



Do Something Wild!

# Keystone Wild! Notes

Fall 2010 Edition

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## What's All the Fuss about Marcellus?

by Jessica Sprajcar, DCNR Office of Conservation Science



It seems like every time I open a newspaper or turn on the local news there is something about the Marcellus shale. What is Marcellus shale? What constitutes the natural gas industry in Pennsylvania? Will we be able to balance drilling with natural resource conservation? Those and many other questions are on the minds of Pennsylvania's citizens and politicians right now, and are poised to remain in the spotlight for months, if not years, to come. To learn more about how it is produced, I set out on a fact-finding mission. I would like to share my discoveries with you.

In 1821, William Hart dug a 27-foot deep well in New York. By 1825, his well produced enough natural gas for lights in two stores, two shops and a grist mill. Fast forward another 25 years and Fredonia Gas Light Company, North America's first natural gas company, had drilled a second well 200 feet into the ground. Shale gas wells were dug along the Lake Erie shoreline from New York to Ohio, but all these wells were considered "shallow gas wells." Gas wells in the Marcellus shale formation are known as "deep gas wells." The vertical depth of the Marcellus formation ranges from 1,500 feet deep near the Lake Erie shoreline to over 9,000 feet in Elk County, Pa.



The Marcellus shale is a geologic formation that lies underneath portions of West Virginia, Ohio, New York and Pennsylvania. (Image: Pa. Topographic and Geologic Survey)

### How natural gas drilling got its start

Drilling for natural gas in shale is not new;

article continues on page 9



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**Keystone Wild! Notes** is the official online publication of the Pennsylvania Wild Resource Conservation Program. Its goal is to inform people about the activities of the program, which supports research and protection efforts for the state's natural heritage—its unique collection of native nongame animals and wild plants. The program, which is administered by the Pennsylvania Department of Conservation and Natural Resources, is financed through Growing Greener and by public contributions: voluntary checkoffs on the state income tax return form, direct donations or the purchase of the Wild Resource license plate. If you have comments about Keystone WILD! Notes, please send them to The Editor, Wild Resource Conservation Program, P.O. Box 8764, Harrisburg, PA 17105-8764, or e-mail to [ra-wrcp@state.pa.us](mailto:ra-wrcp@state.pa.us). To subscribe, please go to [www.dcnr.state.pa.us/wrcp/subscribe.html](http://www.dcnr.state.pa.us/wrcp/subscribe.html) and enter your e-mail address.

## From the Editor's Desk



This summer I had the good fortune to meet with some WRCP-funded researchers as they worked in the field. From spadefoot toads to regal fritillary butterflies, these scientists and conservationists are working diligently to understand our natural world so that we may better protect it. In this and future issues of *Wild!Notes*, we will highlight some of the work underway in a new feature called *WRCP Grants in Action*, and tie it to short video clips on our [Youtube](#) page. In the premier article, we take a look at the endangered Eastern spadefoot toad. Additional information about the toads and frogs of Pennsylvania can be found in the *Wild! For Kids* section.



The pickereel frog is one of over a dozen species of frogs and toads in Pa. (Photo: Andrew Shiels, Fish & Boat Commission)

Taking a leap from amphibians is the subject of energy production, the theme for this issue. Energy production appeared frequently in the news this summer, starting with the Massey coal mine fire in West Virginia, followed by the BP oil well gusher in the Gulf of Mexico, an oil pipeline rupture near the Kalamazoo River in Michigan, and explosions and fires at several gas wells in Pennsylvania and West Virginia. These events point to the cost of our energy needs and reliance on fossil fuels, but I wondered if alternative energies are any better? In the articles, *Biofuels: How Can they Coexist with Wildlife?*, *Forest Lands and Energy Needs - Balancing Energy Development with Resource Protection*, and *Harnessing Wind Energy in Pennsylvania While Protecting Wildlife*, we examine the pros and cons of alternative energies, paying specific attention to their impacts on wildlife and habitats.

Natural gas is being touted as a transition fuel between oil and alternative energies. Underneath Pennsylvania lie trillions of cubic feet of natural gas in the Marcellus shale. While natural gas may be one of the cleaner fossil fuels, extracting it from rock thousands of feet underground is not without some effects on the natural world. In the cover story, *What's All the Fuss with Marcellus?*, we examine the ins and out of Marcellus shale drilling in Pennsylvania. Greg Czarnecki and I were lucky enough to visit some well pad sites and see for ourselves what they look like in our landscape. I was surprised by things I saw and learned there; read the article to find out more.

Thanks to our first *Letter to the Editor* from Tom S. of southwestern Pa. His question about building bat houses is very timely considering the threat of White Nose Syndrome on our resident bat populations. Keep those letters coming (either through snail mail: 400 Market Street, 9<sup>th</sup> floor, Harrisburg, PA 17105, email: [jsprajcar@state.pa.us](mailto:jsprajcar@state.pa.us), or on our [Facebook page](#))! ✓



Editor Jessica Sprajcar is a Conservation Program Manager with DCNR's Office of Conservation Science.



Staff from DCNR's Office of Conservation staff visits a natural gas drill rig. (Photo: Bruce Snyder, Range Resources)

# Letter to the Editor



I hope you can help. You see, a few weeks ago I noticed a funny looking substance on the side of my house, directly under my shutters. When I pulled back the shutter closest to me, I saw a small brown, fuzzy thing—a bat! Checking under some of the shutters higher up on the house exposed six more little critters.

I really love what these bats do in terms of keeping the mosquitoes down, but I really hate their guano all over the side of my house. I was wondering if building a bat house would help get them off MY house, but keep them in the area for bug patrol? If so, how do I build a bat house?

Thanks for the help,

Tom S.

## Dear Tom S.,

I'm glad you recognize the valuable role bats play in eating mosquitoes and other annoying insects. Did you know that a single brown bat can eat 500 to 1000 mosquitoes in an hour?!

Yet bats need our help—thanks to the threats of White Nose Syndrome and habitat loss, bat numbers are dwindling statewide. Bat houses and bat condos can provide much needed habitat for bats, but they must be built and installed correctly. There are too many details to list here, so I want to point you to two good websites with bat house plans: the [National Wildlife Federation](#) and [Bat Conservation International](#). These sites tell you the materials you will need to purchase and take you step-by-step through the process.

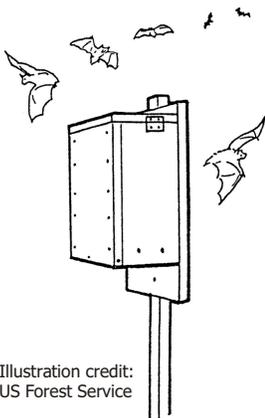


Illustration credit:  
US Forest Service

Here are some general guidelines to follow: First decide where to locate the house. The site should receive at least six to eight hours of sunlight a day, especially in the early morning. The box should be more than 10 feet off the ground to prevent predators from getting to the bats (the higher, the better), mounted to a pole that is firmly embedded in the ground. They do not recommend mounting the

house to a tree because they are more vulnerable to predators and branches can get in the way of their "fly zone". The ideal size of the house is 24 inches tall, although anything above 18" will do, and is made out of plywood, not pressure-treated lumber, because that contains chemicals that can be harmful to bats. If the

house is painted a dark color it will retain more heat, which the bats like, but use water-based or no-VOC paint and stain—otherwise the fumes might keep away bats.



A properly sited and constructed bat house can provide habitat for many pest-eating bats. (Photo: NY DEC)

Start with one bat house and see if they move from your house to their house. It may not happen over night—it can take as long as several years—but hopefully your effort will pay off, and then you can construct additional boxes in other areas of your yard. If after 2 years you haven't had any bats in the house, try moving it to a new location in your yard and see what happens.

And remember, once you've built the house and bats have moved in, monitoring and maintenance are very important. Check the box in late winter or early spring for separating seams, woodpecker holes, leaks or wasp nests. Repair any damage that could harm your resident bats. Just like any house, bat houses need some TLC too.

Good luck! And if you could send us photos of your finished bat house, we would be happy to print the results in a future issue of *Keystone Wild!Notes*. Thanks. ✓

# A Word From the



# Wild!

by Greg Czarnecki

Executive Director of WRCP



In this issue we tackle the hot topic of energy. As we begin to tap into new energy sources in the state we need to balance the potential environmental impacts with their economic and societal benefits. Let's face it, a reliable source of energy is essential for our economy and to maintain our modern way of life, but which types of energy are most benign?

That's a tough question to answer, because all types of energy have environmental consequences, and none are inherently good or bad. To evaluate an energy source you need to look at two things—how it's produced and how it's used.

Let's start with production. The ways in which energy production affects the environment varies widely from one source to another. One big determinant is whether the source is directly usable in the form in which it's extracted or whether it needs to be processed first. Wind and solar, for example, directly produce usable electricity. There's no more processing needed, you just have to get it to where it's needed (transmission, of course, has consequences too).



Wind turbines directly produce electricity; no processing required. (Photo: Greg Czarnecki)

Fossil fuels and biomass, on the other hand, have to be converted from their natural state into usable fuel. A lump of coal won't cool your house; it has to be burned to generate heat that makes steam that spins a generator that makes electricity that runs your air conditioner. There are also all of the other factors associated with production, such as earth disturbance, transportation to the processing facility and then to the end user, water use and the waste products left over after the process is complete.

Now let's look at use. There are two questions you need to answer. First, do you need to burn it to make usable energy? If you do, then what and how much emissions are produced?

In answering the first question, once again, renewable energies, such as solar, wind and hydropower, as well as nuclear, come out way ahead of fossil fuels. By answering the second question we can evaluate which of the fossil fuels are most environmentally-benign. The cleanest of the fossil fuels, based on the emissions produced during combustion, is natural gas. It is, many argue, a bridge to a future where renewable energy will dominate. That renewable future isn't here yet because current technologies haven't made widespread renewable energy economical.

Natural gas deposits can be found under much of the state. (Photo: Jessica Sprajcar)



Just like fossil fuels, not all renewable energies are created equal either. You need to look at the overall picture, from the land cleared for production and transmission, to the resources needed to build the generation equipment. Compare wind-generated electricity with ethanol made from corn, for example. If you put 15 wind turbines on a thousand-acre plot, you'll produce 224 trillion BTUs (British Thermal Units) over the course of a year. Planting corn on the same plot and producing ethanol will yield only 26 billion BTUs. The energy return on the wind farm ranges from 50:1 to 100:1; the energy return on corn-based ethanol is only 0.8:1 to 1.65:1.

While Pennsylvania has historically been a coal producing state (along with lesser amounts of oil and natural gas from shallow wells), deep gas wells, commercial wind farms and biomass are now rapidly changing the face of energy production in the state. As these energy sources change the landscape, it's important to understand the consequences they may have on Pennsylvania's species, habitats and ecosystems. ✓

**DCNR Office of  
Conservation Science  
Director**

**I** was fortunate to grow up in the country in southwestern Pennsylvania where my brother, sister and I had plenty of places to roam and play. With our trusty collie, who actually did do smart things just like Lassie, we would hike through the woods to a rock overhang that we called our cave. There we would swing on “monkey vines”, play in the creek, collect salamanders, crayfish and other wonderful “wild things”. I loved bugs and hoped one day to become an entomologist or lepidopterist. My moth and butterfly collection was one of my favorite treasures. My parents also enjoyed the outdoors and instilled in us a love of nature. My father took us spelunking—lowering us on ropes into the depths of caves— camping in the back country of Canada, identifying trees and marching up mountain trails.

When I first started college I was a French major, but I soon switched to a subject more dear to my heart: geography and the environmental sciences. I completed my education in Switzerland, where I studied the Rhine River—its origin in a mountain glacier, the social and political issues along its course north, and its final destination in the North Sea. My parents thought that I would never find a job with such a focus, but I did and have loved every aspect of it. Never will you find a more dedicated and hard working group of people than those committed to better understanding and conserving our natural world.

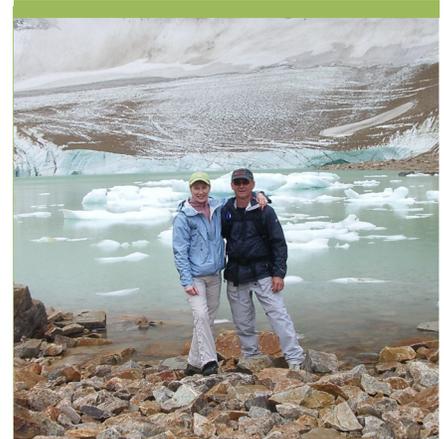
I am currently the director of DCNR's Office of Conservation Science (OCS). The aim of the office is to bring scientific information to inform policy, projects, strategic investment and land use planning through a variety of conservation efforts housed within OCS: the WRCP, the PA Natural Heritage Program (PNHP), PNDI Environmental Reviews and the Sustainable Lands program. Science is essential for achieving our goals, measuring the outcome of our actions and learning and evolving policy to improve efficiency and success.

When I am not at work, my passion and most of my spare time is dedicated to my horses. My husband and I manage a horse farm with 11 horses, and I ride dressage on my horse Faust. This past spring we patiently worried over the birth of our foal, Sophie, after 12 long months of waiting. My husband and I have three daughters; Abby (married to Mitch), Emily and Kara, and in August became grandparents to a little boy, Asa. My other passion is hiking with my husband to the top of high mountains and sitting at the top of the world. Worries and petty problems disappear from that perspective as the vastness of the world overwhelms and inspires.

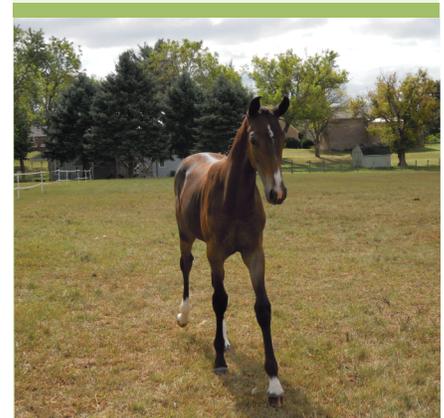
My involvement with WRCP began in 2003, when the program became part of the OCS. My role is to connect the program with other conservation work within DCNR and with external partners. I love the Wild Resource festivals! It is so much fun to see children's faces glow as they catch a butterfly in a net, bring in a fish for the first time or hold a snake. WRCP has brought me into contact with some amazing scientists, too. I am constantly impressed with the harsh weather conditions, nasty biting insects and modest pay that these brilliant dedicated scientists endure for the love of the research and learning.

WRCP is not just a nice program about the “flowers and the birds,” but is about conserving a sustainable, healthy world for all of us. Humans are not only part of this natural world, but we also rely on the natural resources for our own well being. In order to ensure the health of our world, we need to advance our understanding of it and how to deal with the issues facing us. WRCP plays a key role in this effort.

WRCP does not receive any general fund money. All operating dollars come from the caring people and organizations who understand the value of nature. Thank you for your donations and support through the tax check-off over the years!



Sally and husband Walter at the Edith Cavell glacier in the Canadian Rockies.



Sophie is a Dutch Warmblood foal.

### “Like” us on Facebook

WRCP has revamped our Facebook page and we hope that you “like” it. When you click on the “like” button, you will become a member of our online presence and be the first to know about upcoming events, publication debuts and important news in the world of WRCP and conservation. So please find us on Facebook by searching for “PA Wild Resource Conservation Program” and join our group.





## Forgotten Friend Reptile Sanctuary

by **Jessica Sprajcar** PA Department of Conservation & Natural Resources  
Conservation Program Manager

This new feature article highlights partner organizations that support the Wild Resource Conservation Program's mission of education, research and conservation. In this premier installment, learn how Forgotten Friend Reptile Sanctuary is saving species and educating both young and old alike.



Jesse Rothacker loves reptiles: has since he was young. Like most kids, he was fascinated by lizards and turtles and frogs and owned numerous dinosaur toys and books. As a very young boy he caught a pond turtle on a family vacation and spent the whole day fascinated with it. Reminiscing he says, "I can remember catching lizards as a boy and watching them for hours. I guess I always had the nature bug, but didn't have my first pet reptile until I was 16, when I begged my parents for a corn snake for Christmas."



Jesse Rothacker and Abraham the sulcata tortoise, of Forgotten Friend Reptile Sanctuary.

Jesse was able to translate his love of reptiles into a career. In 2004, he submitted newspaper ads offering a good home to unwanted pet reptiles. Those humble beginnings grew into the **Forgotten Friend Reptile Sanctuary**, a 501(c)(3) nonprofit organization located in Lancaster County, Pa. The sanctuary's goals are two-fold: animal rescue and education. The organization finds better homes for pet reptiles and amphibians, and provides

educational outreach in the community to cultivate conservation mindsets and nature-appreciation. That is a grand goal for a paid staff of one, but Jesse and his many volunteers seem well-matched for the task.

The sanctuary is home to about 100 reptiles, but that number is always changing. Many of the reptiles are permanent residents and visit thousands of families every year at programs. Others, like the alligators and sulcata tortoises, live at the sanctuary for a few years until their increasing size requires a warmer climate. Many more stay for only a few weeks or months until the sanctuary staff can find new homes for them. The sanctuary even helps find homes for hundreds of animals, via **ForgottenFriend.org**, that never

physically come through the doors. The sanctuary's native turtle garden also attracts neighborhood amphibians, so at any given time there may be one or two resident frogs and toads, or hundreds of tadpoles, froglets and toadlets!

Every year Forgotten Friend provides hundreds of nature programs for schools, churches and family events. Their programs feature 15 live reptiles from around the world and closer to home. Jesse says that "I love to help people of all ages laugh and learn about my favorite creatures and introduce them to herpetology - the study of reptiles and amphibians. It's great to take volunteers from the audience who have never touched a snake and watch them smile in front of the crowd when they experience it. It is a blessing to visit thousands of families every year in classrooms, school assemblies, scout events, camps, vacation bible schools or wherever we can serve. I am very thankful to have a job as a nature ambassador."

Jesse takes more than a dozen exotic and native species, like this corn snake, into classrooms.



When not on the road visiting classrooms and picnics, Jesse produces audio "Reptile Fun Facts" for the **Kids Cookie Break** (KCB) radio show, Saturday mornings on **WJTL 90.3** out of Lancaster, where he plays the role of "Critter Correspondent." Jesse also shares nature videos through the KCB website and was a founding member of the **Lancaster Herpetological Society**.

Partnerships, like the one with WRCP, are one significant piece to Forgotten Friend's success over the last six years, and Jesse is thankful to have them. "We've been

## "Forgotten Friend Reptile Sanctuary" continued...

able to provide outreach programs at WRCP events, and WRCP has shared educational resources for us to give out at other community events. We share similar missions of conservation and education so it's great to work together. And we love the river otter license plate on our reptile van!"



Jesse and reptiles from Forgotten Friend have made appearances at Wild Resource Festivals and other WRCP events (Photo: Jessica Sprajcar).

What does the future hold for Forgotten Friend Reptile Sanctuary and the future of reptiles in general? Jesse notes that there are many threats to reptiles across the globe but habitat loss and collection are the two biggest. Recently, a multi-state sting operation called "Operation Shell Shock" busted reptile poachers and smugglers from Florida to Pennsylvania to Canada (and many areas in between). Such illegally-caught reptiles are being harvested for the pet trade, for reptile collectors and for the Asian food market. But there is another threat that is harder to quantify and more pervasive; people consider reptiles to be second-class citizens of the animal kingdom. Ever since Lucifer took the form of a serpent, in the *Book of Genesis*, reptiles have been fighting a losing public relations battle. Jesse notes that, "Many people will swerve to avoid running

over a squirrel but will drive into the other lane to purposely hit a snake. If people find ducklings in their garden they get their camera. If they find reptile hatchlings they get their shovel. We need to help people appreciate all creatures, even those that slither and crawl."

Those threats and misunderstandings are what make Forgotten Friend's work so critical. Education, a key mission of both the sanctuary and WRCP, helps people appreciate the special qualities of snakes and other reptiles. If you would like to learn more about reptiles through one of the sanctuary's educational programs, they would be glad to send you a free program booklet. Jesse can be reached at [info@forgottenfriend.org](mailto:info@forgottenfriend.org) or through the Forgotten Friend's website.

Other ways to get involved in reptile conservation include: if you find a wild reptile, leave it right where you find it. As Jesse suggests, "Take pictures, don't take them home." If you have a pet reptile that needs a new home, please visit [ForgottenFriend.org](http://ForgottenFriend.org) and they will be happy to help. Above all, never release pet reptiles into the wild! Most will die but others may become invasive, like red eared slider turtles in Pennsylvania and boa constrictors in Florida, and out-compete our native reptiles for food and shelter.

You can also protect reptile and amphibian wildlife and their habitat by leaving vegetative buffers around waterways, avoiding chemical treatments on lawns, and most importantly, teaching kids to appreciate nature. Jesse cautions that, "Many kids are being raised by their TV or computer or X-box or cell phone, and do not even realize that different trees have differently shaped leaves. Make sure to spend time with your kids and their friends in nature. People cannot appreciate what they do not know, and they will not protect what they do not appreciate. If we don't pass on our nature passion to the next generation, it will become a lost art." ✓



### Earn Money for WRCP while Searching or Shopping the Internet



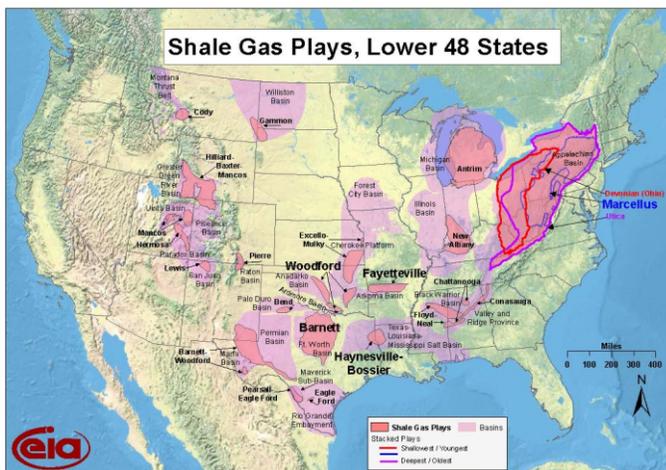
You can contribute to the Wild Resource Conservation Program without spending a penny! When you use [iSearchiGive.com](http://iSearchiGive.com) for your web searches or online shopping, a donation will be made to the Wild Resource Conservation Fund in your name. More than 700 major retailers are part of the [iSearchiGive.com](http://iSearchiGive.com) network, so you can do all your shopping from the comfort of your home and help support the Wild Resource Conservation Fund at the same time. And every time you search the web using [iSearchiGive.com](http://iSearchiGive.com), \$.02 will be donated to the fund. So go to [www.iSearchiGive.com](http://www.iSearchiGive.com) today, and choose the Wild Resource Conservation Fund as your cause.

# What's All the Fuss about Marcellus? continued...

## Drilling down to the Marcellus shale

**Marcellus shale** is an organic-rich, black shale that was deposited nearly 390 million years ago. For more than 75 years, people have known that it contains oil and gas, but it is only in recent years that full-scale production ramped up. A big reason for that is the cost. Drilling down into the Marcellus shale can cost anywhere from \$1.5 to \$3.5 million per well. It wasn't until the price of petroleum rose in excess of \$130 per barrel, and the price of natural gas rose to \$10 per thousand cubic feet, that Marcellus shale drilling could be competitively priced with other energy sources.

In 2003, the company Range Resources drilled a well in Washington County, Pa. They experimented with several drilling techniques and found that hydraulic fracturing, a process that had been used for several decades in the Barnett Shale formation of Texas, would work for Marcellus shale drilling here in Pennsylvania. The **U.S. Geologic Survey's** initial estimates of how much natural gas could be obtained from the Marcellus shale were under 2 trillion cubic feet, but as more companies began exploring the geology, they discovered that between 363 and 500 trillion cubic feet of natural gas could be recovered from the Marcellus shale (all states combined, not just Pa.). To give you some perspective, the U.S. uses close to 23 trillion cubic feet of natural gas per year, according to the **Energy Information Administration**.

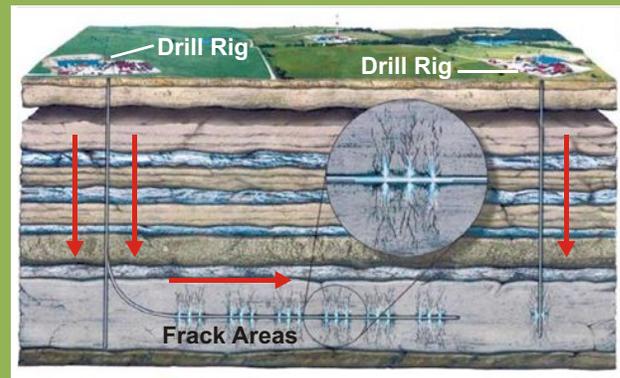


**Marcellus isn't the only natural gas containing shale in the U.S. (Image: Energy Information Administration, 2010)**

## Getting gas from a rock

Most Marcellus shale drilling involves a horizontal gas well. First the drill bit goes down vertically for thousands of feet. Once it reaches the Marcellus shale layer, the bit slowly begins a curving descent, finally drilling horizontally within the shale. The bit can extend for hundreds or thousands of feet in the shale, depending on how far the property lines extend. The drill bit and drill pipe are then withdrawn, steel casing is inserted into the hole and cement is poured in to separate the casing from the surrounding rock layers and groundwater. Depending on the depth of the well, several layers of cement may be used to increase the level of protection between the well and the surrounding environment.

### Horizontal Technology

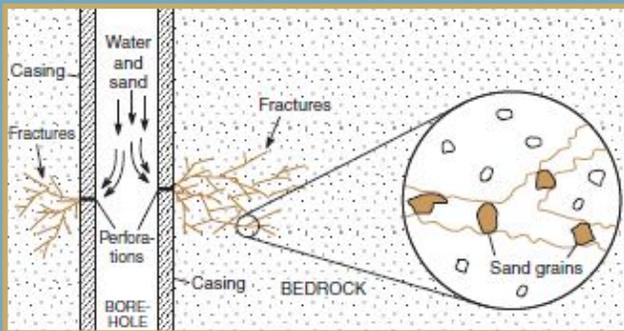


A computer controls the direction of the drill bit, moving it from a vertical path to a horizontal path. Once the casing is within the Marcellus shale, the well is fracked. (Image: Range Resources)



It takes roughly 30 days for the drilling process to occur. What happens next is referred to as hydraulic fracturing, or fracking. Explosive charges known as shots are lowered into the hole and detonated, creating small holes in the bottom portion of the casing that allow sand, water and chemical additives to flow under high pressure into the rock. This process causes the rock to fracture, exposing the natural gas that was trapped within the rock pores, and allows it to flow up the pipe, where it will be transported through pipelines to consumers. Natural limestone barriers above and below the Marcellus shale formation are thought to keep the hydraulically-created fractures from spreading upward and downward into adjacent geologic formations and groundwater.

## What's All the Fuss about Marcellus? continued...



Small explosions create fractures in the shale. Water, sand and chemicals are then pumped in to force the natural gas out of the shale. (Illustration: Pa. Topographic and Geologic Survey, 2002)

The average Marcellus shale fracking process uses more than 3 million gallons of water. Where does all that water come from? Drilling companies look for local sources of water, whenever possible, (streams and rivers) but sometimes they have to truck water in from elsewhere. If the drilling occurs in the Susquehanna or Delaware River basins, the company must obtain a water withdrawal allowance from the [Susquehanna River Basin Commission](#) (SRBC) or [Delaware River Basin Commission](#) (DRBC), respectively. These organizations were created by Congress to regulate the amount of water any one user can withdraw at a given time and can deny access if they determine that the withdrawal will have adverse impacts on the water resources of the river basin. Each well pad must monitor its water use on a daily basis and report their findings to the basin commission quarterly. For water withdrawals outside those watersheds, the [Department of Environmental Protection](#) (DEP) is in charge of issuing water withdrawal permits.

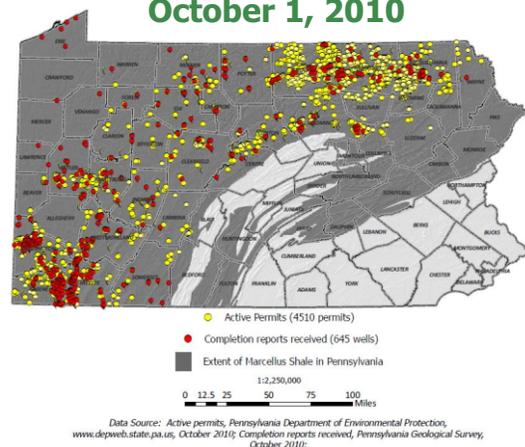
Roughly 20 to 30 percent of the water is recovered after fracking, meaning the rest remains below ground in the well. The water that is recovered is either recycled for use in another well or stored in a tank until it can be shipped to a waste water treatment facility. The flowback water contains a variety of natural rock sediments, sometimes radioactive material from uranium and thorium in the ground, as well as brine, toxic and non-toxic metals, and hydrocarbons (the natural gas and liquids). The additives in the fracking fluid are used to prop open the rock fractures, prevent scale and mineral build-up in the pipes and reduce friction. The exact combinations and concentrations of these chemicals are considered proprietary by the drill companies, but some are beginning to publish full lists online. To see a list of

all potential frack fluid additives used in Pennsylvania, go to the [DEP website](#).

### The economies of shale

There are at least 10 drilling companies operating in Pennsylvania. They have more than 960 Marcellus wells completed throughout the state (according to [DEP's Bureau of Oil and Gas Management](#)), with over a thousand more that have been permitted but not yet drilled. As interest in the Marcellus shale grows, the price of mineral rights has gone up. Before hydraulic fracturing became standard practice, standard gas leases went for as little as \$25 an acre for five years, with a 12.5 percent royalty. Fast forward to 2010, where you can see leases as high as \$6,000 an acre for five years, with 25 percent royalties. What this means is that landowners in the Marcellus shale area can earn a lot of money by leasing their mineral rights to a natural gas drilling company. In places like north-central Pa., where there are few industries and not enough jobs, the Marcellus shale boom has helped bolster the region's economy and lower the unemployment rate.

### Pennsylvania Marcellus Wells as of October 1, 2010



**While not every issued permit will become a drilled well, this map gives a sense of the scope of Marcellus shale industry in the state. (Image: Pa. Topographic and Geologic Survey)**

If current projections are correct, Marcellus shale drilling could continue to grow to as many as 3000 new wells a year, which is roughly twice the number anticipated to be drilled in 2010. What you need to remember is that 3000 wells translates to 600 or so well pads, assuming multiple horizontal wells per pad. Drilling in the Marcellus could last several decades, and according to Bruce Snyder of Range Resources, "By next year and for years to come, Pennsylvania will be a net exporter of natural gas."

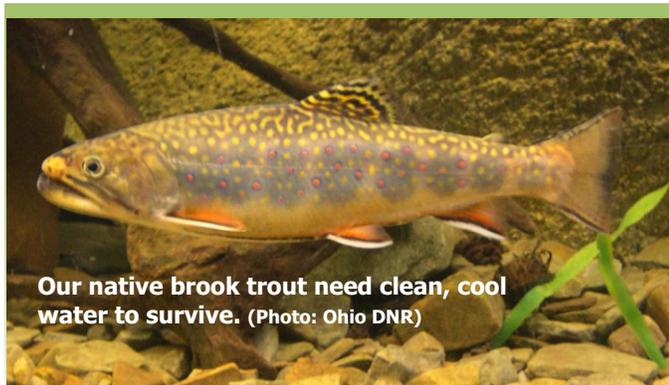
## What's All the Fuss about Marcellus? continued...

### It all depends on water

Many people seem to think that hydraulic fracking is a new process, but that isn't true. Fracking has been used since the 1950s. The horizontal drilling technique is newer than that (from the 1980s), but both have been successfully used in numerous states for decades. Yet a majority of the concerns surrounding Marcellus shale drilling relate to hydraulic fracking and its water requirements. How can drilling be done without negatively impacting local water sources and aquatic life?

3.5 million gallons of water a day seems like a huge amount to me, but then I discovered that the average indoor water use per person per day is 69.3 gallons, according to the [American Water Works Association](#). Multiply that by the estimated population of Pennsylvania in 2009 (12,604,767 people according to the [U.S. Census](#)), and you get more than 873 million gallons of water each day, and that doesn't include outdoor water uses! The SRBC estimates that when the natural gas industry is working at full capacity it will use up to 28 million gallons of water a day; still very low in comparison to household consumption. The water used for fracking is like a drop in the bucket compared to other water users in the state, but it is still important to regulate where it is withdrawn from and how it is being disposed of.

Care must be taken to ensure that water is not withdrawn from high value streams, particularly trout streams. Our native brook trout require specific water levels and temperatures. Fluctuations in either can wipe a population out, and they are already facing the threats of human development and warming water temperatures from climate change. As water levels in a stream drop from either natural or man-made causes, the water temperature typically rises - harming trout and other aquatic organisms.



**Our native brook trout need clean, cool water to survive.** (Photo: Ohio DNR)

The river basin commissions and DEP must also ensure that drought conditions—something much of Pennsylvania has experienced this past summer—are factored in when issuing water withdrawal permits (for all water users, not just natural gas companies) so that enough water remains for aquatic life to survive. SRBC is doing just that: in recent weeks they have prohibited drilling water withdrawals from 60 of 133 approved water withdrawal points due to drought conditions.

Many times there are no adequate sources of water near a well site, so up to a thousand tanker truck trips must bring in this water from elsewhere, according to the [Marcellus Shale Coalition](#). The water is either stored on-site in water trucks or in impoundments: man-made ponds that can hold thousands to millions of gallons of water, depending on their size. As many as another 500 trucks per well may be used to bring in all the drilling equipment, transport stone and earth for road and well pad construction, and transport flowback fluid to wastewater treatment facilities. With so many heavy vehicles traveling along rural routes and forestry roads, sometimes accidents happen.



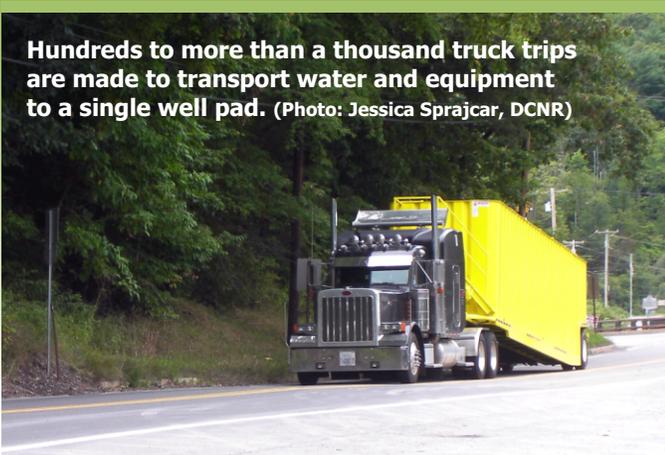
**Water is stored on-site in impoundments until it is needed for fracking.**

(Photo: Jessica Sprajcar, DCNR)

Surface spills remain one main concern with the drilling process. Diesel fuel from the trucks' tanks, along with the chemical additives used in the fracking fluid, could spill or leak into streams and rivers if a driver has an accident. During a 3-day enforcement effort in June 2010, 699 traffic citations and 818 written warnings were issued to trucks hauling Marcellus shale drilling wastewater in northern Pa. DEP has cited over 850 violations of Marcellus shale drillers in 2010 alone. These violations include discharge of industrial waste including spills and discharges into streams (15 percent), violations of the Pa. Clean Stream Law (9 percent) and improper construction of wastewater impoundment (15 percent), among other issues.

# What's All the Fuss about Marcellus? continued...

Hundreds to more than a thousand truck trips are made to transport water and equipment to a single well pad. (Photo: Jessica Sprajcar, DCNR)



## Changing the character of our forests

Aside from water issues, there can be impacts to the land, as well. Habitat fragmentation occurs when the well pads, impoundments, roads and pipeline transmission corridors are constructed in areas of valuable wildlife habitat. Animals may find it difficult to navigate around these large open areas without succumbing to predators. Fragmentation also opens up the area to more sunlight, drawing in invasive plant species that might have hitchhiked in on vehicle tires or blown in on the wind. Invasives, as the 2010 [summer issue](#) of *Keystone Wild!Notes* points out, have dramatic negative consequences to our native species, and can compound the problems brought about by drilling.

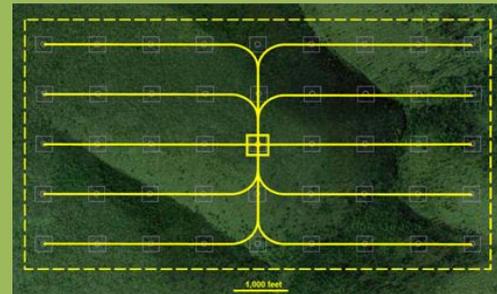
The lights at a drill rig site are on from sundown to sunrise for the month or so that it takes to drill and frack a well. There are also the occasional bursts of light and heat when the natural gas is flared—a process used to vent waste gas and relieve pressure from the wells. Do these sources of light pollution affect nocturnal animals like bats and moths? According to studies done by the [National Park Service](#) and the [National Association of Development Organizations](#), light and noise pollution from the drill sites may have negative impacts on wildlife and human neighbors. For instance, noise levels at drilling rigs can reach 100 decibels, a level equal to a snowmobile engine and strong enough to cause hearing loss if exposed to for a prolonged period of time. The sound level drops off significantly as you move away from the pad, but in the immediate area it can be quite loud. Some companies are working with surrounding landowners, particularly within our state forests, to regulate the timing of flaring to minimize the impacts to our night sky, and they turn lights inward and toward the ground in order to reduce the light pollution effect.

## To see a thing is to know it

Reading about drilling is not the same as seeing it firsthand, so I joined Greg Czarnecki, Director of the Wild Resource Conservation Program, and several DCNR colleagues, on a tour of a few Marcellus shale drill sites. Bruce Snyder, Senior Regulatory Compliance Specialist for [Range Resources](#), was our tour guide. With almost 20 years of experience working for the oil and gas industry, Bruce had the insight and knowledge of the drilling process we were looking for. Meeting at a mom-and-pop general store in Lackawanna County, Bruce filled us in on the basics of Marcellus drilling methods.

What impressed me most was when he showed us two different maps—one that had dozens of small black squares indicating vertically-drilled gas wells, and one with several black squares, indicating horizontally-drilled gas wells. If the drilling company chose to use the vertical drilling method, the forest would be fragmented by dozens upon dozens of well pad sites, but by choosing the horizontal drilling method, a single well pad can have six or more underground pipelines, significantly reducing the surface disturbance. In addition, horizontal wells are able to recover 20 to 40 percent of the natural gas in the Marcellus shale, while vertical wells can only harness 8 to 15 percent, so the horizontal wells are more than twice as effective at extracting natural gas.

## Horizontal Drilling - smaller footprint



Total surface disturbance during drilling including access road, drilling pad and required pipeline infrastructure  
■ Horizontal (yellow) develop 1,000 acres per pad with 1% surface disturbance  
■ Vertical (purple) on 1,000 foot spacing develop 20 acres per well with 19% total surface disturbance

**One horizontally-drilled well can reach as much natural gas as 23 vertical wells, reducing the surface disturbance and fragmentation.**  
(Image: Range Resources)



I was amazed by the size of the well pad and drill rig. The rig towers several stories into the air, and the well pad covers four or more acres of ground. Very little of that space is left open—it is filled with loud, humming generators; dumpsters to haul away the debris left over from drilling; trailers to house the staff; yards of

## What's All the Fuss about Marcellus? continued...

pipes waiting to be placed underground; trucks holding water; and other machinery and equipment I couldn't put a name to. The few workers that we saw wore coveralls black with drill mud (a liquid concoction used to reduce drill bit friction and carry rock fragments up and out of the pipe). The drill rig operates 24-hours a day, 7 days a week, for roughly a month.

Seeing something so industrial in the middle of the forest is a little disconcerting at first, but companies like Range Resources try to minimize impacts to the environment, whenever possible. The drill rig and all the equipment was placed on top of a thick rubber pad with rolled edges. If a surface spill did occur, the spilled material would stay on the rubber mat, not end up contaminating the ground. The location of the rig was placed away from wetlands and streams. The buffer zone helps to protect these valuable resources. When the fracking process begins for wells in the area, one large water impoundment will be used, rather than numerous small ones. This lowers the overall footprint of the impoundment area, reducing forest fragmentation.

Unless you are a landowner in the northern or southwestern part of the state you may never get to see one of these drill rigs firsthand. If you want to get a sense of what we saw on our trip, you can view two videos—one of the construction of a water impoundment, one of the well pad and drill rig—on our YouTube page at [www.youtube.com/wrcp](http://www.youtube.com/wrcp).

Once we saw the active drill site, we then traveled a few miles down a gravel road to see a completed site. Gone were the drill rig, trailers, trucks and noise. All that remained was a small fence, roughly 7 feet tall and taking up no more than 6 square feet of land, containing the well. Surrounding the fence was 4 acres of "restored" land—the flattened gravel well pad was re-contoured to mimic the original topography, and the site was planted with a variety of grasses and forbs. I saw several spring azure butterflies feeding from the clover flowers.

Once the drill rig and heavy machinery are gone, all that remains is a well head.  
(Photo: Jessica Sprajcar, DCNR)



Well sites are not devoid of life, as this spring azure butterfly shows.  
(Photo: Jessica Sprajcar, DCNR)



The drill rig will lay pipe thousands of feet into the earth before the well is fracked. The drill rig itself remains on-site for one month per well drilled. (Photo: Greg Czarnecki, DCNR)

While the site wasn't what biologists would call pristine habitat—most species that were planted were exotic, and what used to be forestland is now grassland—I could see the potential for wildlife habitat value, as long as the area is monitored for invasive species over the long-term. According to Bruce, the drill pad sites are "returned to their approximate original contour with the exception of a small level area in the middle where the well heads and the production equipment are located. The topsoil that was stockpiled during construction is then spread back over the site. The site is seeded and mulched to comply with the erosion control regulations.

## What's All the Fuss about Marcellus? continued...

This is usually done with a mix of grasses and legumes.” Companies like Range Resources are willing to work with the landowner to use a specific seed mix, shrubs or small trees that are beneficial to wildlife species for food or cover. Whatever is put in place, however, must not interfere with any potential future activity on the site, like the eventual plugging of the well. To learn about the restoration methods being promoted on state forestland, see the side bar on *Restoring a Marcellus Well Pad Site*.

Scientific research shows that drilling for natural gas in the Marcellus shale can have consequences for the environment regardless of whether or not all safety procedures and best management practices are followed. Forests will have to be fragmented to build well pads and roads, noise pollution will occur and large amounts of water will have to be used to frack wells.

But most drilling companies are working with landowners and regulatory agencies to minimize these impacts as much as possible. If strong regulations and penalties are put in place to protect against the occasional accident, perhaps there is a way to make natural gas extraction compatible with the natural world, while also spurring our economy and ensuring local job growth. Many questions are yet to be answered, and we will have to continuously weigh the costs and benefits of drilling for natural gas. ✓

*Thanks to the [Pennsylvania Topographic and Geological Survey](#), the [DCNR Bureau of Forestry](#) and the [Department of Environmental Protection](#) for their extensive information on Marcellus shale and natural gas drilling, and to Bruce Snyder, Range Resources, for arranging the site tours.*

### Restoring a Marcellus Well Pad Site

There is currently no regulation requiring a certain level of land restoration once natural gas production ends, so restoration can range from a meadow to a reforestation project. What happens to a well site after all the equipment is moved out depends on what the land owner is able to negotiate into the lease agreement. If you want the land to look as natural as possible after all is said and done, make sure to include restoration language into your contract.

Here are some guidelines adapted from those that the [Bureau of Forestry](#) is using on their lands to ensure that the long-term footprint of drilling is as small as possible:

- Re-contour the site to its original topography
- Reserve the original topsoil from the site before initial gas construction and re-spread topsoil evenly over the area before planting
- Re-vegetate the site using native trees, shrubs and seed mixes that occur naturally in the surrounding area
- Avoid planting trees and shrubs near access roads and the wellhead, but native evergreens may be planted to provide a visual screen of the disturbed areas

The restoration practices used on a given site will depend in large part on the land use prior to the drilling—was it a farm, forest or field? Regardless of the land use, the site should be monitored for invasive species and if they are found, they should be controlled immediately. Once an invasive plant population becomes established it can be very difficult, if not impossible, to remove entirely.

If steps are taken to re-vegetate the site with native plants soon after the drilling disturbance has ceased, the more likely wildlife will return and find suitable habitat. Drilling in the Marcellus shale is going to have impacts on the natural world, but if we are careful about it, those impacts can be reduced.



This former well pad site was restored using a grass and forb mix. Landowners can decide what they want planted on the site once the drill rig is gone. (Photo: Jessica Sprajcar, DCNR)



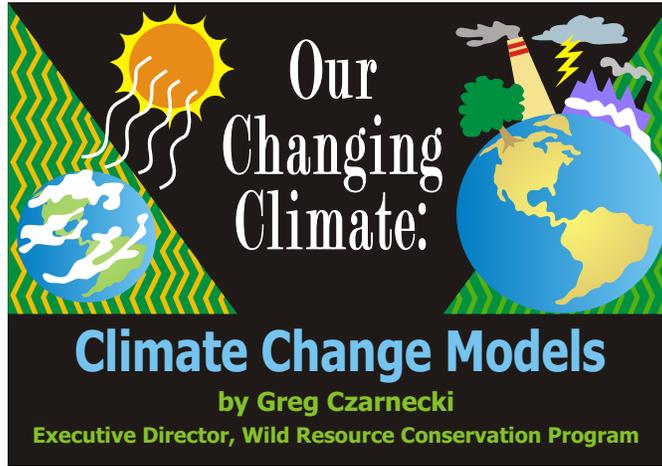
When I was a boy I loved to build models. Cars, boats, airplanes, even the Starship Enterprise, it didn't matter. The level of detail and fidelity to the original varied, but it was so cool to build those miniature representations of real-life machines (well most of them were real), complete with spinning propellers, rolling wheels and turning rudders.

Today when I hear the word model, it means something very different. Nearly every news story about climate change mentions climate models. Unlike those models of my youth, which represented something that was, climate change models tell us what might be.

What exactly is a climate model? It's a very sophisticated computer program that uses scientific principles, data and lots and lots of math to simulate future climate conditions. There are many different types of models, from the simplest ones that look at only a few variables to the most sophisticated of all, the **General Circulation Models** or GCMs.

There are many GCMs, each using somewhat different assumptions and data to arrive at their predictions. Generally named after the organization where they were developed, some of the more commonly used models include the Hadley CM3 model, NOAA's **Geophysical Fluid Dynamics Laboratory Model** and the **Parallel Climate Model**.

GCMs break the world up into three dimensional boxes, each of which contains not only a chunk of atmosphere but also any land,

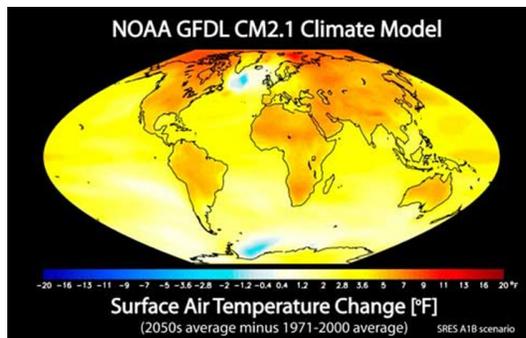


amount of energy entering and leaving the earth's atmosphere, the movement of carbon into and out of the atmosphere due to human activities and natural processes, temperature, precipitation, ocean currents, ocean salinity, winds, unpredictable events like volcanic eruptions and more.

water or ice beneath it. Within each of these boxes different variables can be modified to see what impact the changes will have on the complex interactions between the variables and ultimately the climate. Among the variables that can be changed are the

The models are so complex, and the number of mathematical calculations so large, that they can only be run on supercomputers. One of the models, the **Community Climate System Model**, developed by the **National Center for Atmospheric Research**, needs thousands of hours to make three trillion calculations to simulate climate conditions for just one future day!

None of these models perfectly simulates our global atmospheric system because we don't fully understand how all of these variables interact and influence one another, but they can be tested. The models, which are continually being refined as our knowledge of the earth's systems improves, are run to see if they can accurately simulate past and present climate conditions. Based on these tests, the GCMs are good at predicting near-surface temperatures, but not as good at predicting precipitation patterns and cloud cover. ✓



**NOAA's laboratory model shows projected global warming.**



**Climate models require supercomputers to run trillions of calculations. (Photo: NOAA)**

# Forest Lands and Energy Needs

## Balancing Energy Development with Resource Protection



by Jeff Woleslagle

Natural Resource Specialist in  
DCNR Bureau of Forestry



**O**ur 2.2-million-acre state forest system provides many benefits and values for the citizens of the Commonwealth, including clean water, recreational opportunities, a diversity of wildlife and plants, wood products and mineral resources—all critical to healthy and sustainable communities and to our state as a whole. Increasingly, our state forests are being called upon to meet our nation's growing energy needs.

The Department of Conservation and Natural Resources (DCNR) **Bureau of Forestry** is responsible for conserving and sustaining our state forests and balancing their many uses and values, including energy production. Finding that balance is challenging. There are benefits from energy production on our forests, but it must be done with great care to ensure the health of the forest is not compromised. Natural gas extraction and biomass harvesting are currently the main forms of energy extraction that take place on state forest lands. While wind energy is not currently a use of the state forest system, DCNR recently completed a feasibility study on its potential use. The Bureau of Forestry is working to balance energy extraction with natural resource protection.

### Natural gas

The main emphasis in energy production currently is the extraction of natural gas from the rich **Marcellus shale** deposit. DCNR has a 60-year history of leasing state forest land for natural gas extraction. Until recently, that history was centered around the drilling of shallow wells, but new technologies have enabled energy companies to access the bountiful gas deposits of the deeper Marcellus shale formation. In 2008, DCNR's natural gas

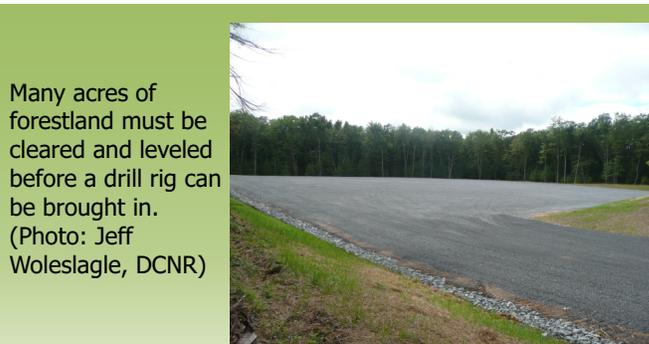
drilling policy changed to concentrate on this deeper drilling that uses centralized pad sites to decrease surface impacts in the forest. At the same time DCNR also strengthened its land use and environmental protection guidelines.

Currently there are approximately 700,000 acres of state forest land available for natural gas development. DCNR recently completed a comprehensive analysis that found that no additional state forest natural gas leases involving surface disturbance can take place without jeopardizing the forest's long term health and sustainability. This analysis can be found at [www.dcnr.state.pa.us/forestry/marcellus/moratorium.html](http://www.dcnr.state.pa.us/forestry/marcellus/moratorium.html).

Natural gas exploration and extraction permanently or temporarily converts the existing natural habitats in our forests into well pad sites, freshwater impoundments, roads, pipelines and areas for gas storage. This land use conversion has some obvious impacts on plants and wildlife, including threatened and endangered species, and some impacts that are not so obvious. Impacts can range from direct injury or mortality through loss of food and water sources, loss of sheltering vegetation, introduction of invasive exotic species and the disruption of plant seed production or an animal's breeding activities. Another impact is forest fragmentation, which occurs when a forest stand becomes separated from its original forest block when the surrounding forest is converted to different land uses. Pipelines, well pads, impoundments and roads fragment the forest into smaller, disconnected or partially connected tracts, complicating successful management of forests and resources. Fragmentation contributes to isolated populations of species and communities, increased predation and changes in habitat conditions.



Drilling in the Marcellus shale requires large rigs and many vehicles. (Photo: Jeff Woleslagle, DCNR)



Many acres of forestland must be cleared and leveled before a drill rig can be brought in. (Photo: Jeff Woleslagle, DCNR)

## Forest Lands and Energy Needs continued...

Other potential impacts of gas exploration and extraction include soil compaction and erosion and degradation of water quantity and quality. DCNR works to manage these potential environmental impacts of energy extraction through several processes. For instance, environmental reviews are conducted for each site to check for rare plant and animal species, unique and sensitive habitat types, and impacts on recreational uses in the forest. Areas of special consideration are avoided or buffered to minimize impacts to the resource. Roads, pipelines, impoundments and well pads are all required to follow existing road networks or be located as close as possible to existing ones to minimize forest fragmentation. The companies involved in natural gas extraction on state forest lands are under continual review and in constant contact with the district forest office that oversees each particular site. This helps to ensure that extraction is being done in accordance with DCNR's environmental protection guidelines.

Most well sites are considered a temporary disturbance to the forest, ranging from two to 15 years, although it could be longer in some situations. Once a well has been removed, the area can revert to its original habitat or may develop into new habitat types. Over time, recovering well sites again become part of a viable, healthy ecosystem.

As with any change to the forest environment, natural gas exploration will positively and negatively impact both recreational users and the plant and wildlife species found on our state forests. Snowmobilers might find increased riding opportunities and grouse might thrive in the newly disturbed areas. Conversely, hikers may not relish crossing pipeline corridors on the trail and species of songbirds that require large unfragmented areas may not do as well as they did in undisturbed tracts.

### Wind energy

In 2004, Pennsylvania's Governor signed into law [Act 213](#), which requires that 18 percent of the electricity sold to retail customers in Pennsylvania come from renewable and advanced energy sources within 15 years. Wind power will compete for a substantial share of this alternative energy market, and has become a growing industry in the state, but current legislation does not authorize wind development on state forests.

Although there are many benefits to wind energy, there are also some limitations. Wind turbines have the potential to impact raptor, songbird and bat populations, especially if constructed along migratory routes. Like

natural gas development, forest fragmentation, habitat disruption and the spread of invasives could result from the infrastructure needed for wind development. Wind turbines are large and when constructed along ridge tops, they have the potential to disrupt scenic views and aesthetics and cause noise when in operation. Lighting on wind turbines can attract birds and sometimes conflict with other land uses, such as stargazing in dark night skies.



Current legislation does not allow wind turbines, like these on private land, on state forestlands.  
(Photo: Ralph Campbell, DCNR)

To assist wind energy development in a responsible manner, the [Pennsylvania Wind and Wildlife Collaborative](#) was formed to develop a set of state specific principles, policies, best management practices, guidelines and tools that can be used to assess risk to habitat and wildlife from wind power development and to mitigate impacts of that development. For more information, visit the DCNR website at <http://www.dcnr.state.pa.us/wind/index.aspx>, and read the article, *Harnessing Wind Energy in Pennsylvania While Protecting Wildlife*, in this issue of *Keystone Wild!Notes*.

### Biomass

Another way our forests might help provide energy in the future is in the production of biofuels from woody biomass. Biofuels are used for combined heat and power, but currently they are most widely used for heat production. About 9,500 cords of firewood were sold last year from state forestlands to heat or supplement the heating of homes, vacation lodges and hunting and

## Forest Lands and Energy Needs continued...

fishing camps across the state. The bureau estimates that firewood from its permit program is the sole heating source for nearly 2,000 homes, and the wood provides supplemental heat to hundreds more. One cord of dried hardwood can supply roughly the same amount of heat as 150 gallons of fuel oil. Statewide, this locally grown, renewable fuel wood resource replaces the equivalent of 1.4 million gallons of non-renewable, and often imported, fuel oil.



Over 9000 cords of firewood from state forestlands were sold in 2009. (Photo: National Park Service)

The Bureau of Forestry is currently involved in the [Fuels for Schools Program](#), which is a statewide energy-use initiative promoting the use of local renewable resources to provide reliable energy for Pennsylvania schools and

businesses. More information on the program can be found at [www.pafuelsforschools.psu.edu](http://www.pafuelsforschools.psu.edu). Harvesting woody biomass from Pennsylvania's forests could help meet the demand for alternative sources of energy and reduce greenhouse gas emissions, but should not compromise other important forest functions and values, including protecting water quality, critical natural areas and communities, biodiversity, recreational opportunities and wildlife habitat.

As with other forms of energy from our forests, the use of woody biomass will continue to be examined carefully to determine what will produce the greatest benefit while having the least impact. To help ensure biomass harvesting operations are done in a sustainable manner, in 2008 DCNR released a comprehensive set of best management practices, which can be found at [www.dcnr.state.pa.us/pa\\_biomass\\_guidance\\_final.pdf](http://www.dcnr.state.pa.us/pa_biomass_guidance_final.pdf).

As we utilize state forest lands to meet our energy needs, we must proceed with care. We must make every effort to avoid the environmental mistakes of the past and ensure the forest we pass on to future generations is healthy and productive. DCNR's Bureau of Forestry is leading those efforts every day. ✓

## Unique Way to Support WRCP



**Ed and Emily Speer happily display one of the table cards that greeted their wedding guests. (Photo: Elle Photo Design)**

Ed and Emily (Koch) Speer were searching for a special way to thank their wedding guests, while at the same time support something they are very passionate about – the outdoors. Emily contacted the Wild Resource Conservation Program office in Harrisburg with a unique request; could we create some sort of wedding favor in exchange for a donation to WRCP? Specifically she hoped that we could create table cards or signs that would explain what the couple had done.

With the help of the Department of Environmental Protection's graphics department, decorative table signs were created for Ed and Emily's wedding day on September 11, 2010. 140 guests joined the Speer's at The Farmhouse at People's Light and Theater in Malvern, Pa. for the special evening. The guests really enjoyed the idea of a donation as a wedding favor. Many remarked on what a unique idea it was. Others appreciated that they didn't have to take home something that they would never use.

What gave Emily this creative idea? She said that, "We have both frequented Pa. state parks, and go camping, hiking and canoeing all of the time. We wanted to do something that would share that love of the outdoors with our guests, while at the same time giving back to the organization that make those times so enjoyable."

She also said that the process was really stress-free; everyone at WRCP was "amazing." It was "one of the easiest decisions we made when planning our wedding." Emily hopes that more people decide to donate for their wedding favors, and we do too!

If you are interested in donating to WRCP in lieu of wedding favors, as a birthday gift to a loved one, to remember someone who has passed on, or for any other occasion, please email Deb Miller at [debmiller@state.pa.us](mailto:debmiller@state.pa.us) or call 717-787-3212.

Thanks again to Ed and Emily Speer for "Doing Something Wild!" We wish you the best of everything as you begin your new life together.

## Harnessing Wind Energy in Pennsylvania While Protecting Wildlife



by Tracey Librandi Mumma

Pennsylvania Game Commission  
Wildlife Biologist

**T**hroughout the country, people are searching for alternative energy sources to replace fossil fuels. Pennsylvania is no exception. Act 213 of 2004, the [Alternative Energy Portfolio Standards Act](#), signed into law by Governor Edward G. Rendell, requires that within the next 15 years, 18 percent of the electricity sold to retail customers in Pennsylvania will come from renewable and advanced energy sources. Wind power is one of the technologies competing for a substantial share of Pennsylvania's alternative energy market, but it is not without drawbacks.



Wind energy is one way to meet the Governor's alternative energy mandate. (Photo: Tracey Librandi Mumma, PGC)

The [Pennsylvania Game Commission](#) (PGC), which has jurisdiction over birds and mammals in the state, raised concerns regarding wind energy development in Pennsylvania after the results from two scientific studies (one in a report submitted to the [Bat and Wind Energy Cooperative](#), one in the journal [Hawk Migration Studies](#)) came to light. The findings from these studies document negative impacts to birds and mammals—death and habitat loss—caused by wind energy development. The PGC immediately set out to work collaboratively with wind energy developers (referred to as “cooperators”) in order to address these potential impacts to the Commonwealth's birds and mammals.

Staff from the PGC bureau of Wildlife Habitat Management and Wildlife Management, who have expertise in Pennsylvania bats, birds and threatened and endangered species, drafted a Cooperative Agreement in 2007. The Cooperative Agreement draft was then

presented to the [PA Wind and Wildlife Collaborative](#), an organization that includes wind energy developers, government agencies and conservation organizations, for their input. The Cooperative Agreement was finalized and the first 12 cooperators signed the agreement on April 18, 2007. Currently, 29 of the 35 known wind developers in Pennsylvania have signed the agreement. Only one of the six wind developers that have not yet signed the cooperative agreement has operational wind facilities in the state.

The cooperators' wind projects represent 73 percent of Pennsylvania's active and proposed wind energy projects. There are currently 16 active wind energy projects in Pennsylvania, with 420 turbines that can produce up to 748 megawatts of power. Wind developers initially targeted ridge tops because of the high wind potential (most of the active wind energy projects in Pennsylvania are found at elevations greater than 2000 feet above sea level), but have started to branch out into some less prominent areas statewide. For example, the northwest and southeast portions of Pennsylvania are now starting to be targeted, and talk of offshore wind energy development on Lake Erie has increased.

There are many direct and indirect impacts to birds and mammals from wind energy development and operation including death, loss of habitat and habitat fragmentation (the primary land cover type for most wind energy sites is deciduous forest). Environmental concerns for offshore wind are similar to those for onshore, in that there are potential impacts to both migrating birds and bats, but different in that there are also a host of potential aquatic impacts. PGC protocols have been set forth to assess the risks to wildlife and to gain information so that wind turbines are built in areas where they will avoid impacts to birds, mammals and their habitats. Early planning has resulted in the avoidance of sites that have been deemed to be of high value to wildlife. The challenge remains in keeping these high value areas free of wind energy development.



Bats and birds are sometimes struck by turbine blades and killed. (Photos: Tracey Librandi Mumma, PGC)

## “Harnessing Wind Energy in Pennsylvania While Protecting Wildlife” continued...

Wind energy development in Pennsylvania continues to occur, and with the creation of the PGC [Wind Energy Voluntary Cooperative Agreement](#), much data regarding the impacts to birds and mammals is gained. Analysis of this data continues to provide much-needed insight into which species are at risk from wind energy development and helps all parties involved determine the best ways to avoid and minimize impacts to birds and mammals. Before a wind energy project is built, pre-construction surveys are conducted by the cooperators, to ensure that the turbines are sited in an appropriate area. Data from these surveys has uncovered new information on several state-listed species, including documentation of the second largest Indiana bat (*Myotis sodalis*) maternity colony in Pennsylvania and the first evidence of silver-haired bats (*Lasionycteris noctivagans*) breeding in Pennsylvania.



Endangered Indiana bat colonies can be found in a handful of sites in Pennsylvania (Photo: Greg Turner, PGC)

Once a wind turbine project has been completed, post-construction monitoring takes place. Mortality data collected by cooperators since 2007 have documented higher levels of bat mortality than bird mortality at wind energy facilities. Bird mortality tends to result from direct collision with turbines, whereas bat mortality occurs from barotrauma and direct collision with turbines. Barotrauma, according to authors Erin Baerwald and others in a 2008 [Current Biology](#) article, is caused by rapid air pressure reduction that occurs around moving turbine blades. The rapid air pressure reduction causes the air in bat lungs to expand beyond their capacity, resulting in internal hemorrhaging. Researchers have come up with two theories as to why bats are at risk due to wind energy development: one is that bats may be attracted to wind turbines; the other is due to their migration patterns (more information on these hypotheses can be found in the 2009 [Journal of Mammology](#) article, “Causes of bat fatalities at wind turbines: hypotheses and predictions,” by Paul M. Cryan and Robert M. R. Barclay).

The PGC is currently working on determining what levels of bird and bat mortality are acceptable. The PGC is using the best data available regarding population sizes and trends for the various species to determine what level of take (mortality) can be tolerated. According to research presented by E.B. Arnett and others to the *Bat and Wind Energy Cooperative* in 2010, curtailment—shutting down the turbines during evenings of high bat activity—has shown promise in regards to reducing the mortality to bats at operational wind sites.

The PGC is committed to making sure all wind energy projects, including those operated by non-cooperators, are employing feasible measures of protection and minimization of adverse impacts to the Commonwealth's bat and bird resources. Best management practices will be finalized by the end of 2010 that will aid both the PGC and cooperators in avoiding and minimizing impacts from wind energy. Once finalized, the best management practices will be incorporated into the PGC Wind Energy Voluntary Cooperative Agreement, which can be found on the [PGC website](#).

With the unprecedented decline in bats due to White Nose Syndrome (see [Keystone Wildnotes](#) Summer 2010 and Fall 2008 issues for more information), it is anticipated that additional bat species will be added to both the state and federal threatened and endangered species lists. No one has yet quantified what the combined effect of White Nose Syndrome and mortality from wind energy operations has been to Pennsylvania bat populations, but it is fair to say that Pennsylvania's bats are facing greater threats now than in decades past.

Yet through the PGC's *Wind Energy Voluntary Cooperative Agreement*, Pennsylvania has become a national leader on addressing wildlife impacts from wind energy development. Due to the collaborative efforts between the wind industry and PGC, the agreement will continue to provide all involved parties with the valuable information needed to best manage for wildlife at wind energy sites. Those wind companies that are cooperators have set an example that all should aspire to follow. They have proven to be partners in developing conscientious renewable energy with the highest regard for the Commonwealth's wildlife.

For more information on the PGC *Wind Energy Voluntary Cooperative Agreement* and its accompanying protocols, or for a list of current Cooperators, go to the PGC's public website at [www.pgc.state.pa.us](http://www.pgc.state.pa.us). Click on “Wildlife”, “Habitat Management” and then click on “Wind Energy.” ✓

# Biofuels: How Can They Coexist with Wildlife?

by Jessica Sprajcar

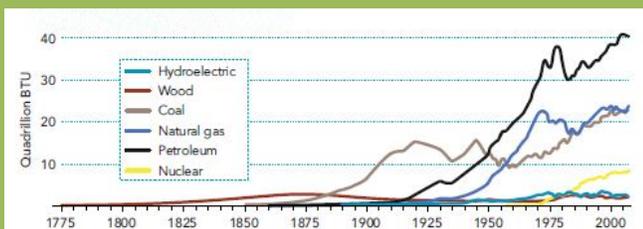
Conservation Program Manager for DCNR



Fossil fuels like coal, oil and natural gas started out as the remains of decomposing organisms like plankton that settled to the bottom of a sea or lake. After millions of years in that low oxygen, high pressure condition, a fossil fuel formed. While some of these fuels are still relatively abundant—think natural gas in Pennsylvania—they are not always easy to extract. We do not have millions of years to wait for the next supply of fossil fuels to develop, so what can be used in the near-term?

Scientists and industry researchers are looking into alternative fuel sources. One area that looks promising is biofuels. A biofuel is derived from a renewable plant or animal (biological) source. Biofuels include reusing old cooking oil, creating ethanol and biodiesel from plants, and capturing methane from agricultural manure digesters or landfills. The use of biofuels is not new; they have been around as long as vehicles have been on the road. Henry Ford's Model Ts were built to use ethanol and early diesel engines ran on peanut oil. Yet as the price of petroleum dropped, bringing gasoline and diesel to the fore, biofuels were pushed into relative obscurity—until now.

## U.S. Primary Energy Consumption



The use of fossil fuels like coal, natural gas and petroleum have increased dramatically between the late 1800s and today, while the use of alternative energy sources like hydroelectric and biomass (wood) have remained low. (Source: U.S. Department of Energy)

Biofuel is an umbrella term for several types of fuels that are created from plant and animal materials. Chemical reactions, fermentation and heat are used to break down the starches, sugars and other molecules in this organic material. The leftover products are refined to create a biofuel. While not an inclusive list, here are some biofuel terms:

**Biomass** refers to plant matter used to generate electricity or produce heat. Wood, organic matter in trash, and alcohol fuels constitute biomass fuels. When someone uses a pellet stove, they are using biomass to heat their home or business. Biodiesel and bioethanol are created using specific types of biomass.

**Biodiesel** is made from plant oils (soy, canola, palm), used cooking oil, animal fats or algae and can be mixed with regular diesel. It is the most common form of biofuel in Europe, but not as common in the U.S.

**Ethanol/Bioethanol** is an alcohol made from sugars derived from plant materials—both directly from crops like sugar cane and corn kernels (grain-based) or from plant byproducts like corn husks and wood chips (cellulosic). Most gasoline available in the U.S. now contains a small percentage of ethanol. In order to use higher concentrations of ethanol, vehicles need special engines.

**Cellulosic biofuel** is a type of bioethanol that is created from plant byproducts. Bioethanol created from agricultural byproducts has a lower input cost than using virgin materials, better energy output and reduces greenhouse gases by 90 percent over fossil fuel use.

**Gaseous biofuels** are the least commonly used biofuel—solid and liquid biofuels are much more common. They are created by the microbial degradation of a biomass like manure or landfill waste. The gases from these materials (methane, hydrogen and carbon dioxide) are captured and burned to create energy.

## Biofuels: How Can They Coexist with Wildlife? continued...

Biofuels are touted as a way to solve our energy independence and avoid the potentially damaging consequences of fossil fuel extraction, yet biofuels are not without their own drawbacks. Here is a comparison of some of the positive and negative features of biofuels. Please note that not all these benefits and risks will apply to every form of biofuel, and some are highly dependent on the type of biomass used and the manner in which it is grown and processed.

### Potential Positive Features of Biofuels

- Reduce dependence on foreign oil
- Boost local economy – if biomass is grown and refined nearby
- Keep agricultural lands in production, rather than conversion to residential or commercial areas
- Provide habitat for wildlife – if appropriate plant species are chosen and managed sustainably
- Reduce waste ending up in landfills and incinerators
- Lower greenhouse gas emissions than fossil fuels, although it can vary widely

### Potential Negative Features of Biofuels

- Conversion of cropland to fuel production
- Creation of monocultures – all one species lacking biodiversity
- Spread of invasives – both through the use of invasive plants for biofuel and through land disturbance
- Loss of wildlife habitat – if land is managed in the traditional, monocultural way
- Use of petrochemicals (fertilizers and pesticides) to grow crops for fuel
- Use of large quantities of water to grow crops and then convert to a fuel
- Transportation issues – shipping fuel across the country in fossil fueled vehicles

Looking at biofuels from a wildlife and habitat conservation angle, there are some concerns to address. One of the most commonly heard worries is that land currently managed for wildlife habitat will be converted to agricultural lands, particularly to grow corn and soy for ethanol. Evidence already shows that some farmers have taken their lands out of the [Conservation Reserve Program](#) (CRP)—a program of the [USDA](#) that pays farmers to leave some of their land as wildlife

habitat—to grow additional acres of corn. In September 2007, the amount of land enrolled in the CRP peaked at 36.8 million acres. Just one month later, CRP lands declined by 2.3 million acres, as national ethanol mandates came online. CRP lands are very important wildlife habitat: a study of grassland birds in North and South Dakota, published in a 2009 issue of [Bioscience](#), indicated that nearly two million birds of five species would be lost without the CRP in those two states. Grassland birds throughout the country, like eastern meadowlarks and bobolinks, are declining in number for other reasons as well—housing developments, climate change and herbicide use—but the loss of their grassland habitat is the primary culprit for their demise.



The Bobolink is one of a handful of grassland birds with shrinking populations (Photo: Joe Kosack, PGC)

How can we overcome habitat loss while still promoting biofuels? Researchers say that there are at least two ways to produce biofuels without destroying wildlife and habitat. One is to use biomass sources that don't require additional land, such as agricultural residues like corn husks, and wastes from other industries and municipal sources. The [Pa. Department of Agriculture](#) is one organization in the state working to make cellulosic biomass a viable option. Michael Rader, Biofuel Development Program Manager for the agency, says that, "Pennsylvania has made it a priority to advance second generation biofuels such as cellulosic ethanol because of the potential that exists with the massive amounts of agricultural biomass waste we have right here in PA. There are certain advantages from one feedstock to the next, including lower costs, better operating levels, and higher yields. The department supports any technology—biomass or biofuel—that can

## Biofuels: How Can They Coexist with Wildlife? continued...

help create additional markets for our farmers while maintaining agriculture's role in pursuing energy independence in Pennsylvania."

He goes on to say that, "producing the fuel from locally produced agricultural products and consuming the finished product locally, will prevent unneeded carbon miles to transport the fuel, benefiting rural Pennsylvania, creating jobs and protecting the air we breathe. Additionally, it takes one year to produce biomass for biofuels, which can be done year after year on a sustainable basis, compared to the tens of millions of years that it takes the earth to develop crude oil, so agriculture has an important role in harnessing Pennsylvania's energy potential by supplementing our state and national energy supplies with renewable resources."

The other option for promoting ethanol, while protecting wildlife habitat, is to grow native perennials like switchgrass and big bluestem. Using native grasses for ethanol has many benefits—they can be grown in soils that aren't suited for corn and soy production, they only have to be planted once (they are a perennial), as opposed to every year for corn (an annual), and they usually don't need pesticides or fertilizers to grow, so there is less of a negative impact on the natural world. In addition, researchers at the [University of Minnesota](#) discovered that while 1 gallon of fossil fuel is required to make 1.2 gallons of corn-based ethanol, that same amount of fossil fuel can create 5 gallons of ethanol from native prairie grasses.

Closer to home, Pennsylvania uses roughly 1 billion gallons of fuel oil each year. According to research presented by Scott Singer, biologist for the [USDA Natural Resources Conservation Service](#), we could replace 108 gallons of fuel oil with each ton of native grass biomass. One acre of land would produce 3 tons of grass (using a conservative estimate), thus offsetting 324 gallons of fuel oil per acre.



Switchgrass (*Panicum virgatum*) is one of several native grasses that can be used for biofuel production. (Photo: USDA)

Developing native plants for biofuels must be a thoughtful process. It is essential that more than one species is chosen. Use of just one species, like switchgrass, will provide cover for small mammals and birds but won't always provide a source of food for them. Fields with a variety of plant species attract and retain more wildlife than a monoculture will. Proper management is also important. If biofuel crop fields are harvested once a year, ideally during late fall or winter, negative impacts to wildlife are reduced. Harvesting biomass during the spring can kill many nesting birds and mammals.

If native grass biofuels are more energy efficient than corn-based fuels, why aren't they being used for widespread ethanol production? Creating cellulosic biofuel is more complicated than grain-based biofuel production because it is more difficult to break down cellulose into a fuel than it is to break down plant sugars. Grain-based ethanol production has been around for many years, while cellulosic technology is still in its infancy. Technology moves by leaps and bounds, however, and with more cellulosic ethanol plants coming online each year, it is poised to take a stronger hold of the market.

Unfortunately there is no magic bullet to solve our energy issues, but we all require energy sources to fuel our daily lives. Fossil fuels have the greatest impact on the environment but solar, wind and biofuels are not without faults. We must tread cautiously down the alternative energy pathway in order to protect the natural world while freeing ourselves from fossil fuels. ✓

### Want to learn more about biofuels?

These websites provide additional details from both sides of the debate. Disclaimer: WRCP does not endorse or support any of the information provided on these sites.

Alternative Energy News –  
[www.alternative-energy-news.info](http://www.alternative-energy-news.info)  
Biofuel Guide –  
<http://biofuelguide.net>  
National Renewable Energy Laboratory –  
[www.nrel.gov](http://www.nrel.gov)  
Energy Future Coalition –  
[www.energyfuturecoalition.org](http://www.energyfuturecoalition.org)  
Facts about Ethanol –  
[www.facstaboutethanol.org](http://www.facstaboutethanol.org)



## Energy Conservation in Survival

**F**at drips of water splattered onto my collar as I walked under a mosaic of autumn maple leaves in the Laurel Highlands. Fall weather is a transient affair; one day warm, another cold, and with the long overdue rains I was taking time for a trek to catch today's version of fall colors, knowing that tomorrow and the next day the forest would look completely different as fall wrought its changes.

The days were now settling into the 50s, and rain made it feel chillier yet. I had dressed in lightweight layers to keep warm and was covered in Gore-Tex to keep water away from my skin. The life-giving rain had been absent for the better part of the summer, leaving the soil parched and cracked; the plants in my native wildflower garden looked healthy and yet weren't as full as in past years. Finally the rains were here, if only for a few days, driving the changes of fall even faster.



Animals cannot escape to heated homes; they must conserve internal energy to survive. (Photo: Jake Dingel, PGC)

Seeking to get out in the woods and feel the rain on my face, I had to dress carefully; for although water gives life, getting wet can also suck the warmth from the body, turning a 50°F day into a dangerous situation. The body works harder, expending more energy to maintain core body temperature. Humans are remarkably insulated from worries about energy—our needs are easily met, because we keep ourselves stitched into seasonally appropriate fabrics and live and travel in cleverly designed shelters.

According to Bernd Heindrich, author of *A Winter World*, "We're adapted to a tropical environment and maintain it around ourselves all year long, through our housing and

*clothing. Most of us already feel uncomfortable experiencing 32°F, the temperature at which water turns to ice. What would we know of -50°F? We don't experience such temperatures so we can hardly imagine how animals survive; by the time the winter world descends, most of us have surrounded ourselves in artificial tropics."*

As I trudged along the trail in my artificial shelter, I was lucky. For here in nature, energy use is the top issue. Energy in nature is more primal and immediate: do or die. Animals must earn their survival and stake their claim in life's competitive race by placing their genes in with that of other competitors. They do this primarily through their management and use of energy.

On this cold, wet day a lone mourning dove offered its voice to the fog and a few chickadees called from the hemlocks. I stooped under the boughs and settled against the dry trunk while the chickadees excitedly dropped out of the gloom of evergreen boughs to examine me. As I sat, mopping off my binoculars and sipping water, a high keening call filtered through the calls of the chickadees and nuthatches, almost as an afterthought. Golden crowned kinglets, those little olive-drab shadows, more seen than heard, were also occupying the little hemlock grove.



Golden crowned kinglets are year-round residents of Pennsylvania. (Photo: Sally King, NPS)

These tiny passerines sport tiny bills for gleaning insect eggs, larva and small spiders hiding among twigs and buds. This part of Pennsylvania is in the year-round range for the little kinglets, and they forage constantly in all seasons, in order to fuel their high metabolisms.

Kinglets remain active throughout winter. Peter Marchand, author of *Life in the Cold*, sums up the

## Wild Watch "Energy Conservation in Survival" continued...

challenge faced by kinglets and other such animals; "... to survive they must maintain a body temperature within quite narrow and relatively high limits. This means that the animal must produce enough heat by metabolism of its food or its fat reserves to offset that which is lost to its cold surroundings. At a time when mobility is restricted and food resources are scarce, survival of the cold often becomes equated with heat conservation."

Kinglets have long fascinated scientists. How do these diminutive birds find enough food in winter to maintain the energy needed to survive? If they are without food for just a couple of hours, they die.

As one might expect, nature never provides one simple and clear answer. Animals have evolved a complex set of physiological and behavioral adaptations to deal with extremes. Kinglets are no exception. The tiny birds maintain an exceptionally high core temperature, even higher than other birds of similar size. They forage constantly to provide the necessary energy, and of course use a variety of behaviors such as huddling, shivering to increase circulation, fluffing up their feathers to provide better insulation, and flexibility in their diet to account for food availability.

Despite my binoculars, I couldn't seem to get a fix on the ever-moving kinglets as they hopped through the hemlock foliage. Kinglets aren't easily spooked by people; they rarely spend enough time in one place for good observation. As I sat there in the shade of the hemlocks, the patter of rain increased. I offered a series of harsh 'pssht pssht' calls to rouse the curiosity of the chickadees, who responded by hopping down to eye level, regarding me with bright black eyes and fluttering of wings.

These charming little birds that flitted around me are twice as heavy as the kinglets and have perfected another adaptive strategy for winter survival. Chickadees are known for foraging constantly; they need all the energy they can get to allow them to shiver throughout long winter nights to stay warm. When temperatures drop near zero, however, their fat reserves are not enough to fuel the need to shiver. Chickadees then enter into torpor, a state of lowered body temperature that helps them make the most of the energy won from foraging. With this ability, the fat reserves built up during the day's foraging can last them through the night.

The chill of the rainy day was seeping in, turning my hands achy and making my nose red. I brushed off the hemlock needles clinging to my rain pants and headed back onto the trail. The chickadees' scolding calls and



The black-capped chickadee is able to lower its body temperature to survive cold nights. (Photo: Jake Dingel, PGC)

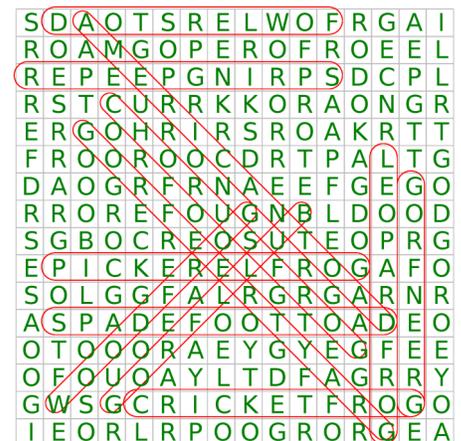
the higher whispery calls of the Golden crowned kinglets faded under the sounds of the rain. A good walking pace would stir my circulation and ease the cold in my hands.

The chickadees and kinglets were just getting started in their fight for survival in the cold season. Energy conservation is faced in the animal world on a daily basis. The cute chickadees that visit our feeders in winter aren't just sampling some gourmet seeds we thoughtfully provide—they are seeking vital sources of fat to burn in order to survive the night. For these animals, the cold season means survival is day to day and even hour to hour.

We humans may raise an eyebrow at the news and talk heatedly about energy use in our lives; what it costs monetarily or environmentally. But for most of us, we are lucky to be faced with such mundane arguments because we can go to sleep at night knowing our very survival is not in question.

The chill of my rainy autumn hike signaled the last concession of the warm season. Soon the rain drops would change to snow flakes. The shadowy kinglets and the gregarious chickadees scolding me from the brush would begin foraging in earnest competition to make it through the winter nights, their day to day survival dependent on what meager energy they would seek in the winter landscape. ✓

Answers to Word Search on Page 32.



# Assessing Wet Thickets in Pennsylvania



Photos and text  
**by Mary Ann Furedi, Ph.D.**  
Ecologist for the  
Pennsylvania Natural Heritage Program



**W**et thickets are wetland plant communities found across Pennsylvania. By definition, they are saturated or seasonally flooded communities dominated by shrubs and tree saplings under 20 feet tall. The different types of wet thickets often differ from one another in structure, composition and landscape setting. For example, wet thickets often occur where open marshes or bogs transition into drier adjacent uplands. In other instances, wet thickets represent a successional stage (an orderly change in the composition or structure of an ecological community) from poorly-drained abandoned fields to young wetland forests. Different wet thicket communities are characterized by different plant species, and also often support different species of wildlife. Understanding the differences between various wet thicket communities is an important key in their management, both for plants and wildlife.



A blueberry dominated thicket in spring at Ricketts Glen State Park.

At first appearance, wet thickets may just look like a tangled mass of dense shrubs or as scattered patches of shrubs, yet wet thickets provide important ecological functions that benefit humans, plants and animals. Wet thickets provide potential habitat for a wide suite of species, including some of high conservation priority in Pennsylvania. The dense shrub layer, characteristic of most thickets, provides good protection, nesting opportunities and vertical structure for birds. Moist soils, sphagnum moss mats and shade from the dense shrub layer provide ideal habitat for amphibians and reptiles. Some wet thickets, such as those dominated by highbush blueberry, provide food sources for birds and mammals like mice and black bears. Rare plants and plant communities may also be found in wet thickets.

Wet thickets also provide services to society through erosion control, pollution filtration, water quality management, and other benefits like food and fiber.

**Highbush blueberries not only serve as a food source for birds and mammals but are often picked by humans too.**



There is currently little information on the composition and extent of naturally-occurring wet thicket habitat in Pennsylvania. Similarly, little information exists on whether different wet thicket types host different animal species, especially birds. The [National Wetland Inventory](#) (NWI) provides some insight into the distribution of wet thicket habitats in Pennsylvania; though they are generally grouped with other scrub-shrub types into one class under palustrine systems (palustrine is a general term for marshes, fens, bogs and other wetlands not associated with lakes or rivers). However, NWI maps are not detailed enough. They only indicate structure (e.g., shrub wetland versus forested wetland), and provide no detail on plant community composition. Knowledge of the plant composition of wet thickets is an important component of managing this habitat for species of conservation concern (rare, threatened or endangered) as well as more common species. In addition, most of the NWI maps for Pennsylvania are at least 25 years old and may not represent the true extent of palustrine shrubland habitat, since some palustrine habitat represents successional communities that may have matured into young forests since the completion of the NWI maps. Another source of information on wet thickets is the book, [Terrestrial and Palustrine Plant Communities of Pennsylvania](#), by Jean Fike, however the palustrine shrublands in this classification do not seem to fit all the wet thicket types in Pennsylvania, suggesting the need for more information.

## Assessing Wet Thickets in Pennsylvania continued...



The fall colors of a low shrub thicket dominated by leatherleaf.

The carnivorous pitcher plant is one of many plants found in certain types of wet thickets.



To begin to address these knowledge gaps, the **Pennsylvania Natural Heritage Program** (PNHP) is currently conducting a project to identify different types of wet thickets found within Pennsylvania. Using a combination of aerial imagery, NWI maps, and **Geographic Information Systems** (GIS) analysis (a type of computerized mapping), PNHP identified over 60 sites for possible inclusion in the study. All sites were visited to determine the presence and condition of wet thicket habitat and ultimately, 40 sites, distributed statewide, were chosen for vegetation surveys. Following site selection, multiple fixed area plots were established at each site to capture the composition of plant communities occurring within each wet thicket. Plant occurrence and abundance data, along with environmental data and the presence of invasive and rare species, were collected for each plot.

To date, all field work has been completed and PNHP has begun the data analysis phase of the project. The

results and final report will be available in December 2010. A cursory analysis of the vegetation data reveals several new wet thicket community types that can be used to update the plant community classification system for Pennsylvania. New locations of rare plants were noted as a result of this project. Also, information from this project has been used to help inform several other wetland-related projects. Through our efforts, we hope that the results of this project will provide further insight into the composition of wet thickets that can be used for the conservation of this habitat type and the species that use it. ✓

To see a video of Mary Ann Furedi and Greg Czarnecki visiting a wet thicket, visit our YouTube page at [www.youtube.com/wrcp](http://www.youtube.com/wrcp).

*This project is jointly funded through the **Wild Resource Conservation Program** and a **State Wildlife Grant**.*



"Information for the Conservation of Biodiversity"

### Pennsylvania Natural Heritage Program

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

## Save the Date

The next **Wild Resource Festival** will take place on October 15, 2011 at **Point State Park**. The festival will have the same great interactive activities, displays and field trips that you've come to expect, but a few new things will be added too. See you in Pittsburgh!



**Point State Park provides green-space in the urban environment of Pittsburgh. (Photo: Jessica Sprajcar)**

## Conserving Spadefoot Toad Habitat

by **Jessica Sprajcar** Conservation Program Manager  
DCNR Office of Conservation Science

**T**he steady hum of cicadas greeted us as we arrived at our destination: an ordinary-looking housing development with extraordinary amphibious residents. We were in search of the state endangered **Eastern Spadefoot**; a toad species found in seasonal pools and wetlands on or near agricultural lands. The housing development was surrounded by fallow and active fields, so hopes ran high that we would come across some of these tiny toads.

The Eastern Spadefoot toad has co-existed with farmers in Pennsylvania for centuries. These toads feed on insects and other invertebrates that are considered by farmers as pests, so the toads' presence is a plus. The tilled soil of a farm field allows these toads to burrow down, protecting them from adverse weather conditions and predators. Unfortunately, as agricultural lands are converted into housing developments and shopping malls, the spadefoots lose some of their habitat. "If we continue to impact Pennsylvania's farms, forests, wetlands and waters in an unsustainable manner," said Brandon Ruhe, a herpetologist for **East Stroudsburg University** and one of our tour guides for the day, "life may be pretty difficult for Eastern Spadefoots, and all of us too."

But all is not bleak for this burrowing toad. In 2003, children from this Berks County neighborhood discovered an unusual looking amphibian and brought their special find to Brandon, who identified it as the Eastern Spadefoot. A visit to the site confirmed the presence and breeding of this toad at two pools—a species range extension of nearly 100 miles. That lucky encounter kicked into motion a tale of conservation worthy of the Wild Resource Conservation Program (WRCP).

The **Pa. Fish and Boat Commission** (FBC), a partner organization of WRCP, has jurisdiction over amphibians like the Eastern Spadefoot. Because of the limited number of individual toads and breeding sites in Pennsylvania, coupled with the threats posed to the species, the FBC was able to list the species as endangered in 2005 (these toads are also threatened in Massachusetts, endangered in Ohio and Connecticut, declining in New Jersey and rare in West Virginia). The owner of the property, a residential land developer, had plans to build numerous homes on the property, but once the toads were discovered onsite, development



**Eastern Spadefoot Toad**  
(*Scaphiopus holbrookii*)

**Description:** One to three inches in length. Orange spots on their hind legs, a lyre-shaped body and elliptical "cat" eyes. Skin is smoother than other toads and ranges in color from olive to brown to black. The toad's name comes from a black sickle-shaped "spade" on their hind feet, used for digging.



**Note the small "spade" on each hind foot.**  
(Photo: Greg Czarnecki)

**Distribution:** In Pennsylvania there are five historical occurrences, all of which still have toads today. Fish and Boat Commission staff has located a handful of other small sites in the state. Elsewhere it can be found from Massachusetts through New York, south to parts of Florida, west to the southern Great Lakes region, all the way down to Louisiana, but in many of the more northern states the toad is rare or threatened.

**Interesting Fact:** These toads spend a considerable amount of time underground, although scientists are still trying to document just how long. Myths claim that the toad can survive years buried underground, but the truth is closer to weeks or months in length. During periods of drought the toads will curl into a tight ball and excrete a fluid that hardens the soil around them. That chamber will retain moisture until heavy rains soak the soil and signal that it is safe for the toads to dig to the surface once again.

**Conservation Concern:** Changing land uses, particularly conversion of farm land to residential and commercial areas, as well as the filling in of wetlands and seasonal pools, are reducing the amount of good habitat for the Eastern Spadefoots. Roads and the vehicles that travel on them are a hazard to toads as they move from one pond to another to breed.

## “Conserving Spadefoot Toad Habitat” continued...

came to a stand-still. After several years of negotiation between FBC, the [Department of Environmental Protection](#) and the developer, the [Berks County Conservancy](#) was brought in to purchase the 8.7-acre property, using funds from the [William Penn Foundation](#) and a [Conservation and Community Partnership Program grant](#) from the [Department of Conservation and Natural Resources](#) (DCNR). In addition to owning and managing the land, the conservancy placed a conservation easement on the site so that future development would be forbidden.



Eastern Spadefoot Toads find wet agricultural fields good habitat. (Photo: Greg Czarnecki)

Why all the fuss about an easily-overlooked amphibian? Chris Urban, Non-game and Endangered Species Coordinator for the FBC, sees the toad as: “a remarkable animal in many ways. It has special adaptations to survival that make its life history complex, like their sporadic breeding behavior; their fossorial nature—they stay hidden in burrows for significant amounts of time; and their role as an integral part of Pennsylvania’s fauna that make them worthy of conservation and protection.” Amphibians act as canaries in the coal mine, as they are excellent indicators of ecosystem stress. They help us understand the ecological importance of all species and their interconnections; connections that the property has in abundance. All three Pennsylvania toad species (the Spadefoot, the [American toad](#) and the vulnerable [Fowler’s toad](#)) live onsite, as do a variety of butterflies like tiger and spicebush swallowtails, bird species of concern like Horned larks and Lapland longspurs, as well as [gray tree frogs](#) and foxes.



**Fowler’s Toad** (*Anaxyrus fowleri*), a state-listed vulnerable species, is large, light brown to gray in color, and lives in sandy, open habitats throughout all but the northern portions of the state. (Photo: Fish & Wildlife Service)

What does it take to manage habitat for Eastern Spadefoots? No one is 100 percent sure, but the research that the conservancy, the FBC and East Stroudsburg University are doing is going a long way toward determining the toads’ needs. The organizations worked together to create a management plan, funded by a WRCP grant, that is amended every five years, or more frequently when necessary. The plan includes habitat management methods such as tilling part of the field for toad and water movement, planting trees and shrubs for toad refugia (hideouts) and building up dirt mounds for the toads to dig into. The site has been fenced in to keep out intruders and the occasional neighbor dumping yard waste.

Most neighbors have been respectful of the project and a few are even actively participating in habitat management—one neighbor discovered Eastern Spadefoots living in his backyard, so he helps monitor their activities and reports back to Brandon with his discoveries. The biggest complaint from the neighbors concerned thistles. Because the toad habitat was not being mown as it had during its agricultural days, some thistle seeds were blowing into the neighbors’ backyards. Conservancy staff periodically spot-treats thistles with a selective herbicide and has seen a major reduction in thistles onsite and in neighboring yards.

Greg Czarnecki, Director of WRCP, has this to say about the importance of this project and site: “We support projects that make a significant impact on species conservation or that can serve as a prototype for conservation efforts across the Commonwealth. This project does both. It conserves an important population of one of our native species and serves as a model of collaboration between property owners, conservationists and local government.”

Active habitat management is being combined with scholarly research done by Brandon, who said that, “Very little is known about the natural history of the Eastern Spadefoot—the what, where, when and why of spadefoot biology and distribution. Hopefully this work will allow us to figure out some basic, but unknown, questions about what the critters are doing.” It will be important to know how long the toads live, how long they stay in their underground burrows, when they breed and how far they travel. Right now there is some anecdotal evidence of these issues, but very little of their life history has been documented in scientific studies. It is important to have the answers to these questions in order to manage, protect and conserve them.

## “Conserving Spadefoot Toad Habitat” continued...

Brandon has set up monitoring stations next to the pools to determine what weather conditions are best for Eastern Spadefoot breeding. The monitoring stations house a rain gauge, anemometer (wind gauge), barometer and thermometer as well as a microphone that records toad calls. The call logs and weather station are synced to record data every hour of everyday. Brandon then periodically downloads the recordings, enters them into a computer program that listens for toad calls and will then compare the timing of the calls with the weather conditions at the time. No one knows what constitutes suitable breeding conditions, but the data that is being collected may shed some light on that. Right now the data is “all over the place”—toads have been breeding and calling from April through September—so Brandon will have to do further analysis to determine what is going on.



Weather data and toad calls are captured at this monitoring station and analyzed at East Stroudsburg University. (Photo: Greg Czarnecki)

What does the future hold for the Eastern Spadefoot? In terms of this location, the conservancy hopes to one day purchase another tract of land adjacent to the pools to expand the suitable habitat, but the site is currently held up in court because of a land dispute. Should that issue be resolved, the conservancy will seek out additional funds to purchase the additional acreage. Also needed are baseline population data for long-term monitoring of this species. The relative health of the seasonal pool communities on this and other Eastern Spadefoot sites will be determined by periodically sampling the amphibians, invertebrates, water and soil quality and vegetation at the site and comparing it to baseline data.

As we got ready to leave the site and say goodbye to our toad friends, a Berks County Conservancy staff member remarked: “All species hold the same future; all species are strands in a web. Respect for all species strengthens the web of our world. Until human beings make a commitment to the shared health of our planet and give nature enough room to operate, the future will be uncertain for the Eastern Spadefoot toads and human beings.” Brandon then added, “These toads are a part of our rural and agricultural heritage in Pennsylvania. Chances are we will sure as heck miss them, like all other species, when they are gone.”

To see video of a juvenile Eastern Spadefoot and to hear about the work being done by experts in the field, go to: [www.youtube.com/pawrcp](http://www.youtube.com/pawrcp) ✓

### How can you help protect amphibians and other species?

- Get active at the local level. Real change happens one community at a time through effective zoning and planning. Go to local government meetings to make sure habitats are protected from development.
- Become a citizen scientist. Help study animals, plants or habitats for monitoring projects like the [Mid-Atlantic Phenology Network](#), [Earth Trek](#), [Networked Naturalist](#), the [National Ecological Observatory Network](#), [Frogwatch](#), and the [North American Monitoring Program](#).
- Keep wild things wild. Don't collect and keep wild animals and plants. Take photos instead.
- Reduce the use of chemicals in your yard and home. Green cleaning products and integrated pest management methods can do the same work with less environmental impact.
- Learn to identify rare species. If you think you have found an Eastern Spadefoot, take a photograph and report it to the FBC Natural Diversity Section office at 814-359-5237.
- Donate your time or money to a local conservation organization—think globally, act locally.

# WEED IT & REAP

## Have You Seen This Weed?

### Japanese Stilt Grass



#### Japanese Stilt Grass

Text and illustration by  
**Jessica Sprajcar**

Conservation Program Manager,  
Department of Conservation &  
Natural Resources  
Office of Conservation Science

**Aliases:** *Microstegium vimineum*, Nepalese browntop

**Last Seen:** Creeping along the edges of roadsides and trails throughout much of Pennsylvania and New England, south through Virginia and west to Indiana.

**Description:** An annual grass that grows two to three feet tall by summer's end. Leaves are pale green, lance-shaped, one to three inches long and have a silvery mid-vein. Slender stalks of tiny flowers appear in late summer. Grows in dense mats, typically in shady areas.

#### Don't Pick up Hitchhikers!

Stilt grass is an invasive species with seeds that are easily spread on the soles of hikers' shoes, in tire treads, and on construction equipment. When hiking or biking in an area where stilt grass is present, brush off your boots and wash the bike's tires before leaving. For more information on this shady character, visit [www.nps.gov/plants/alien/fact/mivi1.htm](http://www.nps.gov/plants/alien/fact/mivi1.htm).



#### Follow us on Twitter!

The Wild Resource Conservation Program is tweeting about important conservation-related topics like climate change and habitat protection. Our Twitter feed will also be the first place to find out about new *Wild! Notes* issues, our festivals and other upcoming events. To become one of our followers, go to [Twitter](#) and search for "PAWRCP."

# Frogs and Toads of Pennsylvania



# Wild! For Kids

# Word Search



S	D	A	O	T	S	R	E	L	W	O	F	R	G	A	I
R	O	A	M	G	O	P	E	R	O	F	R	O	E	E	L
R	E	P	E	E	P	G	N	I	R	P	S	D	C	P	L
R	S	T	C	U	R	R	K	K	O	R	A	O	N	G	R
E	R	G	O	H	R	I	R	S	R	O	A	K	R	T	T
F	R	O	O	R	O	O	C	D	R	T	P	A	L	T	G
D	A	O	G	R	F	R	N	A	E	E	F	G	E	G	O
R	R	O	R	E	F	O	U	G	N	B	L	D	O	O	D
S	G	B	O	C	R	E	O	S	U	T	E	O	P	R	G
E	P	I	C	K	E	R	E	L	F	R	O	G	A	F	O
S	O	L	G	G	F	A	L	R	G	R	G	A	R	N	R
A	S	P	A	D	E	F	O	O	T	T	O	A	D	E	O
O	T	O	O	O	R	A	E	Y	G	Y	E	G	F	E	E
O	F	O	U	O	A	Y	L	T	D	F	A	G	R	R	Y
G	W	S	G	C	R	I	C	K	E	T	F	R	O	G	O
I	E	O	R	L	R	P	O	O	G	R	O	R	G	E	A

American toad  
cricket frog  
green frog  
spadefoot toad

bullfrog  
Fowlers toad  
leopard frog  
spring peeper

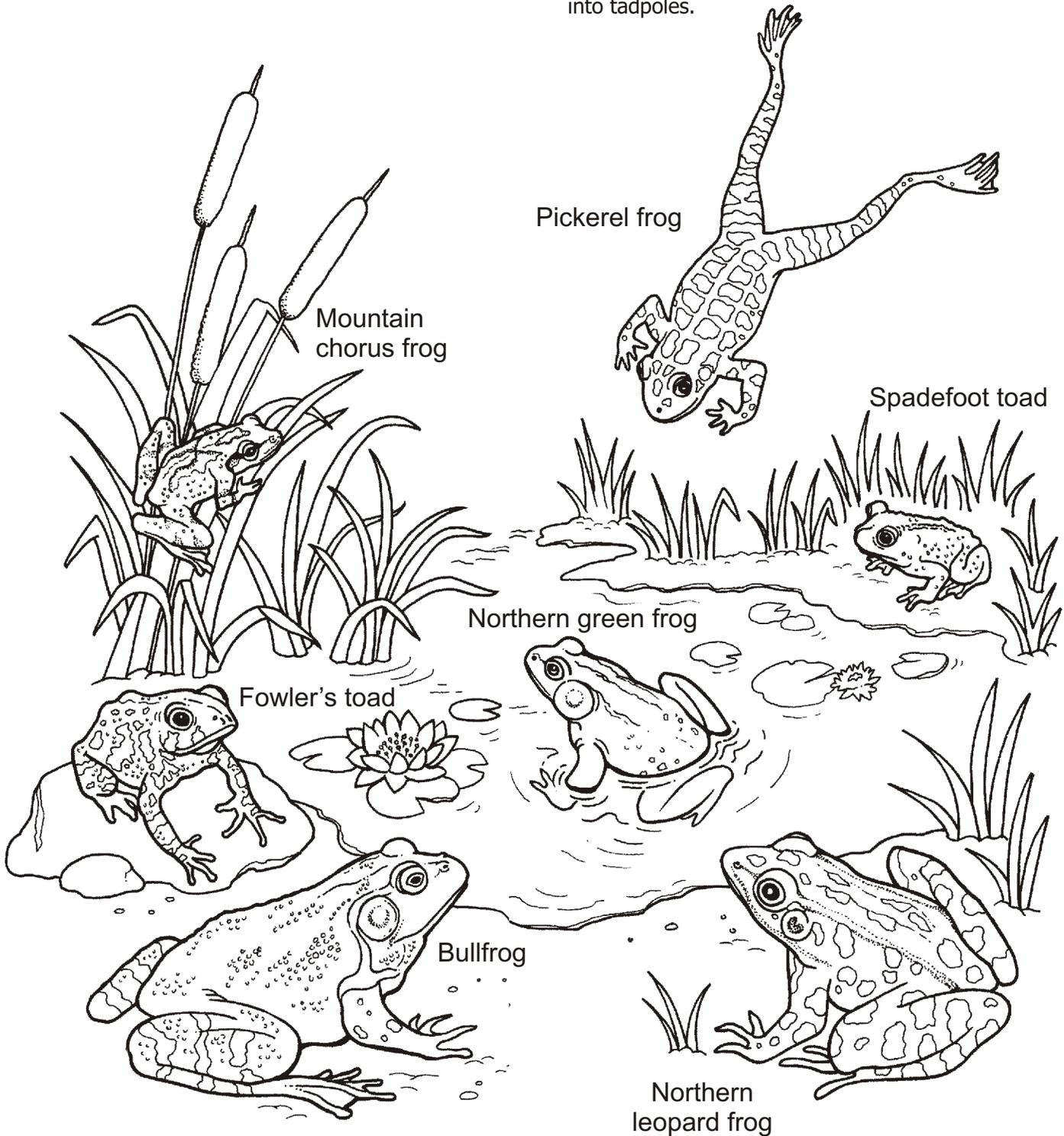
chorus frog  
gray treefrog  
pickerel frog  
wood frog

Answer key located on page 25.

## Color Me Wild!



Pennsylvania is home to more than a dozen frog and toad species. Frogs typically live in wet environments and have smooth skin, while toads live in drier areas and have bumpy skin. Both need to lay their eggs in some form of pond or puddle. Eggs then develop into tadpoles.



# Wild! Buys

## Show Your Wild Side!

### Our Tops are Tops!



#### WRCP Logo Long-sleeved T-shirt (Adults-Men's Sizes only)

Sizes: M, L, XL, XXL - \$18  
The WRCP logo is embroidered on a 100% cotton T-shirt (Chocolate brown)



#### WRCP Logo Long-sleeved Faded Blue Denim Shirt

Men's sizes: S, M, L -- \$25; 2XL, 3XL -- \$27  
Ladies' sizes: S, M, L, XL -- \$25; 2XL, 3XL -- \$27  
This 100% cotton shirt features double-needle stitching and a button-down collar. WRCP logo is embroidered above the patch pocket (no pockets on ladies' shirt).



#### WRCP Logo Long-sleeved Forest Green Pique Polo Shirt (Men's sizes only)

Sizes: S, M, L -- \$25; 2XL, 3XL -- \$27  
This extra-heavy 100% ring-spun Egyptian cotton pique polo shirt features WRCP logo embroidered on the left chest.



#### COSMO'S WORLD T-SHIRTS

The WRCP logo is on the front (see above) and Cosmo and Terra are on the back (at right). The T-shirt is 100% cotton, pre-shrunk and available in both Tangerine and Natural.  
Children's sizes: S, M, L -- \$15  
Adult sizes: S, M, L -- \$17



#### Salamander T-shirt

The image of the red eft is embroidered in full color on this 100% cotton T-shirt (Periwinkle).  
Youth sizes: S, M, L -- \$12  
Adult sizes: S only -- \$14

### Quantities of these shirts are limited.

Before ordering a shirt, please call Deb at 717-787-3212 to make sure that we have your size. Thanks for your understanding.



# Wild! Buys

## Show Your Wild Side!



### WRCP Logo T-shirt (Youth)

The WRCP logo is embroidered on a 100% cotton T-shirt (Sand).  
Youth sizes: S, M, L -- \$12



### Flying Squirrel T-shirt

The image of a flying squirrel is embroidered in full color on this 100% cotton T-shirt (Sand).  
Adult sizes: S, L, XL -- \$14



### WRCP Logo Hooded Sweatshirt

The WRCP logo is embroidered on an 80/20 cotton/poly hooded sweatshirt. (Blue; Gray)  
Adult sizes: S, M, L, XL, XXL -- \$27  
Youth sizes: S, M, L - \$22

## Colorful Embroidered Patches to Wear or Collect

- 2009 Massasauga Rattlesnake --\$6 (+ .36 tax)
  - 2009 Cosmo's World Patch - \$6 (+.36 tax)
  - 2008 Presque Isle Festival -- \$10 (+ .60 tax)
  - 2008 Serpentine Barrens -- \$6 (+ .36 tax)
  - 2007 Northern Flying Squirrel Festival -- \$10 (+.60 tax)
  - 2007 Rachel Carson Centennial -- \$6 (+.36 tax)
  - 2006 Wine-capped Stropharia Festival -- \$10 (+.60 tax)
  - 2006 Yellow Morel -- \$6 (+.36 tax)
  - 2005 American Kestrel Festival -- \$10 (+.60 tax)
  - 2005 American Kestrel -- \$6 (+.36 tax)
  - 2004 Allegheny Crayfish -- \$6 (+.36 tax)
  - 2003 Spreading Globeflower -- \$4 (.24 tax)\*
  - 2002 Red Eft -- \$5 (+.30 tax)
  - 2001 Luna Moth -- \$5 (+.30 tax)
  - 1999 Wood Thrush -- \$5 (+.30 tax)
  - 1998 Dogwood -- \$4 (+.24 tax)\*
  - 1997 Bog Turtle -- \$4 (+.24 tax)\*
- \* Limited quantities



### River Otter Toy

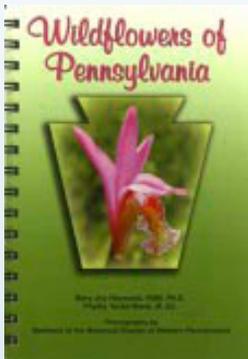
**Fuzzy River Otter** looks just like the real animal reintroduced into PA through efforts funded by the WRCP. 20 inches from nose to tail -- \$12 (+.72 tax)



# Wild! Buys

## Show Your Wild Side!

### Read All About It—In Wild! Books



#### WILDFLOWERS OF PENNSYLVANIA

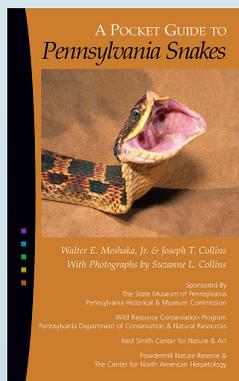
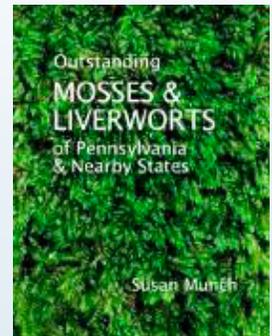
This book is for all who enjoy nature and would like to become more acquainted with wildflowers. It will help the observer to identify the plants seen on a spring, summer or fall hike in a natural area. The book uses photographs of the plants, as photos reveal much more detail than can be found in drawings.

Price: \$20 (+ \$1.20 tax)

#### OUTSTANDING MOSSES AND LIVERWORTS OF PENNSYLVANIA

Botanist Susan Munch brings us the first full-color field guide for mosses in the Mid-Atlantic region. The guide's 89 pages contain detailed color photographs allowing for easy ID of many of the most common, yet striking, mosses and liverworts. No microscope is necessary. The guide is suitable for both professionals and non-botanists.

Price: \$20 (+ \$1.20 tax)



#### POCKET GUIDE TO PENNSYLVANIA SNAKES

WRCP teamed up with the State Museum to produce this very affordable and informative little book that provides photos and natural history information about all of the state's serpents. This is the first in a series of pocket guides to be produced; *A Pocket Guide to Pennsylvania Amphibians* will be published later this year.

Price: \$4.72 (+ \$.28 tax)

#### THE RETURN OF MAGIC

A delightful children's book for ages 4 and up, the *Return of Magic* tells the story of a young kestrel through poetry and beautiful watercolor illustrations. The book is packed with information on the life cycles of these colorful raptors and even includes a design for building a kestrel nesting box. The *Return of Magic* was written and illustrated by Wendy Plowman, for the [Hawk Mountain Sanctuary](#).

Price: \$5 (+ \$.30 tax)





# Wild! Buys

## Show Your Wild Side!

Full of style and color, these wildlife earrings by Jabebo "Inspire Curiosity" and are made in Pennsylvania with post-consumer materials and surgical steel hangers. Price: \$10 (+ .60 tax) for each pair. Please note earring name on order form.



Global Biome



Piping Plovers



Little Brown Bats



Great Blue Herons



Ruby-throated Hummingbirds



White-breasted Nuthatches



Saw-whet owls



Barn Owls



Dragonflies (colors not identical)



Rivers Otters



Cardinals (male & female)



Fritillary Butterflies



Painted Turtles



Flying Squirrels

### WRCP Salamander Ball Cap

**Quantities are Limited**

Our cap features the red eft salamander, the land-dwelling sub-adult of the aquatic red-spotted newt. The cap is constructed of garment-washed 100% cotton twill. One size fits all (adjustable). Colors: Blue (at right); Sand (light tan); and Green. Price: \$15 (No tax)





# Wild! Buys

## Show Your Wild Side!



### Mushrooms and More, Oh My!

The Wild Resource Conservation Program has released its 14th documentary video, **"FUNGI: Pennsylvania's Hidden Treasures"**. This award-winning video looks at both the ecological and the economic importance of fungi, an under-appreciated but essential part of our ecosystem. A DVD of the video is available as an appreciation gift for donations of \$15 or more to WRCP. Order using the form below from WRCP, P.O. Box 8764, Harrisburg, PA 17105-8764; 717-787-3212; or e-mail [debmilller@state.pa.us](mailto:debmilller@state.pa.us).



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<b>KEYSTONE WILD! NOTES:</b> Please enter my web subscription_____				<b>Postage</b>
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### PA State Sales Tax

WRCP is responsible for collecting 6% Pennsylvania sales tax on most items we sell, excluding apparel. The amount owed on each item is noted next to the item price.

### Shipping Fees

Total amount of order	Postage Fee
\$0 - \$10.00	\$2
\$10.01 - \$20.00	\$4
\$20.01 - \$40.00	\$5
\$40.01 - \$70.00	\$6
\$70.01 - \$100.00	\$7
\$100.01 or more	\$8