

Welcome to *Keystone Wild!Notes* newest feature, “Our Changing Climate.”

In this column, we’re going to explore climate change and how it will influence Pennsylvania’s species and habitats. To kick it off, I thought we’d begin with the basics. So let’s talk about what’s gotten us into this mess -- CARBON.

It’s important to recognize that carbon is not bad. In fact, it’s the element on which all life is based. We are all carbon-based units, to borrow a phrase from Star Trek. So why, then, is it causing such problems?

In order to answer that, we first need to understand where and in what forms carbon naturally occurs. Carbon is found in four global reservoirs:

- 1) Geologic – Carbon occurs underground in the form of coal, oil and natural gas.
- 2) Terrestrial – On land, carbon is found in the form of living things, like people and trees, and in the soil.
- 3) Atmospheric – Carbon is found in the atmosphere in several different forms, but the most common is carbon dioxide.
- 4) Oceanic – Sea water contains high levels of dissolved carbon dioxide, carbonates and other carbon compounds; and it’s contained within the bodies of sea creatures as well.

These reservoirs aren’t static. Carbon is constantly moving back and forth between them through the carbon cycle. The rate and direction of this movement has been relatively stable, at least until recently.

We’ve been removing huge amounts of carbon from the geologic reservoir. This began with the industrial revolution, and then really kicked into high gear after Edwin Drake drilled

the first commercially successful oil well in Titusville, Pennsylvania, in 1859.

As we burn coal, oil and natural gas for fuel, we transfer geologic carbon to the atmospheric reservoir. Additionally, deforestation, particularly in the tropics, is converting large amounts of terrestrial carbon into atmospheric carbon as well.

The end result is the insulating blanket of atmospheric carbon dioxide that makes our planet habitable is beginning to feel more like a down comforter in summertime.

And on top of that, as the level of carbon dioxide in the atmosphere increases, the amount that is transferred to the oceans is also increasing, leading to concerns about ocean acidification.

If we’re throwing the system out of balance, what should we do?

There are three essential and complimentary steps:

- 1) Stop transferring carbon from the geologic to the atmospheric reservoir. In other words, switch from fossil fuels to renewable energy.
- 2) Begin removing carbon from the atmospheric reservoir and putting it into one of the other reservoirs. This is a process known as carbon sequestration.
- 3) Begin planning for and coping with the changes to come (*see the story on climate change adaptation in the Summer 2009 issue, [www.dcnr.state.pa.us/wrcp](http://www.dcnr.state.pa.us/wrcp)*).

Each of these strategies, and many more aspects of climate change, will be covered in future installments of this series. If you have specific climate change topics you’d like us to cover, send me an e-mail at [gczarnecki@state.pa.us](mailto:gczarnecki@state.pa.us).

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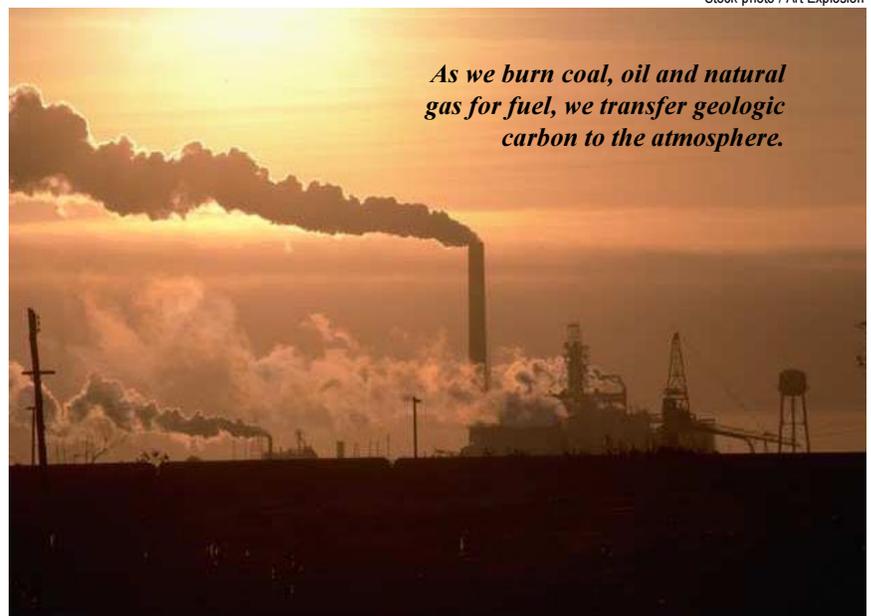
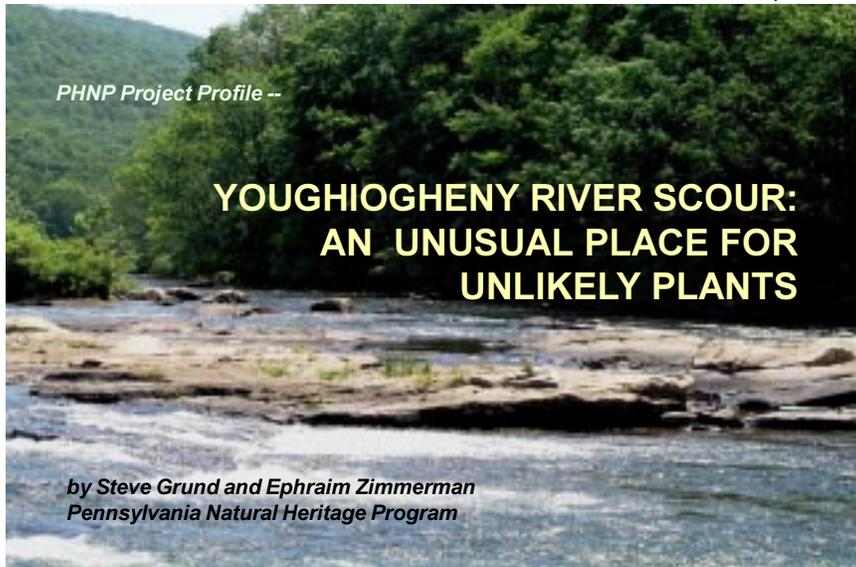


Photo by Steve Grund



PHNP Project Profile --

## YOUGHIOGHENY RIVER SCOUR: AN UNUSUAL PLACE FOR UNLIKELY PLANTS

by Steve Grund and Ephraim Zimmerman  
Pennsylvania Natural Heritage Program

While kayaking or canoeing the rivers of Western Pennsylvania, you might have noticed patches of prairie-like grasslands found along the sand, cobble, boulder and bedrock banks.

These ecosystems are home to many species of conservation concern, and they have become increasingly rare in Pennsylvania due to habitat conversion and damming. They have also suffered from the onslaught of invasive alien plants. These prairie-like ecosystems are often found at the mouths of tributary streams, where small deltas called “cobble fans” form, as well as on islands, at rapids and where large boulders or exposed bedrock is directly in contact with the flowing water. They are definitely places you don’t want to be during the spring floods!

Known as ice-scour grasslands, riverbank bedrock communities, or river floodplain prairies, these grass and herb dominated ecosystems are pummeled each year by intense floodwaters and flowing sheets of ice that crash and scour the floodplains, at times down to the bedrock.

Flooding is a natural disturbance process on all streams and is important for maintenance of floodplain ecosystems of various kinds. On larger rivers, especially those that carry significant amounts of ice during spring melts, this process is very vigorous, ripping up much of the vegetation, creating a zone we call “river scour.”

In Pennsylvania, significant river scour occurs on the Allegheny, Clarion, Conemaugh, Delaware, Susquehanna, Juniata and Youghiogheny rivers, as well as on some stretches of their major tributaries. On many rivers, especially the Monongahela, the lower Susquehanna and the Ohio, damming of the rivers for flood control, water supply and to form navigation pools and recreational lakes has highly modified or eliminated floodplain habitats, including scour.

The Youghiogheny River, specifically the stretch called the Youghiogheny Gorge, between the Youghiogheny Reservoir and Connellsville, is the most dynamic large river in Pennsylvania because of the steep descent it makes while cutting through

Laurel Ridge and Chestnut Ridge. This steep gradient is why the rapids are there, and scour has kept much of the area along the stream free of substantial accumulations of soil.

From its origin in the mountains of Maryland and West Virginia, the Youghiogheny weaves its way through a variety of landscapes, rock formations and elevational gradients, resulting in a great diversity of scour habitats. Add to the habitat diversity the large number of Appalachian species that extend to the northern limits of their ranges in this deep river valley, which runs from south to north, and you get one of Pennsylvania’s most important regions for biodiversity conservation.

Scour zones share ecological characteristics with river banks, floodplains, wetlands and prairies. This combination of conditions leads to a unique grouping of species generally associated with one or more of those ecosystems.

Often the most conspicuous component of scour habitats are what we tend to think of as prairie grasses, such as big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), switch grass (*Panicum virgatum*), cordgrass (*Spartina pectinata*) and Indian grass (*Sorghastrum nutans*). While commonly associated with the Midwestern prairies of Ohio, Michigan, Illinois and Wisconsin, these plants find a home in Pennsylvania among the scoured cobbles and bedrock of the river floodplains.

Despite the importance of these species, only a few other species usually associated with prairies are common in the scour areas along the Youghiogheny. These include wild-indigo (*Baptisia tinctoria*), tall tickseed (*Coreopsis tripteris*), flowering spurge (*Euphorbia corollata*), yellow star-grass (*Hypoxis hirsuta*), and early goldenrod (*Solidago juncea*).

A smaller number of the plants found in scour areas in the

Youghiogheny River Gorge are species commonly found on stream banks and floodplains in less dynamic habitats. Perhaps the most conspicuous of these is a tree, the sycamore (*Platanus occidentalis*). Sycamores are common -- even locally abundant -- but rarely reach what we think of as tree size in this habitat. Some of the sycamores are gnarly, small but perhaps very old, having been repeatedly battered by the powerful forces of floods  
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Photo by Steve Grund



Top, a scour island in the Youghiogheny River.  
Left, pink-flowered swamp milkweed grows in scoured cobble areas along river.

**Youghiogheny River Scour, from page 15**

and ice scour. A few silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*) are also present.

Another floodplain tree species that is occasional in Youghiogheny Gorge scour communities is umbrella magnolia (*Magnolia tripetala*). This species is common in and near the coastal plain in southeastern Pennsylvania, but is also found in Fayette County, known from several locations along the Youghiogheny and Casselman rivers.

Other stream bank and floodplain species found commonly in Youghiogheny scour include ninebark (*Physocarpus opulifolius*), one of our sedges (*Carex torta*), nodding onion (*Allium cernuum*), bluets (*Houstonia caerulea*), cardinal-flower (*Lobelia cardinalis*), and wingstem (*Verbesina alternifolia*).

Surprisingly, the largest group of plants found in the Youghiogheny River scour communities are the wetland species. These ecosystems have meager amounts of organic soil, so it seems out of place to find all these wetland plants in a habitat where, unless you are visiting during a flood event, your feet only get wet when you step (or slip!) directly into the water of the stream. But they're there.

Smooth alder (*Alnus serrulata*), southern arrow-wood (*Viburnum dentatum*), swamp rose (*Rosa palustris*), blue vervain (*Verbena hastata*), boneset (*Eupatorium perfoliatum*), buttonbush (*Cephalanthus occidentalis*), flat-topped white aster (*Doellingeria umbellata*), golden ragwort (*Packera aurea*), royal fern (*Osmunda regalis*), sensitive fern (*Onoclea sensibilis*), swamp milkweed (*Asclepias incarnata*), and tall meadow-rue (*Thalictrum pubescens*) are wet habitat plants that are common in scour areas along the Youghiogheny.

One small but interesting set of

Photo by Paul Wiegman



plant species occurs in Pennsylvania primarily or only along the Youghiogheny in ice scour communities. A few plants are globally rare.

The most famous of these is the globally imperiled large-flowered marshallia (*Marshallia grandiflora*, sometimes called "Barbara's buttons" or just "marshallia"). Marshallia is typically found in crevices of horizontally oriented bedrock, but can also grow in coarse cobble and occasionally in sand. It is an attractive member of the composite family, with pink flower heads that bloom from mid June to early July. Its range includes a few counties in Tennessee and extends in the Allegheny Mountains north through Kentucky and West Virginia into Pennsylvania. The Youghiogheny Gorge represents its northern limit.

Also globally imperiled is sand grape (*Vitis rupestris*). Unlike most grapes, sand grape does not climb on other plants even if given the opportunity; it has only vestigial tendrils. It can, however, survive in very severe scour habitats, where it anchors firmly into bedrock crevices. It is annually scoured to almost nothing but its roots, yet consistently grows back.

Carolina tassel-rue (*Trautvetteria caroliniensis*) grows abundantly along the Youghiogheny River and a few of its tributaries, but nowhere else in Pennsylvania. It is sometimes found in the inhospitable extreme scour zone where sand grape grows, but grows more luxuriantly at the rear of the scour zone, where some soil accumulates. The plant has showy flowers, but it is the stamens rather than petals that put on the show.

Stiff-leaved aster (*Ionactis linariifolius*) grows in Western Pennsylvania only in scour habitats in the Youghiogheny River Gorge. Often it grows by itself in small crevices in rocks that require some rock-hopping to get to. This is a very attractive plant even before it flowers, with numerous short, stiff, dark green, linear leaves on an unbranched stem usually less than a foot long. The pale lilac flower heads make it even prettier.

Of course there are animals that use scour zones, as well. Several rare dragonflies and damselflies use the open habitat for basking and hunting.

Tiger beetles also like these open, sunny habitats. Northern water snakes (*Nerodia sipedon*) and copperhead snakes (*Agkistrodon contortrix*) like the warm rocks and the cool spaces below, as well as the adjacent water -- so watch your step. River otters (*Lontra canadensis*) have been reintroduced to the Youghiogheny Gorge and seem to be doing well.

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Photo by Steve Grund



Photo by Steve Grund

Photo below by Dave Powell, USDA Forest Service, Bugwood.org

**Plants of the Youghiogheny River scour zones are adapted to ripping floods, then full sun. Several are rare. From top, large-flowered marshallia; buttonbush; cardinal-flower and plant community; Carolina tassel-rue; and sand grape.**



Photo below by Scott Bauer, USDA Agricultural Research Service, Bugwood.org



*Youghiogheny River Scour, from page 16*

Photo by Steve Grund



Copperhead snakes find a home in Youghiogheny River scour zones.

Among the birds that use scour habitat in the Youghiogheny Gorge are common yellowthroats (*Geothlypis trichas*), song sparrows (*Melospiza melodia*), rufous-sided towhees (*Pipilo erythrophthalmus*) and spotted sandpipers (*Actitis macularia*).

Major threats to riverside scour communities include outright habitat conversion by development, water pollution, trampling in areas popular for recreation, changes to river hydrology and the establishment and spread of invasive plant species. Often, these threats occur together.

In the Youghiogheny Gorge, major habitat conversion is unlikely because most of the gorge is within Ohiopyle State Park. Some small areas have been lost to park development, such as boat accesses, but most of the habitat conversion occurred before the park was established. Much of that, such as scattered small mining towns and mills, has recovered significantly since being abandoned decades ago.

Water pollution can impact scour ecosystems, especially in coal mining areas, but the Youghiogheny Gorge has experienced limited damage from mine drainage. Nutrient loading from agriculture and sewage is a concern, but less so in this area than in many other parts of Pennsylvania, because much of the watershed is forested.

Trampling in recreation areas can cause damage, and some sandy beach areas along the Youghiogheny River that are popular lunch spots are devoid of vegetation. It's unclear how susceptible scour plants are to trampling. This is a natural disturbance system, but the wrong kind of disturbance or disturbance at the wrong time can clearly cause damage, both directly and by encouraging invasive species.

Dams alter the timing of water flow and reduce the amount of ice during the spring thaw. Dams reduce the natural spikes in flow after rain events and spring warming that lead to flooding and scour. The impact of the Youghiogheny Reservoir Dam is significant but is mitigated by the entrance of a major tributary, the Casselman River, just below the dam. Studies are needed to determine whether adjustments should be made in management

of the dam to assure long-term viability of scour ecosystems and the globally and regionally imperiled plants that live there.

Dams and other permanent structures, such as bridges, also contribute to invasive species problems by slowing the flow of water, causing river sediments to accumulate. These sediments, often rich in nutrients, and the reduction of scouring provide ideal conditions for invasive plants.

The most significant invasive plant along the river in the Youghiogheny River Gorge is Japanese knotweed (*Polygonum cuspidatum*). Although it cannot grow under vigorous scour conditions, it proliferates in adjacent areas where the rushing water slows down, causing soil and other materials it is carrying to drop out, creating what we call "deposition zones." The dense growth of the knotweed in these zones might slow the water even more, creating a positive feedback loop that increases the size of the deposition zones. Also, the profuse growth of knotweed's semi-woody stems one year leads to copious piles of dead stems the next, a process that probably reduces the size of scour zones by burying portions of them.

Purple loosestrife (*Lythrum salicaria*) is a relatively new invasive species in the area and will likely become a major problem, as it can withstand flood forces enough to invade some of the scour habitats. Morrow's honeysuckle (*Lonicera morrowii*), another invasive plant, is common in the Youghiogheny River Gorge and displaces native species at the outer edge of the scour zone.

Funding by the Wild Resource Conservation Program as well as the Bureau of State Parks has enabled Pennsylvania Natural Heritage Program biologists to find and document the rare species in the Youghiogheny River Gorge. The work continually refines our understanding of which species are most at risk, where they are and what might be threatening them.

A Pennsylvania Natural Heritage Program study of floodplains, funded by the U.S. Environmental Protection Agency, has also contributed significantly to our understanding of this ecosystem. The staff at Ohiopyle State Park actively uses this information to prioritize invasive species management efforts and to inform management generally, so that recreation at the park continues to be compatible with viability of the highly significant ecological systems there.

So, go and enjoy! Raft or kayak and have fun on the "Yough." While there, learn the plants and look for river otters and tiger beetles. Show these things to other people; they will probably tread more lightly once they, too, understand.



*About the authors: Ephraim Zimmerman is an Ecologist with the PNHP and the Western Pennsylvania Conservancy. He recently completed a study of river floodplains of Pennsylvania's portion of the Ohio River Watershed. Steve Grund is a Botanist for the Western Pennsylvania Conservancy and the PNHP. He has chaired the Pennsylvania Rare Plant Forum since 1997.*



## Pennsylvania Natural Heritage Program

"Information for the Conservation of Biodiversity"

on the location and status of important ecological resources (plants, vertebrates, invertebrates, natural communities and geologic features). Its purpose is to provide current, reliable, objective information to help inform environmental decisions. PNHP information can be used to guide conservation work and land-use planning, ensuring the maximum conservation benefit with the minimum cost. To learn more about what we do, and about species of special concern, visit us on the web at [www.naturalheritage.state.pa.us](http://www.naturalheritage.state.pa.us).

The Pennsylvania Natural Heritage Program (PNHP) is a member of NatureServe, an international network of natural heritage programs that gather and provide information