base.

Environment: This small patch community occupies somewhat steep to steep shale slopes with southeastern to western aspects. Elevations of the 20 sampled plots range from 950 to 2,360 feet (~ = 1975 feet). All known occurrences are confined to Devonian shales of the Brallier Formation and Chemung Group (WV Geological and Economic Survey 1968). Soils are mapped as Weikert shaley silt loams, Berks-Weikert channery silt loams, Lithic Udorthents-Rock outcrop complex, Montevallo channery silt loam, and steep rock land (USDA Soil Conservation Service 1972, 1978, 1989, 1992). These are described as shallow, strongly acid soils (or lithic substrates) with low fertility and low moisture capacity. There is relatively high percent ground cover by small shale fragments (~ = 45.2%), low percent exposed bedrock (~ = 4.4%), and moderate litter cover (~ = 27.3%) in the plots compared to other WV shale barren types.

Vegetation: This community is typically a sparse woodland (40% mean canopy cover in the plots) dominated by relatively short *Pinus virginiana* (Virginia pine), with moderate cover in the subcanopy (~ = 22.3%), sparse cover in the tall (~ = 4.3%) and short shrub (~ = 6%) layers, and sparse to moderate cover in the herb layer (~ = 15%) which is characterized by high diversity and presence of a number of shale barren endemics and near endemics (Braunschweig et al. 1999). *Juniperus virginiana* (eastern red cedar), *Pinus strobus* (white pine) and *Pinus pungens* (table mountain pine) are additional conifers in the canopy of some stands. *Quercus prinus* (chestnut oak) is subdominant in the canopy of most stands. Additional deciduous canopy species found in lesser amounts include *Quercus rubra* (red oak), *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Carya ovalis* (oval pignut hickory), *Fraxinus americana* (white ash), *Quercus alba* (white oak), and *Quercus velutina* (black oak). There is high diversity in the subcanopy which in addition to the canopy species commonly includes *Amelanchier arborea* (serviceberry), *Nyssa sylvatica* (black gum), *Ostrya virginiana* (ironwood), *Quercus ilicifolia* (scrub oak), and *Robinia pseudoacacia* (black locust). The most common species in the shrub layers are *Amelanchier arborea*, *Quercus ilicifolia*, *Vaccinium pallidum* (upland low blueberry), and *Vaccinium stamineum* (deerberry). The herb layer is usually dominated by *Carex pensylvanica* (Pennsylvania sedge); this,

*Danthonia spicata* (poverty oatgrass), and *Houstonia longifolia* (long leaved bluets) are nearly constant in the plots. Additional herbs with high constancy (40%) include *Arabis serotina* (shale barren rockcress), *Clematis albicoma* (whitehaired leatherflower), *Paronychia montana* (mountain nailwort), *Phlox subulata* (moss phlox) and *Potentilla canadensis* (Canada cinquefoil). Shale barren endemics in the plots include *Eriogonum allenii* (yellow buckwheat), *Arabis serotina*, *Clematis albicoma*, *Oenothera argillicola* (shale evening-primrose), *Packera antennariifolius* (pussy-toe leaved ragwort), and *Trifolium virginicum* (Kate's Mountain clover). Near endemics include *Antennaria virginica* (shale barren pussy-toes), *Paronychia montana*, *Scutellaria ovata* ssp. *rugosa* (heart-leaved skullcap), and *Solidago arguta* var. *harrisii* (shale barren goldenrod). Lichens in the genus *Cladina* were reported in almost half the plots.

Classification comments: This is the "classic" Central Appalachian shale barren (Fleming and Coulling 2001). The vegetation described above based on West Virginia plots is quite similar to the one given by Fleming and Coulling for Virginia plots, however they found the herb *Packera antennariifolia* (syn. *Senecio antennariifolius*) to have relatively high constancy and included it in their community name. This species was found in only 25% of our plots. There are probably other subtle regional variations.

Plots: 1, 2, 4, 5, 7, 9, 11, 12, 13, 14, 17, 32, 38, 39, 43, 46, 53, 54, 55, 56 (n = 20)

*Pinus virginiana*-*Juniperus virginiana*-(*Quercus stellata*)/(*Opuntia humifusa*, *Viola pedata*) shale barren woodland

Common name: Virginia pine-eastern red cedar-(post oak)/(prickly pear, birdsfoot violet) shale barren woodland

Descriptive name: North-central Appalachian dry shale barren woodland

National Vegetation Classification

Class: Woodland

Subclass: Mixed evergreen-deciduous woodland

Group: Mixed needle-leaved evergreen-cold deciduous woodland

Formation: Mixed needle-leaved evergreen-cold deciduous woodland

Alliance: not described

Association: not described

Range: This community is found in the eastern panhandle of West Virginia in Grant, Hardy, Mineral and Hampshire counties. Similar communities are also found in Maryland (Berdine 1999) and Pennsylvania (Fike 1999).

Environment: This small patch community occupies somewhat steep to steep shale slopes with southern to western aspects. Elevation of the plots ranges from 760 to 1,200 feet. Known occurrences are confined to Devonian shales of the Brallier, Harrell, and Mahantango formations, and the Chemung Group (WV Geological and Economic Survey 1968). Soils are mapped as Weikert and Berks shaley silt loams (alone and in complex)

and Lithic Udorthents-Rock outcrop complex (USDA Soil Conservation Service 1978, 1989). These are described as shallow, strongly acid soils with low fertility and low moisture capacity. There is a relatively large proportion of unvegetated ground cover by small shale fragments (~ = 41.5%) and a small proportion by litter (~ = 25.8%) compared to other shale barren woodlands in the state. This is probably the hottest, driest shale barren type in WV.

Vegetation: This is a woodland community dominated by short (usually 10 m, always 15 m in the plots) *Pinus virginiana* (Virginia pine) and *Juniperus virginiana* (eastern red cedar) with *Quercus stellata* (post oak) codominant in many stands. Additional trees found in some plots include *Carya glabra* (pignut hickory), *Carya ovata* (shagbark hickory), *Fraxinus americana* (white ash), *Quercus prinus* (chestnut oak), and *Quercus rubra* (red oak). The subcanopy and shrub strata are extremely sparse to non-existent and composed primarily of the canopy species, but in a few plots *Celtis occidentalis* (hackberry), *Celtis tenuifolia* (dwarf hackberry), *Hypericum prolificum* (shrubby St. John's wort), *Quercus muhlenbergii* (chinquapin oak), and *Rhus aromatica* (fragrant sumac) occur in small amounts. The herb layer is likewise typically sparse and somewhat species poor. Herbs with the highest constancy in the plots are *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oatgrass), *Opuntia humifusa* (prickly pear), *Packera antennariifolius* (pussy-toe leaved ragwort), and *Viola pedata* (birdsfoot violet). Lack of dominance by *Carex pensylvanica* is notable and helps differentiate this community from other shale barren woodlands in WV. One plot (SHALE.50) included in this group by cluster analysis is somewhat atypical in having heavy cover (50%) in the herb layer which is dominated by the grass *Schizachyrium scoparium* (little bluestem). Shale barren endemics (Braunschweig et al.1999) in the plots include *Clematis albicoma* (whitehaired leatherflower), *Oenothera argillicola* (shale barren evening primrose), *Packera antennariifolius*, and *Trifolium virginicum* (Kate's Mountain clover). Near endemics include *Paronychia montana* (mountain nailwort), *Scutellaria ovata* ssp. *rugosa* (heart-leaved skullcap) and *Solidago arguta* var. *harrisii* (shalebarren goldenrod).

Classification comments: This type appears most similar to the *Pinus virginiana*-*Juniperus virginiana* woodland described in the Maryland community classification (Berdine 1999) and to the red cedar-mixed hardwood rich shale woodland of the Pennsylvania classification (Fike 1999). It is also similar to PA's red cedar-prickly pear shale shrubland, however, that type lacks shale barren endemics (Fike 1999). The most atypical plot in the WV data set (SHALE.50) approaches the description in the MD classification of *Carex pensylvanica*-*Schizachyrium scoparium*/*Quercus stellata* herbaceous vegetation (Berdine 1999). Variation in the WV data and under-sampling of shale barrens in northeastern WV suggest that recognition of more than one shale barren type with dominance by *Juniperus virginiana*, possibly related to soil/substrate pH and/or nutrient regime, may be warranted. Additional sampling from this part of the state including data on soil/ substrate chemistry is needed to resolve classification of these types.

Plots: 6, 15, 16, 20, 25, 26, 29, 37, 44, 50, 52 (n=11)

*Pinus virginiana-Quercus prinus/Oenothera argillicola-Solidago arguta* var. *harrisii*  
shale barren sparse woodland

Common name: Virginia pine-chestnut oak/shale barren rockcress-shale barren evening  
primrose shale barren sparse woodland

Descriptive name: steep rock outcrop shale barren

#### National Vegetation Classification

Class: Woodland

Subclass: Mixed evergreen-deciduous woodland

Group: Mixed needle-leaved evergreen-cold deciduous woodland

Formation: Mixed needle-leaved evergreen-cold deciduous woodland

Alliance: *Pinus (rigida, pungens, virginiana)-Quercus prinus* woodland

Association: *Pinus virginiana-Quercus prinus/Deschampsia flexuosa-Cunila origanoides*  
woodland (CEGL006288)

Range: Plots of this community type were sampled from shale barrens in the northeastern panhandle of West Virginia in Morgan and Hampshire Counties and from a single disjunct stand in Greenbrier County.

Environment: This small patch community occupies steep shale slopes with southeastern to western aspects. Elevations of the 8 sampled plots range from 490 to 2,090 feet (~ = 875 feet). Geology of the occurrences are mapped as Devonian shales of the Hampshire, Mahantango, and Marcellus formations, and the Chemung Group, and Silurian shales of the McKenzie formation (WV Geological and Economic Survey 1968). Soils are mapped as Berks channery silt loams, Weikert shaley silt loams, Berks-Weikert channery silt loams, and Lithic Udorthents-Rock outcrop complex (USDA Soil Conservation Service 1972, 1978). These are described as shallow, strongly acid soils (or lithic substrates) with low fertility and low moisture capacity. There is relatively high percent ground cover by exposed bedrock (~ = 26.3 %) and small shale fragments (~ = 38.8%), and low litter cover (~ = 11.4%) in the plots compared to other WV shalebarren types. This type is best characterized by its steep, unstable slopes with high bedrock exposure which may physically limit establishment of vegetation cover.

Vegetation: This is a sparse woodland (30.6% mean canopy cover in the plots) community dominated by *Pinus virginiana* (Virginia pine) and *Quercus prinus* (chestnut oak). Additional canopy trees in at least 2 plots include *Pinus strobus* (white pine), and *Juniperus virginiana* (eastern red cedar). The subcanopy is very sparse (9.4% mean cover) but in addition to the canopy dominants commonly includes *Amelanchier arborea* (service berry), *Ostrya virginica* (ironwood), and *Quercus rubra* (red oak) . The tall shrub layer is extremely sparse (0.6% mean cover) and species poor. The short shrub layer is somewhat better developed (5.6% mean cover); shrubs (excluding tree saplings) in this stratum occurring in more than 2 plots include *Amelanchier arborea*, *Quercus ilicifolia* (scrub oak), *Rhus copallina* (winged sumac), and *Vaccinium stamineum* (deer berry). Woody vines appear to be more common in this community than in other shale barren

types; species include *Toxicodendron radicans* (poison ivy) and species of *Rubus* (raspberry) and *Vitis* (grape). The herb layer has sparse to moderate cover ( $\tilde{=} 21.3\%$ ) which is typically dominated by the graminoids *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oatgrass), and/or *Deschampsia flexuosa* (crinkled hairgrass). The shale barren endemic (Braunschweig et al. 1999) *Oenothera argillicola* (shale barren evening primrose) and near endemic *Solidago arguta* var. *harrisii* (shale barren goldenrod) are constant in the plots. Other endemics/near endemics in some plots include *Antennaria virginica* (shale barren pussy-toes), *Packera antennarifolia* (pussy-toe leaved ragwort), *Paronychia montana* (mountain nailwort), and *Scutellaria ovata* ssp. *rugosa* (heart-leaved skullcap). Additional herbs with 350% constancy in the plots include *Asplenium platyneuron* (ebony spleenwort), *Houstonia longifolia* (long-leaved bluets), *Parthenocissus quinquefolia* (Virginia creeper), *Phlox subulata* (moss phlox), and *Uvularia puberula* (mountain bellwort). Species of the lichen genus *Cladina* were reported from half the plots.

Classification comments: This community is the mostly northern shale barren woodland type which is distinguished by steep, unstable slopes with high bedrock exposure. It appears similar to the description of the NVC type (CEGL006288) in Virginia (Fleming and Coulling (2001), the *Pinus virginiana-Quercus prinus/Deschampsia flexuosa* woodland from Maryland (Berdine 1999), and the Virginia pine - mixed hardwood shale woodland from Pennsylvania (Fike 1999).

Plots: 8, 18, 21, 22, 30, 35, 36, 45 (n = 8)

*Carex pensylvanica-Dichanthelium depauperatum-Paronychia montana* shale barren herbaceous vegetation

Common name: Pennsylvania sedge - starved panic grass - mountain nailwort shale barren herbaceous vegetation

Descriptive name: shale barren herbaceous opening

Range: This community was sampled only from Greenbrier and Morgan Counties in West Virginia, but similar herbaceous openings might be expected throughout the range of shale barrens. Herbaceous shale barren types are also described from Maryland (Berdine 1999) and Virginia (Flemming and Coulling 2001) and are included as inclusions within the concept of shale barren woodlands in the Pennsylvania classification (Fike 1999).

Environment: Plots of this community were sampled on steep southeast to southwest facing shale slopes. Elevations of the Greenbrier County sites range from 2,100 to 2,120 feet and the Morgan County site is 460 ft. Known occurrences are confined to Devonian shales of the Brallier Formation and Chemung Group in Greenbrier Co. and the Hampshire Formation in Morgan Co.. Soils are mapped as Wiekert shaly silt loams and Lithic Udorthents-Rock outcrop complex (USDA Soil Conservation Service 1972, 1978). These are described as shallow, strongly acid soils (or lithic substrates) with low fertility

and low moisture capacity. There is moderate exposure of bedrock (~ = 12% cover) and small shale fragments (~ = 35% cover) and low cover by litter (~ = 12.5%) compared to plots of the shale barren woodland types.

Vegetation: This is a small patch herbaceous community which occurs as openings within shale barren woodland types. There is less than 5% cover for each of the woody strata in the plots. The most common woody species are dominants of the surrounding woodlands such as *Pinus virginiana* (Virginia pine), *Juniperus virginiana* (eastern red cedar), and *Quercus prinus* (chestnut oak). Other woody species include *Cercis canadensis* (redbud), *Crataegus* sp. (hawthorn), and *Rosa carolina* (pasture rose). Herbaceous cover is above the average for other shale barren types ranging from 20% to 80% in the plots (~ = 35%). The herb layer is typically dominated by graminoids including *Carex pensylvanica* (Pennsylvania sedge), *Danthonia spicata* (poverty oatgrass), and *Dichanthelium depauperatum* (starved panic grass). Additional herbs having high constancy or relatively high cover (>1%) in some plots include *Ambrosia artemisiifolia* (common ragweed), *Clematis albicoma* (shale barren evening primrose), *Houstonia longifolia* (long-leaved bluets), *Paronychia montana* (mountain nailwort), *Phlox subulata* (moss phlox), *Potentilla canadensis* (Canada cinquefoil), and *Viola pedata* (bird'sfoot violet). Shale barren endemics and near endemics (Braunschweig et al. 1999) found in the plots include *Arabis serotina* (shale barren rockcress), *Calystegia spithamea* ssp. *purshiana* (shale bindweed), *Clematis albicoma*, *Paronychia montana*, *Scutellaria ovata* ssp. *rugosa* (heart-leaved skullcap), and *Trifolium virginicum* (Kate's Mountain clover). Species of lichens in the genus *Cladina* were reported from all plots.

Classification comments: This is a relatively artificial group which includes all plots with herbaceous physiognomy. It seems most similar to the *Carex pensylvanica*-*Danthonia spicata*/*Juniperus virginiana*-*Ostrya virginiana* herbaceous vegetation from Maryland (Berdine 1999). One plot in the WV data set (SHALE.50) classified here as *Pinus virginiana*-*Juniperus virginiana*-(*Quercus stellata*)/(*Opuntia humifusa*, *Viola pedata*) shale barren woodland approaches the description in the MD classification of *Carex pensylvanica*-*Schizachyrium scoparium*/*Quercus stellata* herbaceous vegetation (Berdine 1999). Additional examples of bunchgrass dominated shalebarren openings observed in northern WV (Berdine, personal communication) have yet to be sampled.

Plots: 10, 19, 33, 40

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DRAFT NATIONAL CLASSIFICATION as of February 2002.  
NatureServe, Arlington, VA.

Woodland.B.2.N.a. Cold-deciduous woodland.B.2.N.a.4. FRAXINUS AMERICANA - CARYA GLABRA - (JUNIPERUS VIRGINIANA) WOODLAND ALLIANCE Ash - Pignut Hickory - (Eastern Red-cedar) Woodland Alliance. Woodland Concept: Woodlands in this alliance have *Fraxinus americana* and *Carya glabra* as typical canopy dominants, although *Juniperus virginiana*, *Quercus prinus*, or other *Carya* spp. may have significant coverage in some associations. Some associations have a nearly closed or locally closed canopy, and could in some cases as readily be considered as forests, while others have an edaphically maintained woodland physiognomy. Other minor canopy species vary with geography, but may include *Quercus rubra* var. *rubra*, *Pinus virginiana*, *Ulmus alata*, *Quercus stellata*, *Carya ovata*, and *Carya pallida*. Subcanopy and shrub species are variable between associations, but can include *Amelanchier sanguinea*, *Ceanothus americanus*, *Celtis tenuifolia*, *Cercis canadensis*, *Chionanthus virginicus*, *Crataegus* sp., *Hypericum prolificum*, *Juniperus virginiana* var. *virginiana*, *Lonicera flava*, *Ostrya virginiana*, *Philadelphus hirsutus*, *Physocarpus opulifolius*, *Ptelea trifoliata*, *Rhus aromatica* var. *aromatica*, *Rhus typhina*, *Rosa carolina*, *Spiraea betulifolia* var. *corymbosa*, *Symphoricarpos orbiculatus*, *Toxicodendron radicans*, *Vaccinium arboreum*, *Vaccinium pallidum*, *Vaccinium stamineum*, *Viburnum rafinesquianum* (= var. *rafinesquianum*), and *Viburnum rufidulum*. Herbaceous species vary among associations, but species known from these woodlands include *Allium cuthbertii*, *Andropogon gerardii*, *Andropogon gyrans*, *Andropogon ternarius*, *Anemone berlandieri*, *Anemone virginiana*, *Antennaria virginica*, *Aquilegia canadensis*, *Arabis canadensis*, *Arabis hirsuta* var. *pyncocarpa* (= *Arabis hirsuta* var. *adpressipilis*), *Arabis laevigata*, *Aristida purpurascens*, *Aristolochia serpentaria*, *Asclepias quadrifolia*, *Asplenium platyneuron*, *Symphyotrichum oblongifolium* (= *Aster oblongifolius*), *Symphyotrichum patens* var. *patens* (= *Aster patens* var. *patens*), *Campanula divaricata*, *Cardamine parviflora* var. *arenicola*, *Carex pennsylvanica*, *Cheilanthes lanosa*, *Claytonia virginica*, *Coreopsis major*, *Coreopsis pubescens*, *Cunila organoides*, *Danthonia compressa*, *Danthonia sericea*, *Danthonia spicata*, *Desmodium rotundifolium*, *Dichanthelium boscii*, *Dichanthelium scoparium*, *Dodecatheon meadia*, *Draba ramosissima*, *Elymus hystrix*, *Erigeron pulchellus*, *Helianthus divaricatus*, *Helianthus microcephalus*, *Houstonia longifolia*, *Hypericum gentianoides*, *Hypericum punctatum*, *Melica mutica*, *Muhlenbergia tenuiflora*, *Phacelia dubia*, *Phlox nivalis* ssp. *henzii*, *Piptochaetium avenaceum*, *Polygala paucifolia*, *Polygonum tenue*, *Pycnanthemum incanum*, *Pycnanthemum montanum*, *Saxifraga michauxii*, *Schizachyrium scoparium*, *Sedum glaucophyllum*, *Selaginella rupestris*, *Packera millefolia* (= *Senecio millefolium*), *Packera obovata* (= *Senecio obovatus*), *Solidago arguta* var. *harrisii* (= *Solidago harrisii*), *Solidago juncea*, *Solidago nemoralis*, *Sorghastrum nutans*, *Tradescantia ohioensis*, *Verbesina occidentalis*, *Woodsia ilvensis*, and *Woodsia obtusa*. These woodlands are often a physiognomic complex of woodland, grassland, and rock outcropping, often associated with granitic domes or rocky summits.

Soils are circumneutral and derived from such base-rich rocks as greenstone, plagioclase-rich granite, hornblende gneiss, amphibole gneiss, limestones, or calcareous shales. Woodlands in this alliance are currently defined from 1000-3800 feet elevation in the southern and central Blue Ridge, the Ridge and Valley of Virginia, and the upper Piedmont of Georgia, North Carolina, and Virginia.: These woodlands are often a physiognomic complex of woodland, grassland, and rock outcropping, often associated with granitic domes or rocky summits. Soils are circumneutral and derived from such base-rich rocks as greenstone, plagioclase-rich granite, hornblende gneiss, amphibole gneiss, limestones, or calcareous shales. Woodlands in this alliance are currently defined from 1000-3800 feet elevation.: Woodlands in this alliance have *Fraxinus americana* and *Carya glabra* as typical canopy dominants, although *Juniperus virginiana*, *Quercus prinus*, and other *Carya* spp. may have significant coverage in some associations. Other minor canopy species vary with geography, but may include *Quercus rubra* var. *rubra*, *Pinus virginiana*, *Ulmus alata*, *Quercus stellata*, *Carya ovata*, and *Carya pallida*. Subcanopy and shrub species are variable between associations, but can include *Amelanchier sanguinea*, *Ceanothus americanus*, *Celtis tenuifolia*, *Cercis canadensis*, *Chionanthus virginicus*, *Crataegus* sp., *Hypericum prolificum*, *Juniperus virginiana* var. *virginiana*, *Lonicera flava*, *Ostrya virginiana*, *Philadelphus hirsutus*, *Physocarpus opulifolius*, *Ptelea trifoliata*, *Rhus aromatica* var. *aromatica*, *Rhus typhina*, *Rosa carolina*, *Spiraea betulifolia* var. *corymbosa*, *Symphoricarpos orbiculatus*, *Toxicodendron radicans*, *Vaccinium arboreum*, *Vaccinium pallidum*, *Vaccinium stamineum*, *Viburnum rafinesquianum* (= var. *rafinesquianum*), and *Viburnum rufidulum*. Herbaceous species vary among associations, but species known from these woodlands include *Allium cuthbertii*, *Andropogon gerardii*, *Andropogon gyrans*, *Andropogon ternarius*, *Anemone berlandieri*, *Anemone virginiana*, *Antennaria virginica*, *Aquilegia canadensis*, *Arabis canadensis*, *Arabis hirsuta* var. *pyncocarpa* (= *Arabis hirsuta* var. *adpressipilis*), *Arabis laevigata*, *Aristida purpurascens*, *Aristolochia serpentaria*, *Asclepias quadrifolia*, *Asplenium platyneuron*, *Symphyotrichum oblongifolium* (= *Aster oblongifolius*), *Symphyotrichum patens* var. *patens* (= *Aster patens* var. *patens*), *Campanula divaricata*, *Cardamine parviflora* var. *arenicola*, *Carex pensylvanica*, *Cheilanthes lanosa*, *Claytonia virginica*, *Coreopsis major*, *Coreopsis pubescens*, *Cunila origanoides*, *Danthonia compressa*, *Danthonia sericea*, *Danthonia spicata*, *Desmodium rotundifolium*, *Dichanthelium boscii*, *Dichanthelium scoparium*, *Dodecatheon meadia*, *Draba ramosissima*, *Elymus hystrix*, *Erigeron pulchellus*, *Helianthus divaricatus*, *Helianthus microcephalus*, *Houstonia longifolia*, *Hypericum gentianoides*, *Hypericum punctatum*, *Melica mutica*, *Muhlenbergia tenuiflora*, *Phacelia dubia*, *Phlox nivalis* ssp. *henzii*, *Piptochaetium avenaceum*, *Polygala paucifolia*, *Polygonum tenue*, *Pycnanthemum incanum*, *Pycnanthemum montanum*, *Saxifraga michauxii*, *Schizachyrium scoparium*, *Sedum glaucophyllum*, *Selaginella rupestris*, *Packera millefolia* (= *Senecio millefolium*), *Packera obovata* (= *Senecio obovatus*), *Solidago arguta* var. *harrisii* (= *Solidago harrisii*), *Solidago juncea*, *Solidago nemoralis*, *Sorghastrum nutans*, *Tradescantia ohioensis*, *Verbesina occidentalis*, *Woodsia ilvensis*, and *Woodsia obtusa*.: Alliances:(GLABRA, OVATA) - FRAXINUS AMERICANA - QUERCUS (ALBA, RUBRA) FOREST ALLIANCE (A.258)QUADRANGULATA - (JUNIPERUS VIRGINIANA) WOODLAND ALLIANCE (A.1913)Alliance Comments: In relation to the possible presence of this alliance in Tennessee (Fleming 1999), see the *Fraxinus quadrangulata* - (*Juniperus virginiana*) Woodland Alliance (A.1913).:Elevation

Granitic Dome, Basic Variant, in part (Schafale and Weakley 1990): Fleming (1999) discusses classification questions related to this alliance in Virginia and in the Nashville Basin of Tennessee: "In a study of woody vegetation in the Tennessee Central Basin, Crites and Clebsch (1986) found communities sorted along a topographic-moisture gradient. A 'Carya - Juniperus - Quercus Community' that may be similar to the *Fraxinus americana* - *Carya ovata* / *Frangula caroliniana* / *Helianthus hirsutus* Woodland (CEGL008458) (sensu Fleming 1999) was classified from subxeric upland habitats. The dominants of the Tennessee community (based on the importance values of woody species >2.5 cm dbh) were *Fraxinus americana*, either *Carya ovata* or *Carya glabra* (pignut hickory), and *Juniperus virginiana*. *Fraxinus americana* was considered a 'local successional species,' the densities of which were 'masking' the importance values of oaks (Crites and Clebsch 1986). Implicit (but not directly stated) in this assessment is the concept that *Quercus muehlenbergii* and other oaks represent a more advanced successional stage on the subxeric uplands. Of course, without data on shrub and herbaceous composition, it is impossible to accurately evaluate the similarity of the Virginia and Tennessee communities" (Fleming 1999). In relation to the possible presence of this alliance in Tennessee, see the *Fraxinus quadrangulata* - (*Juniperus virginiana*) Woodland Alliance (A.1913). Distribution: Woodlands in this alliance are currently defined from 1000-3800 feet elevation in the southern and central Blue Ridge and in the upper Piedmont of the United States.: CA US/Provinces: AL? GA MD NC PA SC? TN VA WV? Ecoregions: 50:C, 51:C, 52:C, 59:CEcoregions: 212A:CC, 212B:CC, 221A:CC, 231Aa:CCC, 231Ae:CCC, 231Ak:CCC, 231Ap:CCC, M221Aa:CCC, M221Ab:CC?, M221B:C?, M221Ca:CC?, M221Cb:CC?, M221Cc:CC?, M221Ce:CCC, M221Da:CCC, M221Db:CCC, M221Dc:CCC, M221Dd:CCCLands: NPS (Blue Ridge Parkway, Great Smoky Mountains?, Shenandoah); USFS (Cherokee, George Washington, Jefferson, Nantahala, Oconee, Pisgah) Sources: A.S. WEAKLEY, MOD. L. SNE, RW, SCS Identifier: A.604: Crites and Clebsch 1986, Dellinger 1992, Fleming 1999, Schafale and Weakley 1990, Small 1996.

*Juniperus virginiana* - *Fraxinus americana* - *Carya glabra* / *Carex pensylvanica* - *Cheilanthes lanosa* Woodland. Red-cedar - White Ash - Pignut Hickory / Pennsylvania Sedge - Hairy Lipfern Woodland Appalachian Circumneutral Shale Woodland Group (SCS;MCS): Appalachian Shale Glades and Barrens (440-40; 2.3.4.4) Concept: This shale barren woodland community occurs on steep slopes of the Central Appalachians. The circumneutral to basic soils are derived from calcareous shales of the Jennings and Hampshire Shale formations on steep, south- or southwest-facing slopes. Soils are thin but generally better developed than other shale barren associations of steeper slopes. The woodland canopy ameliorates to some degree the otherwise xeric conditions imposed by exposure and slope. Canopy closure varies from 20-26% cover over an herbaceous layer that forms 30-90% ground cover. The canopy is codominated by *Juniperus virginiana* and *Fraxinus americana*, with other associates including *Carya glabra*, *Quercus prinus*, *Quercus rubra*, and *Amelanchier arborea*. The herbaceous layer is very diverse. Characteristic species include *Carex pensylvanica*, *Danthonia spicata*, *Cheilanthes lanosa*, *Woodsia obtusa*, *Phacelia dubia*, *Deschampsia flexuosa*, *Solidago arguta* var. *harrisii* (= *Solidago harrisii*), *Schizachyrium scoparium*, *Phlox subulata*, *Silene antirrhina*, *Elymus hystrix* (= *Hystrix patula*), *Tradescantia virginiana*, *Rhus aromatica*, and *Arenaria*

serpyllifolia.: : : Associations::cedar-white ash alkaline shale woodland (CAP 1998)& Reasons: G2 (98-11-23). This small patch community likely totals less than 1000 acres rangewide in fewer than 60 occurrences. It is restricted to a single subsection in the Central Appalachians. Although the community is relatively isolated by its steep slope and unstable substrate, it is threatened by invasive exotics such as *Bromus sterilis*, *Bromus tectorum*, *Bromus japonicus*, *Centaurea biebersteinii*, *Lonicera japonica*, *Verbascum thapsus*, *Alliaria officinalis*, and *Ailanthus altissima*. ranked species: : Distribution: This association is restricted to a single subsection of four states in of the Central Appalachians.: US/Provinces: MD:S?, PA:S?, VA:S?, WV?Ecoregions: 59:CEcoregions: M221Aa:CCC, M221B:C?Lands: Sources: ECS Confidence: 1 Identifier: CEG006037: CAP 1998.

C.3.N.a. Mixed needle-leaved evergreen - cold-deciduous woodland.C.3.N.a.9. PINUS (RIGIDA, PUNGENS, VIRGINIANA) - QUERCUS PRINUS WOODLAND ALLIANCE(Pitch Pine, Table Mountain Pine, Virginia Pine) - Rock Chestnut Oak Woodland Alliance. Woodland Concept: This alliance includes woodland vegetation dominated by *Pinus virginiana*, possibly with a mixture of *Pinus rigida*, *Pinus pungens*, and/or *Quercus prinus*. Associations in this alliance are possible from central Pennsylvania southwest to Virginia and Tennessee, but tend to occur under extreme conditions (such as steep, shaley slopes) that maintain the open structure of the vegetation.: : : Alliances: VIRGINIANA FOREST ALLIANCE (A.131)Alliance Comments: *Pinus virginiana* forests are classified in I.A.8.N.b *Pinus virginiana* Forest Alliance (A.131).:Pine: 79, in part (Eyre 1980): Distribution: This alliance is found in North Carolina, Tennessee, Maryland, Pennsylvania, Virginia, and West Virginia.: US/Provinces: MD NC PA TN VA WV Ecoregions: 43:?, 44:P, 50:?, 51:C, 52:?, 59:CEcoregions: 231Aa:CCC, 231E:CC, M221Aa:CCC, M221Ab:CCC, M221Ba:CCP, M221Bd:CCC, M221Da:CCC, M221Dd:CCCLands: USFS (Cherokee, Daniel Boone?, George Washington, Jefferson, Pisgah)Sources: D.J. ALLARD, RW, ECS Identifier: A.677: Eyre 1980

*Pinus virginiana* - *Juniperus virginiana* / *Carex pensylvanica* Woodland [Provisional]\*Pine - Eastern Red-cedar / Pennsylvania Sedge WoodlandPine - Red-cedar / Pennsylvania Sedge Shale Woodland (Northern Type)\* Nonstandard type (needs review)Concept: 12/98 CAP Dry, open coniferous woodland dominated by *Pinus virginiana* and *Juniperus virginiana*. Associates: *Quercus stellata*, *Quercus rubra*, *Quercus prinus*, *Carya glabra*. Sparse understory of lichens and tenacious herbs: *Carex pensylvanica*, *Danthonia spicata*, *Cunila origanoides*, *Uvularia puberula*, *Trifolium virginicum*, *Lespedeza procumbens*, *Draba ramosissima*. Environmental setting: Dry, shallow, acidic soils of steep shaley slopes and other extreme conditions.: : : Associations::& Reasons: G? (99-07-08). ranked species: : Distribution: : US/Provinces: PA:S?Ecoregions: 59:CEcoregions: Lands: Sources: ECS Confidence: Identifier: CEG006561:

*Pinus virginiana* - *Quercus* (*prinus*, *velutina*) / *Packera antennariifolia* - *Phlox subulata* Woodland [Provisional]\*Pine - (Rock Chestnut Oak, Black Oak) / Shalebarren Ragwort - Moss Phlox WoodlandOak - Virginia Pine / Ragwort Acidic Shale Woodland (Southern

Type)Group (SCS;MCS): Appalachian Shale Glades and Barrens (440-40; 2.3.4.4)\*  
 Nonstandard type (needs review)Concept: 12/98 CAP Dry, open, steep-slope, mixed woodlands of *Pinus virginiana* and *Quercus prinus*. Associates of *Juniperus virginiana*, *Quercus velutina*, *Carya glabra*, *Carya ovata*, *Fraxinus americana*. Scattered shrub layer: *Vaccinium stamineum*, *Rosa carolina*, *Rhus copallinum*. Ground layer of grasses: *Schizachyrium scoparium*, *Carex pensylvanica*, *Danthonia spicata*, ferns: *Asplenium platyneuron*, *Cheilanthes lanosa*. Rich and distinctive forb layer of *Campanula divaricata*, *Solidago bicolor*, *Lespedeza repens*, *Lespedeza* sp., *Clematis coactilis*, *Coreopsis major*, *Symphotrichum undulatum* (= *Aster undulatus*), *Solidago erecta*, *Helianthus divaricatus*, *Paronychia montana*, *Penstemon hirsutus*, *Viola pedata*, *Cunila origanoides*, *Potentilla simplex*, *Antennaria virginica*, *Packera antennariifolia* (= *Senecio antennariifolius*), *Houstonia longifolia* var. *tenuifolia*. Environmental setting: Steep unstable, shallow soil shale slopes with areas of exposed bedrock. Southern West Virginia and Virginia.: Habitats are steep to very steep (up to 45 degrees, mean = 28 degrees), unstable shale slopes. Instability is the result of ongoing incision of thick but relatively weak shale strata by small to large streams, and continual mass wasting of the exposed substrates. These slopes are strongly convex in at least one direction, with southerly aspects and high surface cover of exposed mineral soil (mean in plots = 19%) and small shale fragments (mean = 25%). Shale bedrock exposures are common, averaging 12% of plot-sampled areas. Soils are very strongly acidic (mean pH = 4.8) with relatively low base status. Organic (O) horizons are absent, or nearly so. Both the south to west aspects and the shedding of rainwater by surficial shale fragments contribute to a xeric moisture regime with high summer soil temperatures and evaporation rates. These factors limit the establishment and survival of many vascular plants while favoring a number of specially adapted ones (Braunschweig et al. 1999, Platt 1951, Allard and Leonard 1946).: Stand physiognomy varies from largely herbaceous with sparse scrub to open stunted woodland. The most characteristic woody plants are stunted (maximum 10-15 m tall) *Pinus virginiana*, *Quercus prinus*, *Carya glabra*, and *Amelanchier arborea*. Less frequent woody associates include *Quercus ilicifolia*, *Quercus velutina*, *Quercus rubra*, *Fraxinus americana*, *Juniperus virginiana* and, rarely, *Quercus stellata*. *Rosa carolina*, *Vaccinium stamineum*, and/or *Rhus copallinum* form low shrub patches at many sites. Stands typically have patchy (25-40%) herb cover in a matrix of exposed shale fragments and soil. The graminoids *Carex pensylvanica*, *Danthonia spicata* and, more locally, *Schizachyrium scoparium* contribute the greatest herb cover, with the forbs *Phlox subulata*, *Potentilla canadensis*, and *Packera antennariifolia* (= *Senecio antennariifolius*) also relatively constant and locally abundant. Other herbs with relatively high constancies in plot samples include *Paronychia montana*, *Houstonia longifolia*, *Asplenium platyneuron*, *Allium cernuum*, *Helianthus divaricatus*, *Dichanthelium depauperatum*, *Penstemon canescens*, *Solidago bicolor*, and *Draba ramosissima*. Inconstant, but nevertheless characteristic, herbs include *Antennaria virginica*, *Helianthus laevigatus*, *Brickellia eupatorioides*, *Solidago arguta* var. *harrisii*, *Clematis albicoma*, *Clematis coactilis*, and *Blephilia ciliata*. Many additional species, both woody and herbaceous, occur at low cover. Despite its xerophytic character, this community type has relatively high species richness (mean = 42 taxa per 100 m<sup>2</sup>; = 49 taxa per 400 m<sup>2</sup> and 1000 m<sup>2</sup>).: Associations:*virginiana* / *Packera antennariifolia* - *Houstonia longifolia* Woodland [Provisional] (CEGL006564):*virginiana* / *Schizachyrium scoparium* - *Eriogonum allenii* -

Senecio antennariifolius Woodland (Fleming and Moorhead 2000)virginiana - Quercus prinus - Carya glabra / Phlox subulata - Packera antennariifolia Woodland (Fleming and Coulling 2001)virginiana - Quercus prinus / Senecio antennariifolius Association and all nested subassociations (Rawinski et al. 1996)& Reasons: G3G4 (01-10-01). There are probably at least 100 and possibly several hundred occurrences of this community type in Virginia alone.ranked species: ARABIS SEROTINA (G2), ECHINACEA LAEVIGATA (G2), TRIFOLIUM VIRGINICUM (G3), PYRGUS WYANDOT (G2): The provisional USNVC unit, Pinus virginiana / Packera antennariifolia - Houstonia longifolia Woodland [Provisional] (CEGL006564), appears to be synonymous with the community type classified here.

This association represents the classic shale barren of west-central Virginia and adjacent West Virginia, the region in which these habitats and their endemic or near-endemic flora are most abundant. Both the environment and vegetation of this unit are unique and easily recognized. The dangerously steep, warm slopes with exposed shale outcrops, fragments, and mineral soil are diagnostic, along with a distinctive floristic assemblage with several shale-barren endemics.Distribution: This community is endemic to the Central Appalachian region of west-central Virginia and eastern West Virginia. In Virginia, it is mostly confined to Ordovician, Silurian, and Devonian shales of the Ridge and Valley province. There are a few, very localized occurrences on Cambrian (Harpers Formation) metasilstone and phyllite of the Northern Blue Ridge, and a single known occurrence on Cambrian (Hampton Formation) shale in the Ridge and Valley (Wythe County). The principal range in West Virginia includes Pendleton, Greenbriar, and Monroe counties.: US/Provinces: VA:S3, WV:S?Ecoregions: 50:C, 51:C, 59:CEcoregions: M221Aa:CCC, M221Ab:CCC, M221Da:CCCLands: USFS (George Washington, Jefferson)Sources: G. Fleming and P. Coulling, ECS Confidence: Identifier: CEGL006562: Allard and Leonard 1946, Braunschweig et al. 1999, Fleming and Coulling 2001, Fleming and Moorhead 2000, Fleming et al. 2001, Platt 1951, Rawinski et al. 1996.

Pinus virginiana - Quercus prinus / Deschampsia flexuosa - Cunila origanoides Woodland. Pine - Rock Chestnut Oak / Wavy Hairgrass - Rock Oregano WoodlandAppalachian Acidic Shale WoodlandGroup (SCS;MCS): Appalachian Shale Glades and Barrens (440-40; 2.3.4.4)Concept: This shale barren woodland occurs in the central Appalachian Mountains from south-central Pennsylvania to southwestern Virginia. The community occurs on steep unstable shale slopes with areas of exposed bedrock. Canopy dominants are Pinus virginiana and Quercus prinus. Associates include Juniperus virginiana, Quercus rubra, Quercus velutina, Carya glabra, Carya ovata, and Fraxinus americana. The shrub layer is open and includes Vaccinium stamineum, Rosa carolina, Quercus ilicifolia, and Rhus copallinum. The ground layer is characterized by Carex pensylvanica, Danthonia spicata, Asplenium platyneuron, Cheilanthes lanosa, Helianthus divaricatus, Paronychia montana, Penstemon hirsutus, Viola pedata, Cunila origanoides, Potentilla simplex, Antennaria virginica, Packera antennariifolia (= Senecio antennariifolius), Houstonia longifolia (= var. longifolia, = Houstonia tenuifolia), Solidago arguta var. harrisii (= Solidago harrisii), Silene caroliniana ssp. pensylvanica (= Silene pensylvanica), and Phlox subulata. Southern examples may contain Clematis albicoma, Arabis serotina, and Penstemon pallidus (= Penstemon brevisepalus): Specific information on the habitats of this community is lacking, except that the type occurs on

steep, unstable shale slopes with areas of exposed bedrock. In Virginia, this vegetation appears to be associated with steep to very steep shale slopes and cliffs that have high surface cover of exposed bedrock (mean in plots = 82%). Mean slope in plots is 42 degrees. Aspect is variable. Soils, where present, are very strongly acidic (mean pH = 4.8) with moderately high calcium (mean = 1164 ppm) and magnesium (mean = 211 ppm) levels.: In the main, northern part of this community's range, canopy dominants are *Pinus virginiana* and *Quercus prinus*. Associates include *Juniperus virginiana*, *Quercus rubra*, *Quercus velutina*, *Carya glabra*, *Carya ovata*, and *Fraxinus americana*. The open shrub layer includes *Vaccinium stamineum*, *Rosa carolina*, *Quercus ilicifolia*, and *Rhus copallinum*. The herb layer is characterized by *Carex pensylvanica*, *Deschampsia flexuosa*, *Danthonia spicata*, *Cheilanthes lanosa*, *Helianthus divaricatus*, *Paronychia montana*, *Penstemon hirsutus*, *Viola pedata*, *Cunila organoides*, *Potentilla simplex*, *Antennaria virginica*, *Packera antennariifolia* (= *Senecio antennariifolius*), *Houstonia longifolia*, *Solidago arguta* var. *harrisii*, *Silene caroliniana* ssp. *pensylvanica*, and *Phlox subulata*. Virginia examples have similar woody species composition and open to sparse herb layers dominated by *Deschampsia flexuosa* and *Phlox subulata*. Additional characteristic herbs include *Campanula divaricata*, *Solidago bicolor*, *Danthonia spicata*, *Schizachyrium scoparium*, *Selaginella rupestris*, *Packera antennariifolia*, *Woodsia obtusa*, *Carex pensylvanica*, *Cheilanthes lanosa*, *Houstonia longifolia*, and *Hylotelephium telephioides* (= *Sedum telephioides*). *Dicentra eximia* and *Clematis coactilis* are typical of the southernmost occurrences in Craig County. High surficial rock cover appears to limit species richness (mean = 21 taxa per 100 m<sup>2</sup>) in this type of shale barren.:

Associations::oak-Virginia pine/hairgrass acidic shale woodland (northern type) (CAP 1998)*pinus* - *Pinus virginiana* / *Deschampsia flexuosa* - *Selaginella rupestris* - *Packera antennariifolia* Woodland (Fleming and Coulling 2001)& Reasons: G3 (98-12-14). This association is restricted to shale talus slopes of the central Appalachian Mountains. Fewer than 100 occurrences of this community are suspected to occur rangewide.ranked species:  
: This community type is representative of shale barren vegetation to the north and south of the region of highest floristic endemism (west-central Virginia and adjacent West Virginia). Further data collection and analysis is needed to better characterize environmental factors influencing this association across its full geographic range.Distribution: This community occurs in the Central Appalachian Mountains from the Ridge and Valley of south-central Pennsylvania and Maryland to eastern west Virginia and west-central Virginia. It appears to be the typical vegetation type of more northern shale barrens. In Virginia, this unit is restricted to the Ridge and Valley province. It is most common in northwestern Virginia (Page, Shenandoah, Warren, and Frederick counties), with disjunct stands in Craig and Botetourt counties, near the southern limits of shale barrens in Virginia.: US/Provinces: MD:S?, PA:S?, VA:S3, WV:S?Ecoregions: 59:CEcoregions: M221Aa:CCC, M221Ab:CC?, M221Bd:CCCLands: Sources: G. Fleming and P. Coulling, ECS Confidence: 2 Identifier: CEG006288: CAP 1998, Fleming and Coulling 2001, Fleming et al. 2001.

*Pinus virginiana* / *Packera antennariifolia* - *Houstonia longifolia* Woodland  
[Provisional]\*Pine / Shalebarren Ragwort - Longleaf Summer Bluet WoodlandPine / Ragwort / *Houstonia* Shale Woodland (Southern Type)\* Nonstandard type (needs review)Concept: 12/98 CAP Dry, open, coniferous, steep-slope woodlands dominated by

*Pinus virginiana*. Associates: *Quercus stellata*, *Quercus rubra*, *Quercus prinus*, *Carya glabra*, *Juniperus virginiana*. Sparse shrub layer: *Vaccinium stamineum*, *Rosa carolina* and *Quercus ilicifolia*. Scattered, sparse herb layer of graminoids: *Carex pensylvanica*, *Danthonia spicata*, and herbs: *Packera antennariifolia* (= *Senecio antennariifolius*), *Houstonia longifolia* var. *tenuifolia*, *Clematis albicoma*, *Penstemon pallidus* (= *Penstemon brevisepalus*), *Arabis serotina*. Environmental setting: Extremely dry, shallow soil, steep shaley slopes of moderate elevation. Southern half of West Virginia (Pendleton, Greenbriar, Monroe counties).: : : Associations::& Reasons: G? (99-07-08). ranked species: : Distribution: : US/Provinces: WV:S?Ecoregions: 59:CEcoregions: Lands: Sources: ECS Confidence: Identifier: CEGL006564: . Herbaceous Vegetation.A.5.N.e. Short sod temperate or subpolar grassland.A.5.N.e.5.

CAREX PENNSYLVANICA HERBACEOUS ALLIANCE Sedge Herbaceous Alliance.A. Perennial graminoid vegetation Concept: This alliance includes montane grasslands strongly dominated by *Carex pensylvanica*. In the Southern Blue Ridge these grasslands are ungrazed grass balds with deep soil. Associated species include *Rumex acetosella* (exotic), *Carex debilis*, *Polytrichum commune*, *Helenium autumnale*, *Danthonia compressa*, *Sibbaldiopsis tridentata*, *Fragaria virginiana*, *Ageratina altissima* var. *roanensis*, *Angelica triquinata*, *Oclemena acuminata* (= *Aster acuminatus*), *Bromus pubescens*, and *Dennstaedtia punctilobula*. These grasslands typically occur over 1220 m (4000 feet) elevation in the Southern Blue Ridge. In the Central Appalachians, these communities are found on acid shale.: In the Southern Blue Ridge these grasslands are ungrazed grass balds with deep soil, which typically occur over 1220 m (4000 feet) elevation. In the Central Appalachians, these communities are found on acid shale.: Associated species include *Rumex acetosella* (exotic), *Carex debilis*, *Polytrichum commune*, *Helenium autumnale*, *Danthonia compressa*, *Sibbaldiopsis tridentata*, *Fragaria virginiana*, *Ageratina altissima* var. *roanensis*, *Angelica triquinata*, *Oclemena acuminata* (= *Aster acuminatus*), *Bromus pubescens*, and *Dennstaedtia punctilobula*.: Alliances:Alliance Comments: :a. Grass Bald, in part (Allard 1990)Bald, in part (Schafale and Weakley 1990)Balds, in part (Pyne 1994): The affinities of this community are northern; it might be better placed in V.A.5.N.g short alpine or subalpine sod grassland.Distribution: This alliance is found in North Carolina, Tennessee, Virginia, and West Virginia.: US/Provinces: NC TN Ecoregions: 51:C, 59:CEcoregions: M221Dc:CCC, M221Dd:CC?Lands: USFS (Cherokee, Pisgah)Sources: K.D. PATTERSON, RW, SCS Identifier: A.1278: Allard 1990, Pyne 1994, Schafale and Weakley 1990

*Carex pensylvanica* - *Danthonia spicata* - *Cheilanthes lanosa* Herbaceous Vegetation [Provisional]\*Sedge - Poverty Oatgrass - Hairy Lipfern Herbaceous Vegetation Sedge - Poverty Grass Acidic Shale Opening Group (SCS;MCS): Appalachian Shale Glades and Barrens (440-40; 2.3.4.4)\* Nonstandard type (needs review)Concept: Grassy openings on shale slopes characterized by *Carex pensylvanica*.: : : Associations::& Reasons: G? (99-07-08). ranked species: : Distribution: : US/Provinces: MD?Ecoregions: 59:CEcoregions: Lands: Sources: ECS Confidence: Identifier: CEGL006541:

## **APPENDIX D: Explanation Of Natural Heritage Ranks**

The Nature Conservancy and NatureServe have established a ranking system to denote the rarity and vulnerability of plant and animal species. Each species is assigned a rank from 1 (most rare) to 5 (abundant) based primarily on numbers of occurrences and individuals, but also taking into account condition of occurrences, threats, and number of protected occurrences. Species are given both global ranks (G-ranks) that reflect their status rangewide, and state ranks (S-ranks) that consider status within the boundaries of a state. A species may be common over much of its range, but rare within a state. The definitions of G-ranks given below can be applied to S-ranks within a given state or province. Subspecies and varieties are similarly assigned T-ranks (e.g., G5T2, indicating a rare variety of a common species).

### **Rank Definition**

**GX** Presumed Extinct - Believed to be extinct throughout its range. Not located despite intensive searches of historical sites and other appropriate habitat and virtually no likelihood that it will be rediscovered.

**GH** Possibly Extinct - Known from only historical occurrences, but may nevertheless still be extant; further searching needed.

**G1** Critically Imperiled - Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction. Typically 5 or fewer occurrences or very few remaining individuals (<1,000).

**G2** Imperiled - Imperiled globally because of rarity or because of some factor (s) making it especially vulnerable to extinction. Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000).

**G3** Vulnerable - Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.

**G4** Apparently Secure - Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.

**G5** Secure - Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.

### **Variant Ranks**

## Rank Definition

**G#G# Range Rank** - A numeric range rank (e.g., G2G3) is also used to indicate uncertainty about the exact status of a taxon. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).

**GU Unrankable** - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. NOTE: Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express uncertainty, or a range rank (e.g., G2G3) is used to delineate the limits (range) of uncertainty.

**G?** Unranked - Global rank not yet assessed.

## Rank Qualifiers

### Rank Definition

**?** Denotes inexact numeric rank

**Q** Questionable taxonomy that may reduce conservation priority - Distinctiveness of this entity as a species is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank.

**APPENDIX E: Photographs Of Sensitive Species**



*Allium oxyphilum*



*Arabis serotina*



*Phlox buckleyi*



*Arabis serotina* rosette



*Asplenium bradleyi* (photo by Paul Redfearn)



*Scutellaria ovata* var. *rugosa*



*Trifolium virginicum*

**APPENDIX F: Photographs Of Shale Barrens**



Little Fork Shale Barren, Pendleton Co., WV



South Branch Shale Barren, Pendleton Co., WV



Waits Draft, Greenbrier Co., WV

**APPENDIX G: Occurrences Of Rare Shale Barren Plant Species On Monongahela National Forest**

Note: The following data are from the WVDNR Wildlife Diversity Program database. The number following the species name is the "occurrence number". No occurrences were found on the MNF for *Asplenium bradleyi*, *Astragalus distortus*, *Scutellaria ovata* or *Hieraceum traillii*.

NAME: ALLIUM OXYPHILUM 005 LAST SEEN: 1986-08-22

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
RUCKER GAP

POPULATION DATA: 8/25/84: 10,000 OR MORE INDIVIDUALS, IN LEAF AND IN FLOWER.

8/22/86: ABOUT 600 PLANTS, IN LEAF, BUD AND FLOWER AND W/IMMATURE FRUIT.

HABITAT: LARGE SHALE BARREN UNDERCUT BY MEADOW CREEK. SW-FACING SLOPE.

SIZE: 10

COMMENTS: ACCORDING TO R.BARTGIS ONE OF BEST BARRENS IN WV. RESEARCH NATURAL AREA

-----

NAME: ALLIUM OXYPHILUM 006 LAST SEEN: 1986-09-05

SITE: UPPER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1985: 1100 TO 1200 PLANTS. 1986: ABOUT 500 PLANTS ESTIMATED.

HABITAT: SW-FACING, LOWER SLOPE SHALE BARREN.

SIZE: 4

COMMENTS:

-----

NAME: ALLIUM OXYPHILUM 010 LAST SEEN: 1985-06-27

SITE: MIDDLE MOUNTAIN SHALE BARRENS COUNTY: GREENBRIER QUADRANGLE:  
ALVON

POPULATION DATA: 350 PLANTS, MOST ABUNDANT IN SHADED WOODS EDGE,  
SCATTERED  
THROUGHOUT. FLOWER BUDS AND PREVIOUS SEASON'S FRUIT STALKS.

HABITAT: SHALE BARREN. A SEEMINGLY CALCAREOUS SLATY OPENING ON  
WEST-FACING SLOPE ABOVE NORTH FORK OF ANTHONY CREEK.

SIZE:

COMMENTS:

-----

NAME: ALLIUM OXYPHILUM 012 LAST SEEN: 1997-08-04

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ANTHONY

POPULATION DATA: 1997: About 350 plants. Plants mostly in bloom. 1985: ABOUT  
400 PLANTS. FLOWER BUDS AND PREVIOUS SEASON'S FRUITS.

HABITAT: SHALE BARREN ON STEEP S-FACING SLOPE. OPEN WOODLAND WITH A  
SERIES OF OPENINGS AND ROCK OUTCROPS.

SIZE:

COMMENTS: Not really a shale barren, more rocky, open woods.

-----

NAME: ALLIUM OXYPHILUM 020 LAST SEEN: 1986-08-25

SITE: LOWER WHITES DRAFT COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 250 PLANTS NOTED MOSTLY ON UPPER SLOPES AND WOODS

HABITAT: SHALE BARREN.

SIZE:

COMMENTS: PROPOSED RESEARCH NATURAL AREA.

-----

NAME: ALLIUM OXYPHILUM 023 LAST SEEN: 1985-08-16

SITE: COLES RUN COUNTY: GREENBRIER QUADRANGLE: RUCKER GAP

POPULATION DATA: 300 PLANTS AT BORDER OF WOODS. FLOWERS, IMMATURE FRUITS

HABITAT: XERIC, ACIDIC, PINE WOODLANDS

SIZE: 1

COMMENTS:

-----

NAME: ARABIS SEROTINA 001 LAST SEEN: 1988-08-15

SITE: WHITMAN'S DRAFT SHALE BARREN COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 3 FLOWERING PLANTS; 13-20" TALL; NO ROSETTES FOUND.

HABITAT: WEST-FACING, BOTTOM OF SLOPE.

SIZE:

COMMENTS:

-----

NAME: ARABIS SEROTINA 002 LAST SEEN: 1994-07-27

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE: RUCKER GAP

POPULATION DATA: 8/25/84: THREE PLANTS SEEN. 8/22/86: 5 PLANTS - ONE ON UPPER

SLOPES AND 4 ON SHALE CLIFF NEAR BASE; MATURE FRUIT, BUT NO SEED DISPERSING. 9-8-88: 14 ROSETTES, 4 BOLTING. 8-22-89: 10 ROSETTES, 244 BOLTING PLANTS. 1993: 18 BOLTING (13 WITH BROWN SILIQUES, 5 FLOWERING) AND 11 ROSETTES. 7/94: 2 ROSETTES, 2 BOLTING.

HABITAT: A STEEP SHALE BARREN RISING SHARPLY FROM THE CREEK BELOW. MANY STEEP RAVINES AND ROCK OUTCROPS RUNNING VERTICALLY THROUGHOUT THE AREA. UPSLOPE THE BARREN GRADES INTO AN OAK-HICKORY FOREST, WHILE THE SIDES ARE BOUNDED BY AN OAK-PINE-HICKORY FOREST. SEVERAL EO'S ARE AT THIS SITE.

SIZE:

COMMENTS: PROPOSED RESEARCH NATURAL AREA. 1988 EXTREME DROUGHT YEAR.

UNDER LONG-TERM MONITORING PROJECT. ARABIS LAEVIGATA IN SEED BANK ALONG CREEK (1993).

-----  
NAME: ARABIS SEROTINA 003 LAST SEEN: 2000-08-29

SITE: UPPER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER  
QUADRANGLE: ALVON

POPULATION DATA: 1985: OVER 100 PLANTS. 1986: 124 PLANTS SCATTERED THROUGHOUT; MOST ABUNDANT WHERE SOMEWHAT SHADED.  
FLOWERING.

1993: A TOTAL OF 24 ROSETTES AND 18 BOLTING PLANTS. FRUIT PRESENT. BROWSE EVIDENT. 2000: 2 ROSETTES. 6 BROWSED BOLTS, 5 NON-BROWSED (6 SEARCH HOURS, LOWER & UPPER).

HABITAT: SW-FACING, MID- AND LOWER SLOPE SHALE BARREN.

SIZE:

COMMENTS: RESEARCH NATURAL AREA

-----  
NAME: ARABIS SEROTINA 006 LAST SEEN: 1999-09-29

SITE: TURKEY PEN RUN SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ALVON

POPULATION DATA: 6-27-85: 34 PLANTS. FLOWER BUDS. 9-88: ROSETTES SEEN, BUT NOT POSITIVE ON ID. NO BOLTING PLANTS. 8-30-89: 62 ROSETTES, 76 BOLTING PLANTS. 1993: 14 ROSETTES, 11 BOLTING (6 OF WHICH WERE BROWSED). FRUIT. 1999: 15 PLANTS SEEN. 10 ROSETTES, 5 BOLTS (3 BROWSED, 2 NOT BROWSED). 5 PLANTS IN SEED.

HABITAT: SMALL, STEEP SHALE BARREN WITH OPEN AREAS AND ECOTONAL WOODS.

SIZE: 50M X 40M

COMMENTS: 1988 FIRST YEAR FOR SURVEYS INCLUDING ROSETTES.

NAME: ARABIS SEROTINA 007 LAST SEEN: 1993-08-27

SITE: MIDDLE MOUNTAIN SHALE BARRENS COUNTY: GREENBRIER QUADRANGLE:  
ALVON

POPULATION DATA: 6-27-85: ONE PLANT, WITH FLOWER BUDS. 8-29-89: 4 ROSETTES,  
7

BOLTING PLANTS WITH IMMATURE AND MATURE FRUIT. 1993: 3 SHALE  
BARREN OPENINGS WITH A TOTAL OF 8 ROSETTES AND 1 BOLTING  
PLANT (WITH IMMATURE FRUIT). 1999: SEARCHED FOR, NOT FOUND.

HABITAT: SHALE BARREN. A SEEMINGLY CALCAREOUS SLATY OPENING ON  
WEST-FACING SLOPE ABOVE NORTH FORK OF ANTHONY CREEK.

SIZE: 1

COMMENTS: HERBIVORY - TOPS OF PLANTS EATEN OFF EARLY IN SEASON. UNDER  
LONG-TERM MONITORING PROJECT. 1999: POOR SITE, ONLY  
MARGINALLY CONSIDERED A "SHALE BARREN".

-----  
NAME: ARABIS SEROTINA 008 LAST SEEN: 1999-09-14

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ANTHONY

POPULATION DATA: 6-28-85: 16 PLANTS, SOME GRAZED BY DEER. FLOWER BUDS.  
WITH

A. LAEVIGATA. 9-7-88: NONE OBSERVED IN EITHER ROSETTE OR  
BOLTING STAGE. 8-23-89: NO ROSETTES, 15 BOLTING. 1993: 2  
ROSETTES AND 10 BOLTING PLANTS WITH GOOD SEED PRODUCTION. 5  
OF BOLTING PLANTS HAD BEEN BROWSED. 1995: NOT SEEN. 1996:  
NOT SEEN. 1997: NOT SEEN. BARREN IS BECOMING OVERGROWN AND  
EXOTICS ARE INVADING. 1999: 8 ROSETTES, 2 BOLTS. 2000: NO  
PLANTS FOUND, BECOMING MARGINAL HABITAT.

HABITAT: SHALE BARREN ON STEEP S-FACING SLOPE. OPEN WOODLAND WITH A  
SERIES OF OPENINGS AND ROCK OUTCROPS. EAST SIDE OF RIDGE  
OVERGROWN WITH GRASSES, BIDENS AND AMBROSIA.

SIZE: 3

COMMENTS:  
-----

NAME: ARABIS SEROTINA 015 LAST SEEN: 1997-03-04

SITE: HUMPHREY'S DRAFT COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1989: 3 PLANTS, ALL BOLTING; IMMATURE FRUIT. NO ROSETTES

FOUND. 1997: ONE DEAD STALK WITH FRUITS AND SEED FROM PREVIOUS YEAR. 1999: NONE OBSERVED.

HABITAT: SHALE BARREN/DRY OAK WOODLANDS: SW ASPECT; MOSTLY WOODDED EXCEPT ONE OPEN AREA WITH A LOT OF SEDGES AND GRASSES AT ABOUT MID-SLOPE. ASSOC. SPP: OAKS AND MTN. LAUREL.

SIZE: 1

COMMENTS: POPULATION, WHILE SMALL, IS PROBABLY BIGGER THAN WE THINK. THIS RIDGE HAS SEVERAL SHALE BARREN-LIKE PATCHES ALTHOUGH HABITAT IS MARGINAL. AREA IS NOT QUITE OPEN ENOUGH FOR REALLY GOOD BARREN VEGETATION. A. LAEVIGATA IS FOUND IN THE TRANSITIONAL BARREN AREAS.

-----  
NAME: ARABIS SEROTINA 016 LAST SEEN: 1993-08-27

SITE: MIDDLE MOUNTAIN SHALE BARRENS COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1989: 33 ROSETTES SEEN. 14 BOLTING PLANTS. IMMATURE AND MATURE FRUIT. 1993: 2 ROSETTES, 1 BROWSED (EARLY, AT BASE) BOLTING PLANT IN FLOWER. 1999: SEARCHED FOR, NOT FOUND.

HABITAT: OPEN AREA WITHIN CLOSED FORESTED "BARREN." DRY XERIC. W-FACING.

SIZE: 20' X 15'

COMMENTS: HERBIVORY - TOPS OF PLANTS EATEN OFF EARLY IN SEASON. UNDER LONG-TERM MONITORING PROJECT. 1999: POOR SITE, ONLY MARGINALLY CONSIDERED A "SHALE BARREN".

-----  
NAME: ARABIS SEROTINA 019 LAST SEEN: 2000-08-29

SITE: LOWER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1988: 2 BOLTING, 3 ROSETTES. FLOWER AND FRUIT. 1989: ?. 1992: 3 ROSETTES, 2 BOLTING. FLOWERS, FRUIT AND YOUNG

PLANTS. 1993: 5 ROSETTES, 2 BOLTING. ALL WITHIN 1 SQ YD.  
BOLTING PLANTS HAD BEEN BROWSED. 1994: 3 ROSETTES, 1 BOLTING  
PLANT. 4/1997: 6 OBSERVED, STARTING TO BOLT. NOT A COMPLETE  
SURVEY. 9/1997: 11 ROSETTES, 37 BOLTS. BARREN VERY DRY,  
ABOUT OF THE ROSETTES WERE CLOSED. 2000: 1 ROSETTE ON CLIFF  
AT FIRST BRIDGE (6 SEARCH HOURS).

HABITAT: UNDISTURBED SHALE BARREN.

SIZE: 2+

COMMENTS:

-----

NAME: ARABIS SEROTINA 027 LAST SEEN: 1999-10-05

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
RUCKER GAP

POPULATION DATA: 1999: 6 PLANTS (1 ROSETTE, 5 BOLTING).

HABITAT: LARGE, VIGOROUS SHALE BARREN UNDERCUT BY MEADOW CREEK.  
BARTGIS LISTS AS ONE OF BEST SHALE BARRENS IN WV.

SIZE:

COMMENTS:

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NAME: CALYSTEGIA SPITHAMAEA SSP PURSHIANA 003 LAST SEEN: 2000-08-29

SITE: LOWER WHITES DRAFT COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1976: IN FLOWER. 1983: ABUNDANT & IN FLOWER. 1986: 40  
PLANTS.

1997: ABOUT 650 PLANTS. COMMON OVER WHOLE BARREN. 2000:  
A=60, B=23.

HABITAT: SW-FACING SHALE BARREN. ASSOCIATES INCLUDE ROBINIA  
PSEUDOACACIA, CARYA SPP, PINUS VIRGINIANA, ERIOGONUM  
ALLENII, PHLOX SUBULATA, CAREX SP.

SIZE: 2+

COMMENTS:

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NAME: CALYSTEZIA SPITHAMAEA SSP PURSHIANA 007 LAST SEEN: 1999-10-05

SITE: HUMPHREY'S DRAFT COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1999: 12 PLANTS, SMALL, BUT HEALTHY LOOKING. 1989: NO DATA.

HABITAT: SHALE BARREN/DRY OAK WOODLANDS: SW ASPECT; MOSTLY WOODED EXCEPT ONE OPEN AREA WITH A LOT OF SEDGES AND GRASSES AT ABOUT MID-SLOPE. ASSOC. SPP: OAKS AND MTN. LAUREL.

SIZE: 1

COMMENTS:

-----

NAME: CALYSTEZIA SPITHAMAEA SSP PURSHIANA 019 LAST SEEN: 2000-08-29

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE: ANTHONY

POPULATION DATA: 2000: 19 PLANTS (2 SEARCH HOURS). 1985: ABOUT 300 PLANTS. CLONAL SPREADING.

HABITAT: SHALE BARREN ON STEEP SOUTH-FACING SLOPE. OPEN WOODLAND WITH A SERIES OF OPENINGS AND ROCK OUTCROPS.

SIZE: 2+

COMMENTS:

-----

NAME: CALYSTEZIA SPITHAMAEA SSP PURSHIANA 031 LAST SEEN: 1986-08-22

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE: RUCKER GAP

POPULATION DATA: 8/84: 100-150 INDIVIDUALS, IN LEAF. 8/86: ABOUT 300 PLANTS ON LOWER SLOPES. IN LEAF, NO REPRODUCTION MATERIAL NOTED.

HABITAT: LARGE, VIGOROUS SHALE BARREN UNDERCUT BY MEADOW CREEK.

SIZE: 5

COMMENTS:

-----

NAME: CALYSTEZIA SPITHAMAEA SSP PURSHIANA 032 LAST SEEN: 2000-08-29

SITE: UPPER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER  
QUADRANGLE: ALVON

POPULATION DATA: 2000: 152 PLANTS. 1985: 400 PLANTS. CLONAL SPREADING.

HABITAT: SW-FACING SHALE BARREN.

SIZE: 2+

COMMENTS:

-----

NAME: CALYSTEZIA SPITHAMAEA SSP PURSHIANA 041 LAST SEEN: 1986-06-22

SITE: GUNPOWDER CAVE COUNTY: PENDLETON QUADRANGLE: UPPER TRACT

POPULATION DATA: ABOUT 2000 PLANTS IN PERHAPS 15 CLONES.

HABITAT: HIGH S-FACING CLIFF WITH ADJACENT XERIC CALCAREOUS  
WOODLANDS.

SIZE: 10

COMMENTS:

-----

NAME: CALYSTEZIA SPITHAMAEA SSP PURSHIANA 052 LAST SEEN: 1993-06-10

SITE: YOKUM ROCKS COUNTY: GRANT QUADRANGLE: PETERSBURG WEST  
SHOOK HOLLOW PENDLETON UPPER TRACT  
LOCUST FLAT  
COUNTY LINE LIMESTONE BARREN  
SITE 4  
SITE 7

POPULATION DATA: SCATTERED DIFFUSELY ACROSS MOUNTAIN. OVER 2 DOZEN  
PATCHES.

HABITAT: XERIC LIMESTONE SUMMIT/BARREN AND GLADE WOODLANDS.

SIZE: 2+

COMMENTS:

-----

NAME: CALYSTEGIA SPITHAMAEA SSP PURSHIANA 072 LAST SEEN: 1973-06

SITE: GUNPOWDER RIDGE COUNTY: GREENBRIER QUADRANGLE: ANTHONY

POPULATION DATA: GUNPOWDER RIDGE: LOCALLY COMMON.

HABITAT: SHALE SOIL OF DRY TO AVERAGE WETNESS; OPEN EXPOSURE.

SIZE:

COMMENTS:

-----

NAME: CLEMATIS ALBICOMA 009 LAST SEEN: 2000-08-29

SITE: UPPER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER  
QUADRANGLE: ALVON

POPULATION DATA: 1985: 1200 PLANTS FOUND. FRUITING. 1986: ABOUT 750 PLANTS.  
1994: STILL PRESENT, BUT NO DATA. 2000: 124.

HABITAT: SW-FACING, MID- AND LOWER SLOPE SHALE BARREN.

SIZE: 4

COMMENTS:

-----

NAME: CLEMATIS ALBICOMA 021 LAST SEEN: 2000-08-29

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ANTHONY

POPULATION DATA: 1982: OVER 100 PLANTS. 1983: OVER 100 PLANTS. 1985: ABOUT  
400 PLANTS. FRUITING. 1994: PRESENT. 1997: LESS THAN 50  
PLANTS WIDELY SCATTERED OVER EAST SIDE OF RIDGE. 1999: 13  
PLANTS. 2000: 22 PLANTS (2 HOUR SEARCH TIME).

HABITAT: SHALE BARREN ON STEEP S-FACING SLOPE.

SIZE:

COMMENTS:

-----

NAME: CLEMATIS ALBICOMA 025 LAST SEEN: 2000-08-29

SITE: LOWER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER  
QUADRANGLE: ALVON

POPULATION DATA: 1959: SPECIMEN. 1982: NO DATA. 1983: COMMON. IN FLOWER &  
FRUIT. 1986: ABOUT 800 PLANTS SCATTERED THROUGHOUT BARREN.  
FRUITING. 1994: STILL PRESENT, BUT NO DATA. 1997: COMMON AND  
WIDESPREAD ON BARREN. 2000: (A)80, (B)268, TOTAL 348.

HABITAT: SHALE BARREN.

SIZE: 20

COMMENTS:

-----

NAME: CLEMATIS ALBICOMA 031 LAST SEEN: 1994-07-27

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
RUCKER GAP

POPULATION DATA: 8/84: ABOUT 1000 INDIVIDUALS. IN FLOWER AND FRUIT. 8/86;  
ABOUT 500 PLANTS. VIGOROUS. MATURE FRUIT. 7/94: STILL  
PRESENT, BUT NO DATA.

HABITAT: LARGE VIGOROUS SHALE BARREN UNDERCUT BY MEADOW CREEK.

SIZE:

COMMENTS:

-----

NAME: CLEMATIS ALBICOMA 040 LAST SEEN: 1994-07-28

SITE: MIDDLE MOUNTAIN SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ALVON

POPULATION DATA: 1985: ABOUT 140 SCATTERED PLANTS. FRUITING. 1994:  
PRESENT.

HABITAT: SHALE BARREN. A SEEMINGLY CALCAREOUS SLATY OPENING ON  
W-FACING SLOPE ABOVE NORTH FORK OF ANTHONY CREEK.

SIZE: 2+

COMMENTS:

-----  
NAME: CLEMATIS ALBICOMA 052 LAST SEEN: 1994-07-28

SITE: HUMPHREY'S DRAFT COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA:

HABITAT:

SIZE:

COMMENTS:

-----

NAME: ERIOGONUM ALLENII 011 LAST SEEN: 2000-08-29

SITE: LOWER WHITES DRAFT COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1982: IN FLOWER. 1993: 17 PLANTS IN FLOWER. 1994: STILL  
PRESENT, BUT NO DATA. 1997:NO COUNT, PLANTS IN LEAF.  
RESTRICTED TO OUTCROP AREA ABOVE BRIDGE. 2000: A: 166  
CLUMPS, 267 FLOWER SPIKES. B: 102 CLUMPS, 50 FLOWERS STALKS.

HABITAT: SW-FACING VERTICAL SHALE WALL. OENOTHERA AND CLEMATIS  
ALBICOMA.

SIZE: 5000 SQ FT.

COMMENTS:

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NAME: ERIOGONUM ALLENII 013 LAST SEEN: 1994-07-27

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
RUCKER GAP

POPULATION DATA: 8/25/84: 3000 INDIVIDUALS ESTIMATED. 8/22/86: 1000+ PLANTS  
SCATTERED THROUGHOUTEXCEPTIONALLY VIGOROUS AND IN BUD,  
FLOWER, AND WITH IMMATURE FRUIT. 7/94: STILL PRESENT, BUT NO  
DATA.

HABITAT: LARGE, VIGOROUS SHALE BARREN UNDERCUT BY MEADOW CREEK.

SIZE:

COMMENTS: EXCELLENT QUALITY SITE FOR SPECIES; RESEARCH NATURAL AREA.

-----  
NAME: ERIOGONUM ALLENII 014 LAST SEEN: 2000-08-29

SITE: UPPER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER  
QUADRANGLE: ALVON

POPULATION DATA: 1985: 80 PLANTS IN MOST OPEN PART OF BARREN. 1993: 18 IN  
FLOWER. 2000: 68 CLUMPS, 154 FLOWER STALKS.

HABITAT: SW-FACING SHALE BARREN, MID- AND LOWER SLOPE.

SIZE:

COMMENTS:

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NAME: HELIANTHUS LAEVIGATUS 001 LAST SEEN: 1994-07-27

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
RUCKER GAP

POPULATION DATA: 8/25/84: 400 TO 500 INDIVIDUALS. 8/26: IN FLOWER. 500+  
PLANTS. 7/94: STILL PRESENT, BUT NO DATA.

HABITAT: A STEEP SHALE BARREN RISING SHARPLY FORM THE CREEK BELOW.  
MANY STEEP RAVINES AND ROCK OUTCROPS RUNNING VERTICALLY  
THROUGHOUT THE AREA. UPSLOPE THE BARREN GRADES INTO AN  
OAK-HICKORY FOREST, WHILE THE SIDES ARE BOUNDED BY AN  
OAK-PINE-HICKORY FOREST. SEVERAL EO'S ARE AT THIS SITE.

SIZE:

COMMENTS: PROPOSED RESEARCH NATURAL AREA.

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NAME: HELIANTHUS LAEVIGATUS 003 LAST SEEN: 1974-09-02

SITE: HOPKINS MOUNTAIN COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1974: SCATTERED.

HABITAT: IN DRY SAND-LOAM; OPEN.

SIZE:

COMMENTS:

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NAME: HELIANTHUS LAEVIGATUS 007 LAST SEEN: 1985-06-28

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ANTHONY

POPULATION DATA: ABOUT 55 PLANTS. FLOWER BUDS.

HABITAT: SHALE BARREN ON STEEP S-FACING SLOPE. OPEN WOODLAND WITH A  
SERIES OF OPENINGS AND ROCK OUTCROPS.

SIZE:

COMMENTS:

-----  
NAME: HELIANTHUS LAEVIGATUS 011 LAST SEEN: 1985-08-16

SITE: COLES RUN COUNTY: GREENBRIER QUADRANGLE: RUCKER GAP

POPULATION DATA: 3 CLUMPS NOTED ON ROAD BANK. FLOWERING

HABITAT: XERIC, ACIDIC, PINE WOODLANDS

SIZE: 1

COMMENTS:

-----  
NAME: LIATRIS TURGIDA 008 LAST SEEN: 1973-09-03

SITE: BLUE BEND-WEST COUNTY: GREENBRIER QUADRANGLE: ANTHONY

POPULATION DATA: 1973: SCATTERED.

HABITAT: ABOVE ROAD ON DRY ROCKY HILLSIDE; BROKEN CANOPY.

SIZE:

COMMENTS:

NAME: OENOTHERA ARGILICOLA 001 LAST SEEN: 1981-07

SITE: RIFFLE CREEK ROAD - EAST COUNTY: RANDOLPH QUADRANGLE: MILL CREEK

POPULATION DATA: SHALE EVENING-PRIMROSE FROM ROADSIDE ALONG RTE 250, W SLOPE OF CHEAT MTN, 3.2 MIE OF RIFFLE CREEK RD, ON 7-22-81.

HABITAT:

SIZE:

COMMENTS:

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NAME: OENOTHERA ARGILICOLA 032 LAST SEEN: 2000-08-29

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE: ANTHONY

POPULATION DATA: 2000: 1 BOLT, 2 ROSETTES. 1999: 1 ROS. 1 BOLT. 1997: 3 PLANTS SEEN. 1982: NO DATA.

HABITAT: ON ROCK LEDGE ON WEST SIDE OF SHALE BARREN.

SIZE:

COMMENTS:

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NAME: OENOTHERA ARGILICOLA 044 LAST SEEN: 1994-07-27

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE: RUCKER GAP

POPULATION DATA: 8/25/84: 30 INDIVIDUALS, AVERAGE VIGOR. 8/22/86: ONLY 2 PLANTS NOTED, GROWING ABOUT MID-SLOPE ON SHALE LEDGES; IN FLOWER W/IMMATURE AND MATURE FRUIT. 7/27: STILL PRESENT, BUT NO DATA.

HABITAT: LARGE, VIGOROUS SHALE BARREN UNDERCUT BY MEADOW CREEK.

SIZE:

COMMENTS: PROPOSED RESEARCH NATURAL AREA.

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NAME: OENOTHERA ARGILLICOLA 049 LAST SEEN: 1999-09-24

SITE: TURKEY PEN RUN SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ALVON

POPULATION DATA: 1985: 18 PLANTS ON ROCK LEDGE. FLOWER BUDS AND LAST  
YEAR'S

FRUIT STALKS. 1994: STILL PRESENT, BUT NO DATA. 1999: ABOUT  
125 PLANTS SEEN. SEED PODS ON LARGER PLANTS, SOME YOUNG  
PLANTS SEEN.

HABITAT: SMALL, STEEP SHALE BARREN WITH OPEN AREAS AND ECOTONAL  
WOODS.

SIZE: 25 SQ M

COMMENTS:

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NAME: OENOTHERA ARGILLICOLA 063 LAST SEEN: 1987-08

SITE: BIG BEND LIMESTONE BARREN COUNTY: GRANT QUADRANGLE:  
PETERSBURG WEST  
BLUE ROCK                      PENDLETON

POPULATION DATA: IN BIG BEND AREA 30 PLANTS WERE SEEN IN 1987 AND 50 IN  
1986.

POTENTIALLY MORE. 12 PLANTS SEEN AT BLUE ROCK.

HABITAT: XERIC LIMESTONE SUMMIT/BARREN.

SIZE:

COMMENTS:

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NAME: OENOTHERA ARGILLICOLA 066 LAST SEEN: 1985-08-16

SITE: COLES RUN EAST COUNTY: GREENBRIER QUADRANGLE: RUCKER GAP

POPULATION DATA:

HABITAT: XERIC, ACIDIC, PINE WOODLANDS.

SIZE: 1

COMMENTS:

-----  
NAME: OENOTHERA ARGILICOLA 076 LAST SEEN: 1983-08-07

SITE: BACK FORK COUNTY: RANDOLPH QUADRANGLE: MILL CREEK

POPULATION DATA:

HABITAT:

SIZE:

COMMENTS:  
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NAME: PACKERA ANTENNARIIFOLIA 006 LAST SEEN: 1994-07-25

SITE: UPPER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER  
QUADRANGLE: ALVON

POPULATION DATA: 1985: 1200 PLANTS THROUGHOUT BARREN. FLOWERING;  
CLONAL

SPREADING. 1993: ONLY SEVEN PLANTS SEEN. 1994: STILL PRESENT  
BUT NO DATA.

HABITAT: SW-FACING, LOWER SLOPE SHALE BARREN.

SIZE:

COMMENTS:  
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NAME: PACKERA ANTENNARIIFOLIA 014 LAST SEEN: 1985-06-28

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ANTHONY

POPULATION DATA: 3 PLANTS IN ONE CLONE. MATURE FRUIT.

HABITAT: SHALE BARREN ON STEEP S-FACING SLOPE. OPEN WOODLAND WITH A  
SERIES OF OPENINGS AND ROCK OUTCROPS.

SIZE:

COMMENTS:

-----  
NAME: PACKERA ANTENNARIIFOLIA 025 LAST SEEN: 1994-08-01

SITE: TURKEY PEN RUN SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ALVON

POPULATION DATA: 1985: 450 PLANTS IN CLONES OF 2 TO 18. FRUITS. 1994: STILL  
PRESENT, BUT NO DATA.

HABITAT: SMALL, STEEP SHALE BARREN WITH OPEN AREAS AND ECOTONAL  
WOODS.

SIZE:

COMMENTS:

-----

NAME: PACKERA ANTENNARIIFOLIA 028 LAST SEEN: 1994-07-27

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
RUCKER GAP

POPULATION DATA: 1986: ABOUT 550 VIGOROUS PLANTS ON THE LOWER SLOPES;  
PAST

FLOWERING STAGE. 1994: STILL PRESENT, BUT NO DATA.

HABITAT: A STEEP SHALE BARREN RISING SHARPLY FROM THE CREEK BELOW.  
MANY STEEP RAVINES AND ROCK OUTCROPS RUNNING VERTICALLY  
THROUGHOUT THE AREA. UPSLOPE THE BARREN GRADES INTO AN  
OAK-HICKORY FOREST, WHILE THE SIDES ARE BOUNDED BY AN  
OAK-PINE-HICKORY FOREST. SEVERAL EO'S ARE AT THIS SITE.

SIZE:

COMMENTS: RESEARCH NATURAL AREA.

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NAME: PACKERA ANTENNARIIFOLIA 037 LAST SEEN: 1991-07-21

SITE: BIG BEND SHALE BARREN COUNTY: GRANT QUADRANGLE: PETERSBURG  
WEST

POPULATION DATA: SEVERAL 100 PLANTS. IN FRUIT.

HABITAT: SHALE BARREN WITH PARONYCHIA MONTANA, ANTENNARIA  
VIRGINICA,

PINUS VIRGINIANA, CAREX PENNSYLVANICA, VACCINIUM, SCRUB OAK,  
OSTRYA.

SIZE: 1

COMMENTS:

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NAME: PHLOX BUCKLEYI 010 LAST SEEN: 1997-06-26

SITE: RYDER GAP COUNTY: POCAHONTAS QUADRANGLE: MOUNTAIN GROVE

POPULATION DATA: 1997: HUNDREDS OF PLANTS, WITH ABOUT 500 IN FLOWER.  
POPULATION HAS EXPLODED, PERHAPS DUE TO RECENT  
BRUSH-HOGGING. 1996: TWO SUPPOPLS. OF 11 AND 8 PLANTS.  
FLOWERING. SEVERAL SMALL RUNNERS NOT IN FLOWER. POPL. SIZE  
IS ABOUT 50 YDS OF ROAD BANK. 1994: 3 PLANTS JUST BEGINNING  
TO BLOOM. 1990: ABOUT ONE DOZEN PLANTS IN FLOWER.

HABITAT: SHALE ROAD BANK. PLANTS FOUND ON BOTH SIDES OF ROAD, WITH  
THE MOST PLANTS ON THE EAST SIDE. QUERCUS VELUTINA, PINUS  
STROBUS, NYSSA SYLVATICA, CASTANEA DENTATA, PTIRIDIUM  
AQUILUM, EPIGEA REPENS, VIOLA PEDATA, GRASSES, GILLENIA  
TRIFOLIATA, MOSS, COMPOSITES, SEGDES. HEIRACEUM VENOSUM,  
LICHENS VACCINIUM.

SIZE: 3000 SQ FT

COMMENTS:

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NAME: PHLOX BUCKLEYI 013 LAST SEEN: 2002-05-19

SITE: LAKE SHERWOOD-NORTHEAST COUNTY: GREENBRIER QUADRANGLE:  
MOUNTAIN GROVE

POPULATION DATA: 2002: A) 100 STEMS ABOUT 40 PLANTS; MANY BLOOMS. B) 2  
MULTISTEM PLANTS IN BLOOM.

HABITAT: RED OAK-VACCINIUM, STAMINEUM FOREST(NORTH STAND); RED  
OAK-WHITE PINE FOREST (SOUTHERN STAND). IN VICINITY  
CONVULLARIA MONTANA, MINNIE-BUSH, UVULARIA PUDICA,  
MELANTHIUM PARVIFLORUM.

SIZE:

COMMENTS:

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NAME: SOLIDAGO ARGUTA VAR HARRISII 042 LAST SEEN: 1987-08

SITE: EAGLE ROCK COUNTY: GRANT QUADRANGLE: PETERSBURG WEST  
BLUE ROCK PENDLETON UPPER TRACT  
SHIP ROCK

POPULATION DATA: ONLY A FEW DOZEN PLANTS NOTED AT EACH OF THE SHIP  
ROCK AND  
BLUE ROCK SITES. OVER 2000 PLANTS WITH FLOWER BUDS AT THE  
EAGLE ROCK SITE.

HABITAT: CEDAR GLADES AND CLIFFS.

SIZE: 10+

COMMENTS:

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NAME: TAENIDIA MONTANA 004 LAST SEEN: 1995-08

SITE: ST. GEORGE-EAST COUNTY: TUCKER QUADRANGLE: SAINT GEORGE

POPULATION DATA: NO DATA.

HABITAT: HEAD OF COVE.

SIZE:

COMMENTS:

-----  
NAME: TAENIDIA MONTANA 006 LAST SEEN: 1980-09-13

SITE: SMOKE HOLE ROAD COUNTY: PENDLETON QUADRANGLE: UPPER TRACT  
SMOKE HOLE CAVE

POPULATION DATA: 1929 & 1944: SPECIMENS. 1980: 10-12 PLANTS. FRUITING. 1982:  
SCATTERED. 1997: 10-15 PLANTS SCATTERED ALONG 2 MILE STRETCH  
OF ROAD. IN BLOOM AND JUST PAST PEAK.

HABITAT: SHALE CLIFFS AND OUTCROPS.

SIZE:

COMMENTS:

-----  
NAME: TAENIDIA MONTANA 024 LAST SEEN: 2000-08-29

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ANTHONY

POPULATION DATA: 1981: SPECIMEN. 1985: ABOUT 30 PLANTS. MATURE FRUIT. 1997:  
28 PLANTS. 1999: 8 PLANTS, 2 WITH SEEDS. 2000: 38 PLANTS (2  
SEARCH HOURS).

HABITAT: IN AREAS OF PARTIAL SHADE ON SHALE BARREN ON STEEP, S-FACING  
SLOPE. OPEN WOODLAND WITH A SERIES OF OPENINGS AND ROCK  
OUTCROPS.

SIZE: 2+

COMMENTS:  
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NAME: TAENIDIA MONTANA 031 LAST SEEN: 1985-06-27

SITE: MIDDLE MOUNTAIN SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ALVON

POPULATION DATA: 33 PLANTS, 20% MATURE. FRUITING. IN PARTIAL SHADE.

HABITAT: SHALE BARREN. A SEEMINGLY CALCAREOUS SLATY OPENING ON  
W-FACING SLOPE ABOVE NORTH FORK OF ANTHONY CREEK.

SIZE: 2+

COMMENTS:  
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NAME: TAENIDIA MONTANA 034 LAST SEEN: 1987-06-01

SITE: YOKUM ROCKS COUNTY: GRANT QUADRANGLE: UPPER TRACT  
GUNPOWDER CAVE PENDLETON PETERSBURG WEST

POPULATION DATA: 300 PLANTS AT GUNPOWDER CAVE WITH CONSIDERABLE  
ADDITIONAL

HABITAT. APPROX. 100 PLANTS AT YOKUM ROCKS. LOCALLY COMMON.

HABITAT: LIMESTONE GLADE AND CLIFF. ADJACENT XERIC CALCAREOUS  
WOODLANDS.

SIZE: 10+

COMMENTS:

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NAME: TAENIDIA MONTANA 052 LAST SEEN: 1999-09-16

SITE: WHITMANS DRAFT SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ALVON

POPULATION DATA: 1999: SEVENTEEN PLANTS COUNTED. MOST PLANTS SMALL,  
NON-FRUITING, BROWSED. TWO PLANTS IN FRUIT.

HABITAT: XERIC WOODS. CRATAEGUS SP., OAK, HICKORY, RED BUD, RHUS  
AROMATICA. POPULATION IS AT END OF SIDE RIDGE. PROBABLY  
PRESENT THROUGHOUT ALTHOUGH DIFFICULT TO LOCATE LATE IN  
SEASON. POSITION ONLY NOTED BY GPS.

SIZE:

COMMENTS:

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NAME: TRIFOLIUM VIRGINICUM 002 LAST SEEN: 2000-08-29

SITE: UPPER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER  
QUADRANGLE: ALVON

POPULATION DATA: 1985: THOROUGH CHECK REVEALED ONE PLANT. 1986: 13  
PLANTS IN  
SMALL AREA. 1993: NO POPL. INFO. 1994: STILL PRESENT, BUT NO  
DATA. 2000: 4 PLANTS.

HABITAT: SW-FACING. MID- AND LOWER-SLOPE SHALE BARREN.

SIZE:

COMMENTS:

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NAME: TRIFOLIUM VIRGINICUM 004 LAST SEEN: 1999-10-05

SITE: MEADOW CREEK SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
RUCKER GAP

POPULATION DATA: 1999: 18 PLANTS, NO SEEDLINGS OR OLD FLOWERS SEEN. 1984:  
ABOUT 12 PLANTS...ADDITIONAL PLANTS WERE LIKELY OVERLOOKED.

HABITAT: LARGE, VIGOROUS SHALE BARREN UNDERCUT BY MEADOW CREEK.  
BARTGIS LISTS AS ONE OF BEST SHALE BARRENS IN WV.

SIZE:

COMMENTS: PLANTS HEAVILY BROWSED (1999).

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NAME: TRIFOLIUM VIRGINICUM 011 LAST SEEN: 2000-08-29

SITE: BLUE BEND SHALE BARREN COUNTY: GREENBRIER QUADRANGLE:  
ANTHONY

POPULATION DATA: 1982: 200-300 PLANTS. 6-12-1983: 60-70 PLANTS; IN FRUIT.  
1985: 25 PLANTS. A SIGNIFICANT POPULATION DROP FROM UNKNOWN  
CAUSES. 1994: STILL PRESENT. 1997: 12 PLANTS. 1999: 4  
PLANTS. 2000: 24 PLANTS.

HABITAT: STEEP SOUTH FACING SLOPE OF HOPKINS MOUNTAIN. PART IS OPEN  
WOODLAND AND PART IS A SERIES OF OPENINGS AND ROCK OUTCROPS.  
POPULATION AREA IS ABOUT 2 ACRES.

SIZE:

COMMENTS: PART OF AREA HAS BEEN GRAZED IN PAST.

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NAME: TRIFOLIUM VIRGINICUM 021 LAST SEEN: 1987-06-01

SITE: YOKUM ROCKS COUNTY: GRANT QUADRANGLE: PETERSBURG WEST  
PENDLETON

POPULATION DATA: 1987: OVER 50 INDIVIDUALS FOUND JUNE 1987 AT NORTH END  
OF  
CEDAR GLADE. GROWS AMONG RESIDUAL CLAYS BETWEEN LIMESTONE  
COBBLES. 1986: 35 INDIVIDUALS; POTENTIALLY MORE.

HABITAT: XERIC LIMESTONE SUMMIT/BARREN

SIZE:

COMMENTS:

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NAME: TRIFOLIUM VIRGINICUM 031 LAST SEEN: 1997-09-04

SITE: LOWER WHITES DRAFT SHALE BARREN COUNTY: GREENBRIER  
QUADRANGLE: ALVON

POPULATION DATA: 1997: 150 PLANTS. NO FLOWERS OR FRUIT EVIDENT. 1983: 200  
PLANTS IN FRUITING STAGE. 1973: SCATTERED.

HABITAT: SHALE BARREN.

SIZE:

COMMENTS: THE 1973 COLLECTION MAY HAVE BEEN FROM UPPER WHITES DRAFT  
SHALE BARREN.

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NAME: TRIFOLIUM VIRGINICUM 045 LAST SEEN: 1994-07-28

SITE: HUMPHREY'S DRAFT COUNTY: GREENBRIER QUADRANGLE: ALVON

POPULATION DATA: 1989: 14 PLANTS OBSERVED. 1994: STILL PRESENT, BUT NO  
DATA.  
1999: NO PLANTS SEEN.

HABITAT: SHALE BARREN/DRY OAK WOODLANDS: OPENING WITH SEDGES AND  
GRASSES. SW ASPECT.

SIZE: 1

COMMENTS: