CHAPTER 4. BIOLOGICAL RESOURCES

Ecosystems are groups of plants and animals that live and interact together. Plants and animals are essential for healthy ecosystems and clean water. Biological resources sustain and enhance our quality of life. Wood products, crops, and livestock offer economic income to the Sinnemahoning region. Wild game and fish offer opportunities for hunting, fishing, and wildlife watching. Trees, wildflowers, birds, and butterflies enhance our outdoor experiences. Bees, bats, and other pollinators ensure sufficient crop yields and beautifully blooming gardens. Having a diversity of living creatures is termed biodiversity. Humans, too, are a biological component of watersheds and ecosystems. In this chapter, biological resources, habitats, and threats to those resources will be discussed.

Unique habitats, like this sphagnum bog, characterize the Sinnemahoning Creek watershed

Natural Setting

Ecoregion Characteristics

An ecoregion is an area of land or water containing similar geographic characteristics and species that interact ecologically. Although both province and ecoregion delineations consider the geology of the area, the difference is that an ecoregion also takes into account the climate, ecology, animals, and plants.

Each ecoregion is subdivided into divisions and subregions. The project area is located within Unglatiated Allegheny High Plateau section of the North Central Appalachians division of the Atlantic Highlands subregion of the Northern Forest ecoregion (Woods, Omernik, & Brown, 1999).

The Unglatiated Allegheny High Plateau ecoregion is characterized by rugged, steep, forested hillsides and narrow river valleys. Entrenched streams typically travel along high-gradient channels with prevalent waterfalls. The region experiences a cool, humid climate, along with long winters and a short growing season. This short growing season, coupled with poor soils, decreases the potential for agriculture throughout the region (Woods, Omernik, & Brown, 1999).

Throughout the nineteenth century, the Sinnemahoning watershed was extensively timbered for its large, rich hardwoods, such as chestnut, oak, and maples. Due to such extensive harvesting and the chestnut blight that ravaged the native species throughout its range, the forests of the region are primarily composed of sugar maple, beech, and hemlock today (Woods, Omernik, & Brown, 1999). Other common tree species associated with this ecoregion include red maple, sweet birch, black cherry, white ash, yellow birch, eastern white pine, yellow-poplar, and cucumbertree, and oaks (McNab & Avers, 1994).

Common wildlife that inhabit this region include mammals, such as black bear, bobcat, coyote, whitetail deer, eastern chipmunk, red and gray fox, woodchuck, raccoon, opossum, squirrels, white-footed mouse, striped skunk, cottontail rabbit, porcupine, and deer mouse, among many others (McNab & Avers, 1994). Today, populations of black bear, beaver, and bobcats are rebounding from the devastating effects that historic overharvest has had on their species. Elk were reintroduced to the area, and now form the largest herd east of the Mississippi River.

Eastern larch

Familiar birds, such as wild turkey, ruffed grouse, woodcock, wood duck, warblers and hawks occupy the area, as do bald eagles. The red-backed, spotted, marbled, and northern dusky salamanders, as well as eastern hellbender salamanders can be found in woodlands, wetlands, and streams of the Sinnemahoning watershed. Timber rattlesnakes, tree frogs, wood turtles, and northern coal skinks inhabit the ecoregion, along with freshwater mussels (McNab & Avers, 1994).

Coldwater fish species are common in the high quality streams of the watershed. Common species include brook, brown, and rainbow trout, dace, and darters. Reservoirs and slower moving warm waters of the watershed are often inhabited with bass, sunfish, and bluegill. A complete listing of the fish and wildlife species found throughout the watershed can be found in Appendix I.

Natural Habitats

Urban Forestry

Forestlands provide habitat for plant and animal species, timber for fuel and wood products, income possibilities from other forest products for private forest owners, and recreational opportunities. Not only are rural forest blocks and riparian buffer areas important for the sustainability of healthy ecosystems and water quality, but urban forestry also is an important aspect of watershed conservation. Trees planted in urban settings and along roadways perform a number of functions, ultimately improving the livability and attractiveness of communities. Trees in urban settings regulate heat radiation and ambient air temperature by shading sidewalks, parking lots, and roads. They control erosion and help manage stormwater. Trees can be utilized to reduce energy costs and improve property values. Trees in urban settings improve air quality, improve a community's sense of pride, and enhance business and economic development. The Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Forestry has resources available on rural and community forestry, including a listing of certified service foresters and various programs available to assist individuals and communities (DCNR[4]). A listing of local service providers is available in Appendix Q.

Emporium is a certified Tree City USA

If a town or city, regardless of size, meets four standards set forth by the Arbor Day Foundation, it may become certified as a **Tree City USA**. Emporium has been a Tree City USA for 21 years, and Saint Marys has been one for four years. To meet the requirements, a community must have: a tree board department, tree care ordinance, community forestry program with an annual budget of $2 per capita, and an Arbor Day observance and proclamation. There are many benefits associated with becoming certified as a Tree City USA, including an action framework set-up to ensure the community success in implementing its forestry program, educational opportunities, improved public image and sense of community pride, preferences for financial assistance, and publicity (Arbor Day Foundation, 2007).

Backyard Habitat

Developing or maintaining a woodlot and natural habitat in your yard attracts a variety of wildlife, such as songbirds, butterflies, toads and other amazing creatures, which may help to reduce stress and anxiety at the end of a long work day or commute. These species also help to rid your yard of pests, and they may even reduce or eliminate the need for chemical pesticides.

A vast majority of the Sinnemahoning Creek watershed is forested, providing abundant habitat for wildlife

Forests, woodlots, and backyard habitats offer opportunities for families to learn and bond together while enjoying their own little ecosystem. Backyard habitats and nearby natural areas also encourage outdoor recreation, which helps to combat the childhood obesity epidemic sweeping the nation, since children are becoming more accustomed to sitting in front of the television and playing video games. Having even a small backyard habitat or nearby woodlot offers opportunities for nature exploration, while children remain close to home in a safer area.

Private property owners are encouraged to consider landscaping with native wildflowers, trees, and shrubs versus mowing their entire lawn, especially areas adjacent to water sources. Native plant species that are adapted to the local weather conditions are best, as they require minimal watering and maintenance and are often preferred by native wildlife. Reducing the amount of "lawn" on your property will also save money in maintenance costs for gasoline powered equipment and it will save energy used for electrical equipment, which both reduce the amount of pollutants that are released into the air.

Planting trees on your property will help to manage stormwater runoff and erosion. When planted according to a specific scheme, one can create windbreaks using evergreen trees and native shrubs to protect their homes from harsh winter winds, which may help to reduce home heating bills. In addition to planting wind breaks, shrubs planted close to a home create "dead air" space, which adds another insulating layer to your home. Deciduous shade trees can be utilized to reduce energy bills, as well. During summer months when deciduous trees have a full crown of leaves, shade on the house will lower the temperature naturally, reducing cooling costs. It has also been shown that shading the cooling unit itself can result in a 10 percent increase in efficiency. In the winter, when the tree crown is bare, sunlight is permitted through to warm the home and reduce heating costs (U.S. Department of Energy, 2007).

Forest Habitat

To see a glimpse of what settlers experienced as they entered the old-growth forests of the Pennsylvania Wilds region, one need not go far from the Sinnemahoning watershed. Though most of the forests today are not old-growth, seeing as they were timbered at some point in the early nineteenth century, a few small segments of old-growth forest along with many stands of mature second-growth forests nearing a century old can be found here in Sinnemahoning. Below is a listing of old-growth natural areas of the Sinnemahoning watershed. More information about old-growth natural areas can be obtained by contacting the DCNR Bureau of Forestry (DCNR[3]).

Wykoff Run

The **Quehanna Wild Area** is 48,000 acres of small second-growth mixed hardwoods. The **Wykoff Run Natural Area** is a 1,215-acre patch within the Quehanna Wild Area at the

headwaters of Wykoff Run. In all, they form an impressive stand of large, majestic forest, including a large stand of paper birch. In addition to the old-growth forest of these natural areas, large open meadows bloom with wildflowers in spring and summer offering ample opportunities for bird and wildlife viewing. This area is located along Wykoff Run Road near the town of Sinnemahoning.

Johnson Run Natural Area is a rugged forest full of large, old trees and boulders in the Elk State Forest near the town of Driftwood; the area is not marked. Johnson Run is the last small tributary to enter the Driftwood Branch before its confluence with Bennett Branch to form the Sinnemahoning Creek mainstem. The forest here is reminiscent of the forests early settlers encountered as they traveled through the region, and they protect the high quality cold water of Johnson Run.

Lower Jerry Run Natural Area surrounds its namesake stream, which is a high quality coldwater fishery that enters directly into the mainstem of Sinnemahoning Creek right along the dividing line between Cameron and Clinton counties. An old-growth stand of white pine and hemlock grows here and protects important reptile and amphibian species. This natural area is very remote, and it can only be accessed by hiking into it.

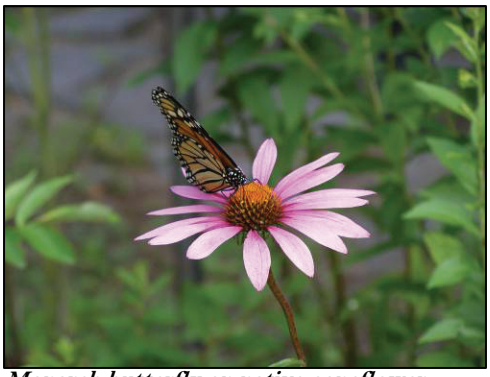
Bucktail State Park Natural Area is a scenic driving route that follows Route 120 through the watershed. While it is not an old-growth forest per se, much of the forest lining its path are comprised of mixed hardwoods representative of the northern forests that historically lined the hillsides. The vast swaths of uninterrupted habitat on either side of the road host populations of elk that sometimes venture near enough for passersby to catch a glimpse of the majestic creatures. Route 120 is a common link to the aforementioned old-growth natural areas, as well.

Sproul State Forest is a proposed Natural/Old-growth Forest Area, which encompasses the lower end of Sinnemahoning Creek and its mouth to the West Branch Susquehanna River near the village of Keating in Clinton County. This forest block is comprised of large, second-growth trees.

Tiger swallowtails

Forests play an important role in the regulation of global climate change and air quality. Carbon dioxide, one of the most abundant greenhouse gases, is naturally present in the atmosphere. When plants "breathe," the process of photosynthesis converts water and carbon dioxide from the atmosphere into sugar for the plants' growth and oxygen, which is released back into the air. The carbon removed from the atmosphere is stored, or sequestered, in the plant components (leaves, stems, branches, roots, etc.) When leaves or trees are downed, the carbon is contributed to the soil matter. Carbon dioxide is also released back into the atmosphere through respiration and the decomposition of organic matter. This natural exchange of carbon, along with other greenhouse gases (including those released from the burning of fossil fuels and gas combustion), contributes to the "greenhouse effect."

In the absence of greenhouse gases, the earth would be a cold, desolate planet that harbors no life. Excess greenhouse gases have the opposite effect, global warming. Human activities, such as deforestation, poor agricultural practices, vehicle exhaust, and the burning of fossil fuels, have greatly increased the contribution of carbon dioxide to the atmosphere. The preservation of forests, maintenance



Monarch butterfly on native coneflower

of riparian forest buffers, and forest management practices that leave residual trees aid in carbon sequestration, which in turn hinders global warming.

Protecting and maintaining the contiguous (uninterrupted) forest blocks that dominate the watershed is critically important. Sustainable forestry practices and the use of Best Management Practices (BMPs) when harvesting forest resources will ensure the future health of forest ecosystems throughout the watershed. Service Foresters are available to assist landowners with technical advice on sustainable forest management. Certified foresters provide cost-share assistance, forest stewardship plans, regional planning, education, and assistance with tree planting and riparian buffer restoration (DCNR[4]).

By selectively planning a harvest with a certified forester, one can ensure a continual return for their investment. Trees can be harvested on a staggered schedule to provide recurring income, while quality trees are left to reseed the area. Nearby, competing trees of less value can be removed to allow remaining trees a greater allocation of resources and nutrients, ensuring a faster growth rate and higher quality of wood. As tree leaves continue to fall to the ground each autumn, the soil is amended with organic matter and nutrients, which also contribute to better growth rates. Erosion and sedimentation are reduced by leaving trees to stabilize the soil.

Pruning and other maintenance activities will improve the quality of the timber in the forest lot. Selectively eliminating diseased and infested trees will improve the overall health of the forest. Wildlife should also be considered when harvesting a forest area. Brush piles made of cut limbs and saplings provide cover for small game, birds, reptiles, and amphibians. Dead, standing trees (called snags) are utilized by cavity nesting birds and other wildlife for shelter, while the insects that eat the decaying wood provide food for forest birds. Large or hazardous snags should be downed to eliminate the safety risk, though. Downed woody debris should be left for creatures of the forest floor, such as amphibians, spiders, insects, etc.

Maintaining tree species diversity in a forest is important to protect the forest from the devastating effects of insects and disease. Plantation-style monocultures (an area consisting primarily of one species) are particularly vulnerable to invasive pest species that attack one species or family of trees, such as the emerald ash borer. More will be discussed on invasive species later in this chapter.

Forestlands offer products other than timber, which can be utilized to boost the local economy with products that represent the timber culture and natural heritage of the Sinnemahoning watershed. Herbs and mushrooms harvested in a sustainable manner provide educational, recreational, and economical benefits. Botanicals and medicines may be derived from forest species. Wreaths and other crafts can be made from limbs, vines, and other forest vegetation. Other forest products include: maple syrup, fence posts, fuel wood, fruits, and nuts.

Successional Forest Habitat

When a disturbance occurs in a forest, such as a logging or a natural event, or as the edge of a forested area transitions over time, the process of succession occurs. **Succession** is the natural process of forest regeneration overtime. For example, if an area adjacent to croplands laid fallow, herbaceous vegetation, like wildflowers and grasses, would occupy the area. As time went on, shrubs and tree seedlings and saplings would grow. Eventually, the trees would grow into a mature forest. The entire

process may take a very long time and can occur on varying scales from several hundred acres to very small areas.

During the early stage of the process, when the land is primarily occupied by grasses, herbaceous vegetation, small shrubs and tree saplings, it is referred to as **early-successional** habitat. This edge habitat is critical for certain species of wildlife. During this stage, grasses, seeds, berries, and twigs provide abundant forage, while shrubs and dense vegetation offer cover and safety for birds and small mammals. A variety of wildlife species prefer this stage of succession, such as rabbits, warblers, and American woodcock (Rodewald, 2006).

During the **middle-successional** stage of forest regeneration, otherwise known as the pole timber stage, trees dominate the landscape. The understory is still relatively dense, with seedlings and some shrubby species that are tolerant of shade. Salamanders and interior-forest birds prefer this type of transitional habitat (Pennsylvania Envirothon, 2007).

A young porcupine, a common mammal of the watershed

Once trees mature, the habitat is referred to as a mature forest habitat. During this stage, trees that have been overtopped by competing, faster-growing, or longer-lived trees tend to die and form "snags" that provide food, perches, and opportunities for cavity nesters, such as owls, woodpeckers, raccoons, and even bats. Retaining downed wood on the forest floor provides habitat for invertebrates, reptiles, amphibians, etc. In a mature forest, there is a greater abundance of mast-producing trees that offer acorns, nuts, and soft or fleshy fruits and seeds for wild turkey, black bear, and pileated woodpeckers that prefer mature forest habitats (Pennsylvania Envirothon, 2007).

Landowners and forest land managers should promote differing stages of succession to offer a variety of habitats for wildlife species. Also, when timbering an area, foresters should stagger and soften the edges of cuts by leaving some older trees and shrubs on the perimeter, and cutting in a meandering fashion to avoid abrupt transitions between habitats.

Grassland Habitat

Reducing the percentage of mowed-grass lawn on one's property will save money, reduce energy use, fuel consumption, and pollution emissions. Native wildflowers, grasses, and forbs can be used to beautify a property, enhance ecological interactions, and reduce the overall amount of lawn to be maintained. Native grassland habitats provide food, cover, and nesting material for a diversity of wildlife. Many of the native species that are attracted to grasslands offer natural pest control of insects, weeds, and vermin. Not only does this reduce the cost of controlling these pests, but it is more environmentally friendly compared to harsh chemical pesticides and inhumane traps.

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) suggests planting drought tolerant warm season grasses suitable to the region, such as big bluestem, little bluestem, buffalo grass, and beardgrass. These grasses provide shelter and forage for wildlife, improve soils, and require little maintenance. When possible, hay harvest should be scheduled around the nesting season for ground-nesting birds, generally before May 1st and after August 15th. This will allow enough time for regrowth to provide cover throughout the winter months (USDA-NRCS, 2007).

Wetlands

Wetlands are functional ecological components of a watershed. Wetlands are defined as having anaerobic or hydric soils, wetland vegetation, and evidence of the area being inundated with water (permanently or seasonally). Wetlands aid in groundwater recharge and filter excess nutrients, chemical pollutants, and sediment from runoff, and offer education and recreation potential. Wetlands provide habitat for a diversity of plants and animals, making them biodiversity hot spots.

Wetlands are critical ecological components of watersheds that maintain water quality and provide habitat for a variety of species

Conserving wetlands and riparian buffers is one essential step to conserving water quality throughout the watershed. Farmers may enroll marginal agricultural lands in the Conservation Reserve Enhancement Program (CREP), fence riparian areas adjacent to streams, create stabilized stream crossings, and restrict access to streams for cattle and other livestock. This will result in cleaner water and it improves the overall health of the surrounding ecosystem and livestock herds. Riparian buffers improve water quality, stabilize streambanks, and host a variety biological species. Pollinators enhance crop productivity and predatory species offer natural pest reduction services. In addition, the variety of life and activity attracted to wetlands adds to the aesthetic appeal and property value of the land. Farmers and landowners are encouraged to protect or create wetlands and riparian areas on their property, not only for the ecological benefits, but also for the direct benefits to the property owner.

Rivers and Streams

Many of the biological organisms that live in rivers and streams indicate the quality of water in which they live. These creatures are called **bio-indicators**. Freshwater mussels, aquatic macroinvertebrates, and lungless salamanders that require high quality water to thrive are natural indicators of water quality and ecosystem health. Conservation groups can study these organisms to gain a better understanding of the overall health of the ecosystem. These bio-indicators can be used to track the improvements in water quality following the installation of restoration projects and best management practices.

Headwater streams are typically small and shallow, and flow into larger streams. Streams contain riffle areas with fast moving water and pools of slower moving water. Different plant and animal communities inhabit distinct sections of the stream with varying characteristics. Small and fast flowing streams, especially those with an intact riparian forest buffer surrounding them, tend to be cold. Coldwater streams host species of fish, such as trout and dace. Most of the Sinnemahoning watershed is comprised of high quality coldwater streams. Some streams with slightly higher temperatures are considered coolwaters, and are inhabited by chubs, shiners, and sucker fish.

In larger, slower flowing streams and rivers, reservoirs, and in streams with little or no riparian vegetation to shade and cool the water, you will find fish that thrive in warmwater, such as bass, bluegills, and sunfish. The reservoir behind the George B. Stevenson Dam at Sinnemahoning State Park harbors many of these species of fish.

Wildlife

In order to conserve a diversity of wildlife, a diversity of quality habitats must be preserved to support various wildlife communities. Wildlife depends on the availability of food in all seasons, clean

Table 4-1. Top 10 Most Popular Recreation Activities in DCNR Region 8

1. Walking
2. View nature
3. Sightseeing
4. Picnicking
5. Visit wild areas
6. Swimming
7. Camping
8. Nature walks
9. Fishing
10. Wildlife watching

water, cover (for protection from predators and the elements), and space (to forage, raise young, and expand territory). Both year-round residents and migratory species depend on the resources the Sinnemahoning watershed has to offer. By conserving natural areas, improving soil and water quality, and restoring degraded habitats, wildlife populations will benefit.

This American goldfinch is just one of hundreds of bird species that frequent the watershed

Wildlife species are a critical component in all ecosystems. The continued balance of nature depends on the existence of biodiversity. Each species and wildlife community provides ecosystem benefits, some of which include: food for other wildlife and humans, pollination, clean water, decomposition, nutrient cycles, clean air, and soil improvements.

A diversity of wildlife and fisheries benefits recreation potential for the area, which in turn improves the local economy and quality of life and health of watershed residents. According to *Pennsylvania's Recreation Plan 2004-2008* (DCNR, 2004a), walking, nature watching, visiting wilderness and natural areas, camping, nature walks, fishing, and wildlife watching were all among the top 10 favorite recreational activities within the Sinnemahoning watershed counties. All of those activities are enhanced by the presence of biodiversity, high quality habitats, and clean air and water. Therefore, these activities inherently include the preservation and conservation of wildlife, fisheries, and their associated habitats.

The Sinnemahoning region has experienced a great deal of stress on its natural resources over the past few decades from resource extraction and pollution. Despite the environmental degradation, there are diverse natural areas, rebounding species, and an abundance of wildlife throughout the watershed.

Birds

Some 198 species of birds are known to inhabit the Sinnemahoning Creek watershed (Appendix I). Birds vary from small, pollinator hummingbirds to forest dwelling warblers and robins. Various sparrows and woodpeckers may be seen in the forests and fields of the watershed. Larger birds of prey, such as eagles, hawks, and owls, hunt small rodents and fish. Birds provide hours of enjoyment for birdwatchers, they control insect and rodent pests, and they pollinate wildflowers and trees.

Bald Eagle

Bald eagle populations were once ravaged by excessive hunting and pesticide pollution in the environment, but are now on the rebound. In the 1980s, breeding pairs in Pennsylvania had dwindled to three pairs. Reintroductions of juveniles and protection through the Endangered Species Act led to a steady increase in populations. As a result, the bald eagle's status was downgraded from endangered to threatened in the Commonwealth of Pennsylvania, and it was removed from the federal list of threatened and endangered species. The Pennsylvania Game Commission (PGC[2]) manages this important bird species in the state. The greatest

threat to the continued successful recovery of bald eagle populations in the state is human disturbance. Over-use of recreational waters, which bald eagles heavily rely on for food sources, hinders their ability to thrive. In addition, too much human disturbance may lead to nest abandonment and decreased reproductive success (PGC[2]).

Eagles are top predators on their food chain and one of the largest birds of prey, weighing up to 17 pounds with a wingspan of seven feet (PGC[2]). Bald eagles primarily feed upon fish, other birds, and small mammals, and they have even been observed stealing prey from other birds. A nesting pair of bald eagles is resident at Sinnemahoning State Park, and can often be seen from the observatory deck on the Stevenson Dam reservoir.

Table 4-2. Amphibians

American toad	Jefferson salamander	redback salamander
bullfrog	longtail salamander	spotted salamander
Cope's gray treefrog	marbled salamander	spring peeper
dusky salamander	mountain dusky salamander	spring salamander
eastern hellbender	northern leopard frog	valley & ridge salamander
eastern newt	northern slimy salamander	Wehrle's salamander
four-toed salamander	northern two-lined salamander	western chorus frog
gray treefrog	pickerel frog	wood frog
green frog	red salamander	Woodhouse's toad

Amphibians

Amphibians depend on moisture to thrive. Some amphibians, such as the eastern hellbender salamander, are completely aquatic, thriving in the high-quality coldwater streams of the watershed. Many terrestrial salamanders depend on the vernal pools present in vast forestlands of the Sinnemahoning watershed to lay eggs and reproduce. There are 27 species of frogs, toads, and salamanders that inhabit the Sinnemahoning Creek watershed.

Eastern Hellbender Salamander

The eastern hellbender salamander is the only amphibian species of concern in the watershed. Hellbenders are long-lived animals, and due to their intolerance of polluted water, they indicate good water quality in the streams they inhabit.

Hellbenders are one of the largest salamanders in the world and the largest salamander in North America, reaching lengths over two feet long and weighing up to five pounds. Hellbenders are completely aquatic amphibians meaning they spend their entire life in streams. They primarily prey upon crayfish. Hellbender populations have declined throughout their range, primarily due to human misperceptions and pollution.

Reptiles

There are 28 species of turtles, skinks, lizards and snakes that comprise the reptile population of the watershed. Some of these species provide natural pest control of insects and mice. Four of those species—coal skink, mountain earth snake, shorthead garter snake, and timber rattlesnake—are among the species of concern found within the

Table 4-3. Reptiles

Bog turtle
Coal skink
Common garter snake
Common map turtle
Common musk turtle
Decay's brown snake
Eastern box turtle
Eastern fence lizard
Eastern hognose snake
Eastern mud turtle
Eastern ribbon snake
Five-lined skink
Milk snake
Northern water snake
Painted turtle
Queen snake
Racer
Rat snake
Red-bellied snake
Ring-necked snake
Short-headed garter snake
Smooth earth snake
Smooth green snake
Snapping turtle
Spotted turtle
Timber rattlesnake
Wood turtle
Worm snake

watershed. Although none of them have been officially listed as threatened or endangered in the state, the timber rattlesnake is at risk of becoming endangered in the future.

Timber Rattlesnake

Timber rattlesnakes are venomous snakes that thrive within the large forest blocks of the Sinnemahoning watershed. They are listed as a candidate species in the state, meaning they could become threatened or endangered in the future. Major threats to the species include unregulated hunting and den raiding, as well as habitat degradation. This species, along with other reptiles and amphibians, is managed by the PFBC. A permit is required to hunt or possess timber rattlesnakes in the state of Pennsylvania.

Mammals

Mammal diversity within the Sinnemahoning watershed includes 59 species of elk, deer, carnivores, bats, opossum, moles, shrews, rabbits, and rodents (Appendix I). Mammal diversity is typically associated with large, intact tracks of forest, such as that of the Sinnemahoning watershed. Small mammals and game species, like whitetail deer, squirrels, rabbits, and foxes can be found throughout the region. Elk, which were once eliminated from the area and the state, now found roaming free within many of the natural areas of the Sinnemahoning watershed. These species, among others, provide opportunities for hunting, trapping, and wildlife viewing recreation. Five mammal species of concern have been known to inhabit the watershed. These species include the Allegheny woodrat, which is threatened in the state of Pennsylvania, the Appalachian cottontail, rock shrew, northern myotis, and water shrew.

Whitetail deer

Proper management of whitetail deer populations will keep the impacts associated with the species to a minimum. In areas that are overpopulated with deer, forest regeneration may be hindered, crops may be damaged, and resources may be scarce for other wildlife. Habitat destruction by overabundant deer populations has a huge impact on songbird populations, especially woodland warblers. In addition, overabundant deer populations pose a significant risk to the safety of motorists and damage to vehicles when roadway collisions occur. Whitetail deer management occurs at the state level through hunting permit allocations by PGC.

Public land managers experiencing high density deer populations should incorporate considerations into land and habitat management techniques. Food plots may be established to improve herd health. Public and private landowners may enroll in the Deer Management Assistance Program (DMAP), which provides hunters with additional permits to hunt antlerless deer on registered properties to help manage deer populations (PGC[1]).

Some participants of the public surveys and interviews that were conducted as part of this planning project discussed concerns over dwindling deer populations. Many hunters have been coming to this watershed for years to hunt, and have noted an apparent decline in deer populations. It is important to maintain a healthy deer herd through hunting limits and habitat management. Quality Deer Management (QDM) is a cooperative effort among landowners, hunters, and state agencies to manage healthy deer populations by balancing the harvest of quality bucks and does with proper stewardship of the habitats on which they depend. Not only does this approach to deer management result in higher quality animals and habitat, but it is educates hunters and provides a better hunting experience for all (Quality Deer Management Association).

This bull elk is part of the largest elk herd east of the Mississippi River

Elk

Known as the wapiti by Native Americans, elk are larger relatives of the whitetail deer. They are easily distinguished by their white rump and large stature. Prior to settlement of the region, elk were found throughout the Sinnemahoning watershed and Pennsylvania. By the mid-nineteenth century, overharvest and habitat destruction nearly eliminated the species from the state, except for isolated populations within the Sinnemahoning region. And within a few years, they too were gone. In the early 1900s, elk were reintroduced to Pennsylvania using animals from overcrowded herds of Wyoming and other western natural areas. As part of the first reintroduction in 1912, elk were released in Clearfield County among other counties. In 1915, a second shipment of animals was brought to Pennsylvania and released in six counties, including Cameron and Potter.

Despite these efforts, ill-managed hunting seasons and poaching caused a major decline in the Pennsylvania elk populations. The remaining population held strong in the Bennett Branch area of the watershed by the 1960s, but overall numbers were drastically low. It was suspected that insufficient habitat was leading to poor reproductive success of the animal, and something had to be done to help the elk population rebound again. In response, a 10,000-acre elk management area was established in Elk and Cameron counties. Though populations continued to experience declines through the 1970s from brain worm and habitat deficiencies, elk herds eventually did make a comeback thanks to habitat improvements and improved cooperation between state game managers, sportsmen, and landowners.

Today elk populations in Pennsylvania are thriving, lottery hunting permits are awarded annually, and habitat improvements continue to be made. Official elk viewing areas have been established in an effort to reduce the impacts of elk viewing tourism on local residents of the watershed, and an elk visitor center will be completed in the near future.

Bats

Bats are common throughout Pennsylvania, and are very beneficial creatures to humans and the environment. Bats control pests, pollinate plants, and disperse seeds. They are both economically and environmentally beneficial. The northern myotis is an important bat species that depends on the Sinnemahoning Creek watershed**.**

Depending on the species, bats may roost and/or hibernate under the bark of trees, in cavities, or in caves. These habitats are most vulnerable to degradation. Forestry and mining activities can disrupt and displace an entire colony of bats. Gates constructed at the entrance of abandoned mines and caves allow for the passage of bats and exclusion of humans to limit disturbance to the habitat.

White nose syndrome (WNS) is a fungus that affects bats with devastating mortality rates. The fungus appears white around the nose and wings of bats. As of August 2009, WNS had not yet been detected within the watershed; however, it was confirmed in the nearby counties of Centre and Mifflin (PGC^3). Though biologists have not yet determined how the disease is transmitted, anyone who explores caves or comes in contact with bats should carefully and thoroughly disinfect their boots, clothing, and equipment to reduce the chance of spreading the fungus (U.S. Fish and Wildlife Service).

Fish and Freshwater Mussels

Most of the waterways within the Sinnemahoning watershed are high-quality coldwater streams that support native trout populations that provide sporting opportunities for fishermen and freshwater mussels that filter water. Some 93 species of fish can be found within the tributaries of the upper West Branch Susquehanna River watershed, many of which may inhabit the Sinnemahoning watershed (Appendix I). Though many species of fish occur throughout the region, none have been identified as species of concern within the Sinnemahoning watershed.

The watershed's streams, some of which are considered to be exceptional value coldwater fisheries, also support bottom-dwelling aquatic insect larvae and nymphs that help conservationists determine the health of the watershed. Eleven invertebrates and two mussels have been identified as species of concern in the watershed.

Species of Special Concern

Plants and animals are ranked on state and global scales based on the number of times the species has been documented in a geographic area. Most species have a rank assigned to them, even if they are not threatened or endangered. In Pennsylvania, a species is commonly considered to be of "special concern" if it has a ranking of "vulnerable" or lower. Global ranks are assigned based on data collected at similar state offices worldwide as a part of a network called NatureServe.

The Endangered Species Act of 1973 (and its amendments) provides broad protection for aquatic and terrestrial species of wildlife and plants that are listed as threatened or endangered in the U.S. or elsewhere. An **endangered** species is a species that is considered to be in danger of becoming extinct throughout its range. A **threatened** species is a species at risk of becoming endangered unless special action is taken. A **candidate** species is one that is proposed by a state or federal agency for listing as threatened or endangered at the state or local level.

In Pennsylvania, threatened or endangered status is determined by the appropriate state agency. For instance, the PGC is responsible for assigning state statuses to bird and mammal species, while PFBC is responsible for fish, amphibians, and reptiles. Since there is no state agency that oversees invertebrates, such as moths and butterflies, these species can only receive threatened or endangered status if they are federally listed. Therefore, there may be some species that technically meet the state threatened or endangered requirements, but have not officially been given this designation. These species are typically monitored by Pennsylvania Natural Heritage Program (PNHP).

Provisions are made for listing species, as well as for the development of recovery plans and the designation of critical habitat for listed species. As part of both federal and state acts, an environmental assessment of properties for species of concern is required before development projects can be permitted. However, rather than stopping development altogether, changes in design or timing of construction can often be made to protect the habitat for these resources.

Within the Sinnemahoning Creek watershed, 49 plant and animals species of concern have been identified, including 22 plants, four birds, 11 invertebrates, two mussels, four reptiles, five mammals, and one amphibian. In addition, one geologic feature and seven natural community types have been listed among the species of concern as important natural features and habitats of conservation significance. To

protect these important species and landowners, the location of individual species cannot be provided. Appendix J lists state and global rankings for species of concern identified within the project area.

Laurel Run is just one of many important habitats that support a diversity of wildlife

Conservation Areas

Natural Heritage Areas

County Natural Heritage Inventories (CNHIs) are conducted by PNHP. The PNHP is a collaborative organization dedicated to the collection, tracking, and interpretation of information regarding Pennsylvania's biodiversity. PNHP partners include WPC, DCNR, PGC, and PFBC. PNHP is a member of NatureServe, which coordinates natural heritage efforts in all 50 U.S. states, Canada, Latin America and the Caribbean.

Natural heritage inventories identify and map the most significant natural places in a county for rare, threatened, and endangered species, as well as unique natural communities. Additionally, landscape level elements, such as large contiguous blocks of forest and high-quality watersheds, are also identified. The final product of the CNHI is a report highlighting specific areas and giving detailed management recommendations for their protection. These reports should be utilized by local municipalities, counties, utility companies, and groups involved with comprehensive planning, zoning, review of development proposals, and other objectives.

Table 4-4. Significance Rankings for BDAs

Significance Rank	Description
Exceptional	Sites are of exceptional importance for the biological diversity and ecological integrity of the county or region, containing one or more occurrences of state or national species of special concern or a rare natural community of adequate size, condition, and extent. These areas deserve complete and strong protection.
High	Sites are highly important for biological diversity of the county or region, and just like exceptional sites, contain species of special concern or natural communities that are highly ranked. Typically large and primarily undisturbed, these sites deserve strong protection.
Notable	Sites contain occurrences of species of special concern or natural communities that are either more common or of smaller size and extent than exceptional or high rank areas, or have activity and disturbance. These sites deserve special protection within the context of their characteristics, degree of disturbance, and place in the community.
County	Sites have great potential for protecting biodiversity in the county, but have not yet been found to contain species of special concern or state significant natural communities. Because of their size, undisturbed character, or proximity to other significant areas, these sites deserve further study and investigation as possible high or exceptional sites.

The natural areas identified in CNHIs are called **Biological Diversity Areas (BDA)**. A BDA is an area of land recognized as supporting species or natural communities of special concern; high-quality

natural communities or ecosystems; or exceptional natural diversity. The core of these areas is typically small and surrounded by a larger area of supporting habitat.

A **Landscape Conservation Area (LCA)** is a larger area of land that contains minimal human disturbance, and allows ecosystems to function on a landscape level. These areas often contain multiple BDAs.

Dedicated Areas (DA) are areas land recognized by an owner's specific intention to protect it, which could result in the site becoming a BDA in the future or a high-quality area within an already designated BDA. Numerous areas within the watershed could be DAs in the future through landowner agreements, special programs, or other methods.

The Sinnemahoning Creek watershed is located within Cameron, Clearfield, Clinton, Elk, McKean, and Potter counties. All of the counties have completed CNHIs, except Cameron County. The following section briefly describes BDAs located within the Sinnemahoning Creek watershed (Figure 4-1). Specific names and exact locations of rare species are sometimes omitted from CNHIs and this report to protect those species and the landowners where they occur. Complete CNHIs can be downloaded from the PNHP website at: www.naturalheritage.state.pa.us.

Table 4-5. Biological Diversity Areas

Area Name	Significance	Important Features
Clearfield County		
Moshannon State Forest LCA	Exceptional	
Southwest Elk State Forest LCA	High	
Panther Rocks BDA	High	Acidic cliff; Appalachian gametophyte
Shagger's Inn Impoundment BDA	High	Osprey
Bennett Branch Headwaters LCA	Notable	
Laurel Run and Saunders Run BDA	County	
Laurel Run Tributary Wetlands BDA	County	
Parker Dam Beaver Ponds BDA	County	
South Bennett Branch Wetlands BDA	County	
Clinton County		
Bucktail State Park Natural Area DA	Exceptional	
Keating Mountain BDA	Exceptional	Hemlock (white pine) – northern hardwood forest community
Lower Jerry Run Natural Area DA	Exceptional	Northern hardwood forest community
Lower Jerry Run Watershed BDA	Exceptional	Northern hardwood forest community
Round Island Run Watershed BDA	Exceptional	High gradient clearwater stream; hemlock (white pine) – northern hardwood forest community
Montour Island Run BDA	High	Big bluestem – Indian grass river grassland community; sycamore – mixed hardwood floodplain
Round Island BDA	High	Big bluestem – Indian grass river grassland community; sycamore – mixed hardwood floodplain
Sinnemahoning Creek Cliffs #1 BDA	High	Allegheny woodrat

Table 4-5. Biological Diversity Areas (continued)

Area Name	Significance	Important Features
Clinton County (continued)		
Sinnemahoning Creek Cliffs #2 BDA	High	Allegheny woodrat
Sinnemahoning Creek Cliffs #3 BDA	High	Allegheny woodrat
Sinnemahoning Creek Cliffs #4 BDA	High	Allegheny woodrat
Lushbaugh Run Watershed BDA	Notable	High gradient stream
Elk County		
Boone Mountain LCA	Exceptional	Timber rattlesnake
Upper Clear Creek LCA	Exceptional	Timber rattlesnake
Elk River LCA	High	
Four Points Wetland BDA	High	Creeping snowberry
Marion Brooks Natural Area BDA	High	Creeping snowberry; aspen – paper birch forest
Silver Mill Headwaters Swamp BDA	High	Hemlock palustrine forest
Byrnes Run BDA	Notable	Exceptional value creek
Dieble/Mix Run BDA	Notable	Exceptional value creek
Upper Clear Creek BDA	Notable	Exceptional value creek
West Branch Hicks Run BDA	Notable	Exceptional value creek
Pine Tree Trail Natural Area BDA	County	Hemlock (white pine) forest; red oak – mixed hardwood forest
Trout Run Oak Forest BDA	County	Hemlock (white pine) – red oak – mixed hardwood forest
McKean County		
Havens Run BDA	High	American brook lamprey
Potter County		
First Fork Sinnemahoning Creek – North BDA	Exceptional	Maine snaketail; northern pygmy clubtail; ocellated darner; superb jewelwing
First Fork Sinnemahoning Creek – South BDA	Exceptional	Spine-crowned clubtail; northern pygmy clubtail; ocellated darner; superb jewelwing
Wharton LCA	Exceptional	
Bailey Run LCA	High	
Big Moore's Run BDA	High	Northern pygmy clubtail
Big Younglove Hollow BDA	High	Great-spurred violet
Birch Run LCA	High	
East Branch Cowley Run BDA	High	Northern pygmy clubtail
East Fork Sinnemahoning Creek BDA	High	Northern pygmy clubtail
Hemlock Trail BDA	High	Swainson's thrush
Cherry Springs Park BDA	Notable	Common claybark tiger beetle
Keating Summit BDA	Notable	Animal species of concern
Lookout Mountain LCA	Notable	
South Woods Branch BDA	Notable	Special animal

Important Bird Areas

Areas that support critical habitat for a diversity of birds species or species of special concern are designated as Important Bird Areas (IBA) by the National Audubon Society Pennsylvania Chapter. Site conservation plans are developed to guide conservation initiatives and management activities based on the specific needs of the area. Two IBAs exist within the project area – **Quehanna Wild Area** and **Southern Sproul State Forest** (Audubon Pennsylvania). Both sites contain large tracks of contiguous forest to support a variety of bird species and other wildlife. An over-wintering pair of bald eagles inhabits the Quehanna Wild Area, adding to its significance. Both IBAs contain unique habitats. The Quehanna Wild Area contains a variety of age classes and forest types, including mixed oak, northern hardwood, red maple, aspen, gray birch, oak, white pine, hemlock, and spruce. The Southern Sproul State Forest contains rare, threatened, or unusual habitat within the Allegheny Plateau Province. It is exceptionally representative of a characteristic hardwood forest within the province.

Important Mammal Areas

Similar to IBAs, Important Mammal Areas Project (IMAP) designates Important Mammal Areas (IMAs) that support mammal species of special concern and a diversity of mammal species. IMAP is a partnership of sportsmen, scientists, and conservation groups and professionals. Mammal diversity typically coincides with large, contiguous tracts of forestland, such as the vast forested landscapes of the Sinnemahoning watershed (IMA). Conserving habitats and connecting natural corridors to these IMAs will help to sustain those mammal species that depend on the resources of the region.

The **Northern Allegheny Plateau IMA** is the largest designated IMA in Pennsylvania, covering nine counties and four million acres. Included in this IMA are numerous state parks, state game lands, and state forests. The site supports diverse or unique communities of mammals, including elk, black bear, fishers, coyote, Appalachian cottontail rabbits, the (Pennsylvania Threatened) Allegheny woodrat, and flying squirrels. Ample opportunities for environmental education exist throughout the IMA, as well.

Invasive Species

Japanese knotweed monoculture along Driftwood Branch

A non-native invasive species can be defined as a plant, animal, or other organism introduced to an ecological system that causes economic or environmental harm, or harm to human health. Invasive species are one of the most significant threats to wildlife conservation in Pennsylvania. Not all non-native species are harmful to other species or to wildlife, but some exotic species may have severe impacts. Invasive plant species can impact agricultural activities and inhibit forest regeneration in areas where disturbance (by deer, erosion, or human activities) gives them a competitive advantage. They may out-compete native species, causing cascading effects throughout the food chain, and reducing food availability and quality for species, such as turkey, bear, and birds.

Exotic species may have been introduced for a specific purpose or inadvertently. For example, autumn olive, an invasive shrub species, was introduced to many state parks by PGC for food and cover for wildlife and soil stabilization. Alternatively, invasive insects may burrow into the wood pallets of packing material to emerge to invade another country.

When invasive species dominate an area, they often cause decreased land value, increased maintenance and control costs, degraded soil or water quality, or direct human health concerns. West Nile

Virus is one example of a non-native pathogen that has the potential to affect human health. Weeds threaten natural areas and wildlife. Invasive pests may decrease crop yields, affect livestock health, and require costly control efforts. Invasive species may be aesthetically unpleasing, encroach upon homes and gardens, affect landscaping, and threaten pets and humans.

Native species that have few natural controls, such as predators, to keep their populations in balance can become invasive too, like these snails that have left the Stevenson Dam reservoir littered with empty shells

Integrated Pest Management (IPM) techniques incorporate science and information about the target pest, varying economic approaches, and utilization of ecologically sensitive control tactics to deal with infestations. In order to be effective at managing invasive species, the first step is prevention. Most invasive species are opportunistic, and take advantage of disturbed areas and weakened species. By managing landscapes and protecting pristine natural areas, invasive species are less likely to overtake an area. By preventing an invasive species from establishing or spreading to an area, little or no money and/or chemicals will be necessary to control it.

The second step is to detect early, and begin control as soon as possible. Early detection and rapid response will result in less money and effort required to control the species. Numerous tools and publications are available to help one properly identify invasive species. Two starting points to access that information are USDA National Invasive Species Information Center (NISIC) at: www.invasivespeciesinfo.gov and the Global Invasive Species Database: www.issg.org/database.

Small, isolated populations should be contained to control spreading. Once established, invasive pests may be controlled by mechanical (physically pulling or cutting weeds, for example), chemical (pesticides), or biological (utilizing another living species to control the invasive target) means. Often, for well-established invasive species, a combination of control methods is necessary to effectively and efficiently control the invasive. When chemical means are necessary to control an invasive pest (weed, insect, or animal) the person(s) applying the pesticide must be certified by the State of Pennsylvania. Landowners and land managers should contact their county Cooperative Extension office or a private, certified applicator to seek assistance.

Education is a critical component in the management of invasive species. Volunteers, land managers, and citizens in general should be taught the correct identification of invasive species that threaten the watershed, so they can be detected and reported to the proper agency at the first sign of encroachment. Addressing the problem early also helps to minimize the negative impacts on native species and natural resources. Once well established, many of these species are difficult and costly to control. Fact sheets on invasive species can be downloaded at the U.S. Forest Service website: http://www.fs.fed.us/ invasivespecies/speciesprofiles/index.shtml. Other useful resource links can be found in Appendix P. Useful Websites.

Plants

Invasive species pose the most significant threat in areas that have been altered by disturbances, such as an impoundment, development, mining, oil and gas extraction, poor forestry, and poor agriculture practices. In disturbed areas, invasive species can displace native plants intolerant to the changing conditions. Native wildlife prefers native plant species for food, and tends to avoid invasive plants, which allows the invasive to proliferate. When a non-native species establishes itself in a foreign habitat, it

usually free of natural predators and pathogens, allowing it to spread and multiply with little natural controls.

Some invasive plants pose a threat to health and human safety, and are categorized as **noxious weeds**. This federal designation, set forth by USDA Animal and Plant Health Inspection Service (APHIS), adds additional penalties and controls on those species. According to the Pennsylvania Department of Agriculture (PDA), it is illegal in Pennsylvania to propagate, sell, or transfer any of the state designated noxious weeds (PDA, 2007b).

A good source of information on invasive plants is *Plant Invaders of Mid-Atlantic Natural Areas*, a guide produced by the National Park Service and U.S. Fish and Wildlife Service (Swearingen et al., 2002).

Table 4-6. Noxious Weeds of Pennsylvania

marijuana (*Cannabis sativa*)
Canada thistle (*Cirsium arvense*)
multiflora rose (*Rosa multiflora*)
Johnson grass (*Sorghum halepense*)
mile-a-minute (*Polygonum perfoliatum*)
kudzu (*Pueraria Montana v. lobata*)
bull or spear thistle (*Cirsium vulgare*)
musk or nodding thistle (*Carduus nutans*)
shattercane (*Sorghum bicolor*)
jimsonweed (*Datura stramonium*)
purple loosestrife (*Lythrum salicaria*)
giant hogweed (*Heracleum mantegazzianum*)
goatsrue (*Galega officinalis*)

Japanese knotweed

One invasive exotic plant species that was found within the project area and could pose serious threats to the native biodiversity of the area is Japanese knotweed. Japanese knotweed has been reliably identified in disturbed areas on the banks Sinnemahoning Creek and some of its tributaries. It spreads mainly through its root system, and one plant can grow to encompass miles of streambank. Very small root and stem fragments are capable of sprouting to generate new growth, and streambank erosion can transport these plant parts downstream to take root in new areas. In urbanized areas, such as Butler, this species can cause major destruction to flood walls, pavement, and even buildings.

On trails and natural areas, knotweed is unsightly, and may be considered a safety hazard. Knotweed monocultures (an area dominated by one species) can encroach upon trails, inhibit growth of trees in riparian areas, increase erosion, and it offers little habitat value to native species. Knotweed grows and spreads aggressively, making it very costly to control once established.

The best control method for well-established knotweed monocultures is to cut the stalks close to the base throughout the spring and summer to prevent flowering and seeding. Cutting also encourages regrowth and expenditure of stored energy, which weakens the plant's reserves. Do not mulch any cut vegetation, as regrowth can occur from each fragment. An herbicide application may be applied before the first killing frost in the fall, which will carry herbicide from the leaves to the roots, resulting in more effective control. A certified herbicide applicator should be contracted to ensure appropriate application procedures and regulations are followed. As with any control strategy for invasive species, persistence is the key to success.

Multiflora rose

Multiflora rose was first introduced to the U.S. as rootstock for ornamental plants in 1866. The U.S. Soil Conservation Service and PGC later promoted it for purposes, such as living fence around livestock pastures, and as wildlife habitat for small game and bird species. The tenacious growing behavior of the plant enables it to quickly dominate large areas and consume resources that would otherwise benefit native shrubs and herbaceous species. The thickets formed by multiflora rose are dense, and it can completely overtake pastures, excluding livestock from grazing large portions of pasture. The large monocultures decrease biodiversity, as the variety of food and nesting habitat available to native birds and

wildlife is decreased. Furthermore, the fruits do not contain the proper fat ratio migrating birds need to survive. Larger mammals, including humans, are often excluded from areas occupied by multiflora rose, as the thorny plant weaves tight, impenetrable assemblage of stems.

To control multiflora rose, bushes may be pulled, but ensure that all of the root system was removed, otherwise regrowth will occur. Herbicides may be effective in controlling this persistent species. A naturally occurring virus spread by mites called rose rosette disease, is one example of a biological control for multiflora rose. However, this disease also affects cultivated roses, and may be considered undesirable by some.

Mile-a-minute

Mile-a-minute is a rapidly growing invasive vine that quickly dominates areas. It is a thorny vine with distinctive triangular leaves and disc shaped leaf appendages. It produces purple-blue berry fruit, which are readily distributed by bird species that feed upon them. Its aggressive growth rate is how it got its name, and it is also the reason why it is so detrimental to the natural areas it invades. It can quickly blanket forests and smother native plant species. It offers little habitat value for native wildlife and may even reduce land value and sustainable forests.

Animals

Invasive animal species include forest pests, such as the emerald ash borer, gypsy moth, and hemlock woolly adelgid, and aquatic species, such as the zebra mussel. The gypsy moth is prevalent throughout Pennsylvania and the hemlock woolly adelgid has been identified in many counties, including those within the Connoquenessing Creek watershed.

Emerald Ash Borer

The emerald ash borer (EAB), an invasive insect, was first positively identified in on June 21, 2007 in Cranberry Township, Butler County. The EAB has already defoliated millions of trees throughout the country, and now threatens Pennsylvania's forests. An immediate ban on the import of firewood to State Parks and State Forests was relayed throughout the state to suppress the spread of the species. Because it is difficult for the average person to tell what species of tree the firewood was derived from, the ban includes all hardwoods. The quarantine restricts or prohibits the transport and sale of ash wood products and plants that may harbor the pest (DCNR, 2007).

Insect traps are set out to survey and track invasive pests

It is not the adult emerald ash borer beetles that cause the devastating effects of girdling and killing trees, but rather their larvae that feed under the bark. As the larvae eat paths under the bark, called "galleries," they disconnect the cells that carry nutrients and water to the limbs and leaves of the tree. Over time, usually within three years of the infestation, the tree dies as a result of stress and inability to circulate life-sustaining nutrients and water throughout the plant.

EAB presence is most easily identified by the D-shaped exit holes bored into the wood of a tree. Adult beetles are approximately a half inch long and slender with dark green metallic coloration. If you suspect the presence of EAB in your area, notify your regional DNCR Bureau of Forestry, PDA, Penn State Cooperative Extension, or the EAB hotline: 1-866-253-7189.

Gypsy Moth

The gypsy moth was introduced to the U.S. from Europe in the 1980s. It feeds while in the larval, or caterpillar, stage. Eggs are deposited in July, and overwinter on bark and stones. Gypsy moth caterpillars

hatch and begin feeding from mid- to late-April in southern Pennsylvania, and in early-to mid-May in the northern part of the state. Oaks, sugar maple, beech, and aspen trees are preferred food sources for this caterpillar's voracious appetite. Large gypsy moth populations may strip entire trees of their foliage, leaving them weakened and susceptible to disease, drought, and attack by other pests. A tree begins to suffer when 30 percent or more of its leaf surface is lost (Purdue Research Foundation, 2004).

According to the 2006 Pennsylvania Annual Pest Conditions Report compiled by DCNR, Bureau of Forestry, Division of Forest Pest Management (2006), "Gypsy moth defoliated more acres of forest than any other pest or pathogen in 2006, and is considered to be at outbreak levels." The state of Pennsylvania initiated a suppression program in 2006, which included the cooperation of five counties, four forest districts, one state park, the PGC, and two stewardship landowners. Gypsy moth populations are expected to continue to increase and the suppression program will expand in the year 2007 to include at least 14 counties on 45,474 acres of land, though those estimates are expected to change.

Gypsy moth populations are typically highest following wet, more temperate winters, while cold, dry winters cause the death of egg masses. Private landowners with forested land containing 250 or more egg masses per acre may be eligible for insecticide applications administered through the DCNR Bureau of Forestry. However, the biggest factor controlling populations is a natural fungus, which grows on most hardwoods, and adversely affects the gypsy moth (Purdue Research Foundation, 2004).

Hemlock Woolly Adelgid

This tiny, fluid-feeding insect was introduced from Japan in the early 20th century, and was first discovered in Pennsylvania in 1969. Cold weather may contribute to high mortality, and will likely limit expansion of this pest. The hemlock woolly adelgid most commonly affects hemlocks, but can also affect spruce trees (DCNR[1]).

The species prefers mild conditions, and is most active from October to June. Eggs hatch in February or March. Damage is inflicted when an immature nymph or adult sucks sap from twigs, which causes hosts to lose needles, and possibly die. Biological control agents include a beetle, which was released by DCNR in 2004 on affected hemlock trees in central and southern Pennsylvania. DCNR is also in the process of establishing sites for chemical applications against the hemlock woolly adelgid (Spichiger, 2004).