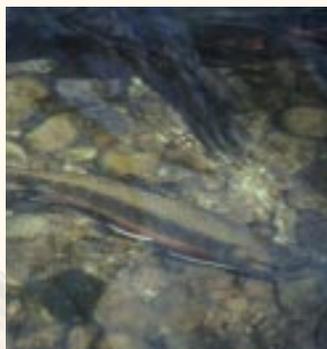


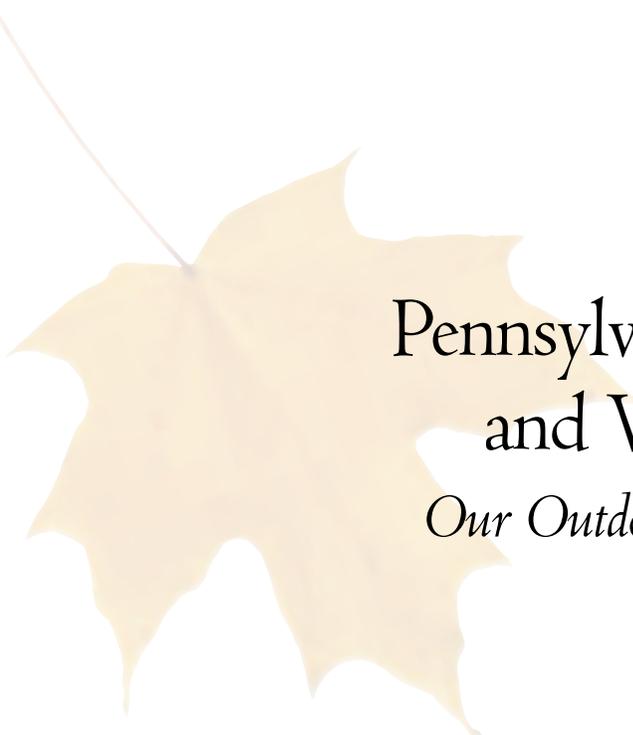
# Pennsylvania's Wildlife and Wild Places



*Our Outdoor Heritage in Peril*



Cover: scarlet tanager (*top left*), white-tailed deer (*top right*), brook trout (*bottom left*), green frog (*bottom right*)  
Relief map (*inside cover*): Michael E. Moore, Bureau of Topographic and Geologic Survey, PA Department of Conservation and Natural Resources



# Pennsylvania's Wildlife and Wild Places

## *Our Outdoor Heritage in Peril*

*Author*  
Ben Moyer

Pennsylvania/*Our Place and Its Past* • 2

A Gap in Understanding • 10

Wildlife Habitat/*Threats and Trends* • 15

Tomorrow's Pennsylvania/*Our Choice Today* • 26

In Search of Balance/*Recommendations* • 28

*Acknowledgements* • 32

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Pennsylvania Fish and Boat Commission  
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Pennsylvania Game Commission

*It has been my opinion, that he who receives an Estate from his ancestors is under some kind of obligation to transmit the same to their posterity.*

— Benjamin Franklin

# Pennsylvania

## *Our Place and Its Past*

**T**he land we now know as Pennsylvania was a far different place when William Penn arrived on the Delaware River estuary in 1682. Forest spanned all the hills and ridges from the Delaware to the Great Lakes. Streams ran clear and cold, crowded with fish in numbers we can scarcely imagine. Wild pigeons, ducks and geese darkened the sky and the Native hunters lived well on elk and deer.



### *Primeval Penn's Woods*

From Penn's Delaware, north and westward, the land rises gently, seeming to align with the curve of the earth itself. For 50 miles it slopes easily upward. Rain and melting snow flow reluctantly along the serpentine courses of the Schuylkill and the Tulpehocken, the Swatara and the Conestoga. Oaks and tulip poplars, their girths as wide as a train, stand across the hillsides and along the streams, rooted in some of the Earth's most fertile soils. Wild turkeys and deer thrive around the forest openings where the Lenape people grow

their squash and corn. Clouds of waterfowl clamor across the skies each spring and autumn.

Farther north, the streams well up as springs in the flank of the great Blue Mountain, underbelly of the Appalachians, arcing across the Piedmont from the Delaware to the southwestern horizon. Only the Susquehanna, Schuylkill, and Lehigh rivers and their larger tributaries breach the long Blue Mountain wall. Silvery American shad, striped bass and eels cram these Atlantic Coast streams with their spawning runs every spring.

Beyond the Blue Mountain are the endless parallel ridges of the vast Appalachian belt. For hundreds of

*The food, the woods, yield, is your elks, deer, raccoons, beaver, rabbits, turkeys, pheasants, heath-birds, pigeons and partredge innumerably. We need no setting dogs to ketch, they run by droves into the house in cold weather. Our rivers have also plenty of excellent fish and waterfowl as sturgeon, roe shad, herring, cadfish, or flatheads, sheeps heads, roach and perch; and trout in inland streams. Of foule, the swan, white, gray and black goose and brands, the best duck and teal I ever eate and the snipe and curloe with the snow bird are also excellent.*

— William Penn, two years after setting foot on the west shore of the Delaware



descend in flocks upon the trees to feed on the nutritious nuts, until the birds break the branches under their own great weight.

At the ridges' northeastern limits, gouged by long-gone glaciers, stands the Pocono Plateau. The Pocono streams linger under dark spruces in mountain wetlands, then plunge over white cascades to the Delaware far below. Otters chase trout in the beaver dams and eagles and ospreys fish the Delaware pools.

West of the ridges looms the Allegheny Front with its high plateau sprawling northward and west toward Lake Erie and the Ohio Valley. Two-hundred-foot white pines, neighbors to hemlocks of equal size, stud the Front. Spring mornings are a cacophony of birdsong.

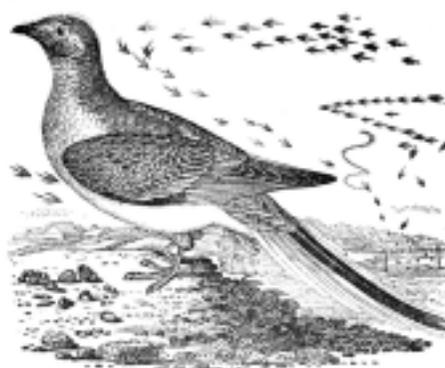
Elk and bison herds summer here on mountain meadows, then migrate into the valleys of the Sinnemahoning, Kettle Creek, and the Susquehanna's

West Branch to spend the winter where the snows lie less deep.

Streams cleave the plateau into a labyrinth of shadowy canyons, gnawing always deeper into the sedimentary innards of the uplands. Every fall, brook trout swarm and splash in the shallows, fiery red in their spawning dress, recreating their kind across 30,000 square miles of mountain watersheds.

miles the ridges track one another along parallel courses, flanked by long narrow valleys. These ridges—Tuscarora, Kittatinny, Blacklog, Tussey, Jacks, Nittany, Bald Eagle, and Shade—are the defining topographic signature of Pennsylvania.

In sheltered hollows along the flanks of these ridges stand great beech trees. Passenger pigeons



PASSENGER PIGEON.

Stretching off to the southwest are the Allegheny Mountains and the region's highest peaks. The first explorers across the Alleghenies report snow on the ridgetops in June, but they are mistaken. The white they see stretching for miles along the heights is the flowering of the American chestnut, prolific producer of nuts that feed deer, bears, turkeys, squirrels, and Native gatherers.



American chestnut

Farther west are the gentler hills of the Ohio Country. Random, endless, they hold a diverse mix of towering trees that blend the forests of north and south. These low hills are the

gathering place for great rivers. From the south probes the sometimes-turbid Monongahela, river of "high muddy banks." Meeting it from the north are the cooler waters of the Allegheny, draining the whole western half of the great plateau. They meet at a triangular spit of land pointing down the broad Ohio, westward toward North America's vast heart.

And northward still spreads the inland sea of Lake Erie, teeming with sturgeon, blue pike, walleye, and perch.

## *Forest to Farm*

At first, the changes Penn's colonists brought to the land were scattered and limited. They could clear and cultivate only small patches that quickly returned to forest when abandoned. By the close of the 17<sup>th</sup> century, Penn's followers had scarcely left a footprint on the land.

Eventually, though, Penn's colony proved more successful than he had probably ever imagined. Early Pennsylvania prospered on the fertile soils and in the hospitable climate of the coastal plain. By the early 1700s, pioneer families were crossing the Blue Moun-

*Hemlock of colossal magnitude filled deep ravines, where pines, beeches, chestnuts, birches, maples, and walnut trees of various kinds, form a gloomy forest, and fallen and decayed trunks check your advance at every step. . . Such old trunks are covered with a whole world of mosses, lichens, fungiwood, sorrel, ferns, etc.; nay even young shoots of maple, beech and tulip trees had taken root upon them.*

— Prince Maximilian of Weid, 1832 in the Allegheny Mountains of Cambria County



tain on the paths cut by hunters, trappers and traders. They filtered into the valleys between the ridges, and with them they brought change.

Every new farm needed fields for crops, and wood for heat, houses, barns, and tools. Axes rang and

the great trees fell. Furnaces that forged the iron for plows and rifles needed charcoal to melt the ore. Each furnace consumed an acre of forest per day. The face



of Pennsylvania's settled regions began to change from forest to open ground.

"In one short century of settlement, this wilderness was broken," wrote Peter Matthiessen in *Wildlife in America*. "William Penn was an early defender of trees, and parts of Pennsylvania, not long after his death, already suffered the long-lived effects of ruthless cutting—erosion, flood, parched summers, and poor crops. The clearing indeed, was feverish, for the settlers dreaded the dark monotone of trees, wild beasts and savages they concealed, the wind-borne whispered reminder of a wilderness unconquered. For every tree that was put to use, countless others knew only the manic ring of axes, and, prostrated in their prime, were left to rot in the tangles of second growth."

Forest wildlife disappeared with the trees. Bounties were paid on wolves for most of the colony's first 200 years, and deer were scarce in the settled regions by 1750. Even squirrels were killed for bounty because they raided cornfields to substitute for acorn and chestnut mast no longer so abundant in the cutover forests. As early as 1731 naturalist Mark Catesby reported that "incredible numbers" of passenger pigeons were shot from rooftops in Philadelphia.

## *Boom Times*

The Civil War and the Industrial Revolution spurred the exploitation of Pennsylvania's forests and game. Miners opened the coal fields to fuel the factories. The demand for timber exploded. The great hemlock forests of the upper Susquehanna were felled for the

bark alone to extract the tannin for making leather, the broad trunks left molding on the hills.

By 1850 the nation's most fevered logging shifted from Maine and New England to northern Pennsylvania, and from then until 1870 Pennsylvania led all the states in the production of sawtimber.

Native elk had disappeared from Pennsylvania by 1870, and the original woods bison were long gone. Wolves and mountain lions were both extinct in the state by the dawn of the 20<sup>th</sup> century. Forest birds such as wild turkeys, barred owls, blackburnian warblers, and pileated woodpeckers declined rapidly as the old-growth forests fell. Beaver, otter, marten, mink, and fisher were trapped and shot without regulation, their numbers shrinking along with the forest in which they lived.

By the time the log boom reached the Clarion and Allegheny rivers in the 1860s, the world's first commercial petroleum industry fledged in Crawford County and quickly spread to Venango and other counties. Wooden pipelines burst and spewed crude oil into streams that fed the Allegheny River, and oil barges capsized in floods or were crushed by ice, spilling oil and suffocating the life from the streams. Salt brine from wells seeped into creeks, killing trout and smallmouth bass.

Downriver at the spit of land pointing west down the Ohio, Pittsburgh's industrial might had begun to blossom. Mill smoke blackened the sky, and sludge, acid, and other wastes flowed free into the now famed "Three Rivers."



The harshest changes occurred in the rivers and streams. Rain sloughed the soil from the naked hills where roots had once held it in place. And sulfur, buried beneath the hills with the coal for 300 million years, combined with water and air when the mines were opened, forming sulfuric acid. It flowed from the mines to poison streams and rivers from the Ohio to the upper Susquehanna.

Not satisfied with the useful and durable wood and abundant nuts of the native American chestnut tree, ambitious horticulturists imported Asian chestnut trees into New England in 1904. The Asian tree carried a fungus under the bark with which it had co-existed for thousands of years. The American chestnut was alike enough to the Asian tree to serve as a fungal host, but the native chestnut could not fight off the blight's stranglehold. The blight spread quickly down the Appalachians and by 1920 had rendered one of the most widespread and beneficial trees in the original forest nearly extinct.

## *Resilience and Renewal*

With the frontier in the past, and no new lands to harness, Pennsylvanians settled into lives in small towns, on farms, and industrial towns clustered along the rivers near the state's large cities. In the early 1900s, the log boom moved on into West Virginia and the Great Lakes states, and the earth began to reveal its resilience.

Freed from constant cutting, surviving tree seedlings grew large enough to drop an annual carpet of



Oak-dominated forest of Appalachians in October

leaves to the impoverished ground. Gradually, forests returned to Pennsylvania's hills.

The new forest was different; there were fewer pines and hemlocks, and the once dominant chestnut was reduced to thickets of sprouts from the still-living roots. But oaks seized the vacant niches and thrived. Oak forests clad the ridges, especially in southern Pennsylvania, uninterrupted for miles.

By the 1930s these new woodlands were beginning to offer some of the benefits of the forests of old. Watersheds stabilized, streams again ran clear and the cycles of flood and drought became less severe. Warblers and thrushes returned to the forest canopy and grouse and deer thrived in the undergrowth of the returning woods. Though vibrant and booming with industry, Pennsylvania's urbanized areas still occupied a tiny percentage of the land early in the 20<sup>th</sup> century.

White-tailed deer were ideally suited to life in the new kind of forest. More adaptable than the elk and bison, deer thrived on the abundant browse and the acorn mast that rained down on the ground each autumn. Deer could also live close to settlements and farms. In the absence of cougars and wolves to trim their numbers, deer herds swelled well beyond the numbers that William Penn encountered along the Delaware.



White-tailed deer

## *New Stewards Awakened*

This rebirth of Pennsylvania's forests and the return of much of our wildlife is a tribute to the resilience of nature. Wildlife recovery also was helped by a new Pennsylvania conservation movement that took hold by the late 1800s.

As early as 1866, concern was spreading for the declining shad runs in the Susquehanna basin. In that

year the General Assembly passed, and Governor Andrew G. Curtin signed a law establishing the position of Commissioner of Fisheries of the Commonwealth of Pennsylvania. The Commissioner post was later expanded to establish the Pennsylvania Fish Commission, one of the oldest fisheries conservation agencies in the United States. In 1895 the Legislature established the Bureau of Forestry, founded principally to fight fires and plant trees. The Game Commission was organized in the same year to protect and enhance what was left of Penn's Woods wildlife.

In 1898 the state purchased a 40,000-acre tract as the first state forest reserve, forerunner of today's two million-acre state forest system. The first state park was established at Mont Alto in 1902 and Pennsylvanians began to think of forests as a source of recreation as well as timber.

In 1920 the Game Commission began to purchase land for wildlife habitat and public hunting, and the U.S. Forest Service made the first acquisitions in Elk, Forest, McKean and Warren counties that would eventually become the Allegheny National Forest.

## *Our Wildlife "Industry"*

Today, Pennsylvania is one of the premier outdoor recreation states in the nation. A million Pennsylvanians enjoy a rich tradition of hunting for deer, bear, wild turkey, grouse, rabbits, pheasants, and squirrels. Nearly a million people fish Pennsylvania's lakes and

streams, and millions more camp, hike the trails, canoe the rivers, or enjoy the outdoors through photography, feeding birds, or watching wildlife at parks or near their homes.

Wildlife is a multi-billion dollar "industry" in Pennsylvania. Hunters spend 14 million days afield each year in the state and spend a billion dollars on travel, equipment, lodging, and food. Pennsylvania's streams and lakes provide 18 million days of fishing each



**Hawk watching on Hawk Mountain's North Lookout**



**Fly-fishing on the Youghiogheny River**

*The total annual impact on the state's economy generated by hunting, fishing, and wildlife-related recreation approaches \$6 billion.*



**Wild turkey hunting**

year and anglers churn 800 million dollars directly into the state's economy. Pennsylvanians devote 19 million days and spend a billion dollars pursuing glimpses or photographs of the state's elk herd, waterfowl, bald eagles, and songbirds. In 2001 alone, one million people visited Pennsylvania woodlands for recreation and 3.4 million participated in watchable wildlife recreation across the state.

Nearly half (45 percent) of all Pennsylvania residents participate in some form of recreation directly linked to wildlife and wildlife habitat. Combined, the total annual impact on the state's economy generated by hunting, fishing, and wildlife-related

recreation approaches \$6 billion. Sales and income tax revenue from fishing tackle purchases alone nets Pennsylvania \$50 million every year, and sales taxes generated by wildlife-watching bring \$70 million into the state general fund annually.

Pennsylvanians' kinship with the forests, streams and wildlife is a unique aspect of life here. That kinship is manifest in many ways—on the calendars of some rural school districts, where students and teachers have the first day of deer season off to enjoy the hunt, in the success of small businesses that rely on hunters and fishermen, along whitewater rivers where thousands of urban dwellers ride the rapids to renew their bond with the land, and in the valued Pennsylvania tradition of sharing a mountain campsite with family and friends.

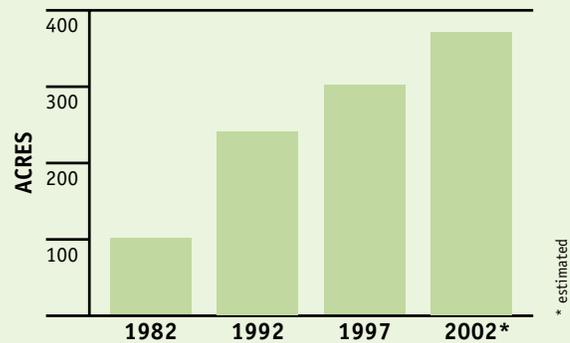
## *New Threats Looming*

Today, our wild lands, open spaces and outdoor traditions, are threatened by a new kind of change, more irreversible than any endured in the past. It is a change that banishes wild things and wild places from its path, that rends apart established communities and neighborhoods, and threatens the diversity of life around us. The new change sweeping across Pennsylvania's landscape is unplanned and unchecked urbanizing sprawl, gobbling up countryside at a rate that has tripled in the past two decades. Rural and forested habitats are being converted to other uses at a rate that exceeds the area of Dauphin County, 332,800 acres, every three years.

In the three centuries that followed Penn's landing on the Delaware in 1682, three million acres of Pennsylvania landscape were converted to urban uses, concentrated in downtown sectors of cities and towns.

But in the past two decades (1982–2002) another one million acres of woods, fields, marshes, and mountainsides have been irreversibly converted to other uses, creating a new kind of landscape we know as sprawl.

### Acres of Pennsylvania open space lost to development per day



Source: U.S.D.A. Natural Resource Conservation Service



*In 1982, Pennsylvania was losing 100 acres per day to sprawl. Today that rate is estimated to be more than 350 acres per day.*

The Pennsylvania 21<sup>st</sup> Century Environment Commission identified urban sprawl as a major environmental issue in this state.

In 1982 Pennsylvania was losing 100 acres per day to sprawl. Today that rate is estimated to be more than 350 acres per day and may be accelerating. Brought together in one place, these developed tracts

would cover an area the size of Delaware County, 122,000 acres, every 12 months.

These are lands that may be changed forever. They may never again grow a crop of soybeans or corn. They are lands where no Pennsylvanian may ever again call a turkey or follow a rabbit dog through blackberry thickets. They are lands that have lost the sights, sounds, smells and experiences that make rural Pennsylvania different from the suburbs of Phoenix, Washington, Atlanta, or Dallas.

Unlike the forests cut over in the logging boom of the 1800s, these lost habitats may never recover. Sprawl is a one-way change. It is permanent within the scale of our experience. Once wetlands are filled, once woodlands are bulldozed, graded and paved, their value as habitat and open space is seldom recovered.

insect. This pest is killing stately stands of hemlocks across the eastern third of the state, and the scourge is spreading. Invasive exotic weeds crowd our best-loved wildflowers from habitats statewide, and accidentally introduced aquatic life such as zebra mussels threaten the ecosystems of lakes and rivers.

Our last large tracts of forest are being fragmented into ever-smaller blocks by roads, towers, rights-of-way, and development. Deer herds that adapt well to the changing landscape are over-browsing remaining forest, eliminating shrubs, wildflowers, and seedling

*As our woodlands, fields, and wetlands dwindle,  
so do our choices for the kind of Pennsylvania  
we will leave to our children.*



**Purple loosestrife, an exotic plant invading our wetlands**

And as our woodlands, fields, and wetlands dwindle, so do our choices for the kind of Pennsylvania we will leave to our children.

As we watch forests and fertile fields changed into housing lots and shopping malls, those wild places that remain are besieged by yet more threats. Invasive exotic species of plants, birds, and insects threaten some of our most cherished icons of Pennsylvania's outdoors. The eastern hemlock, our own state tree, is threatened by the woolly adelgid, an exotic introduced



**Woolly adelgid**

trees over wide regions of the state.

Acid rain and snow continues to fall on our streams and forests, changing the chemistry of the soil itself. Climate change caused by fossil fuel combustion may soon challenge the survival of northern and upland habitats.

Unless we, as a state, can find a way to understand, value, and conserve our wild lands, we face a future that may offer only a shadow of the outdoor heritage we have always enjoyed. The next few years may be our last chance to save the best parts of our home, Penn's Woods.

*To keep every cog and wheel is the first precaution of intelligent tinkering.*

— Aldo Leopold

## A Gap in Understanding

**M**ore than 25,000 species live in Pennsylvania's woods, fields, and streams. Among these, we know best the large, conspicuous plants and animals like oak trees, deer, wild turkeys, and small-mouth bass. Yet these familiar neighbors in our living world make up only a minor fraction of the ecological communities around us. In every woodlot, stream, and pond across Pennsylvania, an interconnected community of plants, insects and fungi, as well as fish, mammals, amphibians, and birds, carry on the

processes of life that make this part of the earth so hospitable to human life. Without the daily, hourly, striving of all these organisms to capture energy and reproduce their kind, there would be no soil on the land, no forests on the soil, and no clean water flowing perpetually across our valleys to the sea.

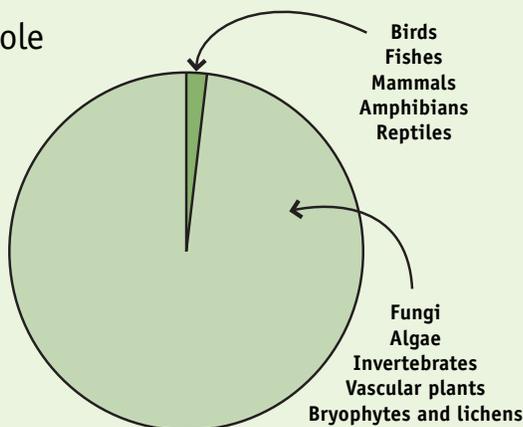
More than ever, we understand that ecosystems are complex, and their stability depends on a full and diverse complement of living things. We are learning that when species disappear from these systems, the

loss can trigger changes we did not expect.

Despite this wider understanding, the gaps in our knowledge about the abundance of wild populations, where they live in the state, and how they depend upon one another are wide and glaring. Our knowledge gap about Pennsylvania's native biology is a case in which what we don't know can hurt us.

### A Fraction of the Whole

**To most people, "wildlife" means familiar birds, mammals, reptiles, fish, and amphibians, but these make up a small minority of all wild species inhabiting Pennsylvania. The vast majority of wildlife species are inconspicuous and little known plants, insects, and fungi, all of which play a critical role in sustaining our forests, streams, and wetlands.**



Source: Pennsylvania Biological Survey

Birds are the only group of vertebrates in our state whose population trends have been carefully investigated. These studies have yielded important knowledge about the health of some species but we still know very little of the status and trends of at least half of our nesting birds. For the other wildlife,

*Birds are the only group of vertebrates in our state whose population trends have been carefully investigated.*

the 397 species of Pennsylvania mammals, reptiles, amphibians, mussels, and fish, our knowledge is even less adequate.

Of Pennsylvania's 186 nesting bird species, 21 (11 percent) are imperiled, meaning they are in imminent danger of being lost from the state. Sixteen of our bird species are officially listed as threatened or endangered, and six of Pennsylvania's native birds, including the passenger pigeon and heath hen, have been lost

from the state or are gone forever.

Even our limited knowledge of birds underscores the link between wildlife abundance and suitable habitat. Many of our imperiled birds, such as the American bittern, king rail, and yellow-crowned night heron must have access to healthy wetlands to nest



**Long-eared owl, a rare Pennsylvania nesting bird**

and thrive. In Pennsylvania and elsewhere, as wetlands have been filled, drained or otherwise destroyed, these birds have declined or disappeared. Similarly, forest birds such as the scarlet tanager, wood thrush and the Blackburnian and worm-eating warblers need large tracts of forest if they are to remain a colorful and important part of Pennsylvania's wildlife. These birds

## Endangered and Threatened Wildlife in Pennsylvania

### BIRDS

#### Endangered

Black tern  
Loggerhead shrike  
Yellow-crowned night-heron  
King rail  
Common tern  
Peregrine falcon  
Short-eared owl  
Bald eagle

#### Threatened

American bittern \*\*  
Great egret \*\*  
Sedge wren  
Least bittern \*\*  
Upland sandpiper  
Yellow-bellied flycatcher  
Osprey

### REPTILES

#### Endangered

Bog turtle  
Eastern massasauga  
Kirtland's snake

#### Threatened

Rough green snake  
Redbelly turtle ††

### AMPHIBIANS

#### Endangered

New Jersey chorus frog  
Mud salamander \*  
Coastal plain leopard frog

#### Threatened

Green salamander

### MAMMALS

#### Endangered

Least shrew  
Indiana or Social myotis  
Delmarva fox squirrel †

#### Threatened

Southern water shrew  
Eastern small-footed myotis  
Allegheny woodrat

### MUSSELS

#### Endangered

Northern riffleshell  
Clubshell

*Many other mussels have been proposed for listing as endangered and threatened. See website.*

### FISH

#### Endangered

Shortnose sturgeon  
Lake sturgeon  
Atlantic sturgeon  
Eastern sand darter  
Longnose sucker  
Gravel chub  
Iowa darter  
Northern brook lamprey  
Spotted gar  
Longear sunfish  
Silver chub  
Ghost shiner  
Ironcolor shiner  
Blackchin shiner  
Tadpole madtom  
Northern madtom  
Black bullhead  
River shiner  
Warmouth  
Burbot  
Bridle shiner  
Mountain madtom  
Redfin shiner  
Banded sunfish  
Threespine stickleback  
Hickory shad  
Cisco  
Bigmouth buffalo

#### Threatened

Channel darter  
Gilt darter  
Bluebreast darter  
Spotted darter  
Tippecanoe darter  
Mountain brook lamprey  
Smallmouth buffalo  
Spotted sucker  
Bigmouth shiner  
Brindled madtom  
Longhead darter  
Goldeye  
Mooneye  
Southern redbelly dace  
Skipjack herring

Refer to PNDI website (see below) for definitions of Endangered and Threatened

\* Proposed Rare  
\*\* Proposed Endangered  
† Proposed Extirpated  
†† Proposed At Risk

Source: Pennsylvania Natural Diversity Inventory, <http://www.dcnr.state.pa.us/forestry/pndi/pndiweb.htm>

and other interior forest species have declined as forests are developed or fragmented by roads, towers and utility rights-of-way.

Since the 1960s, development, intensive cultivation, conversion from hay to row crops, and reverting woodland have claimed most of the grassland habitat remaining in the state, and populations of bobwhite quail, ring-necked pheasants and other grassland birds have plummeted. These birds were once the center of an annual autumn spectacle, summoning hundreds of thousands of Pennsylvania hunters and their dogs to



**Bobolink**

the tawny fields. The U.S. Fish and Wildlife Service reports that pheasants have declined by four per-

*Meadowlarks, bobolinks, grasshopper sparrows and nearly all other grassland birds are in rapid decline in the face of sprawl and intensive cultivation of remaining lands.*

cent per year in Pennsylvania since 1980. Besides their popularity as a game bird, quail were once well known to gardeners and country youngsters across the state. Quail have declined by 80 percent since the mid 1960s and their “bob white” call is seldom heard.

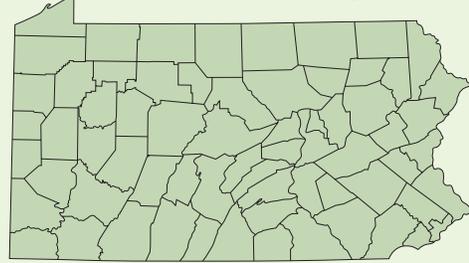
The number of Pennsylvanians who hunt pheasants has dropped by nearly half, from 275,000 to 146,000 since 1990, possibly reflecting the decline in pheasant populations. An autumn field, coursed by pointers and flecked with hunter-orange is a rare sight today in Pennsylvania. Meanwhile, meadowlarks, bobolinks, grasshopper sparrows and nearly all other

## Where and Why

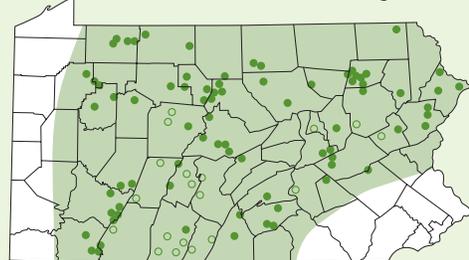
Climate, soils, elevation, and topography influence which species inhabit the state and where they occur. For example, the gray squirrel (*top*) can live under a wide range of conditions, and its adaptability is reflected in its broad range across the state. Timber rattlesnakes (*center*), however, require rocky hillsides and dry upland forests, which restricts this species' range to the more mountainous parts of the state. The green salamander (*bottom*) is a species of the southern Appalachian Mountains that has never been widespread or abundant in the state but reaches the natural northern limit of its range in southwestern Pennsylvania.

If wild species with specialized habitat requirements, such as the rattlesnake and green salamander, are to survive in the state, we must identify the location of suitable habitats and work with landowners or public agencies to protect these sites where they occur.

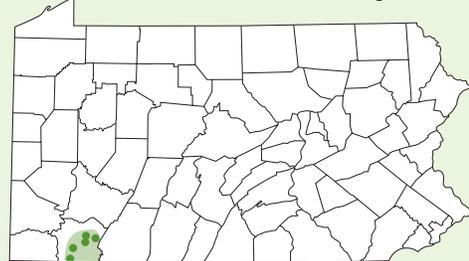
Gray squirrel habitat range



Timber rattlesnake habitat range



Green salamander habitat range



- Voucher specimen available or specimen observed
- Selected records reported by Pennsylvania Herpetological Atlas Project

Source: Amphibians and Reptiles of Pennsylvania, Arthur C. Hulse, C. J. McCoy, Ellen J. Censky, Cornell University Press, 2001



**Bog turtle**

*Bog turtles have declined by 50 percent in Pennsylvania in the last two decades.*

grassland birds are in rapid decline in the face of sprawl and intensive cultivation of remaining lands.

We understand the needs and the role of birds better than any other group of wildlife. For most wild species—plants, insects, fungi, and amphibians—we lack a reliable sense of their abundance or their distribution across the state. As sprawl and development claim more land, and as remaining habitats are fragmented and isolated, understanding where a species lives, and why, is critical to its conservation.

Despite large areas of land reserved for conservation in some regions of Pennsylvania, many species' habitats remain vulnerable and unprotected. One example is the bog turtle, an endangered species in the state.

The bog turtle depends on undisturbed wetlands, connected by natural marshy corridors that allow these small reptiles to travel over miles of interconnected habitats to keep their populations thriving. Nearly all remaining habitat for the bog turtle is in southeastern counties, increasingly surrounded by sprawl, roads, and intensive cultivation that block travel corridors and isolate turtles in patches of habitat. Bog turtles have declined by 50 percent in Pennsylvania in the last two decades, with habitat loss and alteration the primary culprit. Without intervention, healthy, unfragmented wetlands will continue to dwindle

and bog turtle populations will continue their decline.

Similarly, the only known habitats for the green salamander in the state are moist sandstone outcrops surrounded by forest found only in southwestern Pennsylv-

nia. Other species may be equally rare or isolated, and effective conservation programs will depend on a better understanding of their distribution and habitat needs. For the bog turtle and the green salamander, their unique but diminishing habitat lies at the fringe of advancing urban sprawl, representing a critical conservation need.

Even though we have not allocated adequate resources to understanding wildlife and its needs, the trends that we have studied serve as a sobering indicator of environmental health in Pennsylvania today.



**Northern riffleshell clam**

There may be no better example than our freshwater mussels, one of the most globally imperiled groups of wildlife. Freshwater clams, riffleshells, and mussels once lived on the bottoms of streams and rivers throughout what

is now our Commonwealth, supporting fish populations and furnishing food and tools to native cultures. Today, 18 of our original 65 species of freshwater mussels are extinct. Among the 47 survivors, 22 species, or 46 percent, are currently imperiled by

pollution, dams, and invasion by alien species. Freshwater clams in the streams of Penn's Woods once meant food for the Lenape, Susquehannock, and Seneca peoples. For us, their decline points out the vulnerability of our aquatic habitats.

Fish are one of our best indicators of the health of aquatic envi-



**Brook trout**

ronments. However, we do not have adequate monitoring programs in place to determine trends in most fish populations. Habitat assessments contracted by the U.S. Environmental Protection Agency (EPA) indicate that only 14 percent of Pennsylvania stream miles provide good habitat for fish, and our native fish populations seem to reflect that degradation. Nearly 200 species of native fish once swam in Pennsylvania waters. Twenty-seven of these are already extinct, and another 45 (28 percent) of the surviving species are imperiled.

Some Pennsylvania fishes occur only in certain river drainages. Their restricted range makes them more vulnerable to loss and presents special challenges in conservation. A better understanding of these native fishes

and their habitat requirements would not only help to sustain them in the state, but also would yield important knowledge about sustaining the river systems that

we rely on for our clean water and recreation.

Biologists do have a good understanding of population trends, habitat needs and distribution of game species such as deer, bear, and wild turkeys that are the keystone of Pennsylvania's hunting tradition. Hunting license sales provide funding for research on these species

and population trends can be obtained by analyzing hunter harvests. These species, however, represent only a fraction of Pennsylvania's wildlife. The vast majority of wildlife faces a wide range of threats, and all have habitat requirements that we scarcely understand.



Northern red salamander

*The vast majority of wildlife faces a wide range of threats, and all have habitat requirements that we scarcely understand.*

*We have been the most prodigal of people with the land, and for years we wasted it with impunity. There was so much of it, and no matter how we fouled it, there was always more over the next hill, or so it seemed.*

— William H. Whyte

## Wildlife Habitat *Threats and Trends*

### *Farmlands, Grasslands, and Open Habitats*

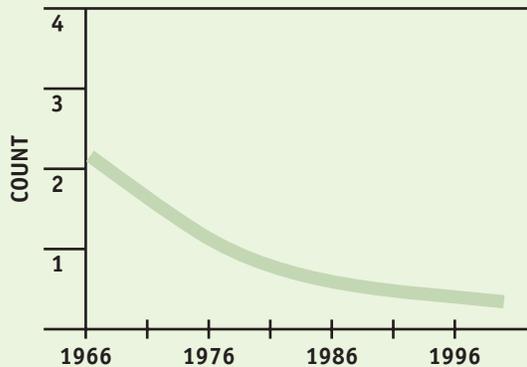
Pennsylvania currently has about 7.2 million acres of farmland, about 25 percent of its total land area, while natural grasslands and barrens occur over 3.2 percent of the state. But sprawl is consuming farmland faster than any other habitat type in the state, despite the premier importance of agriculture in Pennsylvania's economy. According to the U.S.D.A.'s National Resources Inventory, more than 420,000 acres of cropland (about the size of Bucks County) and more than 750,000 acres of pastureland (about the size of Westmoreland County) were developed statewide between 1982 and 1997. Five percent of all Pennsylvania's remaining farmland was lost to development between 1992 and 1997, including some of the most productive farmland in the state.

The loss of farmland is even more acute when viewed on a regional level. The Lehigh Valley around Allentown, once one of the state's best farming regions, lost 27 percent of its farmland between 1969



and 1992. Berks County in southeastern Pennsylvania loses 2,000 acres per year and saw 22,000 acres of farmland developed between 1987 and 1997. During the same period, Delaware County lost half its farmland, neighboring Chester County lost 14,500 acres, and York County saw 17,000 acres converted to urban uses. Meanwhile, urbanized land in southeastern Pennsylvania grew by 81 percent from 1980 to 1990. It is sobering to note that during the 1990s, Pennsylvania ranked 48<sup>th</sup> in the nation in population growth, yet only four other states lost more open land to development.

## Northern bobwhite population trends in Pennsylvania



Source: U.S. Geological Survey, Breeding Bird Survey, Sauer et al. 2000

Because of farmland loss and changes in farming practices, major declines are occurring in almost all groups of farmland and grassland wildlife. Nearly 90 percent of grassland birds monitored by the U.S. Fish and Wildlife Service Breeding Bird Survey, such as the northern bobwhite, show steep declines since 1966. These species are seriously impacted by intensive cultivation practices and the use of pesticides and herbicides on farms today. These modern techniques leave little food or nesting and winter cover for farmland wildlife.

The biggest threat to farmland and open habitats in Pennsylvania, however, is sprawl. The U.S. Department of Agriculture estimates that the state is losing 91,000 acres of open space to development each year, with most of the development occurring in farmland habitats. Over a million acres of Pennsylvania farmland habitat has been lost since the 1960s.

## Forests

### *Still a Land of Trees*

Though our forests have changed, Pennsylvania is still a land of trees. Forests occupy 17 million acres in the state, about 60 percent of our total land area. To the casual observer driving along the Pennsylvania Turnpike or along Interstate 80, Pennsylvania's forests

appear to be vast and wildlife appear abundant. But beyond the roadsides are a range of serious problems that threaten wildlife, our outdoor traditions, and even Pennsylvania's identity as a "forest state."

In some regions, particularly the northeast and southwest, forestland is being lost or degraded at an increasing rate. In heavily forested Monroe County of the Pocono region, the number of homes grew by 23 percent between 1990 and 2000. Most of those new homes were placed in forested settings. Housing unit growth for the same period exceeded 15 percent in Butler County, just north of Pittsburgh. There, new housing developments are often built on wooded hilltops, in a region where large blocks of forest are scarce.

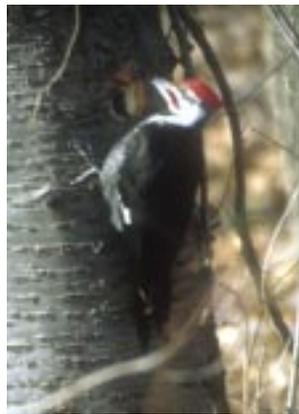
Most of Pennsylvania's forest occurs in relatively small blocks, often privately-owned, with less than half (42 percent) as core or interior forest. "Core" forest is forest that occurs greater than 300 feet from a forest edge or road. For forest wildlife, core forest is the most desirable and stable habitat because it provides the food and cover needed to survive. Forest near edges differs in microclimate, vegetation, and the complex of species present. Much of our wildlife is adapted to life in large forest expanses with an abundance of core or interior forest, and cannot thrive in

open lands or small woodland blocks.

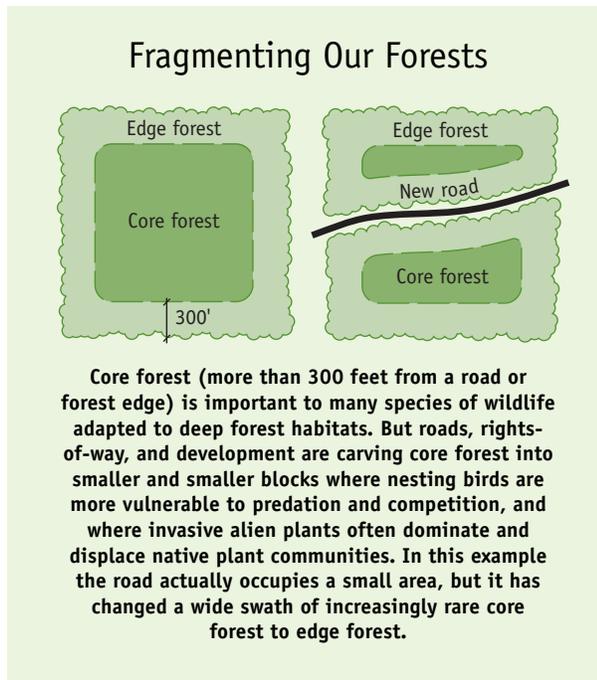
Today, because of the manner in which human alterations have fragmented the landscape, the majority of Pennsylvania's woodlands are considered "edge" forest (within 300 feet of a forest edge), border-



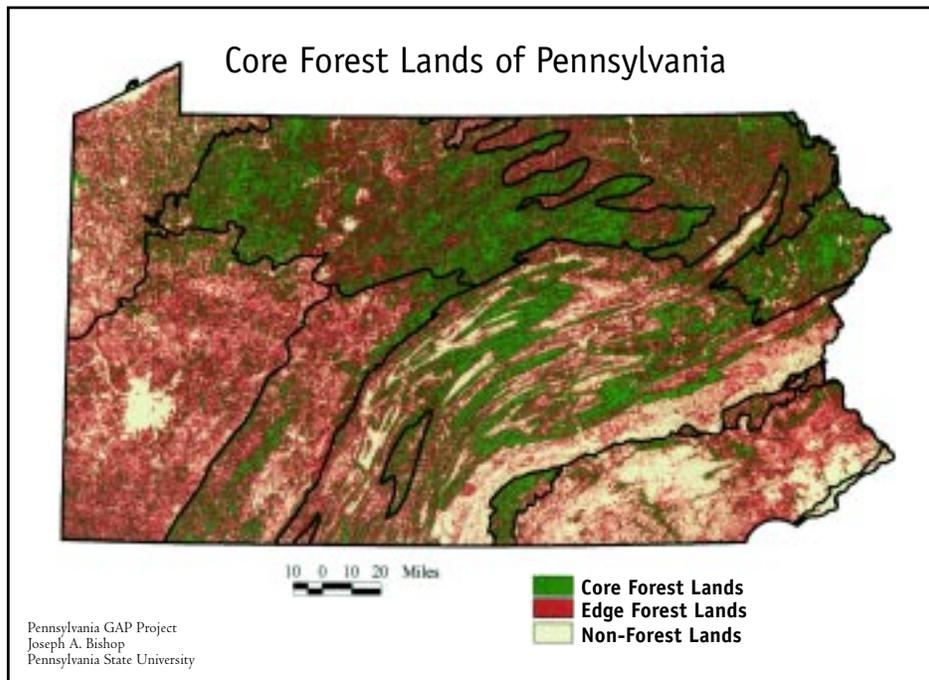
ing fields, utility rights-of-way, roads, railroads, housing developments, commercial establishments, or other non-forest uses. Edge forest is heavily used by adaptable, generalist species of wildlife that can live in a wide array of habitats, such as raccoon, white-footed mouse, Eastern chipmunk, brown-headed cowbird, and American crow. These species prey upon, compete with, or disrupt the nesting of interior forest birds, such as scarlet tanagers, black-throated blue warblers, ovenbirds, and wood thrush. Woodland salamander numbers are also reduced in fragmented forests where changes in moisture and cover reduce habitat quality. Recent research suggests that smaller forest patches generally have higher white-footed mice populations and a



**Pileated woodpecker, a nesting bird of core forest habitat**



*The majority of Pennsylvania's woodlands are considered "edge" forest.*



higher incidence of Lyme-infested ticks, indicating the human health risks of fragmented forests.

Of the remaining core forest in the state, 70 percent is found in patches of 5,000 acres or less. Many species need blocks of forest larger than 5,000 acres to survive including goshawk, fisher, barred owl,

and bobcat. In Pennsylvania, though we still have a large total amount of forestland, we are in danger of losing our large continuous tracts of woods and the wildlife that lives within them.

As development encroaches on forested areas, it carves remaining blocks of forest into ever-smaller

*Pennsylvania is more densely networked with roads and highways than any state in the nation.*

fragments. Roads or power lines may occupy only a small area, yet they impact much larger areas by fragmenting core forest into smaller blocks. Pennsylvania is more densely networked with roads and highways than any state in the nation, and we continue to push more roads into remaining blocks of core forest.



**Marbled salamander**

Highways and even light-duty rural roads can impact wildlife populations even though the road surface occupies only a narrow corridor of land. New roads provide avenues for invasion by exotic plants that can overwhelm native habitats.

Amphibians, such as salamanders, frogs, and toads, must travel long distances to reach aquatic breeding sites in the spring. When new roadways penetrate forest habitat, salamanders and frogs must run a gauntlet of passing cars to reach their breeding ponds, and they rarely survive the journey. Studies demonstrate that as many as 100 percent of individuals attempting to cross will be killed. Roads have also degraded the quality of forest habitat for native turtle species such as the box turtle and wood turtle. The toll of vehicles on populations of these slow-moving forest creatures is unknown but may be equally severe.



**Wood turtle**

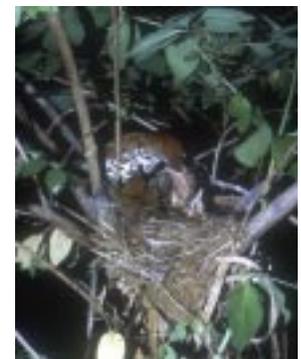
Because Pennsylvania has a high proportion of the forestland remaining in the mid-Atlantic states, our forests are

critically important to regional populations of birds and other forest wildlife. Yet, the U.S. Geological Survey Breeding Bird Survey (USGS-BBS) shows that 11 percent of Pennsylvania woodland nesting birds have declined significantly since 1980, including wood thrush, scarlet tanager, black-billed cuckoo, yellow-billed cuckoo, eastern wood pewee, and great crested flycatcher. All these are forest interior species that reach highest abundance away from edges in larger patches of core forest.

One of the best examples of a declining interior forest species is the scarlet tanager. It ranges throughout much of the eastern United States, nesting in mature hardwood and mixed deciduous forests. The Partners in Flight bird conservation initiative estimates that 17 percent of North America's scarlet tanagers nest in Pennsylvania, thus imparting a special respon-

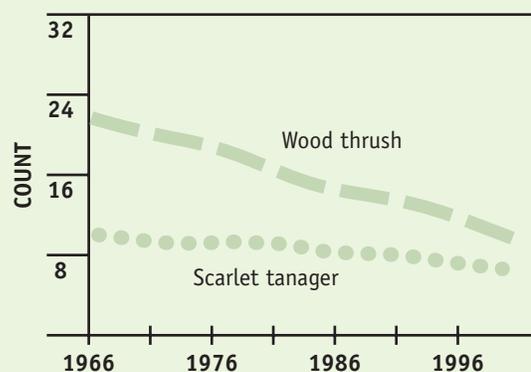


**Scarlet tanager**



**Wood thrush**

### Scarlet tanager and wood thrush population trends in Pennsylvania



Source: U.S. Geological Survey, Breeding Bird Survey, Sauer et al. 2000

sibility to our state for conserving this woodland nester. Tanagers are declining at a rate of one percent per year in Pennsylvania. If we are to continue to enjoy the scarlet tanager and its brilliant contrasting plumage, we must protect blocks of continuous or core forest where such habitat still exists.

The wood thrush, another common Pennsylvania forest bird, reaches its highest nesting success in forest patches over 100 acres in size. Wood thrush numbers declined at a rate of 1.8 percent per year in Pennsylvania between 1980 and 1990, and at 3 percent per year since then (USGS-BBS).

Because Pennsylvania harbors nearly a tenth of all wood thrushes living on the earth, the declines documented in Pennsylvania have direct implications for the survival of the species. Acid deposition and over-browsing of undergrowth by deer may also be affecting wood thrush populations.

Mammals such as the Allegheny woodrat, bobcat, fisher, flying squirrels, and black bears do better in large patches of core forest. Pennsylvanians are justly proud of the state's large and growing bear population, but bears require lots of room, with corridors for safe passage between forest blocks. Range size per



**Allegheny wood rat**



**Southern flying squirrel**



**Black bear**

bear varies from one to seven square miles. Conflicts between bears and humans are less frequent when bears have large expanses of core forest in which to forage, without visiting artificial food sites. Suburban developments are crowding bears and inviting conflict.

### *Tomorrow's Forests Imperiled?*

Pennsylvania's forests are not regenerating as successfully today as they did after the widespread cutting of the 19<sup>th</sup> century. White-tailed deer are the most direct threat to forest regeneration. Deer consume a large variety of plant foods, tree seedlings, fruits, grasses, herbaceous plants, and the buds and twigs of woody plants. They are also well adapted to the increasingly fragmented pattern of forest

cover in the state. Deer are particularly fond of edge forest, but they will move into core forest to feed on browse and mast, such as acorns and beechnuts.

Pennsylvania's diverse forest landscape has encouraged large increases in deer populations throughout every region of the state. Deer densities exceed the habitat sustainability goals set by Pennsylvania Game Commission biologists in nearly every county. Deer



**White-tailed deer**

hunting regulations, however, until quite recently, remained overly restrictive, allowing deer herds to continually grow and expand. As a

result, over-browsing by deer is one of the most serious threats to forest habitats today.

Recent adjustments to deer seasons, bag limits, and the allocations of antlerless licenses by the Game Commission are designed to begin to balance deer herds with the health of the forest resource, but years of over-browsing have already taken a toll. In a recent inventory of Pennsylvania's forest resources, the U.S.



*Over-browsing by deer is one of the most serious threats to forest habitats today.*



**Deer browse line in Pennsylvania forest**

Forest Service determined that only 17 percent of forest stands in the state will regenerate desirable tree species if pressure from deer remains high. Today, there are large sections of northern Pennsylvania woods that ecologists believe have entered an “altered steady state.” So many deer have gleaned their favored foods from the land for so long that only plants shunned by whitetails remain. There is no way to know how long it will take for this trend to reverse.

Entire communities of wildflowers and shrubs have disappeared from sections of the Allegheny National Forest due to deer, and scientists note a decline in forest birds that nest in the understory and on the ground where deer have stripped the vegetation.

Many forests in Pennsylvania show a clearly defined “line” approximately four feet above the ground (about the height an adult deer can easily reach upward) below which the vegetation is sparse or radically altered. This is

known as a “browse line,” and its widespread occurrence across the commonwealth underscores the influence high deer populations have had on forest habitat. Other wildlife dependent on a shrub layer, as well as the health of the deer themselves, decline as deer impoverish their own habitat through over-browsing.

Forest ecologists suggest acid rain may be changing forest structure as well, and that forest communities are being increasingly dominated by acid tolerant species such as striped and red maple. U.S. Forest Service data indicate that the area dominated by red maple stands, which are less valuable for wildlife and forest products, has increased by one-third in the state since 1988. Maple trees do not produce the mast so valuable to wildlife such as turkey, grouse, and squirrels.

As development encroaches on Pennsylvania’s forests, and as remaining forestlands are more intensely used in the future, it will be critically important for our remaining forests to regenerate successfully. High deer populations, introduced species, and acid deposition are direct threats to forest sustainability, and they complicate the future for the forestlands we are able to protect from direct loss to development.

Non-native invasive plants are fast becoming another huge threat to forest wildlife habitat in Pennsylvania. Research is only beginning to reveal the extent of the threat by exotic invasive plants. Over 4,000 exotic plants are documented across the United States. The Morris Arboretum of the University of



**Garlic mustard**

Pennsylvania’s Pennsylvania Flora Project has documented 439 non-native plants in Pennsylvania with many of them threatening native species.

Invasive plants colonize areas that have been disturbed in some way, such as by logging, road building, utility right-of-way maintenance, or even areas over-browsed by

deer. Water runoff brings their seeds into the interior forest as well. Once they become established, invasive species such as multiflora rose, stiltgrass, and garlic mustard out-compete native herbaceous plants, reducing forage and living space for species such as grouse and turkey and nongame such as ovenbirds and salamanders.

The failure of our forests to regenerate themselves threatens the future of the state's wildlife, outdoor traditions, and rural economy.

## Wetlands

Since William Penn's time we've lost half of our original wetlands—swamps, marshes, bogs, and riparian floodplains—to draining, development or conversion to other uses, and the loss continues. The Pocono region in northeastern Pennsylvania has suffered the heaviest loss from draining of bogs and swamps for development. Pollution and disturbance of remaining wetlands further impairs their value to wildlife.



Today, only slightly more than one percent of Pennsylvania (403,924 acres) is considered wetland habitat. Nonetheless, wetlands are critically important to wildlife and to Pennsylvania's people. Wetlands moderate floods and droughts and serve as recharge zones for groundwater aquifers. An acre of wetland lost to development carries a disproportionately high environmental cost in wildlife habitat, water quality, and water supply.

Swamps, marshes, and bogs are a treasure of biological diversity; nearly 1,500 species of invertebrates live in Pennsylvania wetlands alone, and 29 fish species primarily inhabit swamps, bogs, and riparian floodplains. Wetlands provide nesting habitat for waterfowl, herons, and songbirds, as well as endangered wildlife that have made significant recoveries in



Osprey

recent years, such as the bald eagle, osprey, and river otter. Most of our state's waterfowl, reptiles, and amphibians rely on wetlands or river environments for at least some aspect of their life cycle.

In addition to direct loss to development and sprawl, pollution and non-native invasive plants degrade the quality of many wetlands. Sixty percent of Pennsylvania's lakes are degraded by pollution. Marshes and swamps across the state are threatened by the purple loosestrife, an exotic species from

*Since William Penn's time we've lost half of our original wetlands.*

Europe that displaces native wetland plants on which waterfowl depend for food and cover.

Conservation efforts have won some notable successes with wetland wildlife in recent years. Waterfowl and wading birds benefit from managed wetland complexes such as the Pymatuning and Middle Creek wildlife management areas and the Erie National Wildlife Refuge. Bald eagles and osprey use wetlands for nesting and for fishing. Eagles were nearly extinct in Pennsylvania as recently as 1990 when the Game Commission began a reintroduction program, fledging young eagles at artificial nest sites on the Susquehanna River and near Pymatuning in Crawford County. There are now at least 65 active bald eagle nests in the

state. Ospreys, too, have benefited from recovery efforts and can be found in an increasing number of wetland habitats across the state.

Despite some successes, these large well-known wetland species will remain only so long as the wetland fish, invertebrate and plant communities on which they depend can find suitable habitats.

## Streams and Rivers

William Penn could have just as easily named his colony Penn's Flowing Waters as Penn's Woods. Shedding east, west, and north from the state's Appalachian spine are eight major river basins, boasting a network of nearly 85,000 miles of flowing streams. From the limestone springs of the Cumberland Valley to the broad Ohio River, flowing waters shaped our state's history and economy. A

million Pennsylvanians fish rivers like the Susquehanna and Clarion for smallmouth bass, or cast their line for brook, brown or rainbow trout in the 14,000 miles of trout streams. Thousands more Pennsylvania residents and visitors

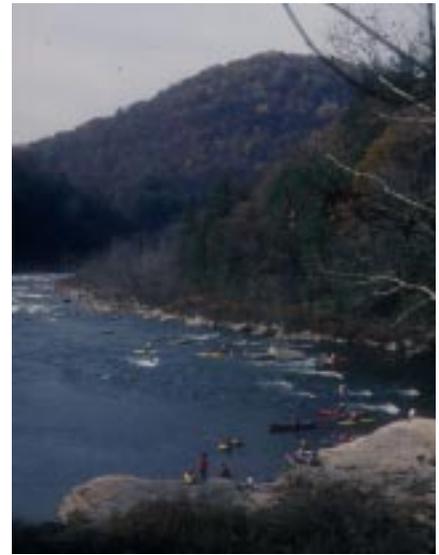


Fishing on Loyalsock Creek

canoe, kayak and whitewater raft the Lehigh and Youghiogheny rivers. Flowing streams are as much a part of Pennsylvania's natural landscape as the forests that cover the hills.

Despite their acknowledged value, our streams and rivers face serious threats from sprawl and development, acid mine drainage, agricultural runoff, acid deposition, pollution from industrial and sewage sources, sedimentation, non-native species, and deforestation. Japanese knotweed, a non-native plant, is out-competing space for native plants along rivers across the state, including along the Youghiogheny where riverbank

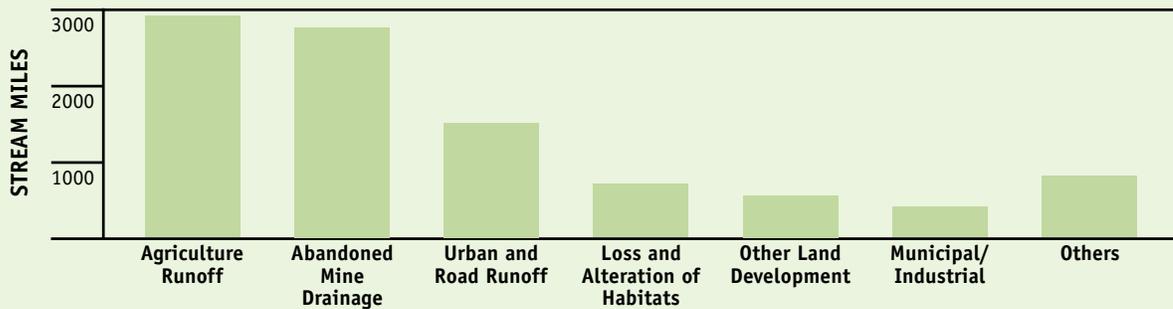
habitat offers the only growing site in the state for the en-



Kayaking on Youghiogheny River

## Sources of stream impairment in Pennsylvania

Nearly 20 percent of Pennsylvania stream miles are polluted. Agricultural runoff, abandoned mine drainage and urban and road runoff are the top three sources of stream pollution in the state according to DEP sampling.



Source: Pennsylvania Department of Environmental Protection

dangered large-flowered marshallia.

Recent stream studies contracted by the EPA found that only 25 percent of stream miles in the state offered good quality habitat for aquatic insects, and only 14

percent of stream miles were rated good quality habitat for fish. Those same studies determined that 40 percent of stream miles offer poor fish habitat.

In Pennsylvania and other forested regions, stream quality is closely linked to the proportion of forest cover remaining in the watershed. All southeastern Pennsylvania watersheds are now more than half occupied by urban or agricultural uses and these streams are degraded by a wide range of sources and pollutants, including sedimentation, riparian habitat destruction, and non-point urban and agricultural runoff.

A new potential threat to streams and wetlands may be water extraction and over-use. Water supply is limited in the state and if the demand for water exceeds the recharge capacity of our aquifers and streams, the impacts on wildlife and water-based recreation could be significant.

Deforestation in the watersheds of headwater mountain streams threatens wild brook trout populations by removing shade that keeps streams cool and by exaggerating the severity of flood and drought. The hemlock is an important source of shade along many Pennsylvania headwater streams. However, hemlock density and the important shade they provide our stream wildlife, is being reduced in many watersheds by serious infestations of an exotic pest, the hemlock woolly adelgid.

Sadly, many headwater streams with high potential as habitat for trout and other wildlife continue to be degraded by acid mine drainage. In 45 counties across



Wood frog eggs developing in vernal pool

Pennsylvania's coal regions, approximately 15,000 stream miles are impacted by acid drainage from active and abandoned mines. Because many of these streams flow through sparsely developed areas, they may be largely pristine except for mine acid pollution. Besides being nearly or completely devoid of life, the acidified streams further impair the water quality in larger rivers far downstream such as the Ohio and Susquehanna.

Acid rain and snowfall compound the impact of acid mine drainage, especially in mountainous areas where soils have little or no capacity to buffer acidity. Rain and snow falling across Pennsylvania range from

*Pennsylvania's rain and snowfall are more acidic than any other region in North America and the impacts on wildlife are far-reaching.*



Acid mine drainage

17 to 25 times more acidic than uncontaminated precipitation. Pennsylvania's rain and snowfall are more acidic than any other region in North America and the impacts on wildlife are far-reaching. Acid rain and melting snows leach toxic metals from soils in a stream's watershed, poisoning fish and aquatic insects. The breeding success of amphibians such as salamanders and frogs is impacted by the acidification of vernal ponds

where many of these animals congregate to breed each spring. Recent research shows that calcium may be depleted from forest soils by acid deposition, affecting the nesting success of forest birds because the birds cannot derive sufficient quantities of this element from their food sources.

As in forests and wetlands, non-native invasive species pose threats to the native wildlife of our streams and rivers. Non-native fishes now occupy



**Introduced Eurasian round goby**



**Native American shad**



**Louisiana waterthrush**

distributed but have declined to a last few strongholds in response to the threats cited above. Maintaining these species as living members of our wildlife heritage will require a greater un-

derstanding of their habitat needs and the threats they face. Twenty additional species of native fishes have not been collected in 20 years and may be gone from state waters forever.

Some streams have shown recovery from abuses such as acid mine drainage. Work by local watershed groups and state organizations, and time alone, have restored some streams from prior degradation. Where the health of streams has been renewed, wildlife are

returning. River otters have been successfully reintroduced into several major watersheds around the state, including the Youghiogheny, Juniata, Tionesta Creek, and Kettle Creek.

Streams are important to birds, mammals, and amphibians in the forests through which they flow. Many mammals and birds rely on streams for drinking and bathing through the dryer summer. Others may depend on streams for food sources. The Louisiana waterthrush nests along the banks of headwater streams and feeds on invertebrates it captures in the stream. Scientists have found that the waterthrush occurs in much lower numbers where stream quality has been degraded by pollution.

*Maintaining native Pennsylvania fish species as living members of our wildlife heritage will require a greater understanding of their habitat needs and the threats they face.*

about half of all stream miles in the state and may be out-competing native fish for food and spawning sites. The non-native round goby, a fish accidentally introduced from Eurasian waters is now abundant in the Lake Erie drainage and has the potential to seriously impact native fish and mussels.

Nine species of native Pennsylvania fish including lake sturgeon, longnose sucker, spotted darter, and Tippecanoe darter, are officially listed as endangered in the state, and nine more species are listed as threatened. Some of these fish are known to inhabit only one stream or stream section. Others were once widely

## Special Habitats

Scattered throughout Pennsylvania's forests, farmlands, wetlands, and along its lakes and rivers are rare and sometimes isolated habitats featuring unusual conditions and specially adapted wildlife. Caves, beaches, vernal ponds, and talus slopes occupy only small areas of the state's surface but contribute greatly to Pennsylvania's wildlife diversity.

Caves are important habitat for bats in the state, providing roosting sites in summer, when bats are active, and hibernation habitat during the critical winter months. If bats are repeatedly disturbed during winter, they use up stored fat reserves rapidly and may not survive.

Only three of the six hibernating bat species found in Pennsylvania have stable populations. The Indiana bat is a federally listed endangered species and two other bats are listed as species of special concern in the state. Cave habitats are threatened by incidental disturbance from cavers, and in some cases outright vandalism. Other bat habitats are destroyed when cave or mine openings are sealed to prevent human entry. Caves gated in such a way to exclude humans but allow bats to pass safely have shown increases in bat populations. Currently there are more than 50 sites in need of protection in the state because they host over 1,000 hibernating bats or a high diversity of bat species.

Allegheny woodrats, timber rattlesnakes and threatened plants such as the shale-barren evening primrose live



Little brown bat



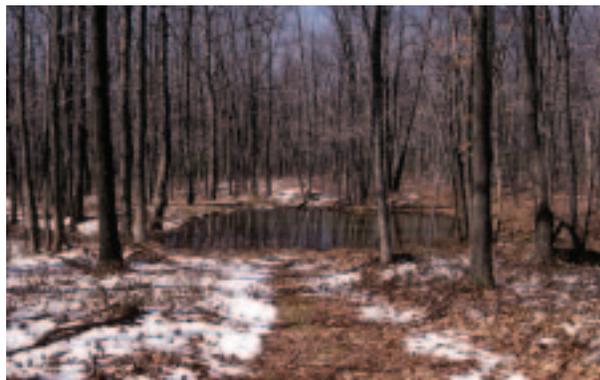
Timber rattlesnake

on rocky talus slopes on the flanks of steep ridges. Because of the challenges such places pose to human access, these habitats can be especially important to secretive species such as the timber rattlesnake, which is threatened by recreational hunting and collecting.

Presque Isle State Park, on a seven-mile spit of land jutting into Lake Erie, features some of the rarest habitats in the state. Dry sandy sites near the park's beaches hold the only specimens of hispid gromwell, a 2-foot-tall, yellow-flowered perennial, and known to exist nowhere else in Pennsylvania. The Lake Erie beaches are also important habitat for migrating shorebirds and waterfowl and once harbored nesting plovers and terns.

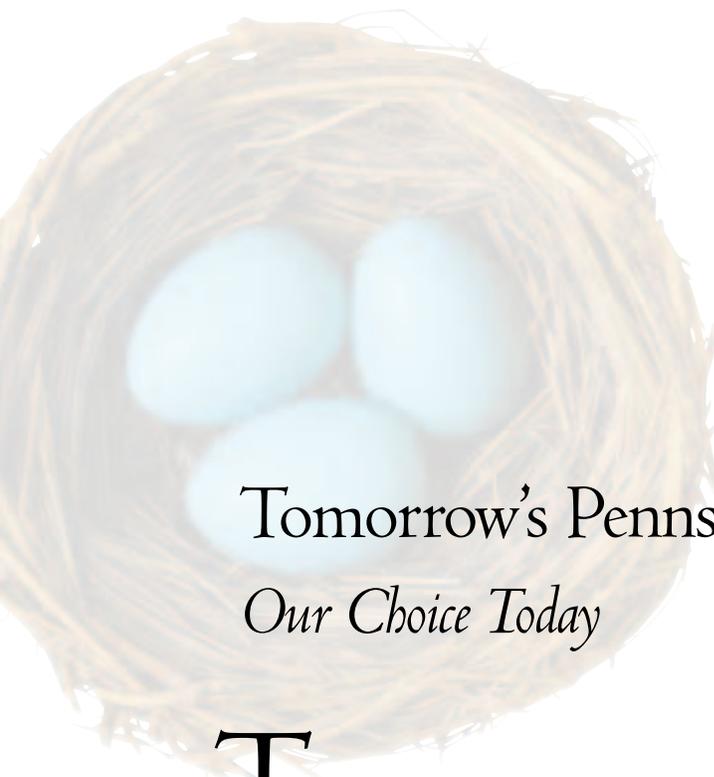
Seasonal vernal ponds that form in spring along the floodplains of streams and rivers are key to the survival of many of the state's amphibians, such as the wood frog.

Frogs and salamanders converge in vernal ponds to breed in spring selecting these pools because they lack fish that would feed on the amphibian eggs. Like many habitat features, vernal ponds are threatened by



Vernal pond

forest fragmentation and development, but a new threat from irresponsible riders of off-road vehicles is reaching deep into previously undisturbed forested areas, turning vernal ponds to muddy quagmires and disrupting the fragile reproductive cycles of forest amphibians.



*Study how a society uses its land, and you can come to pretty reliable conclusions as to what its future will be.*

— *E.F. Schumacher*

## Tomorrow's Pennsylvania *Our Choice Today*

**T**hree centuries of settlement have changed our landscapes in ways that were unimaginable when Penn first set foot in his province. The loss of our native forests, the abuse of rivers, the decline of many types of wildlife, an awakening conservation movement, establishment of conservation agencies and public lands, and the ultimate return of forests and streams reflect the cycles of change Pennsylvania has endured.

Now, new threats are emerging, powerful and widespread enough to permanently change the face of landscapes and wildlife habitat across Pennsylvania.

Most immediate is the threat of sprawling development, which has already destroyed 50 percent of our farmlands and continues to fragment our forests with roads, pipelines, power lines, towers, and homes.

Pennsylvania's citizens have long shown strong support for protecting open space and wildlife habitat, and the state's response to the tide of sprawl has been substantial. Pennsylvania is the national leader in farmland protection, with 250,000 acres

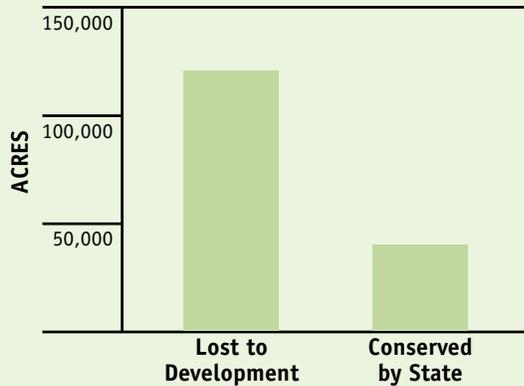
of its cropland protected through permanent easements. Our state conservation agencies add an average of 10,000 acres every year to a 4-million acre system of public lands that forms the foundation of our outdoor heritage. The Pennsylvania Game Commission manages 1.4 million acres of state gamelands and the Pennsylvania Bureau of Forestry manages 2.1 million acres of state forests. Organizations such as the Conservation Fund, Western Pennsylvania Conservancy, Natural Lands Trust, Wildlands Conservancy, The Nature Conservancy, and other local groups have

protected, through purchase or conservation easements, more than 300,000 acres of wildlife habitat and open space.

Despite these efforts, sprawl and development are rapidly outpacing conservation efforts. Current public and private conservation programs preserve about 40,000 acres per year, while 120,000 acres are claimed by sprawl. While invasive species, pollution, and over-browsing by abundant deer degrade the



## Estimated habitat lost compared to habitat conserved by State programs each year



Source: Compiled from Pennsylvania Natural Resources Conservation Service inventory data and state agencies (DCNR unpublished report, Goodrich et al. 2002)

best of our remaining habitats, we lose three irreplaceable acres to sprawl for every one we conserve. And that gap gets wider as the rate of land development accelerates.

This report does not call for an end to growth. Growth and the development it spurs are part of a healthy state economy. Our challenge is to encourage growth without sacrificing our wildlife and wild places. The challenge can be met through innovative design of developments, sound planning, and creative zoning where appropriate. By planning for and managing growth better than we have done in the past, we can welcome new economic activity to our communities without losing those qualities of natural landscape that make Pennsylvania a special place of green hills, clear streams, and diverse wildlife.

If we fail in this challenge there is more to lose than numbers of acres. Sprawl threatens our outdoor traditions and limits urban residents' access to outdoor and nature-based experience. Unchecked, sprawl may compromise our rural communities' hopes for sustainable, resource-based economies such as forestry, wildlife-watching, outdoor recreation,

*Our challenge is to encourage growth without sacrificing our wildlife and the wild places.*

and tourism. In unplanned development we risk the conversion of unique and vibrant landscapes to smears of placeless sprawl. And we are witness to the decline of forest birds and other wildlife that depend upon Pennsylvania's forests, fields, and streams.

Recent declines in hunting and fishing participation are partly due to the lack of undeveloped natural areas and open-waters near people's homes. Open lands near our cities also offer the best potential for urban Pennsylvanians to observe wildlife and participate in outdoor recreation. Hunting, fishing, camping, and hiking bond our families together and support sustainable small business in rural parts of the state. Yet, it is harder and harder for families to enjoy these popular pursuits. Although people can enjoy many outdoor activities in city parks and ball fields, wildlife-oriented pursuits rely on natural landscapes of diverse habitats. The loss of wildlife habitat that



supports these long-standing traditions jeopardizes Pennsylvania's wildlife-related "industry," that stimulates \$6 billion in economic activity every year.

Our Pennsylvania history arose from a land of forested ridges, rushing streams, and the fish and wildlife that grace such a place. Pennsylvanians have shown that we value these things and have worked hard to sustain our legacy of land and water. But our remaining wild places face new and powerful threats. We stand now at a crossroads, where the future of wild lands and the life they support hang in the balance. The choices we make now will forge the future we leave to those who follow us in the Penn's Woods of tomorrow.

*The town is saved, not more by the righteous men in it, than by the woods and swamps that surround it.*

— Henry David Thoreau

## In Search of Balance

### *Recommendations*

If Pennsylvania is to offer ourselves, and our descendants, the desirable features it has provided in the past—abundant forests, tumbling waters, diverse wildlife, and opportunities to hunt, fish, and view our wild legacy—we must cultivate a new relationship with land and the life it supports. We must find a balance between land development and land conservation.

As we learn to view land differently, as a legacy for the future instead of a commodity for quick consumption, there are immediate steps we can take toward a better balance between development and conservation. The past century, and the past 30 years in particular, have seen inequity between land developed

and land preserved. In Pennsylvania we are losing three acres of open land for every one we protect in some conservation status and the rate of loss is accelerating.

Outlined below are five recommendations fundamental to the conservation of wildlife and wild places in Pennsylvania. These recommendations are essential to preserving our outdoor heritage, maintaining the vast economic value of wildlife-linked recreation, and sustaining rural economies that depend on forests, farms, and outdoor tourism.

In the restoration of balance between habitat loss and habitat conservation, these five recommendations offer a place for us to begin.



## *1 Protect the Best of What Remains of Pennsylvania's Major Habitat Types*

Time is short for some of our most endangered wildlife species and their habitats. Meanwhile, the overall diversity of plants, animals, and their habitats in Pennsylvania is rich. The rarest and most threatened habitats and the most intact representative habitats both deserve our protection. To utilize limited conservation funds effectively, we must understand our objectives and set clear priorities for which sites need to be conserved.

The state's land forms and ecological regions are among the most diverse in the entire northeast. We need to synthesize existing wildlife and habitat inventories and develop a conservation priority list with sites identified that conserve both rare and threatened species as well as representative forests, grasslands, wetlands, rivers, and streams. Corridors and connections between habitats are also critical to allow for wildlife dispersal and should be part of our plan. Scientists should be recruited to help determine the size of the areas needed to conserve representative and rare wildlife habitats and conduct additional inventories where information is lacking. Clear conservation priorities will enable us to protect rare and endangered species and to ensure that the best examples of our native habitat types are not lost to development.



## *2 Restore and Improve Degraded or Impaired Habitats*

Large areas across Pennsylvania present opportunities where wildlife habitat and related recreational opportunities can be restored and improved, both on public and private lands. Grasslands can be restored on the state's vast unreclaimed surface mine lands while improving the quality of nearby streams and providing habitat for grassland birds. Keeping deer populations at levels that permit forest regeneration can restore habitat for small mammals, songbirds, forest amphibians, and woodland wildflowers. Control of invasive plant species will invigorate the health of native plant and animal communities.

Restoration of wetland habitats is a critical priority due to the limited occurrence of wetlands in the state and their rich biological productivity.

Thousands of miles of potentially productive streams in Pennsylvania are still degraded by acid mine drainage and need remediation. New and effective treatment technologies and the enthusiasm of local watershed organizations are proving that acid mine drainage is not an insurmountable problem.

Stream corridors in suburban and rural areas can be reforested to improve water quality and offer corridors of habitat for wildlife.

Because of their value to local communities through tourism and enhanced quality of life, the restoration of streams may be one of the most cost-effective efforts that conservation programs could make.



## *3 Work Cooperatively to Conserve Privately Owned, Working Resource Lands*

Private landowners hold the key to conserving most habitat types in Pennsylvania. Working farms and forestlands, under the ownership of 560,000 private landowners, hold rare natural sites, as well as extensive tracts of representative forest, field, and wetland habitats. Maintaining habitat values on these working lands provides major habitat conservation benefits and is the focus of numerous programs to encourage better land stewardship. Already, federal and state assistance programs are helping to form conservation partnerships with private landowners to improve and conserve habitats. These partnerships have proved especially effective in conserving forested stream buffers and in the restoration of small to medium-size watersheds. New initiatives can target specific habitat types and seek longer-term improvements on private lands.

Forested stream corridors can serve to connect wetlands and forests and reduce the impact of habitat fragmentation on wildlife. Easement programs that protect habitat values need to be made available to landowners so they can more readily include wildlife considerations in their land management plans.

Any new habitat conservation initiatives must also work to strengthen the farm and forest-based economies in rural Pennsylvania. Preserving these working lands and their habitat values depends upon maintaining the economic viability of local farm and forestry enterprises.



## *4 Strengthen Species Inventory, Monitoring, and Research Programs*

Gaining deeper understanding of the population trends, distribution, and habitat needs of Pennsylvania's 25,000-plus species will help us more effectively conserve wildlife throughout the state. This knowledge is critical to identifying declining species, critical habitats, and targeting conservation priorities on public and on private lands. A more comprehensive wildlife monitoring and research program is needed in Pennsylvania. This effort should establish statewide inventories and monitoring programs for birds, mammals, fish, reptiles, and amphibians as well as plants, fungi, and invertebrates that will enable us to detect declines before species become endangered. Future research must strive to uncover new knowledge about the state's wildlife while we assemble and integrate current knowledge among state agencies, conservation organizations, and universities. Outreach programs that spread appreciation of wildlife and wildlife habitats to the public should be part of this program. Conservation efforts cannot be successful without public support.



## *Promote Environmentally Responsible Land Use*

Stemming habitat lost to sprawling development presents the most formidable conservation challenge of all. More than 120,000 acres are lost each year to development and the rate of loss is climbing.

Concentrating development in identified locations and guiding it away from important habitats and other



sensitive areas would enable us to make significant conservation progress. Open space and wildlife habitat need to be valued in planning codes as much as they are in our every day lives.

We can also conserve Pennsylvania's landscapes by revitalizing downtown business districts, restoring blighted urban areas, and fostering productive economies in cities and towns. These strategies will play an increasingly critical role in sustaining both Pennsylvania's economy and its natural heritage.

## *Challenge and Choice*

These recommendations do not present an easy path. A plan of action needs to be prepared, implementing responsibilities identified, priorities established, and necessary funding secured. There will be enormous challenges and difficult choices. But we can meet the challenge of habitat conservation.

Underlying these recommendations is the call for a fundamental shift in land ethics and conservation initiatives that assure more land of all habitat types are protected for wildlife and outdoor recreation. Each and every Pennsylvanian has a stake in shifting the habitat balance from land conversion to land conservation. When we lose an acre of woodland, field or marsh to sprawl, we lose more than living space for wild things. We also lose our choices for the future, for once sprawl transforms the living landscape, that change is almost always irreversible. We can

*Wildlife recharges my spirit and betters my day.*  
— Lou Hoffman

no longer stand by without questioning and challenging the impact that development will have on the future of wildlife and wild places in Pennsylvania.

The recent pace of land development is unprecedented. It reduces the quality of our urban and rural communities, degrades the natural landscapes which have historically defined the state, and diminishes the wildlife that support our rich outdoor heritage.

As Pennsylvanians, we are proud of our heritage and we face a challenge that is immediate and great. The price of meeting that challenge will not be cheap, but the reward is rich. If we have the courage to change, to find the balance that conserves wild lands and wildlife, we can ensure our wildlife legacy and traditions will be enjoyed by future Pennsylvanians.

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*For further information contact*  
Pennsylvania Department of  
Conservation and Natural Resources  
7th Floor, Rachel Carson State Office Building  
P.O. Box 8767  
Harrisburg, PA 17105-8767  
717-772-9087  
[www.dcnr.state.pa.us](http://www.dcnr.state.pa.us)

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