Terrestrial Vertebrates of Pennsylvania

A Complete Guide to Species of Conservation Concern

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Wildlife Habitat
The Key to Abundance, Distribution, and Diversity

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Introduction

Where animals are found and how abundant they are result from a number of complex factors, including their evolutionary history, physiology, morphology, behavior, and ecology—as well as the physical features of their habitat. In this chapter, we review the diversity of habitats, geographic location, and geography of Pennsylvania and discuss how these factors influence the distribution of terrestrial vertebrates, why some species are common and others are rare, and why Pennsylvania plays such an important role in the conservation of many of these species. We examine broad trends and relationships. A detailed analysis of terrestrial and aquatic habitats available to vertebrates can be found in Goodrich et al. (2002) and a summary of the physiographic provinces can be found in McWilliams and Brauning (2000) and Merritt (1987). We will not repeat these here but instead highlight the characteristics of the habitats, the physiographic provinces, and the geographic location of Pennsylvania that influence the distribution and abundance of species (fig. 2.1). We focus our examples on the terrestrial vertebrates of Conservation Concern. Detailed information on these species and their habitat requirements can be found in the individual species accounts, which follow the introductory chapters.

Habitats for Terrestrial Vertebrates

Much of the information in the following sections was originally included in an interagency report on the status of wildlife habitat (Goodrich et al. 2002) and in a report on Pennsylvania's comprehensive wildlife conservation strategy (Williams 2007). Our goal here is to further refine and focus this information and, in so doing, provide a context for understanding the diversity and distribution of terrestrial vertebrates in Pennsylvania and neighboring states.

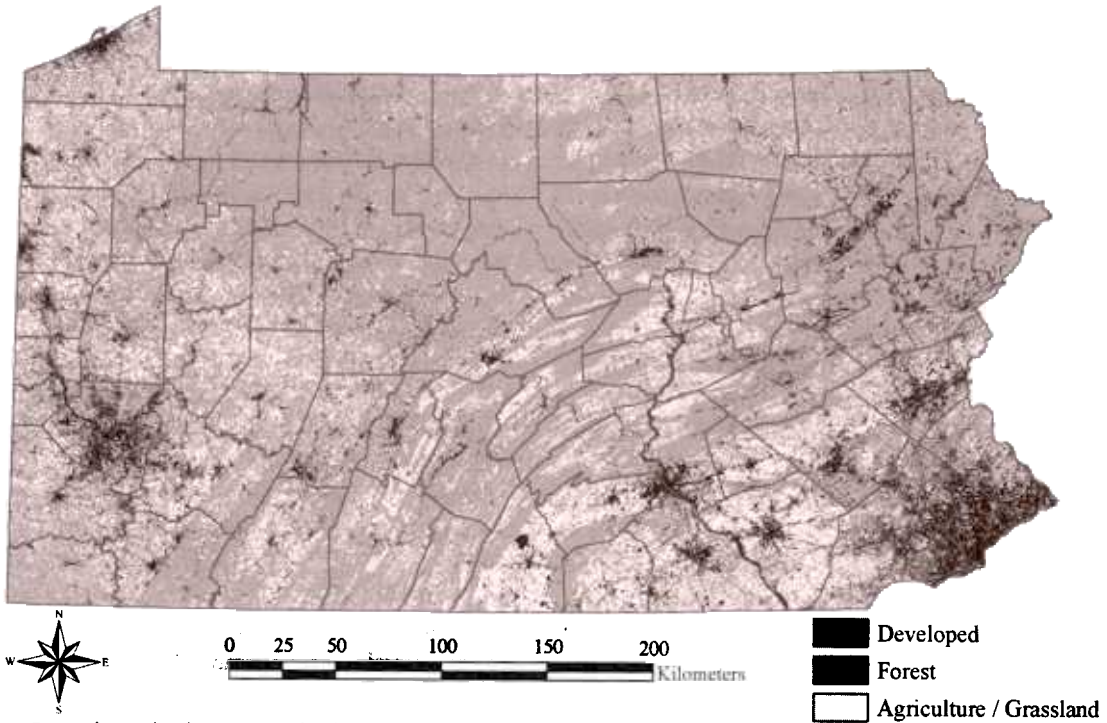

Fig. 2.1. Pennsylvania land cover. 1995 land cover data, Joe Bishop 2009.

Forest Habitat

Forest habitat is the predominate habitat in Pennsylvania with more than 62 percent of the state in forest cover. Forest type and species composition vary with elevation, moisture, slope, and aspect. The varied terrain of Pennsylvania provides a high diversity of species and forest types (Fredrickson 1996, Fike 1999). Deciduous forest represents the vast majority of forest cover types found in Pennsylvania and comprises several natural community types, with oak-hickory and northern hardwoods making up most of Pennsylvania's upland forests (Alerich 1993).

Pennsylvania's extensive forests fill an important role in the conservation of forest wildlife within the northeastern United States (Rosenberg and Wells 1995). Many species that depend on large contiguous blocks of forest are still relatively abundant in Pennsylvania, although they may have declined in number. In other northeastern states with less forest cover, declines have been more extreme, and these species are much less abundant. These include many of the forest-dwelling Neotropical migrants, such as the wood thrush (*Hylocichla mustelina*) and scarlet tanager (*Piranga olivacea*), both of which are considered Pennsylvania Responsibility Species, because such a large proportion of the population breeds in Pennsylvania (Rosenberg and Wells 1995, Williams 2007).

A species that relies on large forested blocks for successful breeding and reaches its greatest abundance in large forested blocks is called a "forest-interior," or "area-sensitive," species. The diversity of area-sensitive birds is highest in the north-central and northeastern regions of the state where large blocks of forest occur and lowest in the southeastern and southwestern parts of the state where forest tends to be found in small woodlots and isolated patches; these patches result from habitat loss and forest fragmentation due to human development and agriculture (Goodrich et al. 2002, Brittingham and Goodrich 2010).

Coniferous and Mixed Forest

Coniferous or mixed conifer-deciduous cover comprises 8.4 percent of Pennsylvania's land cover (Goodrich et al. 2002). Mixed forests include forests dominated by sugar maple (*Acer saccharum*), beech (*Fagus* spp.), birch (*Betula* spp.), spruce-fir (*Picea* spp./*Abies* spp.), and white pine-jack pine (*Pinus strobes*/*Pinus banksiana*). This cover type is found throughout the state with concentrations at high elevations and in the Pocono Plateau and in north-central regions of the state (Goodrich et al. 2002). The state is also dotted with

plantations of Norway (*Picea abies*) and white spruce (*Picea glauca*), as well as red (*Pinus resinosa*), white, and scotch Pines (*Pinus sylvestris*) that were planted in the early and mid-twentieth century (Goodrich et al. 2002).

Although conifer forests make up a relatively small percentage of the total forest cover in the commonwealth, they are important for wildlife. Coniferous forests provide important habitat for breeding and wintering wildlife and add diversity to forest habitats. The northern flying squirrel (*Glaucomys sabrinus*) and red crossbill (*Loxia curvirostra*) are Species of Greatest Conservation Need whose abundance and distribution are closely tied to the abundance and distribution of coniferous forests across the state. Some birds, such as the black-throated green warbler (*Dendroica virens*) and blue-headed vireo (*Vireo solitarius*), preferentially nest in conifers (see species accounts). The distribution of fifteen birds that nest in association with conifers is concentrated in the northern regions of the state where the abundance of conifer cover is the greatest (Goodrich et al. 2002).

Eastern hemlock (*Tsuga canadensis*) is an important component of many conifer forest habitats, as well as a major component of remaining old growth forests (Davis 1996). It is a slow-growing, shade-tolerant late-successional conifer that provides a unique cover type (Orwig and Foster 1998). Several Species of Greatest Conservation Need, including the Acadian flycatcher (*Empidonax virescens*), blue-headed vireo, black-throated green warbler, and Blackburnian warbler (*Dendroica fusca*), depend on, or strongly prefer, hemlock habitats and are often found in highest densities in hemlock-associated habitat types (Benzinger 1994, Swartzentruber and Master 2003, Ross et al. 2004, Becker et al. 2008). In addition, the northern flying squirrel and water shrew (*Sorex palustris*), species of concern throughout the Northeast and mid-Atlantic, are closely associated with hemlock stands (Sciascia and Pehek 1995, Steele et al. 2004).

Old Growth Forests

Strict age and size characteristics to define which forests are "old growth" are hard to establish because it varies with a number of factors, including forest type and soil conditions (Davis 1993). In general, old growth forests have been managed by nature without human interference for a prolonged period, have not suffered recent natural catastrophic disturbance that would reverse succession, and possess characteristics associated with forests that are usually classified as virgin (Davis 1993, Gross 1993). Old growth forests are often typified by large trees of advanced age, downed logs, an abundance of standing snags, and dense leaf litter. Today in Pennsylvania, old growth forests occur on less than 1 percent of the forest land and generally occur in small patches of less than 500 acres (195 ha) (Davis 1993, Goodrich et al. 2002).

Although there are no vertebrate species in Pennsylvania that are found only within old growth forests, many Species of Greatest Conservation Need are often closely associated with old growth or reach their highest abundance within old growth. This is either because of the structural features of the habitat or the abundance of conifer cones and other mast (Haney and Schaadt 1996). Examples of Species of Greatest Conservation Need that are often associated with old growth include birds such as the Blackburnian warbler, the winter wren (*Troglodytes troglodytes*), and the red crossbill. Northern flying squirrels are found in greater numbers in mature mixed-coniferous forest (Haney 1999, Mahan et al. 1999). The federally endangered Indiana bat (*Myotis sodalis*) uses large mature trees with loose bark or snags for roosting (Haney 1999), although recent studies show they will also use smaller trees for roosting (U.S. Fish and Wildlife Service 2007). Salamander populations increase in diversity and in abundance in mature forests, where the abundant woody debris provides the moist microhabitat they require (Haney 1999, Haney and Lydic 1999).

Successional Habitats

Successional habitats in Pennsylvania may occur either as temporal or near-permanent habitat patches. Temporal thicket patches result primarily from farmland abandonment, reclamation and succession of reclaimed strip mines, forest clear-cutting, natural forest disturbances, and maintenance of shrub-wetlands by beaver activity.

Regenerating clear-cuts and reclaimed surface mines provide habitats that mimic natural shrub communities in structure and may be important to native thicket-associated species. These habitats are usually ephemeral, lasting generally five to ten years after disturbance, and they occur in a wider variety of forest types and at lower elevations. In addition to providing habitat for native priority species, these areas support additional early successional species that formerly may have been rare in this forested state. Depending on how

they are managed, significant amounts of habitat for shrub-scrub species can also occur along power lines (Litvaitis et al. 1999). Near-permanent thicket patches occur in a few limited geographic areas as naturally occurring barrens. Barrens are discussed below under "Open Habitats."

Early successional forest or early successional habitat such as overgrown farmsteads, abandoned orchards, regenerating forests, and floodplain areas, are not easily quantified in current inventory and mapping methods. As a result, we do not have an accurate estimate for the total area of successional habitats. However, there is general agreement that this habitat type is currently in decline in Pennsylvania and the northeast United States (Askins 2000). From 1978 to 2002, the total acreage in Pennsylvania forestland remained stable, but the proportion in early successional stages (seedling, sapling, and nonstocked) declined from 21 percent to 12 percent (Alerich 1993, McWilliams et al. 1995). Although the aging of trees is a primary factor in the decline in successional habitats, factors such as highway and urban development, intensification of agriculture, and a reduction in farm abandonment all contributed to decreasing quantity and quality of this important habitat.

As the abundance of successional habitats has declined, a number of species associated with old fields and young forests have declined in numbers. Species of Greatest Conservation Need associated with young forests and old field habitat include birds such as the American woodcock (*Scolopax minor*), brown thrasher (*Toxostoma rufum*), golden-winged warbler (*Vermivora chrysoptera*), and yellow-breasted chat (*Icteria virens*), and mammals such as the least shrew (*Cryptotis parva*). Mammals such as the snowshoe hare (*Lepus americanus*) are associated with areas of dense vegetation particularly regenerating clear-cuts in the northern part of the state. A number of reptile species are often found in early successional habitats, including mountain earth snakes (*Virginia pulchra*), smooth green snakes (*Liochlorophis vernalis*), eastern fence lizards (*Sceloporus undulatus*), and northern coal skinks (*Plestiodon anthracinus anthracinus*).

Farmlands, Grasslands, and Open Habitats

Farmlands

Approximately 25 percent of Pennsylvania is in open herbaceous habitat with the majority of that maintained as farmland (Myers et al. 2000). Historically, Pennsylvania was a forested state, but as Pennsylvania was settled, much of the land was cleared for farming. The total amount of farmland peaked around 1900 with more than 65 percent of Pennsylvania in farmland (McWilliams and Brauning 2000). Since that time, there has been a steady decline in the amount of land devoted to farming and the number of farms. Both cropland and pastureland acreage have been reduced since the 1940s (Goodrich et al. 2002). The steepest decline in acreage occurred from the 1950s through late 1960s, a time when declines in farmland wildlife also were occurring. The loss of farmland habitat continues today, especially in southern Pennsylvania, where overall losses of agricultural land were estimated at as high as 37 percent in areas around Philadelphia between 1969 and 1992 (Goodrich et al. 2002).

Another change in recent decades has been a shift toward larger farms under intense mechanized production. Farmland that is harvested by frequent haymowing or crop-cutting leaves little opportunity for wildlife to find food and cover. The increased use of highly effective pesticides has reduced critical insect prey for grassland-associated wildlife. Because of the demands of modern equipment and economics, fewer brushy hedgerows and "odd areas" remain in today's farmland.

All of this has had adverse effects on farmland wildlife species, many of which thrived in a mix of open habitat, abandoned fields, hedgerows, and woods. For the eastern spotted skunk (*Spilogale putorius*), small farms and reverting farmland seem beneficial, but large-scale agriculture is associated with population declines (Polder 1968, Choate et al. 1974). Never common, this species may now be on the verge of extirpation within the state. Avian Species of Greatest Conservation Need associated with farmland include birds such as barn owls (*Tyto alba*), eastern meadowlarks (*Sturnella magna*), and grasshopper sparrows (*Ammodramus savannarum*). The northern bobwhite (*Colinus virginianus*) is a species that was closely tied to farmland and is now probably extirpated as a native breeder (see species accounts). In southeastern regions, only a small proportion of the area remains in agricultural habitat, and most of that is in small patches of less than 100 acres. Wildlife that require extensive grasslands (e.g., northern harrier [*Circus cyaneus*], short-eared owl [*Asio flammeus*]) are now limited by the availability of such habitats throughout this region.

Strip Mines

Reclaimed surface mines provide extensive nonagricultural grassland habitat in Pennsylvania. A conservative estimate is that there are currently around 35,000 ha of reclaimed strip mines within a nine-county area in western Pennsylvania suitable as grassland bird habitat (Mattice et al. 2005). Statewide, the estimate would be much higher. Though once considered wastelands resulting from resource extraction, these sites can provide quality habitat for grassland-associated species. The acidic, nutrient-poor soils of reclaimed sites provide little potential for agricultural or timber production, and grasses and legumes tend to be the most successful and persistent vegetation types (Vogel 1981). These fields have a slow rate of ecological plant succession and provide habitat for grasshopper sparrows as well as many other grassland-associated birds (Bajema et al. 2001). Their suitability for grassland-associated species from other taxa (i.e., herptiles, invertebrates) has yet to be fully investigated. These anthropogenic grasslands are found primarily in the north-central and northwestern parts of the state where there are more than 300 surface mines (Yahner and Rohrbaugh 1996).

Grassland-dependent species associated with reclaimed surface mines include many of the same species associated with agricultural grasslands. However, reclaimed strip mines are somewhat unique in that they can provide large-scale grassland habitats for area-sensitive species. In western Pennsylvania, and particularly in Clarion County, northern harriers and short-eared owls, two species that require large blocks of grassland habitat, are using these extensive reclaimed strip mines.

Because of the extent of strip mines in Pennsylvania and declines in grassland species elsewhere, these habitats are regionally and even globally important for some grassland species. For example, nearly 9 percent of the global population of Henslow's sparrows (*Ammodramus henslowii*) breed in Pennsylvania, and the majority are breeding on reclaimed strip mines (see species account in chapter 5). Thus, Pennsylvania has a High Responsibility for this species.

Barrens

Barrens habitats are naturally occurring open habitats that are often associated with dry or nutrient-poor soils (Goodrich et al. 2002). The vegetation tends to be a patchy mosaic ranging from woodland to shrubland to sparsely vegetated rocks interspersed with patches of grassy cover. Major types of barrens in Pennsylvania include shale barrens, eastern serpentine barrens, sand barrens, pitchpine scrub oak barrens, ridge-top scrub oak barrens, and mesic till barrens (Thorne et al. 1995, Fike 1999, Goodrich et al. 2002, Latham 2003). Depending on geographic location and soils, barrens habitat can provide suitable habitat for a number of priority species, including the whip-poor-will (*Caprimulgus vociferous*), prairie warbler (*Dendroica discolor*), golden-winged warbler, Appalachian cottontail (*Sylvilagus obscurus*), snowshoe hare, and timber rattlesnake (*Crotalus horridus*). These habitats are also home to a number of rare plant species (Latham 2003).

Wetlands

Wetlands cover less than 2 percent of the land area in Pennsylvania (Tiner 1990). Natural wetlands are concentrated in previously glaciated counties of the northeastern and northwestern portions of the state, with more than 50 percent of the wetlands in the state occurring in these areas (Tiner 1990). The wetlands not only are most abundant here but also have their largest areal extent here. As a consequence, many of the Species of Greatest Conservation Need associated with wetland habitats are most likely to be found in these areas.

Most of Pennsylvania's wetlands (97%) are palustrine (bogs, fens, swamps, shallow pools). Emergent wetlands (marshes, meadows) and shrub swamps compose 10 to 20 percent of state wetlands. Large emergent wetlands, or undisturbed areas of small emergent wetlands mixed with fields, are needed to support many Species of Greatest Conservation Need, such as the American bittern (*Botaurus lentiginosus*), a State Endangered Species and Species of Regional Concern. This preference for large, undisturbed wetlands has made many species vulnerable to population losses, and has likely resulted in the disappearance of species from the commonwealth. The bog turtle (*Glyptemys muhlenbergii*) is a federally Threatened Species associated with emergent wetlands in the southeastern region, where wetland loss has reduced wetland wildlife abundance. Species of Greatest Conservation Need associated with shrub-scrub wetlands include birds like the olive-sided flycatcher (*Contopus cooperi*) and alder flycatcher (*Empidonax alnorum*). Chorus (*Pseudacris* spp.), leopard (*Lithobates* spp.), and northern cricket frogs (*Acris crepitans*), spotted (*Clemmys guttata*) and Blanding's turtles (*Emydoidea blandingii*), and eastern ribbon snakes (*Thamnophis sauritus*), all depend on a

variety of wetland habitats. Wet meadows are important habitats for the eastern massasauga (*Sistrurus catenatus catenatus*), shorthead garter snake (*Thamnophis brachystoma*), and Kirtland's snake (*Clonophis kirtlandii*).

Thirty-six percent of Pennsylvania's wetlands are forested, and these wetlands are often the result of beaver activity. Peat bogs with floating vegetation mats are found in glaciated forested regions of northern Pennsylvania. Bogs are characterized by slow circulation of water and low rates of nutrient turnover. The yellow-bellied flycatcher (*Empidonax flaviventris*) is associated with glaciated bogs and swamps of northern Pennsylvania. Other Species of Greatest Conservation Need found here include the Canada warbler (*Wilsonia canadensis*), winter wren, American woodcock, and northern saw-whet owl (*Aegolius acadicus*).

Freshwater tidal wetlands occur in southeastern Pennsylvania. Brackish water reaches into Pennsylvania from the Delaware Bay at the far southeastern corner, allowing a small area of estuarine environment (Tiner 1990). Historically, species associated with this habitat include the least tern (*Sternula antillarum*) and black rail (*Laterallus jamaicensis*). Species of Greatest Conservation Need within this habitat include the marsh wren (*Cistothorus palustris*), common moorhen (*Gallinula chloropus*), and the eastern redbelly turtle (*Pseudemys rubriventris*).

Streams, Rivers, and Lakes

Pennsylvania is host to 83,000 miles (133,575 km) of streams and rivers, which can be divided into eight primary drainage basins. We tend to think of streams as important habitats for fish, mussels, and aquatic invertebrates, but there are also a number of species we typically consider terrestrial vertebrates that are associated with streams. Species of Greatest Conservation Need associated with streams tend to fall into two groups. The first group is species that are associated with streams with high water quality, often headwater streams surrounded by forest cover. These species presumably declined in numbers or are limited at least in part because of poor water quality found in many streams. For example, the Louisiana waterthrush (*Seiurus motacilla*) is the only stream-dependent songbird in eastern North America. It feeds primarily on aquatic macroinvertebrates, which decline in number in acidified streams. Likewise, breeding waterthrush also decline in number on acidified streams (Mulvihill et al. 2008). Waterthrush breeding densities are lower on acidified streams and it takes almost double the length of an acidified stream to produce the same number of fledglings as a nonacidified stream (Mulvihill et al. 2008). Water shrews and river otters (*Lontra canadensis*) are mammalian Species of Greatest Conservation Need associated with high-quality streams. Because of their vagility, river otters can move from one watershed to another with little effort. Species such as water shrews, however, are likely to experience more permanent local extinctions when water quality declines. Amphibians and reptiles that use high-quality stream habitats include eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*), queen snakes (*Regina septemvittata*), and map turtles (*Graptemys geographica*). Wood turtles (*Glyptemys insculpta*) seldom venture far from the riparian areas along these streams.

The second group of Species of Greatest Conservation Need is a mixed group of species that use streams for feeding and often for a place to nest, but the reasons they are rare within the state are not directly associated with the quality of the stream habitat. For example, both osprey (*Pandion haliaetus*) and bald eagles (*Haliaeetus leucocephalus*) nest along many of our larger rivers and streams and forage within them. The causes for their declines were historically associated with indirect effects of pesticides on their reproductive output and direct persecution (see species accounts). Others, such as some of our colonially nesting waders, are on the northern edge of their geographic range in Pennsylvania (e.g., great egret [*Ardea alba*] and yellow-crowned night heron [*Nyctanassa violacea*]), and are naturally rare as a result.

Lake and pond habitats can be found throughout the state but are most abundant in the northwestern and northeastern parts of the state. There are no Species of Greatest Conservation Need associated exclusively with lakes and ponds, but many of the species associated with streams and rivers will also use larger lakes.

Vernal Ponds

Another category of aquatic habitat within the state includes the temporary pools or vernal ponds located amid riparian and woodland habitats. Vernal ponds are found throughout the state, but there is limited information on specific locations. Vernal ponds are particularly important to amphibian populations as they provide ephemeral breeding sites that are free of predatory fish or other predators. Vernal ponds dry up in

summer and only contain water during wetter months of the year. As a result of this periodic drying, wildlife needing water year-round are not able to survive. The dearth of fishes reduces predation on vulnerable amphibian eggs and young. Species of Greatest Conservation Need dependent on vernal ponds include a number of salamanders and frogs such as the Jefferson salamander (*Ambystoma jeffersonianum*), marbled salamander (*Ambystoma opacum*), the mountain chorus frog (*Pseudacris brachyphona*), and the eastern spadefoot (*Scaphiopus holbrookii*). Spotted turtles (*Clemmys guttata*) also frequently use vernal ponds.

Urban and Suburban Habitats

In Pennsylvania, the largest concentrations of urban and suburban habitat are in the southeast and southwest. In the Ridge and Valley region, development occurs primarily in the valleys, frequently in areas previously devoted to agriculture. As an area becomes urbanized, we see shifts in the type of wildlife present. Urban and suburban areas tend to favor generalists over species that have very narrow habitat requirements. As a general rule, the diversity of wildlife is low in urban areas, but the abundance of wildlife may be very high. Species that can coexist with people often thrive in urban areas, and urban areas tend to have a much higher concentration of nonnative species (ex. pigeon [*Columba* spp.], house sparrow [*Passer domesticus*]), than rural areas. Amphibians and reptiles decline in both abundance and in diversity as native habitat is lost, and the remaining habitat is fragmented by roads and buildings that create major barriers to dispersal.

The amount of urban and suburban habitat in the commonwealth is increasing, but not all urban species are thriving. Some species that became dependent on human structures for nest sites are now declining as changes in building design and management make these structures no longer suitable for roost or nest sites. Chimney swifts (*Chaetura pelagic*), common nighthawks (*Chordeiles minor*), and Indiana bats are examples of Species of Greatest Conservation Need whose declines are attributed, at least in part, to a decline in availability of suitable roost or nest sites. However, the peregrine falcon (*Falco peregrinus*) is an urban success story as the species that formerly nested on cliffs adapted to nesting on buildings and bridges while exploiting the abundance of avian prey (primarily pigeons) in urban cities. Several reptile species, including shorthead garter snakes, find suitable habitat in vacant lots in urban areas.

Although we have not traditionally focused on urban and suburban areas as critical wildlife habitats, there is a growing awareness that if we are going to slow the accelerating loss of native species, we can no longer ignore these areas. Instead, we need to manage suburban and urban areas to provide habitat for the diversity of native plants and animals that occurred here historically and still depend on them for survival and reproduction (Tallamy 2007).

Rock Habitats and Caves

The most essential feature of rocky habitat for wildlife is surface rock in the form of cliffs, ledges, outcrops, boulder fields, and caves. In Pennsylvania, the most common rock habitat types are caves and talus slopes (Goodrich et al. 2002). Man-made rock habitats, such as active and inactive mines and quarries, also provide habitat for wildlife.

There are four different cave types in Pennsylvania: (1) terrestrial solution caves, (2) aquatic solution caves, (3) tectonic caves, and (4) talus caves (Thorne et al. 1995). Solution caves occur in limestone bedrock and are the most common cave in the state, particularly in the Ridge and Valley Physiographic Region. A diverse invertebrate community can be found here, as well as several Species of Greatest Conservation Need, including the federally endangered Indiana bat, eastern small-footed myotis (*Myotis leibi*), and Allegheny woodrat (*Neotoma magister*; Goodrich et al. 2002).

Tectonic caves are formed by subsurface cracks in bedrock and may be associated with sandstone. They are usually dry and are also used by bats and woodrats. Talus caves are formed in boulder piles where openings occur between rocks. Many reptiles and small- to mid-sized mammals may use these for cover. Priority species, such as the Indiana bat, eastern small-footed bat, Allegheny woodrat, timber rattlesnake, and the northern copperhead (*Agkistrodon contortrix mokasen*), may be found using talus caves and talus slopes. Man-made caves, such as deep coal mine shafts or abandoned tunnels, also are inhabited by rock-associated wildlife and can be particularly important for hibernating bats.

Talus slopes, boulder- and rock-strewn regions of mountains or mountainsides, and ravines provide critical habitat for several priority species, including the rock shrew (*Sorex dispar*), rock vole (*Microtus chrotorrhinus*), Allegheny woodrat, eastern spotted skunk, tim-

ber rattlesnake, northern copperhead, eastern fence lizard, and northern coal skink. The complete distribution of talus slope habitat in the state is unknown at this time. However, the habitat type is closely associated with mountain ridges of the northern Ridge and Valley Physiographic Region and the southwest (Allegheny Mountains) portion of the Northern Plateau.

Patterns and Trends

Generalists and Specialists

Habitat can be thought of as the place where an animal lives, where it forages, where it is best able to escape predators, and where it reproduces. The habitat for a chickadee (*Poecile* spp.) might be a patch of deciduous woods while the habitat for a marsh wren would be an emergent wetland. Some species are generalists and can be found in a range of habitats. Others are specialists and will be found in a very narrow range of habitat types. As a general rule, all other things being equal, a species that is a generalist will have a broader range of ecological tolerances and, hence, be more abundant than a similar species that can be found in only a restricted range of habitats and ecological conditions. Thus, it follows—again, as a very general rule—Species of Greatest Conservation Need are often species that specialize on a narrow range of ecological and habitat conditions. An exception to this rule would be species that are locally rare because they are located on the edges of their geographic ranges (see chapter 1).

Habitat Abundance and Species Abundance

For species that are habitat specialists, their abundance can be limited by the availability of the specific habitat type on which they depend. Thus, if a habitat is rare within the state, the species that specialize on that habitat type will also be rare. The best example of this as a group would be our wetland species. Wetlands are found in less than 2 percent of the state, and many are in poor condition. As a consequence, the species that depend on these wetlands are also rare. We can see this with species dependent on certain microhabitats such as birds dependent on hemlock or other conifers. Because this habitat type is rare, the species that depend on this habitat are also rare.

The converse is not always true. Just because a habitat is abundant does not mean that all species associated with it will also be abundant, because there may be other factors that have reduced population size below the carrying capacity of the habitat. For example, populations of many of our raptors were formerly reduced by pesticides that greatly reduced their reproductive output. The outcome was that those population sizes were well below the level that the habitat could support. For migrants that have both a winter and summer home, populations can be limited on the wintering grounds with the result that numbers are well below the level that could be supported by breeding habitat.

Geographic Location and Range Boundaries

Wildlife communities associated with boreal forests to our north and those associated with ecosystems to our south intersect in Pennsylvania. As a consequence, in addition to species in which Pennsylvania is part of its core geographic range, Pennsylvania also hosts species that reach or approach the southern limit of their geographic range in Pennsylvania. Examples include birds like the yellow-bellied flycatcher and mammals such as the water shrew. Although the water shrew is reported from the Appalachian Mountains south of Pennsylvania, it is considered exceedingly rare, as it is reported from only three locations across West Virginia, Virginia, and North Carolina (Webster et al. 1985). But even in Pennsylvania, populations of water shrews are isolated and rare, which reflect both the distribution of the species' habitat in Pennsylvania (high-elevation montane streams) and its sensitivity to water quality.

In addition to the water shrew, there are several assemblages of birds and mammals associated with higher-elevation ridges, which have correspondingly cooler climates and more northerly vegetation, and are often associated with coniferous forest, a habitat type that is much more common in the boreal forests to our north. These high-elevation Appalachian forests extend from Pennsylvania to western North Carolina but are isolated and fragmented at higher-elevations across Pennsylvania and even more so to the south. In the case of the boreal small mammals (rodents and shrews)—some of which are considered relatively common species—both population densities and local abundances decline toward the southern terminus of the Appalachian Mountains, even where suitable habitat exists (Steele and Powell 1999). Thus, the condition and status of these Appalachian forests in Pennsylvania, as well as the species that rely on them, serve as an important indicator for the forests and species to the south.

A second group of species reaches the northern

edge of their distribution in southeastern and southwestern Pennsylvania. In this region, the winters tend to be relatively mild and the summers hot. The mountainous regions prevalent in the northern and central parts of the state do not extend into this region. The topography is generally flat with low rolling hills. Species that reach the northern edge of their geographic range here include birds such as the Kentucky warbler (*Oporornis formosus*), barn owl, summer tanager (*Piranga rubra*), and great egret; mammals such as the West Virginia water shrew and spotted skunk; and amphibians and reptiles such as the New Jersey chorus frog (*Pseudacris kalmi*), southern leopard frog (*Lithobates sphenocephalus utricularia*), rough green snakes (*Opheodrys aestivus*), and broadhead skink (*Plestiodon laticeps*).

Biologists creating state-level lists of Species of Greatest Conservation Need are posed with a dilemma when dealing with these species at the edges of their geographic range. They are generally listed as species of concern because they are rare within the state. However, they may be abundant throughout other areas of their geographic range. Thus, the question is whether these species should be listed, and how does their relative importance as a species of concern compare with other species. One argument for listing has been that range contractions are often noted at the edge of the geographic range, and thus, monitoring species in these locations can be used as an early warning for potential problems or changes (see discussion on geographic ranges in chapter 1).

Appalachian Mountains and Wildlife Distribution

The Appalachian Mountains stretch across Pennsylvania as a series of parallel ridges that lie along a northeast-southwest direction and influence the distribution of wildlife in two important ways. These mountains form barriers to dispersal in some cases or conduits for geographic range expansions from the north in others. For amphibians and reptiles associated with lowland habitat, the mountains can serve as barriers to east-west dispersal (McCoy 1989). Consequently, we find a group of species that may be found to the east and west of the mountainous regions but not within them. Species of Greatest Conservation Need in this group include Fowler's toad (*Anaxyrus fowleri*), northern leopard frog (*Lithobates pipiens*), bog turtle, queen snake, and rough green snake. For others, such as the green salamander (*Aneides aeneus*) or mountain chorus frog, the mountains form an eastern barrier to dispersal, and the population is found to the west of the Allegheny Plateau. Species such as the eastern spadefoot toad (*Scaphiopus holbrookii*) are found to the east of Pennsylvania's mountainous regions. Finally, there are some species specifically adapted to mountainous habitats and restricted primarily to mountainous regions (McCoy 1989). These include reptiles such as the northern coal skink and timber rattlesnake and mammals such as the fisher (*Martes pennanti*) and northern flying squirrel.

The higher elevation of the ridge tops is associated with cooler climates and vegetation more common to the north. As a consequence, both mammals and birds that are more common to the north are able to expand their ranges southward into the commonwealth. The snowshoe hare and water shrew are examples of two mammalian Species of Greatest Conservation Need that show this pattern. These rather extensive ridge tops in Pennsylvania have historically represented a major corridor between the more extensive boreal forests to the north and the fragmented and isolated patches of high-elevation forests to the south.

The rocky ridges are generally forested, and the valleys between them are farmed or developed. The topography has played an important part in the importance of Pennsylvania to wildlife. The rocky ridges are generally not suitable for development, and, consequently, remain as relatively undisturbed large blocks of forest habitat. These provide habitats for many of Pennsylvania's forest specialists such as scarlet tanagers, broad-winged hawks (*Buteo platypterus*), and mammals such as the Allegheny woodrat and rock shrew.

The northeast-southwest ridges are also extremely important as corridors for migrating raptors and songbirds. The golden eagle (*Aquila chrysaetos*) is a Species of Greatest Conservation Need in Pennsylvania because of the high percentage of its population that migrates through the state during the spring and fall.

Pennsylvania the Keystone State

In this chapter, we have reviewed the habitat types of Pennsylvania and their importance to Species of Greatest Conservation Need within the state and the broader region of the east. Pennsylvania is uniquely situated in the East to have both the northern limit for many species that are found primarily in the southern United States and the southern geographic range limit for many species that are much more common to our north and within the boreal forests of Canada. The

northeast and southwest mountains serve as conduits for migration and dispersal for more vagile species and as barriers to dispersal for less mobile species. From a regional perspective, Pennsylvania is extremely important for supporting large populations of high-priority forest birds, while the large reclaimed strip mines provide valuable habitat for grassland species (Rosenberg and Wells 1995). Because of its location and diversity of habitats, Pennsylvania is home to an abundance of amphibian and reptile species. Pennsylvania is truly a keystone state in the East for wildlife because of its geographic location, topography, vegetation cover, and land use history.