

The HOT ZONE

The shale barrens of eastern West Virginia



Pussytoes ragwort by Jim Vanderhorst

Craig Stihler

Shale barrens are natural sunny openings with few trees. Inset photo: pussytoes ragwort, found only on shale barrens.

By Jim Vanderhorst

Although they occupy stiflingly hot and treacherously steep, crumbling slopes, shale barrens have attracted the interest of botanists and ecologists for more than a century. These special habitats, which occur only in some eastern counties of West Virginia and nearby areas of Virginia, Maryland and Pennsylvania, support a group of plant species found nowhere else in the world.

This pattern of restricted geographical distribution is known as endemism. Plant species restricted to shale barrens are called shale barren endemics. Three of the shale barren endemics were first described and given scientific names by eminent botanists in the late 19th century: shale barren wild buckwheat by Sereno Watson in 1890, Kate's Mountain clover by John Kunkel Small in 1894, and pussytoes ragwort by Nathaniel Lord

Britton in 1898. In 1911 Edward Strieby Steele coined the term "shale barren" to describe these unique natural communities.

Ecologically, shale barrens are naturally open communities which occur on hot, dry, typically steep south-facing slopes, on substrates (surfaces) derived from shale, a fine-textured sedimentary rock. The shale was laid down in the Devonian time about 400 million years ago and was later lifted and exposed by the folding and faulting episodes which formed the Ridge and Valley topography in the Permian period about 250 million years ago. Early ecologists hypothesized that shale barrens were kept open by continual erosion of the loose, brittle substrate caused by undercutting of steep shale slopes by streams.

But not all shale barrens are undercut by streams. Perhaps as important to the maintenance of

an open habitat is a hot, dry microclimate which prevents the survival of many species adapted to the moist conditions of the Central Appalachians. The shale barrens lie in a rain shadow (a dry area) to the leeward side of the Allegheny Mountains. They occur only on slopes with the hottest conditions. Drought can prevent germination of seeds or quickly kill seedlings which manage to germinate. Extreme drought episodes can even kill or partially kill long established trees. All of these effects help create an area with few or no trees, a condition known as an open canopy structure.

Shale barren communities range from open woodlands to prairies. Common trees on the barrens include scrub pine, chestnut oak and eastern red cedar, but here these trees do not form a closed canopy (unbroken layer of leaves). It is the

sunny openings between the trees which make these habitats special. The shale barren endemics, and several other rare plants which occur on the barrens, are obligate heliophytes (sun plants), meaning they are not well adapted to growing in the shade. All across the Central Appalachians the predominant vegetation types are closed canopy forests. Natural openings are scarce. Shale barrens are like tiny sunny islands in a sea of shady forest.

The large concentration of shale barren endemics in the Central Appalachians is a testament to the persistence of these open habitats through evolutionary time. A study of plants closely related to these endemics provides hints concerning the ancestry and migration histories of these plant species. Several of the endemics are most closely related to species in the western United States, suggesting a past connection of habitat or possibly multiple instances of long distance seed dispersal. One good example of this western con-

nection is shale barren wild buckwheat. This is the only species of wild buckwheat found as far east as the Appalachians, although in the western United States more than 200 species are known.

Not all shale barrens are the same. In 2004 a group of Natural Heritage Program ecologists from Maryland, Virginia and West Virginia, working with the non-profit organization NatureServe, completed a regional classification of shale barren vegetation. They used modern statistical methods to analyze patterns of species composition, environmental conditions, and geographic distributions of shale

barrens across the Central Appalachians. The analysis resulted in the recognition of five shale barren community types, which are now formal units in the U.S. National Vegetation Classification. West Virginia is home to at least four of these associations.

The "classic" shale barren association is restricted to Greenbrier, Pendleton, Mon-

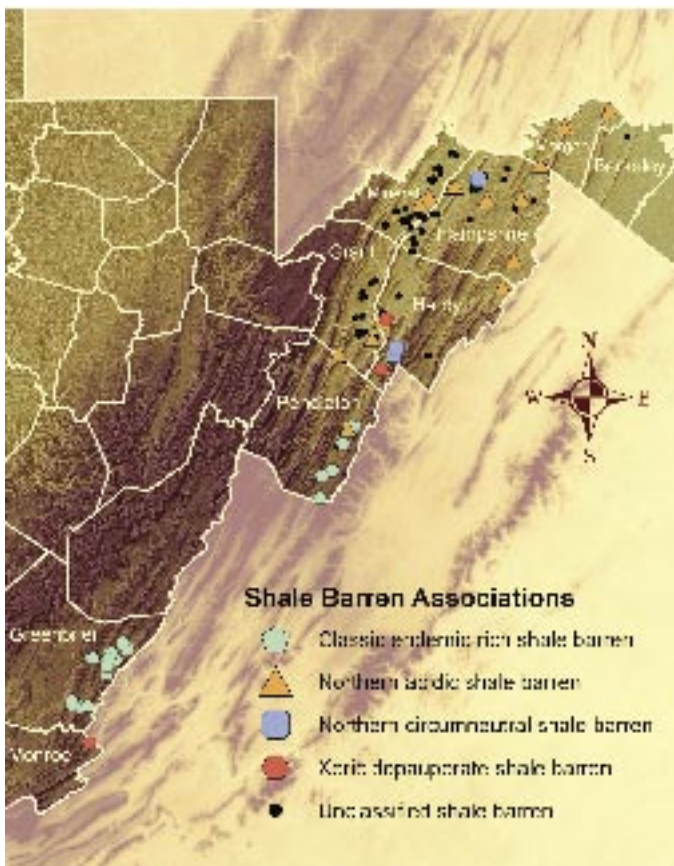
roe and Hardy counties in West Virginia and the neighboring counties of Virginia. This woodland type has the highest concentration of endemics. Further north is another woodland association which is characterized by an abundance of eastern red cedar and prickly pear cactus. A third, more northern association is characterized by circumneutral (pH close to 7, neither acidic nor basic) soils, as opposed to the highly acidic soils of other shale barren types. This type is typically a prairie with scattered trees and includes plant species, such as side-oats grama grass, adapted to calcium-rich soils. The rich soils also make this type especially susceptible to invasions of exotic weeds. A fourth association, which occurs in the hottest, driest sites throughout the range of shale barrens, is characterized by

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Shale barren wild buckwheat, an endemic with closest relatives far to the west.

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Location of shale barrens in eastern West Virginia. Background shows hillshade for the state draped over an elevation model for entire region (highest elevations are darkest).



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West Virginia's shale barren endemics

The name following the italicized scientific name indicates the person who first described and named the species.

Common Name	Scientific Name
shale barren rock cress	<i>Arabis serotina</i> Steele
white-haired leather flower	<i>Clematis albicoma</i> Wherry
shale barren wild buckwheat	<i>Eriogonum allenii</i> S. Watson
shale barren evening primrose	<i>Oenothera argillicola</i> Mackenzie
pussytoes ragwort	<i>Senecio antennariifolius</i> Britton*
Kate's Mountain clover	<i>Trifolium virginicum</i> Small

*recently changed to *Packera antennariifolia* (Britton) W. A. Weber & A. Löve to reflect new genetic evidence of taxonomic relationships

Additional rare plants found on West Virginia shale barrens which may occur in other habitats as well (not strict shale barren endemics)

Common Name	Scientific Name
nodding wild onion	<i>Allium oxyphilum</i> Wherry
shale barren pussytoes	<i>Antennaria virginica</i> Stebbins
Bradley's spleenwort	<i>Asplenium bradleyi</i> D. C. Eaton
bent milkvetch	<i>Astragalus distortus</i> Torrey and Gray
side-oats grama grass	<i>Bouteloua curtipendula</i> (Michaux) Torrey
shale barren bindweed	<i>Calystegia spithamea</i> (L.) Pursh ssp. <i>purshiana</i> (Wherry) Brummitt
chestnut lipfern	<i>Cheilanthes eatonii</i> Baker
shale barren sunflower	<i>Helianthus laevigatus</i> Torrey & Gray
shale barren hawkweed	<i>Hieraceum trailii</i> Greene
mountain pimpernel	<i>Taenidia montana</i> (Mackenzie) Cronquist
Appalachian blazing star	<i>Liatris turgida</i> Gaiser
shale barren goldenrod	<i>Solidago arguta</i> Aiton var. <i>harrisii</i> (Steele) Cronquist

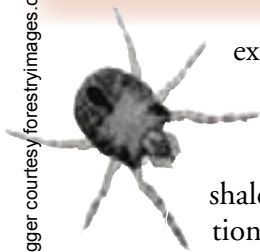


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Clockwise from left: Kate's Mountain clover was first described from Kate's Mountain, just outside White Sulphur Springs; the gnarled dead pine was probably killed by drought; white-haired leather flowers and fence lizards are found on shale barrens.

Microscopic view of a chigger courtesy forestryimages.com



extremely sparse ground cover and low diversity of herbs. The fifth shale barren association recognized in the U.S. National Vegetation Classification is a southern type with circum-neutral soils currently known only from ridge tops in Virginia, but possibly existing, as yet undetected, in southern West Virginia.

Shale barrens also provide habitat for other sun-loving life forms. Perhaps the most memorable of

shale barren animals are chiggers, the larvae of a type of mite (related to spiders and scorpions). If you have ever suffered from the itching welts caused by the bites of these tiny red critters, you will never forget them.

Shale barrens display a high diversity of butterflies which visit for nectar and open space for mating flight rituals. Some caterpillars (butterfly larvae) also depend on shale barren plants for food. On even the hottest days, fence lizards and five-lined skinks can be seen in high

speed pursuit of insect prey. These reptiles have tough, scaly skins which protect the body from drying out. As a result, they are most active during daylight in the hottest months. So if you ever come across a barren opening in the woods and think it inhospitable, keep in mind that it may be "home sweet home" for a whole community of unusual plants and animals who prefer life in the hot zone.

Jim Vanderhorst is an ecologist stationed in Elkins.