PENNSYLVANIA
WILDLIFE ACTION PLAN

2015–2025

Species of Greatest Conservation Need Species Accounts

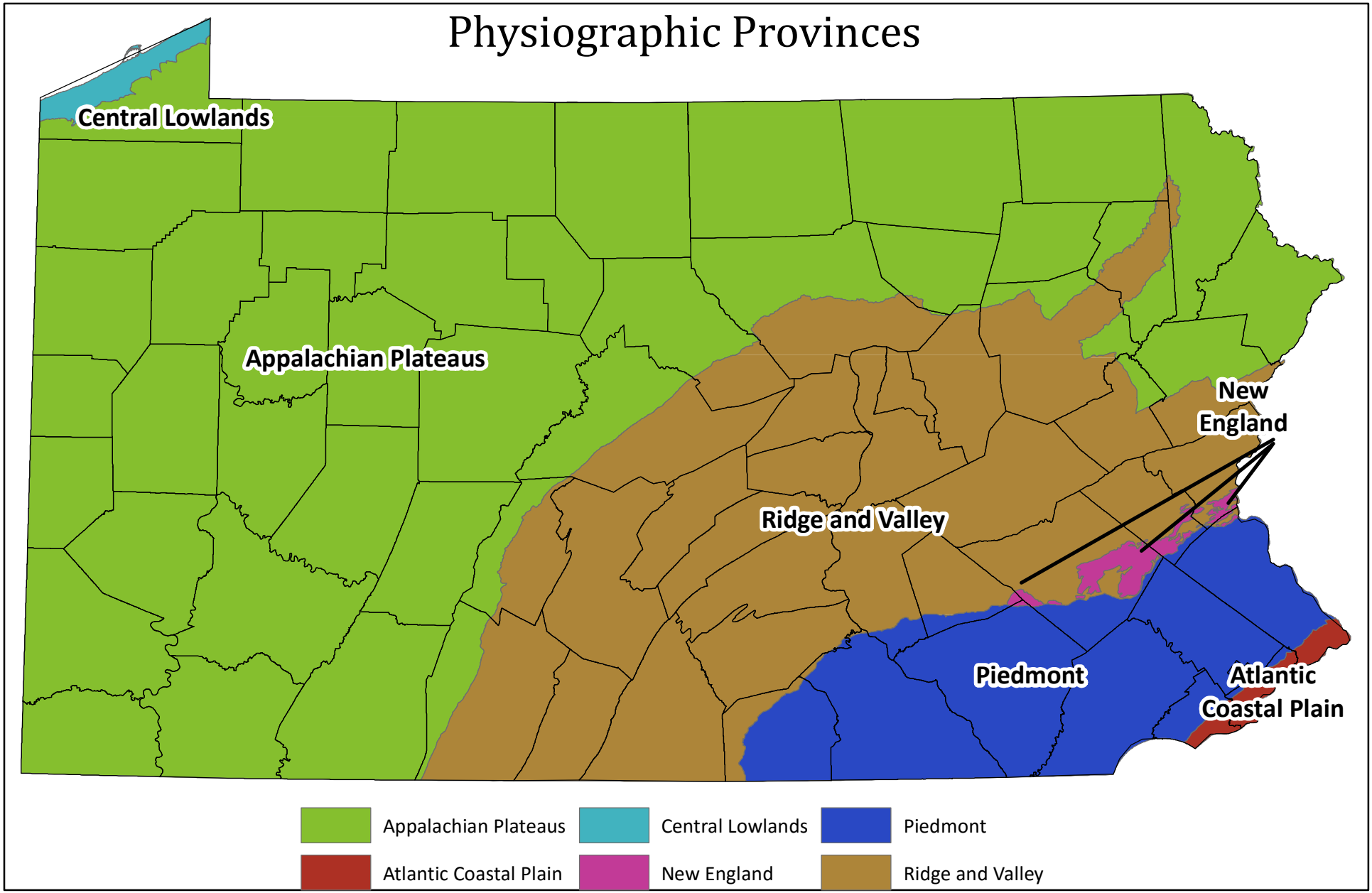
Appendix 1.4B-Mammals

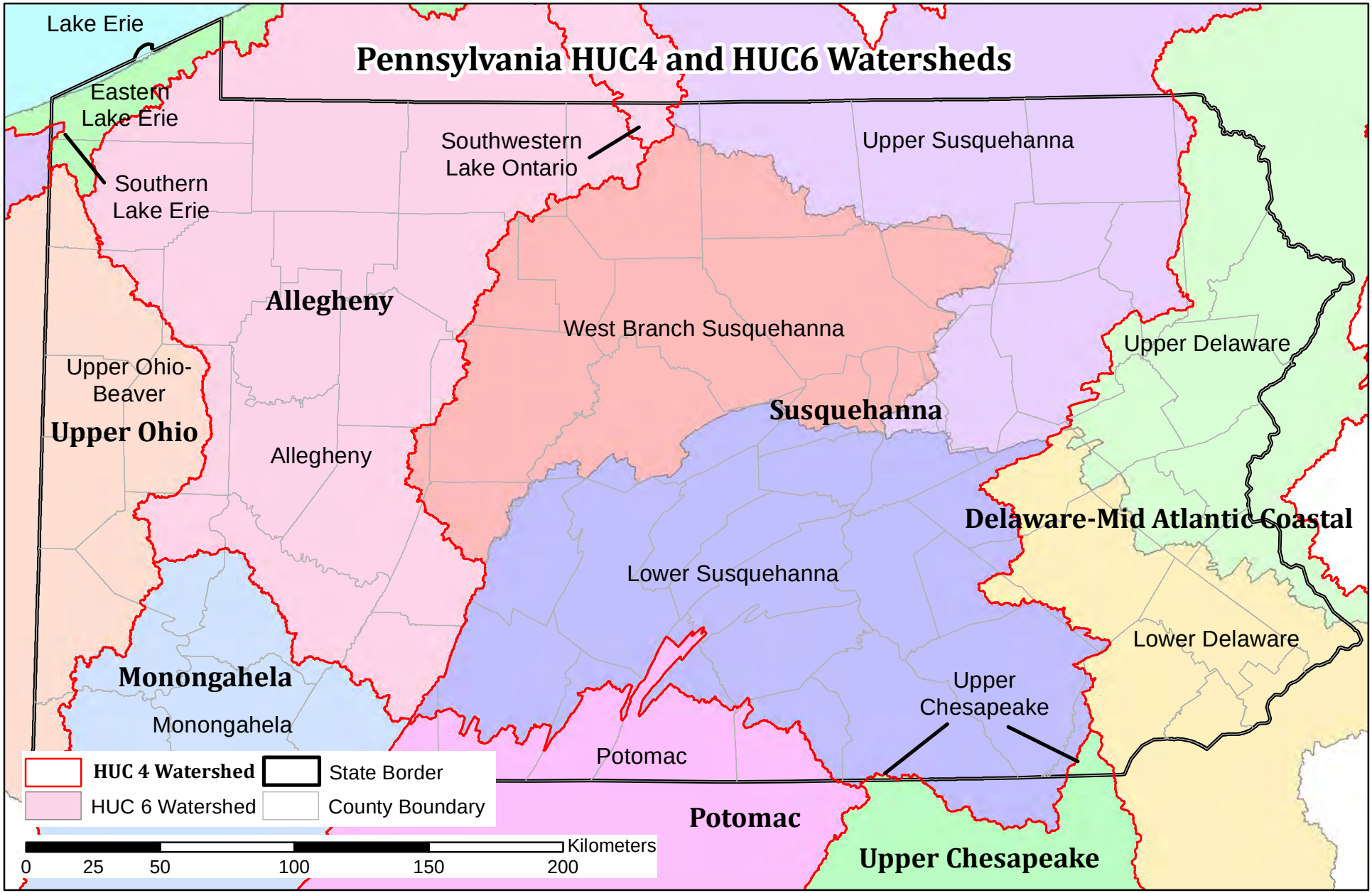
- *Mammalian Species of Greatest Conservation Need*
- *Maps: Physiographic Provinces and HUC Watersheds*
- *Species Accounts (Click species name below or bookmark to navigate to species account)*

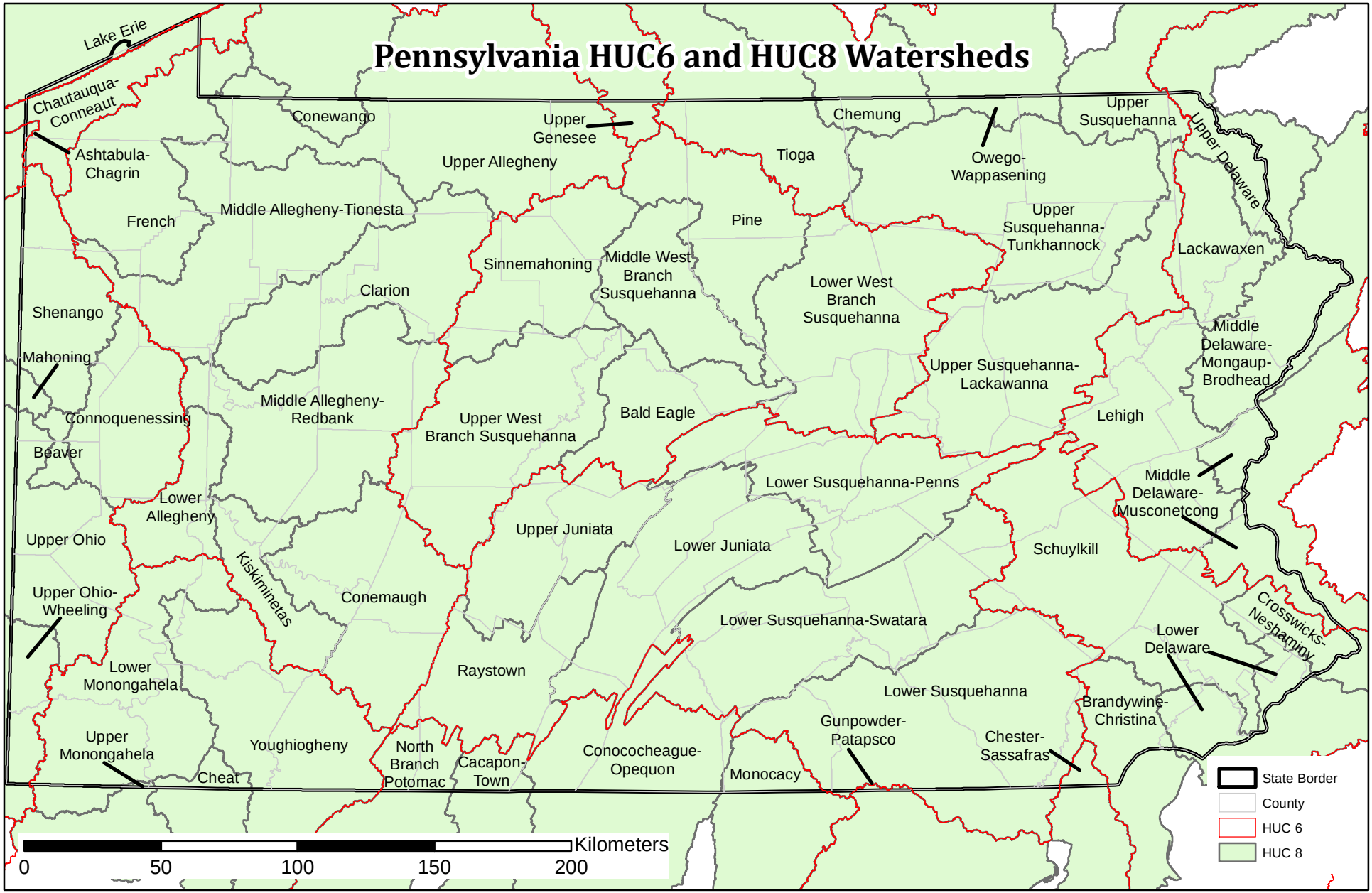
MAMMALS

Eastern Fox Squirrel
Northern Flying Squirrel
Rock Vole
Allegheny Woodrat
Prairie Deer Mouse
Appalachian Cottontail
North American Least Shrew
Long-tailed Shrew
Northern Water Shrew
West Virginia Water Shrew
Maryland Shrew
Big Brown Bat
Tricolored Bat
Northern Long-eared Bat
Eastern Small-footed Bat
Indiana Bat
Little Brown Bat
Silver-haired Bat
Eastern Spotted Skunk

The following Physiographic Province and HUC Watershed maps are presented here for reference with conservation actions identified in the species accounts. Species account authors identified appropriate Physiographic Provinces or HUC Watershed (Level 4, 6, 8, 10, or statewide) for specific conservation actions to address identified threats. HUC watersheds used in this document were developed from the Watershed Boundary Dataset, a joint project of the U.S. Dept. of Agriculture-Natural Resources Conservation Service, the U.S. Geological Survey, and the Environmental Protection Agency.


Physiographic Provinces
Central Lowlands
Appalachian Plateaus
New England
Ridge and Valley
Piedmont
Atlantic Coastal Plain
Appalachian Plateaus
Central Lowlands
Piedmont
Atlantic Coastal Plain
New England
Ridge and Valley


Pennsylvania HUC4 and HUC6 Watersheds
Lake Erie
Eastern Lake Erie
Southern Lake Erie
Southwestern Lake Ontario
Upper Susquehanna
Allegheny
West Branch Susquehanna
Upper Delaware
Upper Ohio-Beaver
Upper Ohio
Allegheny
Susquehanna
Delaware-Mid Atlantic Coastal
Lower Susquehanna
Lower Delaware
Monongahela
Monongahela
Upper Chesapeake
Potomac
Potomac
Upper Chesapeake
HUC 4 Watershed
State Border
HUC 6 Watershed
County Boundary
Kilometers
0 25 50 100 150 200


Pennsylvania HUC6 and HUC8 Watersheds
Lake Erie
Chautauqua-Conneaut
Conewango
Upper Genesee
Chemung
Upper Susquehanna
Upper Delaware
Ashtabula-Chagrin
Upper Allegheny
Tioga
Owego-Wappasening
French
Middle Allegheny-Tionesta
Pine
Upper Susquehanna-Tunkhannock
Lackawaxen
Sinnemahoning
Middle West Branch Susquehanna
Clarion
Lower West Branch Susquehanna
Shenango
Middle Delaware-Mongaup-Brodhead
Mahoning
Upper Susquehanna-Lackawanna
Middle Allegheny-Redbank
Connoquenessing
Upper West Branch Susquehanna
Bald Eagle
Lehigh
Beaver
Lower Susquehanna-Penns
Middle Delaware-Musconetcong
Lower Allegheny
Upper Juniata
Upper Ohio
Lower Juniata
Schuylkill
Kiskiminetas
Upper Ohio-Wheeling
Conemaugh
Crosswicks-Neshaminy
Lower Susquehanna-Swatara
Lower Delaware
Lower Monongahela
Raystown
Lower Susquehanna
Brandywine-Christina
Upper Monongahela
Youghiogheny
North Branch Potomac
Cacapon-Town
Conococheague-Opequon
Gunpowder-Patapsco
Chester-Sassafras
Cheat
Monocacy
State Border
County
HUC 6
HUC 8
Kilometers
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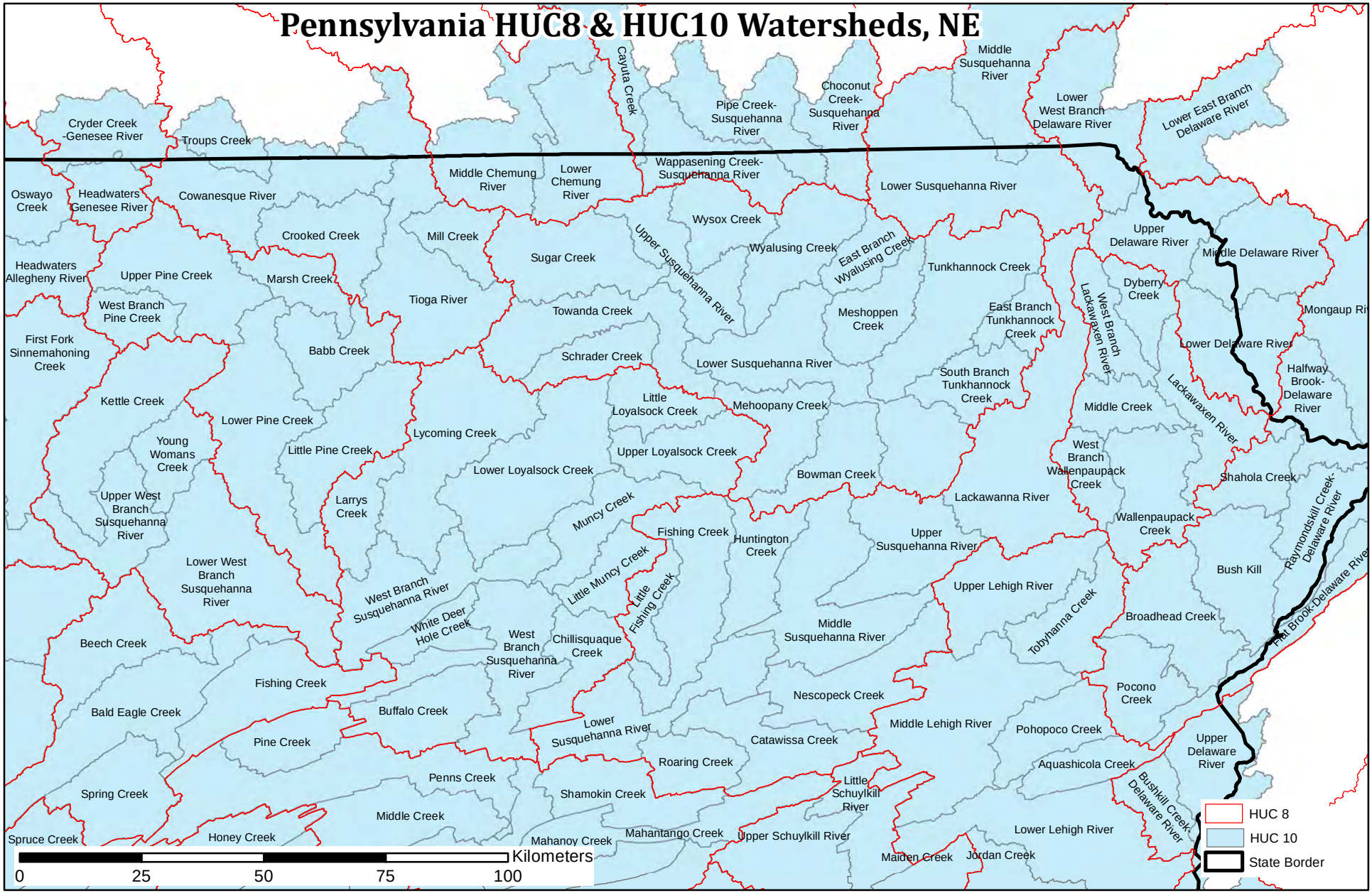
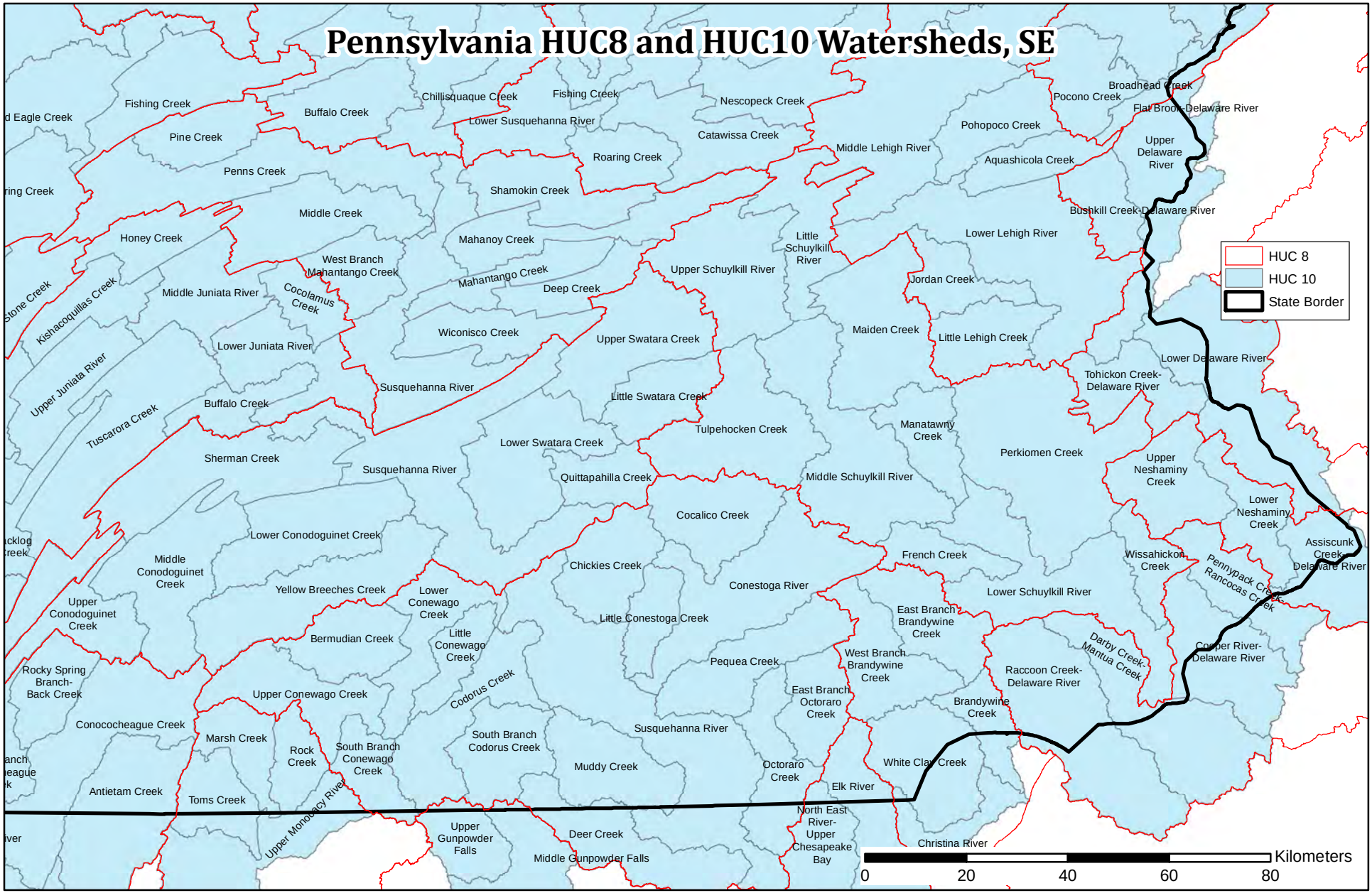
100
150
200


Pennsylvania HUC8 & HUC10 Watersheds, NE
Cryder Creek-Genesee River
Troups Creek
Cayuta Creek
Pipe Creek-Susquehanna River
Choconut Creek-Susquehanna River
Middle Susquehanna River
Lower West Branch Delaware River
Lower East Branch Delaware River
Oswayo Creek
Headwaters Genesee River
Cowanesque River
Middle Chemung River
Lower Chemung River
Wappasening Creek-Susquehanna River
Lower Susquehanna River
Wysox Creek
Crooked Creek
Mill Creek
Upper Susquehanna River
Wyalusing Creek
East Branch Wyalusing Creek
Upper Delaware River
Middle Delaware River
Headwaters Allegheny River
Upper Pine Creek
Marsh Creek
Sugar Creek
Tunkhannock Creek
Dyberry Creek
West Branch Pine Creek
Tioga River
Towanda Creek
Meshoppen Creek
East Branch Tunkhannock Creek
West Branch Lackawaxen River
Mongaup Ri
First Fork Sinnemahoning Creek
Babb Creek
Schrader Creek
Lower Susquehanna River
Lower Delaware River
South Branch Tunkhannock Creek
Halfway Brook-Delaware River
Kettle Creek
Little Loyalsock Creek
Mehoopany Creek
Middle Creek
Lackawaxen River
Lower Pine Creek
Young Womans Creek
Lycoming Creek
Little Pine Creek
Upper Loyalsock Creek
West Branch Wallenpaupack Creek
Lower Loyalsock Creek
Bowman Creek
Shahola Creek
Upper West Branch Susquehanna River
Larrys Creek
Muncy Creek
Lackawanna River
Wallenpaupack Creek
Fishing Creek
Huntington Creek
Upper Susquehanna River
Raymondskill Creek-Delaware River
Lower West Branch Susquehanna River
Little Muncy Creek
Little Fishing Creek
Bush Kill
West Branch Susquehanna River
White Deer Hole Creek
Upper Lehigh River
Tobyhanna Creek
Broadhead Creek
Beech Creek
West Branch Susquehanna River
Chillisquaque Creek
Middle Susquehanna River
Pal Brook-Delaware River
Fishing Creek
Nescopeck Creek
Pocono Creek
Bald Eagle Creek
Buffalo Creek
Lower Susquehanna River
Middle Lehigh River
Pohopoco Creek
Pine Creek
Catawissa Creek
Upper Delaware River
Roaring Creek
Aquashicola Creek
Penns Creek
Little Schuylkill River
Bushkill Creek-Delaware River
Spring Creek
Shamokin Creek
Middle Creek
Lower Lehigh River
Spruce Creek
Honey Creek
Mahanoy Creek
Mahantango Creek
Upper Schuylkill River
Maiden Creek
Jordan Creek
Kilometers
0
25
50
75
100
HUC 8
HUC 10
State Border


Pennsylvania HUC8 and HUC10 Watersheds, SE
HUC 8
HUC 10
State Border
Kilometers
0
20
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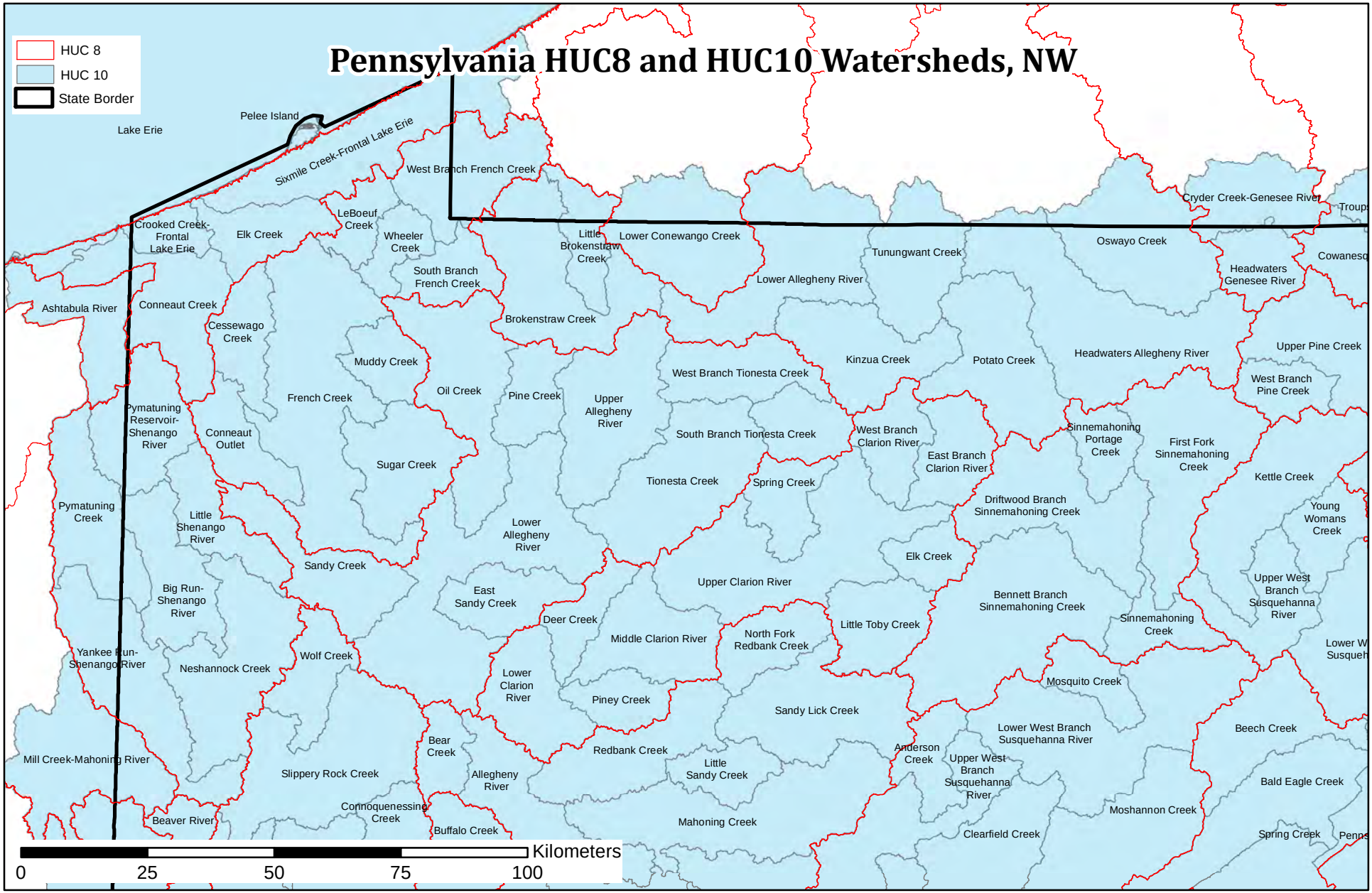
80
Fishing Creek
Buffalo Creek
Chillisquaque Creek
Fishing Creek
Lower Susquehanna River
Nescopeck Creek
Catawissa Creek
Roaring Creek
Middle Lehigh River
Pocono Creek
Broadhead Creek
Flat Brook-Delaware River
Pohopoco Creek
Aquashicola Creek
Upper Delaware River
Pine Creek
Penns Creek
Shamokin Creek
Middle Creek
Honey Creek
Mahanoy Creek
Little Schuylkill River
Lower Lehigh River
Bushkill Creek-Delaware River
West Branch Mahantango Creek
Mahantango Creek
Upper Schuylkill River
Deep Creek
Jordan Creek
Middle Juniata River
Cocolamus Creek
Kishacoquillas Creek
Wiconisco Creek
Upper Swatara Creek
Maiden Creek
Little Lehigh Creek
Lower Juniata River
Upper Juniata River
Susquehanna River
Little Swatara Creek
Lower Delaware River
Tohickon Creek-Delaware River
Buffalo Creek
Tuscarora Creek
Tulpehocken Creek
Manatawny Creek
Lower Swatara Creek
Perkiomen Creek
Sherman Creek
Susquehanna River
Quittapahilla Creek
Middle Schuylkill River
Upper Neshaminy Creek
Cocalico Creek
Lower Neshaminy Creek
Lower Conodoguinet Creek
Assiscunk Creek
Delaware River
Middle Conodoguinet Creek
Chickies Creek
French Creek
Wissahickon Creek
Pennypack Creek
Rancocas Creek
Yellow Breeches Creek
Lower Conewago Creek
Conestoga River
Lower Schuylkill River
Upper Conodoguinet Creek
Little Conestoga Creek
East Branch Brandywine Creek
Bermudian Creek
Little Conewago Creek
Darby Creek-Mantua Creek
Cooper River-Delaware River
Pequea Creek
West Branch Brandywine Creek
Rocky Spring Branch-Back Creek
Raccoon Creek-Delaware River
Codorus Creek
East Branch Octoraro Creek
Upper Conewago Creek
Brandywine Creek
Conococheague Creek
Susquehanna River
Marsh Creek
South Branch Codorus Creek
Rock Creek
South Branch Conewago Creek
Muddy Creek
Octoraro Creek
White Clay Creek
Antietam Creek
Toms Creek
Elk River
Upper Monocacy River
North East River-Upper Chesapeake Bay
Upper Gunpowder Falls
Deer Creek
Christina River
Middle Gunpowder Falls


Pennsylvania HUC8 and HUC10 Watersheds, NW
HUC 8
HUC 10
State Border
Lake Erie
Pelee Island
Sixmile Creek-Frontal Lake Erie
West Branch French Creek
Crooked Creek-Frontal Lake Erie
Elk Creek
LeBoeuf Creek
Wheeler Creek
Little Brokenstraw Creek
Lower Conewango Creek
Cryder Creek-Genesee River
Oswayo Creek
Tunungwant Creek
Lower Allegheny River
South Branch French Creek
Headwaters Genesee River
Ashtabula River
Conneaut Creek
Cessewago Creek
Brokenstraw Creek
Muddy Creek
Kinzua Creek
Potato Creek
Headwaters Allegheny River
Upper Pine Creek
West Branch Tionesta Creek
West Branch Pine Creek
French Creek
Oil Creek
Pine Creek
Upper Allegheny River
Pymatuning Reservoir-Shenango River
Conneaut Outlet
South Branch Tionesta Creek
West Branch Clarion River
Sinnemahoning Portage Creek
First Fork Sinnemahoning Creek
East Branch Clarion River
Sugar Creek
Tionesta Creek
Spring Creek
Kettle Creek
Pymatuning Creek
Little Shenango River
Driftwood Branch Sinnemahoning Creek
Young Womans Creek
Lower Allegheny River
Elk Creek
Sandy Creek
Upper Clarion River
Upper West Branch Susquehanna River
Big Run-Shenango River
East Sandy Creek
Bennett Branch Sinnemahoning Creek
Deer Creek
Little Toby Creek
Sinnemahoning Creek
Middle Clarion River
North Fork Redbank Creek
Yankee Run-Shenango River
Wolf Creek
Neshannock Creek
Lower Clarion River
Mosquito Creek
Piney Creek
Sandy Lick Creek
Lower West Branch Susquehanna River
Beech Creek
Bear Creek
Redbank Creek
Anderson Creek
Upper West Branch Susquehanna River
Mill Creek-Mahoning River
Slippery Rock Creek
Allegheny River
Little Sandy Creek
Bald Eagle Creek
Connoquenessing Creek
Moshannon Creek
Beaver River
Buffalo Creek
Mahoning Creek
Clearfield Creek
Spring Creek
Kilometers
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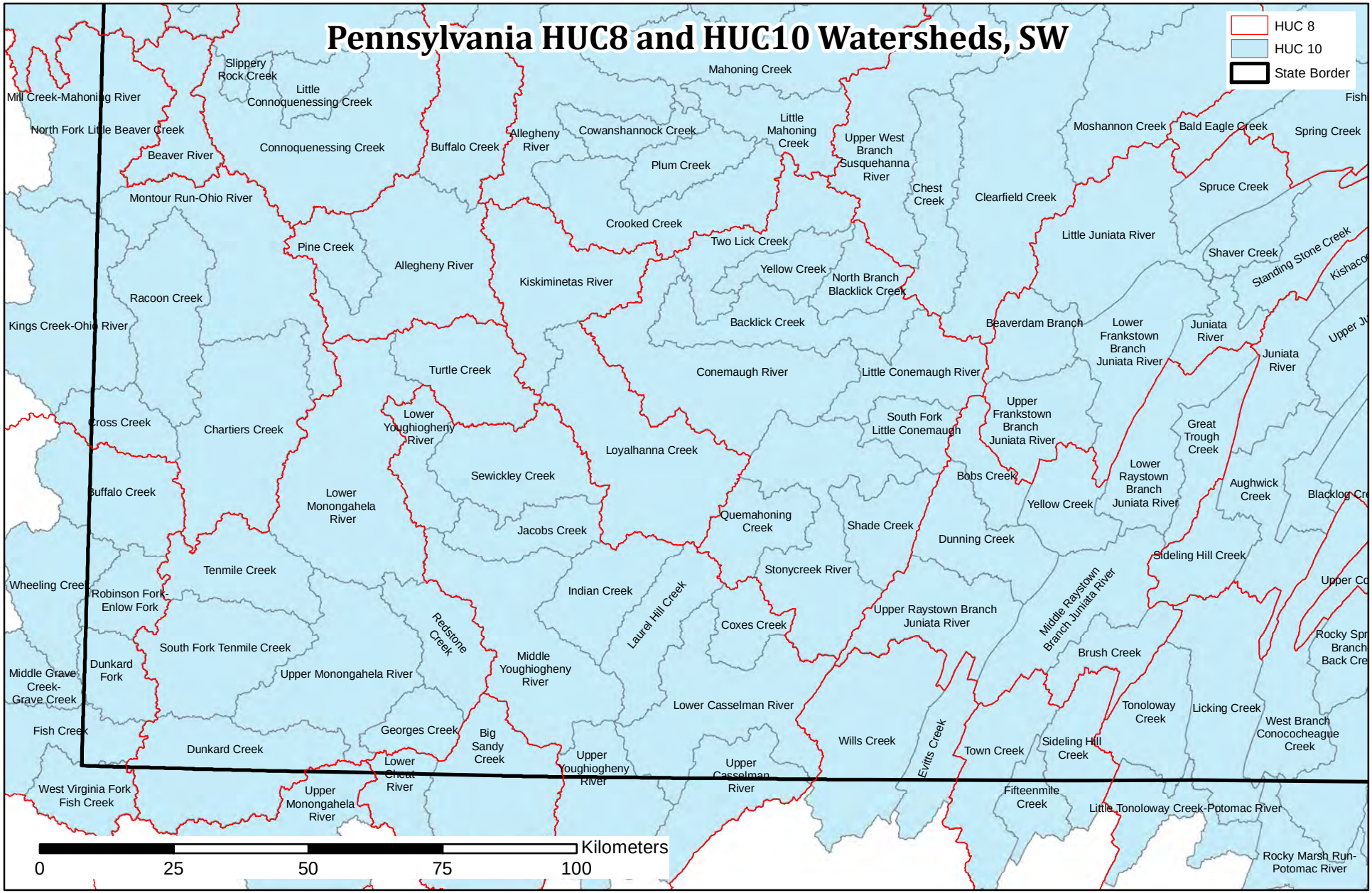
Pennsylvania HUC8 and HUC10 Watersheds, SW
HUC 8
HUC 10
State Border
Slippery Rock Creek
Little Connoquenessing Creek
Mill Creek-Mahoning River
North Fork Little Beaver Creek
Beaver River
Connoquenessing Creek
Buffalo Creek
Allegheny River
Cowanshannock Creek
Mahoning Creek
Little Mahoning Creek
Upper West Branch Susquehanna River
Plum Creek
Chest Creek
Clearfield Creek
Moshannon Creek
Bald Eagle Creek
Spring Creek
Spruce Creek
Montour Run-Ohio River
Crooked Creek
Two Lick Creek
Yellow Creek
North Branch Blacklick Creek
Pine Creek
Allegheny River
Kiskiminetas River
Racoon Creek
Kings Creek-Ohio River
Backlick Creek
Beaverdam Branch
Lower Frankstown Branch Juniata River
Juniata River
Little Juniata River
Shaver Creek
Standing Stone Creek
Turtle Creek
Conemaugh River
Little Conemaugh River
Cross Creek
Chartiers Creek
Lower Youghiogheny River
South Fork Little Conemaugh
Upper Frankstown Branch Juniata River
Great Trough Creek
Loyalhanna Creek
Sewickley Creek
Bobs Creek
Lower Raystown Branch Juniata River
Aughwick Creek
Buffalo Creek
Lower Monongahela River
Quemahoning Creek
Shade Creek
Yellow Creek
Jacobs Creek
Dunning Creek
Sideling Hill Creek
Tenmile Creek
Stonycreek River
Wheeling Creek
Robinson Fork
Enlow Fork
Indian Creek
Laurel Hill Creek
Redstone Creek
Coxes Creek
Upper Raystown Branch Juniata River
Middle Raystown Branch Juniata River
Brush Creek
South Fork Tenmile Creek
Dunkard Fork
Middle Youghiogheny River
Upper Monongahela River
Middle Grave Creek-Grave Creek
Lower Casselman River
Tonoloway Creek
Licking Creek
West Branch Conococheague Creek
Fish Creek
Georges Creek
Big Sandy Creek
Wills Creek
Evitts Creek
Sideling Hill Creek
Town Creek
Dunkard Creek
Lower Cheat River
Upper Youghiogheny River
Upper Casselman River
West Virginia Fork Fish Creek
Upper Monongahela River
Fifteenmile Creek
Little Tonoloway Creek-Potomac River
Rocky Marsh Run-Potomac River
Kilometers
0
25
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75
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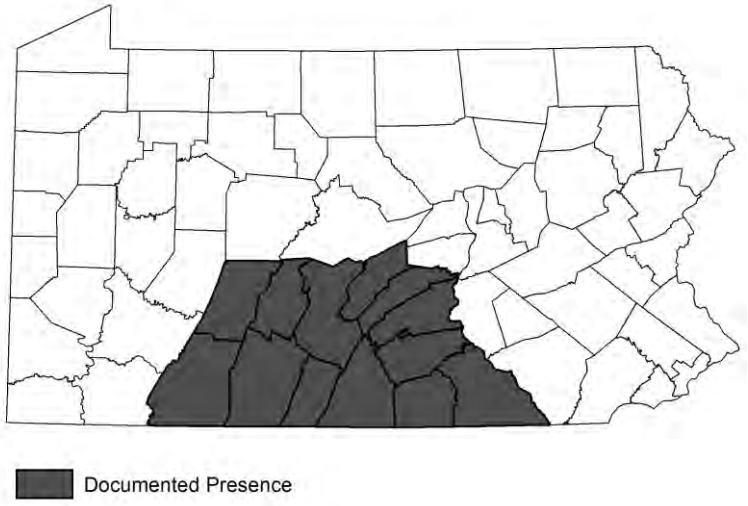
Eastern Fox Squirrel

Sciurus niger vulpinus

Emily S. Boyd
Pennsylvania Game Commission

Photo: Wikimedia Commons



CONSERVATION PROFILE

Global Rank	**G5T4T5**	State Rank	**S2**
IUCN Red List	**Not Yet Assessed**	PA Legal Status	**Protected**
Northeast Region	**Not NE Regional SGCN**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Relatively Stable (<=10% change)**

Conservation Goal:

Improve confidence in distribution and abundance data and determine degree of genetic variability between *S. n. vulpinus* subspecies, including comparisons with populations from Virginia, Maryland, and West Virginia.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Northern Hardwood & Conifer**	
Habitat	**Appalachian (Hemlock)-Northern Hardwood Forest**	

Specific Habitat Requirements:

Open, park-like woods with sparse ground cover.

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: The expansion of western fox squirrel (*S. n. rufiventer*) range into areas historically occupied by eastern fox squirrels is likely diluting the genetic integrity of eastern fox squirrel populations.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 101.0 Species Management Reduce western fox squirrel (*S. n. rufiventer*) source populations near known eastern fox squirrel populations (*S. n. vulpinus*).	Reduce the potential of cross breeding between eastern and western fox squirrels.	Number of eastern fox squirrel populations that are protected.	Annually collect DNA and monitor population dynamics of eastern and western fox squirrel populations that are in close proximity to each other.	1

Action Location: Physiographic Province: Appalachian Plateaus, Piedmont, Ridge and Valley

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: It is unknown how small and fragmented populations may respond to pressures that reduce population density.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 6.0 Land and Water Rights Acquisition and Protection Monitor hunting pressure in areas identified to have genetically pure *S. n. vulpinus*, until more is known about the abundance, distribution, and the influence of hunting on eastern fox squirrel populations.	Protect populations of eastern fox squirrel from over-harvesting.	Number of eastern fox squirrel populations that are protected.	Monitor protected populations of eastern fox squirrel and compare to unprotected populations of eastern fox squirrel to determine effectiveness of populations protection every year.	2

Action Location: Physiographic Province: Appalachian Plateaus, Piedmont, Ridge and Valley

Eastern Fox Squirrel *Sciurus niger vulpinus*

RESEARCH NEEDS

1. To what extent do eastern and western fox squirrels interbreed?

SURVEY NEEDS

1. Survey Pennsylvania's fox squirrel population to determine distribution of eastern and western fox squirrels.

MONITORING PROGRAMS

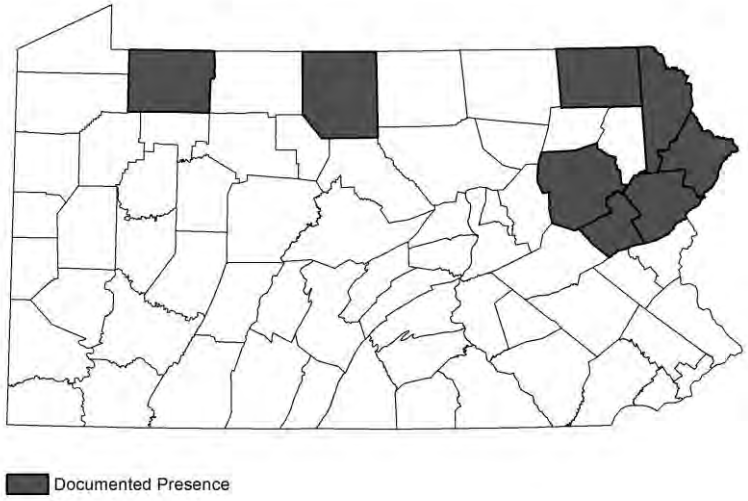
Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

Northern Flying Squirrel

Glaucomys sabrinus

Michael A. Steele
Wilkes University

Photo: Larry Master



CONSERVATION PROFILE

Global Rank	**G5**	State Rank	**S1**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Endangered**
Northeast Region	**Not NE Regional SGCN**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of 11 - 60%**

Conservation Goal:

Maintain known populations and meta population in northeast portion of the state and expand current known range (~15% of historic range) to 25% of range. Continue to explore historic range to improve confidence of distribution.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Northern Hardwood & Conifer**	**Northern Hardwood & Conifer**
Habitat	**Appalachian (Hemlock)-Northern Hardwood Forest**	**Appalachian (Hemlock)-Northern Hardwood Forest**

Specific Habitat Requirements:

Mature, mixed-deciduous-hemlock/spruce/fir stands with closed canopies, open ground cover with a rhododendron component, and thick leaf litter. The best habitats have a red spruce component.

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: This species frequently hybridizes with the southern flying squirrel (*G. volans*). This hybridization appears to follow from climate warming and loss of habitat for northern flying squirrel.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Reduce hybridization between species through habitat modification by increasing habitat specific to northern flying squirrels.	Daylight existing spruce trees or plant 5000 red spruce in next 10 years.	Number of trees planted or number of acres of existing spruce daylighted.	Once every 10 years, assess the number of northern flying squirrels that have hybridized and the amount of spruce habitat generated.	1

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Snowshoe hare, Yellow-bellied Flycatcher, Blackpoll Warbler

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Northward movement of southern flying squirrel has increased competition for resources and introduced the nematode parasite *Strongyloides robustus*.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Reduce the spread of the parasite through separation of the species through habitat modifications. To reduce interspecific interactions, at known northern flying squirrel population: 1) remove mast-bearing trees that promote southern flying squirrel and 2) plant/daylight red spruce to promote northern flying squirrel use.	Daylight existing spruce trees or plant 5000 red spruce in next 10 years.	Number of trees planted or number of acres of existing spruce daylighted.	Annually for at least 10 years, assess via fecal sampling for presence of parasite eggs the number of northern flying squirrels infected with the parasite	1

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Snowshoe hare, Yellow-bellied Flycatcher, Blackpoll Warbler

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Loss of mature eastern hemlock stands due to hemlock wooly adelgid

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Assess the potential for loss of hemlock due to wooly adelgid aphid and proactively replace dead stands with red spruce.	Identify hemlock habitat within 1-mile radius of known populations and assess levels of risk to aphid infestation; plant red spruce seedlings in areas where hemlock loss is deemed most significant.	Quantify loss of hemlock stands in primary and secondary stands around known populations; determine survival and growth of red spruce where planted.	Annually for at least 10 years, measure retention of hemlock and growth of red spruce through ground-truthing and remote sensing analysis.	1

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Northern Goshawk, snowshoe hare, aquatic fauna, silver-haired bat, Yellow-bellied Flycatcher.

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: Removal of coniferous timber, fragmentation, and habitat degradation across the state, including state-owned property.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Prevent impacts where established populations are known. Maintain old-growth characteristics and retention of dead snags within 1 mile radius of established populations and a more limited level of forest protection for 5-mile radius. This secondary area of protection should include a 50% maintenance of mature conifer and mixed conifer, including snags for nest cavities.	Delineate known populations and habitats for primary (1-mile radius) and secondary (5-mile radius) management.	Detailed map of all sites showing primary and secondary management areas.	Every 5 years, quantify species richness and age of forest habitat through ground-truthing and remote sensing analysis.	2

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Northern Goshawk, snowshoe hare, aquatic fauna, silver-haired bat, Yellow-bellied Flycatcher.

THREATS AND ACTIONS

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Habitat loss and fragmentation especially in the Poconos.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Prevent development and maintain snags and mature trees where established populations are known, as practicable.	Identify sites where new development is in close proximity to known populations. Assess habitat quality before and after development.	Amount of suitable habitat lost and maintained.	Every 5 years, determine and monitor trends in habitat loss/gains through ground-truthing and remote sensing analysis.	2

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Northern Goshawk, snowshoe hare, aquatic fauna, silver-haired bat, Yellow-bellied Flycatcher.

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Habitat loss and fragmentation, especially in the Poconos where a sizeable meta-population exists.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Prevent development and maintain snags mature trees where established populations are known, as practicable.	Identify sites where new development is in close proximity to known populations. Assess habitat quality before and after development.	Amount of suitable habitat lost and maintained.	Every 5 years, determine and monitor trends in habitat loss/gains through ground-truthing and remote sensing analysis.	2

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Northern Goshawk, snowshoe hare, aquatic fauna, silver-haired bat, Yellow-bellied Flycatcher.

RESEARCH NEEDS

1. Genetic research is needed to document extent of hybridization zone between *G. sabrinus* and *G. volans*.

2. Captive studies should be conducted to determine the probability of hybridization with *G. volans* and the potential impact of *Strongyloides robustus* on *G. sabrinus*.

SURVEY NEEDS

1. Annual live-trapping and nest box surveys of both flying squirrel species at known sites of occupancy for *G. sabrinus* and additional historic sites. Surveys should especially focus on the Poconos where a sizeable meta-population exists.

2. All demographic surveys should include collection of tissue samples for genetic studies and fecal samples for parasite analyses.

3. Habitat suitability surveys using GIS and ground-truthing should be conducted within in 1-mile and 5-mile radius of known sites of occupancy to periodically determine status and changes in habitat due to development, resource use, logging, etc. Such surveys should be repeated every 5-10 years.

MONITORING PROGRAMS

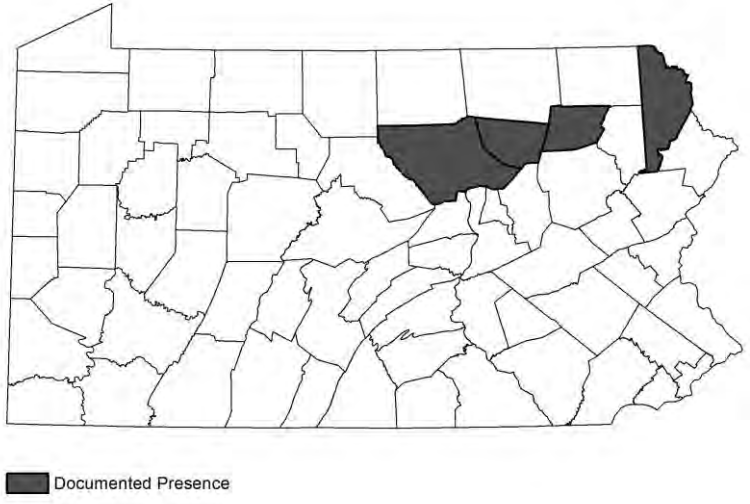
Program Name	Lead Agency	Hyperlink	Description
Pennylvania Game Commission annual occupancy surveys	Pennsylvania Game Commission		Nest-box surveys and live-trapping conducted at sites throughout state to assess occupancy and gather samples.

Rock Vole

Microtus chrotorrhinus

Lindsey M. Heffernan
Pennsylvania Game Commission

Photo: Cal Butchkoski



CONSERVATION PROFILE

Global Rank	**G4**	State Rank	**S3**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**Not NE Regional SGCN**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Unknown**

Conservation Goal:

Improve confidence in data to allow detection of +/- 10% change over 10 years.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Northern Hardwood & Conifer**	
Habitat	**Appalachian (Hemlock)-Northern Hardwood Forest**	

Specific Habitat Requirements:

High elevation, northern hardwood forests characterized by rocks and talus, streams, mosses, and heavy forb cover (Kirkland and Jannett 1982, Orrock et al. 1999, Orrock and Pagels 2003, Hart in PGC-PFBC 2005).

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Habitat fragmentation from the creation of well pads, pipelines, and roads.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Determine the effects of fragmentation related to oil and gas drilling on rock voles, and create/apply Best Management Practices (BMPs) to new projects if the results are significantly negative.	Locate and quantify abundance at two sites before and after drilling to determine impacts caused by fragmentation to this species.	Change in abundance of this species.	Monitor via trapping and radio-telemetry rock vole population parameters at sites that have implemented BMPs, and compare to parameters collected at sites that have not implemented BMPs.	3

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: Masked shrew, smoky shrew, long-tailed shrew, woodland jumping mouse

RESEARCH NEEDS

1. Evaluation of the effects of habitat disturbance, and specifically oil and gas projects, on rock voles.

SURVEY NEEDS

1. Surveys to determine baseline population parameters and demographics (can include trapping, tagging, and radio-telemetry).

2. Surveys to determine the impacts of oil and gas projects on rock voles before and after habitat fragmentation.

MONITORING PROGRAMS

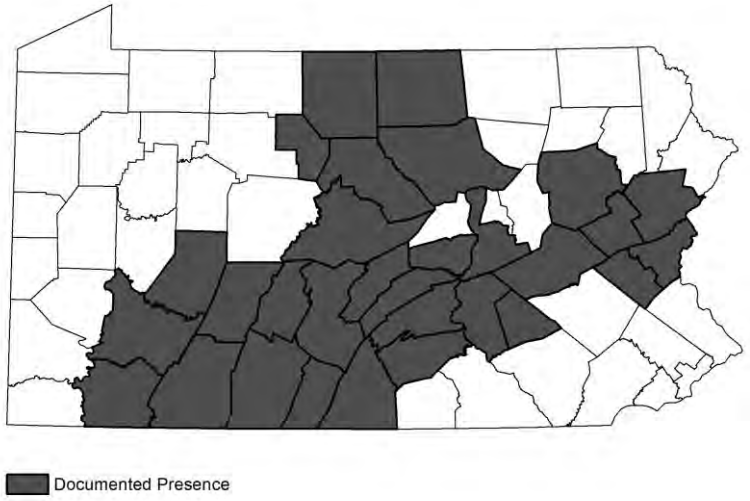
Program Name	Lead Agency	Hyperlink	Description
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

Allegheny Woodrat

Neotoma magister

Lindsey M. Heffernan
Pennsylvania Game Commission

Photo: Joe Kosack



CONSERVATION PROFILE

Global Rank	**G3G4**	State Rank	**S2**
IUCN Red List	**NT Near Threatened**	PA Legal Status	**Threatened**
Northeast Region	**Very High Concern / High Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of 11-40%**

Conservation Goal:

Maintain viable breeding populations in 12 woodrat Conservation Management Areas through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Central Oak-Pine**	**Central Oak-Pine**
Habitat	**Central Appalachian Dry Oak-Pine Forest**	**Northeastern Interior Dry-Mesic Oak Forest**

Specific Habitat Requirements:

Extensive expanses of sandstone and/or limestone rock outcrops in unfragmented oak-hickory forest communities.

THREATS AND ACTIONS

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Habitat fragmentation from railroads and roads which can lead to barriers to dispersal and increased predation.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Minimize or avoid siting proposed railroad and road projects within woodrat habitat and dispersal corridors.	Review all proposed projects for negative impacts to woodrats, offer siting guidance, and provide Best Management Practices.	Number of projects reviewed that would impact woodrats, and percent that were able to minimize or avoid such impacts.	Monitor woodrat habitat and dispersal corridor fragmentation as related to these projects using desktop reviews or site visits.	1

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Eastern spotted skunk, eastern small-footed bat, long-tailed shrew

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Habitat fragmentation from wind energy infrastructure which can lead to barriers to dispersal and increased predation.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Minimize or avoid siting proposed wind energy projects within woodrat habitat and dispersal corridors.	Review all proposed projects for negative impacts to woodrats, offer siting guidance, and provide Best Management Practices.	Number of projects reviewed that would impact woodrats, and percent that were able to minimize or avoid such impacts	Monitor woodrat habitat and dispersal corridor fragmentation as related to these projects using desktop reviews or site visits.	1

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Eastern spotted skunk, eastern small-footed bat, long-tailed shrew

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Removal of rocky habitat used by woodrats from the creation of mines, quarries, and roads; barriers to dispersal.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Minimize or avoid siting proposed mining and quarrying projects within woodrat habitat and dispersal corridors.	Review all proposed projects for negative impacts to woodrats, offer siting guidance, and provide Best Management Practices.	Number of projects reviewed that would impact woodrats, and percent that were able to minimize or avoid such impacts	Monitor woodrat habitat and dispersal corridor fragmentation as related to these projects using desktop reviews or site visits.	1

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Eastern spotted skunk, eastern small-footed bat, long-tailed shrew

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Habitat fragmentation from oil and gas infrastructure which can lead to barriers to dispersal and increased predation.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Minimize or avoid siting proposed oil and gas projects within woodrat habitat and dispersal corridors.	Review all proposed projects for negative impacts to woodrats, offer siting guidance, and provide Best Management Practices.	Number of projects reviewed that would impact woodrats, and percent that were able to minimize or avoid such impacts	Monitor woodrat habitat and dispersal corridor fragmentation as related to these projects using desktop reviews or site visits.	1

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Eastern spotted skunk, eastern small-footed bat, long-tailed shrew

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Mortality caused by exposure to raccoon roundworm.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Determine baseline raccoon roundworm levels for each woodrat Conservation Management Area, and apply repeated treatments to five active woodrat sites.	Number of sites that received treatment	Monitor raccoon roundworm prevalence within each Conservation Management Area and five treated woodrat sites annually for ten years	2
Decrease or maintain low levels of raccoon roundworm within woodrat habitat and dispersal corridors.					

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Squirrels, other rodents

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Loss of American chestnut (*Castanea dentata*) mast as a food source due to chestnut blight.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Plant hybrid chestnut trees at five active woodrat sites within the next ten years.	Number of chestnut trees planted and sites receiving treatment.	Monitor the survival and mast production of planted chestnut trees with visual surveys conducted at each site once every two years for 10-20 years.	2
Increase the number of mast-producing chestnut trees within woodrat habitat and dispersal corridors.					

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Eastern spotted skunk

Allegheny Woodrat *Neotoma magister*

RESEARCH NEEDS

1. Conservation Management Area success over time, focusing on trends in woodrat presence/absence over the next ten years.

2. Evaluation of the short and long term effects of woodrat-specific habitat improvement practices, including hybrid chestnut plantings, on woodrat reproduction and survival.

3. Determination of sites most suitable for the release of captive bred woodrats based on genetic diversity and prevalence of raccoon roundworm.

SURVEY NEEDS

1. Continued inventory and trapping surveys to document woodrat presence within each Conservation Management Area, and analyses of data to characterize differences in successful versus declining areas.

2. Continued surveys that measure the reproduction and survival of woodrats at sites where woodrat-specific habitat improvement practices have been, or will be, implemented.

3. Surveys to determine the baseline and continuous levels of raccoon roundworm within woodrat habitat, focusing on sites that a) are spread across Conservation Management Areas b)will be treated for roundworm, and c) have low genetic diversity and may be selected for captive-bred woodrat releases.

MONITORING PROGRAMS

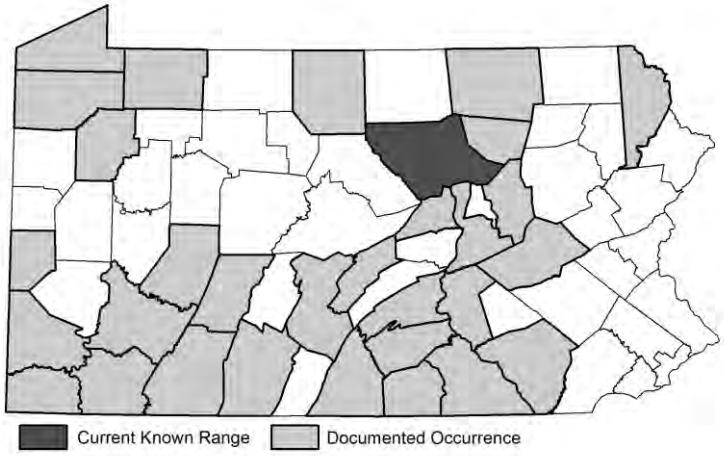
Program Name	Lead Agency	Hyperlink	Description
Allegheny Woodrat Captive Breeding Program	Delaware Valley University	http://www.delval.edu/news/restoring-the-allegheny-woodrat-population	The woodrat captive breeding program originated at Purdue University and was relocated to Pennsylvania. Release of progeny will supplement low genetic diversity in our state's wild populations. Focus areas for release will be guided by the results of the genetic catalog.
Developing a Genetic Catalog for Allegheny Woodrat Metapopulations in Pennsylvania: Identifying conservation concerns and guiding management action.	Indiana University of Pennsylvania		Researchers from the college collected woodrat genetic samples from multiple sites across Pennsylvania and will be finalizing results in 2015. The genetic catalog will guide management actions and eventual release of woodrats from the captive breeding program.
Statewide Allegheny Woodrat Inventory and Monitoring Program	Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt?open=514&objID=1935066&mode=2	Each year, a subset of potential and known sites are surveyed for evidence of woodrat activity, food availability, and predators. Techniques include live trapping and visual surveys.

Prairie Deer Mouse

Peromyscus maniculatus bairdii

Charlie Eichelberger
PA Natural Heritage Program/ Western Pennsylvania Conservancy

Photo: John Wible



CONSERVATION PROFILE

Global Rank	**G5**	State Rank	**S3S4**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**Not NE Regional SGCN**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of 30 - 70%**

Conservation Goal:

Over the next 10 years, determine the distribution of this subspecies and model all potential habitat in Pennsylvania based on inventory results.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup		
Habitat		

Specific Habitat Requirements:

This subspecies is able to inhabit most open habitats with some herbaceous layer. Historically it is thought that the subspecies naturally occurred on the sand dune grasslands and adjacent glacial prairie habitats in the northwestern part of Pennsylvania. As land was cleared for agriculture and utility rights-of-way, the Prairie Deer Mouse expanded it's range south and eastward. In the Midwest, the subspecies is known to live in grasslands, fallow fields, grassy sand dunes, and even cultivated fields.

THREATS AND ACTIONS

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Loss of grassland habitat from natural succession and fire suppression.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Encourage grassland maintenance and restoration through mowing, mechanical shrub and tree removal, or prescribed fire.	Work with conservation organizations experienced with prescribed fire, and initiate burns to maintain and restore habitat for the Prairie Deer Mouse at 10 occupied and 5 formerly occupied sites.	The number of Prairie Deer Mouse occupied sites maintained and the number of formerly occupied sites restored.	Monitor the success of management efforts by following prescribed burns with periodic monitoring of the Prairie Deer Mouse populations.	2

Action Location: Physiographic Province: Central Lowland, Appalachian Plateaus, Ridge and Valley

Associated Species: North American least shrew

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Conversion of open and agricultural lands to housing and commercial development.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Encourage municipalities to maintain existing grasslands and agricultural lands as they are, and prevent them from being developed.	By working with county planning departments/commissions, initiate preservation of core agricultural areas at 10 locations known to harbor the Prairie Deer Mouse.	Number of Prairie Deer Mouse populations protected through agricultural preservation.	Record acreage of preserved land known to harbor the Prairie Deer Mouse, and periodically reconfirm the presence of the Prairie Deer Mouse at those preserved tracts every five years using live trapping techniques.	2

Action Location: Physiographic Province: Central Lowland, Appalachian Plateaus, Ridge and Valley

Associated Species: North American least shrew

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Competition with other native mammals that inhabit open habitats.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 101.0 Species Management Study the interactions that other native mammals and predatory mammals, reptiles and birds have on this subspecies.	Over 10 years, determine the density ratios of the native small mammal community at known Prairie Deer Mouse sites, and determine if a higher population density of a particular species negatively impacts the Prairie Deer Mouse density.	Determine the density of small mammal species at 10 occupied Prairie Deer Mouse sites. Close the populations and manipulate the densities of competing native small mammals, as well as maintain adequate controls.	Monitor the density ratios of the small mammal community in several experimental populations of the Prairie Deer Mouse using live-tapping techniques.	3

Action Location: Physiographic Province: Central Lowland, Appalachian Plateaus, Ridge and Valley

Associated Species: North American least shrew

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Competition and predation by non-native mice and rats.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Management of the invasive House Mouse (Mus musculus) and Norway Ray (Rattus norvegicus) at sites known to house Prairie Deer Mouse populations.	At 3 locations where Prairie Deer Mouse exist, reduce the density of non-native competitive mammals by 50% in 1 year.	A reduction in non-native competing species density accomplished through a live trapping and removal regimen.	Monitor the density of Prairie Deer Mouse and non-natives, continually removing the non-native species using live-trapping techniques. This level of experiment would need to be conducted continuously in order to ensure non-native species remain reduced compared to control sites.	3

Action Location: Physiographic Province: Central Lowland, Appalachian Plateaus, Ridge and Valley

Associated Species: North American least shrew

RESEARCH NEEDS

1. Is the Prairie Deer Mouse distinct enough from its conspecifics to be considered a distinct species?

2. Determine potential conservation actions for this subspecies and examine the impact existing habitat management activities (e.g., prescribed fire) may have on this subspecies.

3. Is it possible to model where the Prairie Deer Mouse existed in Pennsylvania before the spread of agriculture, roads, and utility rights-of-way?

SURVEY NEEDS

1. Determine the current distribution of this subspecies in Pennsylvania.

2. Determine if this subspecies still found in the presumed original and preferred habitat in the dune grasslands along Lake Erie.

MONITORING PROGRAMS

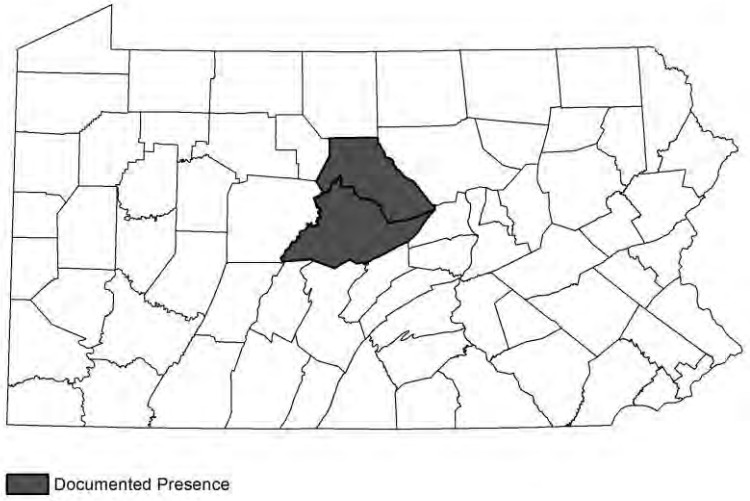
Program Name	Lead Agency	Hyperlink	Description
Terrestrial Small Mammal Database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	A database compiling all PGC permitted terrestrial small mammal surveys in a standardized format.
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

Appalachian Cottontail

Sylvilagus obscurus

Emily S. Boyd
Pennsylvania Game Commission

Photo: Carly Lesser & Art Drauglis



CONSERVATION PROFILE

Global Rank	**G4**	State Rank	**S1S2**
IUCN Red List	**NT Near Threatened**	PA Legal Status	**Protected**
Northeast Region	**Very High Concern / Low Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Relatively Stable (<=10% change)**

Conservation Goal:

Assess state-wide distribution and relative abundance of Appalachian cottontail.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Central Oak-Pine**	
Habitat	**Northeastern Interior Dry-Mesic Oak Forest**	

Specific Habitat Requirements:

High elevation flat ridgetops dominated by mountain laurel with interspersed grassy openings; small, recently planted pine plantations with significant grass and forb cover; young clearcuts; also high elevation beaver meadows with thickets.

THREATS AND ACTIONS

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Destruction, fragmentation, and maturation of suitable habitat.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Manage occupied areas and surrounding habitat at high elevation to be suitable for Appalachian cottontails. Create incentive programs for private land owners to encourage habitat management that is beneficial to Appalachian cottontails.	Create and protect suitable habitat for Appalachian cottontails.	Amount of habitat at high elevation that has extensive understory cover and is suitable to Appalachian cottontails.	Monitor response of Appalachian cottontails to habitat management practices.	1

Action Location: Physiographic Province: Appalachian Plateaus, New England, Ridge and Valley

Associated Species: Ruffed Grouse, snowshoe hare

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Increased competition from introduced or relocated eastern cottontails.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 101.0 Species Management Cease all activities involved with bringing other species of cottontail into PA and reduce translocation of eastern cottontails into Appalachian cottontail habitat.	Reduce competition with introduced cottontails.	Number of areas with prime Appalachian cottontail habitat that are found to have Appalachian cottontails.	Monitor Appalachian cottontail population dynamics.	1

Action Location: Physiographic Province: Statewide, Ridge and Valley, Appalachian Plateaus, New England

Associated Species: Snowshoe hare

THREATS AND ACTIONS

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: Increased pressure and risk of local extinctions from hunting.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 6.0	Land and Water Rights Acquisition and Protection	Maintain Appalachian cottontail populations.	Abundance of Appalachian cottontail populations that are protected.	Monitor protected areas for Appalachian cottontail population dynamics annually.	1

Monitor rabbit hunting in areas identified to have ideal Appalachian cottontail habitat and/or confirmed Appalachian cottontail populations until more is know about their distribution, abundance, and the effect of hunting on their populations.

Action Location: Physiographic Province: Appalachian Plateaus, New England, Ridge and Valley

RESEARCH NEEDS

1. What is the abundance and distribution of Appalachian cottontails in PA?

2. What habitat management practices are most beneficial to Appalachian cottontails?

3. What are the influences of the eastern cottontail on Appalachian cottontails?

SURVEY NEEDS

1. Survey high elevation areas (>800 ft.) for Appalachian cottontails using DNA collection (pellets), rabbit harvest, and/or trap and release.

2. Identify the acreage of suitable habitat conditions at appropriate elevations for Appalachian cottontail in Pennsylvania and what percent of areas with suitable habitat are occupied by Appalachian cottontails, both eastern and Appalachian cottontails, eastern cottontails, or no cottontails.

3. Survey and compare the distribution of Appalachian cottontails and eastern cottontails in high elevation areas of Pennsylvania.

MONITORING PROGRAMS

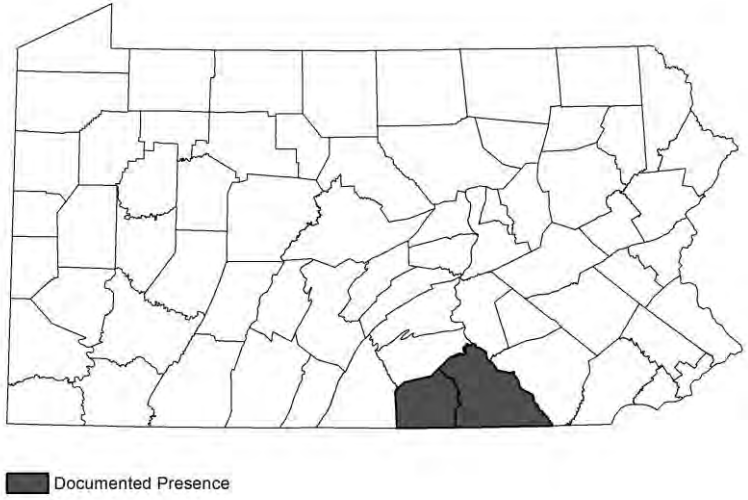
Program Name	Lead Agency	Hyperlink	Description
Appalachian cottontail head collection	Pennsylvania Game Commission		Since Fall 2014, the Pennsylvania Game Commission has collected heads of cottontails legally harvested within Appalachian cottontail habitat or that exhibit physical characteristics typical of the Appalachian cottontail. The collection will help to increase knowledge of Appalachian cottontail distribution in PA.
Lagomorph pellet collection	Pennsylvania Game Commission		Biologists are collecting all lagomorph pellets found in Appalachian cottontail habitat. The DNA in the pellets will be used to identify species and will help to increase knowledge of distribution of the three lagomorph species found in Pennsylvania.

North American Least Shrew

Cryptotis parva

Joe Wisgo
PA Natural Heritage Program/ Western Pennsylvania Conservancy

Photo: Michael Jeffords



CONSERVATION PROFILE

Global Rank	**G5**	State Rank	**S1**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Endangered**
Northeast Region	**Very High Concern / Low Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of 11-40%**

Conservation Goal:

Identify current extent of the breeding population within Pennsylvania

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Urban/Suburban Built**	**Agricultural**
Habitat	**Developed (NLCD 21-24 & 31)**	**Agriculture (NLCD 81-82)**

Specific Habitat Requirements:

The least shrew is an inhabitant of open areas. In Pennsylvania, early successional communities are preferred and include native grasslands, old fields, abandoned pastureland, and weedy meadows (Merritt 1987). Inhabited sites are usually associated with a water source of some form (Hart 2010).

THREATS AND ACTIONS

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Loss of suitable maintained habitats.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 1.0	Coordination and Administration	Maintain 500 acres of existing manmade habitat through 2015	Acreage of habitat reserved	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrew on reserved lands every 5 years following the 10 year action duration.	1
Provide incentives to farm owners that would allow fields to remain fallow for longer periods and avoid further development					

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Terrestrial fauna

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Intense grazing decreases available least shrew habitat.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Decrease overgrazing on 500 acres of core least shrew habitat by 2015	Acreage of habitat reserved	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrew on reserved lands every 5 years following the 10 year action duration.	1
Work with and educate farmers to mitigate the effects of overgrazing on pasture vegetation					

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Terrestrial fauna

THREATS AND ACTIONS

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Intense farming practices do not allow fields to grow fallow.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Incentivize farmers who are willing to preserve tracts of suitable least shrew habitat	Reserve 500 acres of core least shrew habitat by 2025	Acreage of habitat reserved	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrew on preserved lands every 5 years following the 10 year action duration.	1

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Terrestrial fauna

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Conversion of natural grasslands, fallow fields, and successional communities to urbanized landscapes.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 6.0 Land and Water Rights Acquisition and Protection Engage landowners possessing satisfactory amounts of viable habitat and harboring a breeding population of least shrews to pursue conservation easements.	Obtain conservation easements for 1,000 acres of habitat within 10 years.	Acreage of habitat preserved	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrew on eased lands every 5 years following the 10 year action duration.	1

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Terrestrial fauna

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Feral and unrestrained house cats have been known to kill small mammals (e.g., Mitchell and Beck 1992) and may negatively impact least shrew populations.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Reduce feral cat populations by 50% within a 5km buffer of known least shrew populations (NatureServe 2015; 5km is the separation distance for an occurrence in suitable habitat)	Density of local least shrew population	Using PGC terrestrial small mammal survey protocols, conduct surveys to monitor population densities at known least shrew sites every 5 years following the 10 year action duration.	2
Inform the public about the negative impacts generated by feral cat colonies as well as unrestrained house cats					

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Terrestrial fauna

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Natural succession of old fields.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Alleviate succession on 1000 acres of least shrew habitat	Acreage of habitat prevented from succession	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrew on burned lands in the year following each burn and then every 10 years there after.	2
Maintain suitable core habitat by using controlled burns to prevent succession					

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Terrestrial fauna

THREATS AND ACTIONS

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Genetic and population isolation as dispersal barriers.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Avoid construction of large highways through core least shrew habitat	Minimize the fragmentation of core least shrew habitat	Acreage of unfragmented habitat	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrews on reserved lands every 10 years.	2

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Terrestrial fauna

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Commercial construction of industrial centers that destroy large tracts of core habitat and supporting landscapes.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Coordinate with developers and private industry to avoid large scale destruction of core least shrew habitats. Promote the preservation of undeveloped lands to retain core and supporting landscapes.	Coordinate with commercial developers to mitigate the loss of 500 acres of core habitat within the next 10 years.	Acreage of habitat preserved	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrew on preserved lands every 5 years following the 10 year action duration.	2

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Terrestrial fauna

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Native species serve as predators of the least shrew.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Establish long-term monitoring sites	Coordination and Administration	Detect trends of least shrew populations	Presence or absence of least shrews at site	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrew every 5 years following the 10 year action duration.	3

Action Location: Physiographic Province: Piedmont, Ridge and Valley

Associated Species: Small mammals

RESEARCH NEEDS

1. Determine habitat requirements of this species (Hart 2010).

2. Identify the habitat types that serve as dispersal corridors for the least shrew (Hart 2010).

3. Determine the interspecific relationship between this species and other Soricids (Hart 2010).

SURVEY NEEDS

1. Re-survey sites in southcentral Pennsylvania recently known to harbor viable populations of least shrews to determine the current population status.

2. Conduct de novo surveys for this species in appropriate habitat beginning within the current known range in southcentral Pennsylvania and extend surveys to other regions of Pennsylvania.

MONITORING PROGRAMS

Program Name	Lead Agency	Hyperlink	Description
Terrestrial Small Mammal Database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	A database compiling all PGC permitted terrestrial small mammal surveys in a standardized format.
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

Long-tailed Shrew

Sorex dispar

Michael A. Steele
Wilkes University

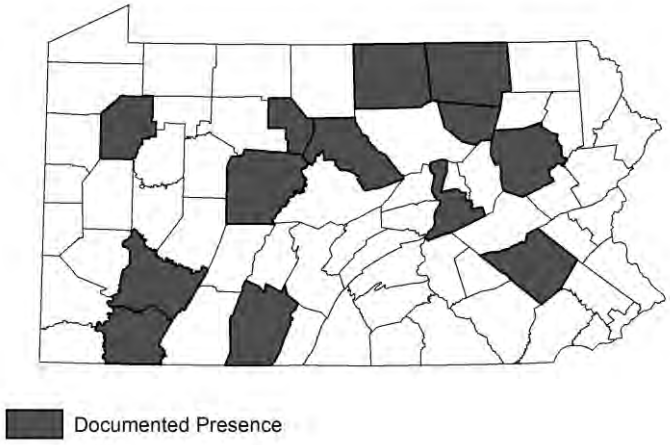
Photo: John Wible

CONSERVATION PROFILE

Global Rank	**G4**	State Rank	**S4**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**Very High Concern / High Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Relatively Stable (<=10% change)**

Conservation Goal:

Continue to explore historic range to improve confidence of distribution. Learn impact of energy exploration on local distribution; conduct basic studies to better understanding demographics, reproduction, and behavior in the species.



HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Northern Hardwood & Conifer**	**Wet Meadow / Shrub Marsh**
Habitat	**Appalachian (Hemlock)-Northern Hardwood Forest**	**Laurentian-Acadian Wet Meadow-Shrub Swamp**

Specific Habitat Requirements:

Cool, moist forests with rocky talus deposits. Often associated with mesic hardwood and mixed hardwood-conifer, and conifer forests with rhododendron component. Almost always associated with rocky, talus substrates.

THREATS AND ACTIONS

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Disturbance and fragmentation of rocky deposits, especially those associated with seeps, and streams.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Minimize or avoid fragmentation of habitat by siting future projects outside of known or potential habitat.	Review all proposed projects for negative impacts to long-tailed shrews, offer siting guidance, and provide Best Management Practices.	Amount of habitat avoided or protected	Survey areas of disturbance resulting from utility and service lines to document presence and absence and other demographic parameters.	2

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Southern bog lemming, Allegheny woodrat, eastern spotted skunk

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Disturbance and fragmentation of rocky deposits, especially those associated with seeps, and streams.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Minimize or avoid fragmentation of habitat by siting future projects outside of known or potential habitat.	Review all proposed projects for negative impacts to long-tailed shrews, offer siting guidance, and provide Best Management Practices.	Amount of habitat avoided or protected	Survey areas of disturbance resulting from transportation and service corridors to document presence and absence and other demographic parameters.	2

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Southern bog lemming, Allegheny woodrat, eastern spotted skunk

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Disturbance and fragmentation of rocky deposits, especially those associated with seeps, and streams.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Minimize or avoid fragmentation of habitat by siting future projects outside of known or potential habitat.	Review all proposed projects for negative impacts to long-tailed shrews, offer siting guidance, and provide Best Management Practices.	Amount of habitat avoided or protected	Survey areas of disturbance resulting from energy production and mining to document presence and absence and other demographic parameters.	2

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Southern bog lemming, Allegheny woodrat, eastern spotted skunk

RESEARCH NEEDS

1. Detailed studies of distribution, reproduction, demography and behavior are absent.

2. Detailed studies on the impacts from fragmentation, disturbance, and infrastructure associated with energy extraction (e.g., hydraulic fracturing, seismic testing) and various forms of development.

3. Long-term studies are needed at 2-3 locations to better understand demography and patterns of local extinction.

SURVEY NEEDS

1. Additional detailed surveys are needed to determine more precise distribution statewide.

MONITORING PROGRAMS

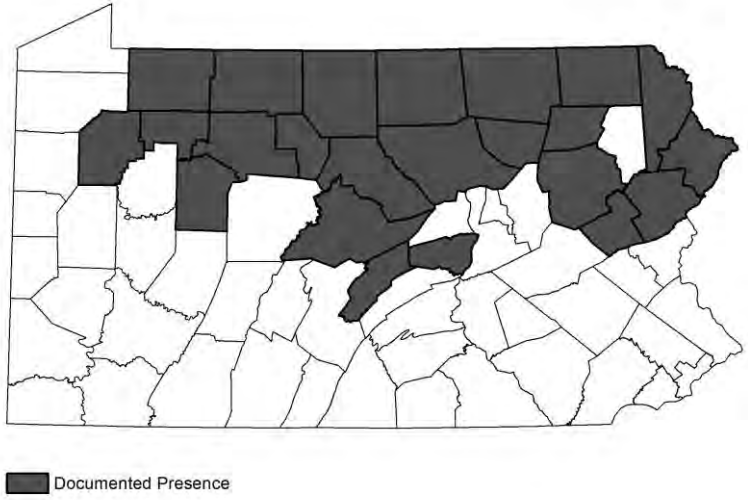
Program Name	Lead Agency	Hyperlink	Description
Terrestrial Small Mammal Database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	A database compiling all PGC permitted terrestrial small mammal surveys in a standardized format.
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

Northern Water Shrew

Sorex palustris albibarbis

Charlie Eichelberger
PA Natural Heritage Program/ Western Pennsylvania Conservancy

Photo:Charlie Eichelberger



CONSERVATION PROFILE

Global Rank	**G5T5**	State Rank	**S3**
IUCN Red List	**Not Yet Assessed**	PA Legal Status	**Protected**
Northeast Region	**High Concern / High Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of 11-40% to Stable**

Conservation Goal:

Over the next 10 years, determine the distribution of this subspecies in Pennsylvania and model all potential habitat in Pennsylvania based on inventory results, and examine its validity as a distinct subspecies from the West Virginia Water Shrew.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Northern Hardwood & Conifer**	**Central Oak-Pine**
Habitat	**Appalachian (Hemlock)-Northern Hardwood Forest**	**Northeastern Interior Dry-Mesic Oak Forest**

Specific Habitat Requirements:

High-quality primary and secondary order streams with moderate flow, deeply undercut banks and other streamside structure (rock shelters, rock jumbles, and brush piles), and high to low gradients. Sites may or may not have dense ground cover. Streams flow through hardwood dominated forests at lower elevations, and primarily mixed forests at higher elevations (1500+ ft.).

THREATS AND ACTIONS

IUCN Threat: 9.0 Pollution

Specific Threat: Atmospheric deposition of heavy metals and acid mine drainage suppress invertebrate prey populations.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Waterways affected by AMD and other pollution sources should be targets for remediation.	Install AMD treatment facilities at 5 point sources where Northern Water Shrews once likely existed by 2025.	The number of stream miles that are restored and made suitable for Northern Water Shrews.	In restored waterways, conduct presence/absence surveys to determine if Northern Water Shrews recolonize as well as monitoring the aquatic prey base to chart the effectiveness of restoration efforts.	2

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: Terrestrial and aquatic species

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Siltation of aquatic habitat from unimproved road runoff.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 100.0 Law and Policy New roads should be sited with Northern Water Shrew habitat in mind. Existing roads should be maintained in way that minimizes impacts to Northern Water Shrew habitat.	Inventory the potential impacts roads are having on Northern Water Shrew sites by inspecting roads and bridges within 1km of all known occupied sites. Of this inventory, make efforts to reduce the number of these impacts at 10% of the known Northern Watershrew locations by 2025.	The number of impacts from roads and bridges within 1km of Northern Water Shrew sites, and water quality parameters above and below the road impacts.	Monitor water quality parameters upstream and downstream of the repaired impacts, and compare the results to those collected before the repair.	2

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Terrestrial and aquatic species

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Water pollution, habitat loss from shale gas development.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance By way of the environmental review process, ensure stream structure and water quality are maintained in their pre-construction condition at oil and gas drilling sites in proximity to Northern Water Shrew habitat through appropriate infrastructure siting.	Minimize direct impacts to Northern Water Shrew occurrences from extraction industry in the next 10 years.	Amount of habitat avoided or protected	Conduct presence/absence surveys for Northern Water Shrews at sites where shale gas drilling is occurring nearby to determine if there are effects on the populations.	2

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: Terrestrial and aquatic species

IUCN Threat: 11.0 Climate Change and Severe Weather

Specific Threat: Population declines from periodic severe storms and flood events.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Stream channels and riparian corridors scoured by natural phenomena should be left to repair themselves.	Allow scoured sections to recover for 6-10 years.	Abundance of aquatic macroinvertebrates and streamside vegetation.	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for Northern Water Shrews after allowing the disturbed area to recover for 5 years.	3

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Terrestrial and aquatic species

RESEARCH NEEDS

3. Is the northern water shrew an effective bioindicator to monitor potential impacts from development (e.g., road construction or shale gas exploration)? If so, do water quality impairments affect species presence and health (e.g., bioaccumulation of pollutants)?

1. Is the Northern Water Shrew a distinct subspecies from the West Virginia Water Shrew genetically and morphologically?

2. To which subspecies do specimens captured between the published ranges of the two subspecies belong?

SURVEY NEEDS

1. Determine the distribution of the Northern Water Shrew in Pennsylvania. Specifically, determine how far south and west the subspecies occurs.

MONITORING PROGRAMS

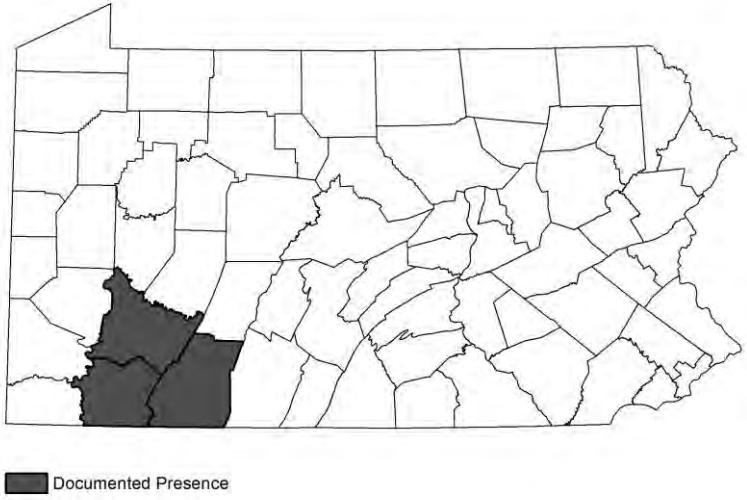
Program Name	Lead Agency	Hyperlink	Description
Pennsylvania Natural Heritage Inventories	Pennsylvania Natural Heritage Program/Western Pennsylvania Conservancy	http://www.naturalheritage.state.pa.us/	Since 2012 WPC/PNHP has been actively conducting surveys for this species to identify new populations and determine range extent.
Terrestrial Small Mammal Database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	A database compiling all PGC permitted terrestrial small mammal surveys in a standardized format.
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

West Virginia Water Shrew

Sorex palustris punctulatus

Joe Wisgo
PA Natural Heritage Program/ Western Pennsylvania Conservancy

Photo: Joe Wisgo



CONSERVATION PROFILE

Global Rank	**G5T3**	State Rank	**S2**
IUCN Red List	**Not Yet Assessed**	PA Legal Status	**Threatened**
Northeast Region	**Very High Concern / High Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	

Conservation Goal:

Maintain existing populations of this species in southwestern Pennsylvania through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Northern Hardwood & Conifer**	**Emergent Marsh**
Habitat	**Appalachian (Hemlock)-Northern Hardwood Forest**	**Laurentian-Acadian Freshwater Marsh**

Specific Habitat Requirements:

Clear mountain streams at elevations > 1,500 to 2,000 ft. with high quality, moderate flow and bordered by deeply undercut stream banks, exposed tree root balls, rock, brush piles, and greater than 75% ground cover.

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Potential leaching or discharge of chemicals associated with hydraulic fracturing for natural gas can degrade water quality.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 100.0 Law and Policy Prevent the leaching or discharge of chemicals associated with hydraulic fracturing for natural gas into Commonwealth waterways in southwest Pennsylvania	Maintain that natural gas extraction companies are in compliance with current laws, and continue enforcement on those companies who do not comply. Reduce the number of violations by 50% in 5 years.	Record the number of environmental violations committed by drilling companies, and monitor overall stream health.	Monitor the chemical and physical properties for streams that could possibly be affected by discharges of hydraulic fracking fluid.	1

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: Terrestrial/ aquatic fauna

IUCN Threat: 9.0 Pollution

Specific Threat: Stream acidification in the form of acid mine drainage (AMD) generated from the extraction of fossil fuels negatively impacts water quality.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Mitigate the effects of AMD on water quality within the Laurel Highlands region of southwest Pennsylvania.	Install 5 passive AMD treatment facilities within the Laurel Highlands of southwest Pennsylvania over the next 10 years.	Stream acidity	Following the installation of passive AMD treatment facilities, perform standard water quality tests annually to determine the effectiveness of the treatment.	2

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: Aquatic fauna

THREATS AND ACTIONS

IUCN Threat: 11.0 Climate Change and Severe Weather

Specific Threat: Severe flooding scours stream channels along with riparian corridors and temporarily destroys habitat.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Allow scoured sections to recover for 6-10 years.	Abundance of aquatic macroinvertebrates and streamside vegetation.	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for *S. p. punctulatus* after allowing the disturbed area to recover for 5 years.	3
Stream channels and riparian corridors scoured by natural phenomena should be left to repair themselves.					

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: Terrestrial/ aquatic fauna

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Nonpoint source pollution in the form of highway effluents containing vehicular contaminants and sediments decrease water quality.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 9.0	Planning	Decrease the volume of highway runoff by 10% within the Laurel Highlands region of southwest Pennsylvania by implementing the Environmental Protection Agency's runoff control BMPs within the next 10 years (EPA 2010).	Levels of pollutants and sediments within waterway	Following the implementation of runoff control BMPs, perform standard water quality tests biannually to determine the effectiveness of the chosen mitigation strategy.	3
Reduce the effects of non-source pollutants from highway effluents on stream water quality within the Laurel Highlands Region of southwest Pennsylvania.					

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: Aquatic fauna

RESEARCH NEEDS

1. Define the northern most range of this species within Pennsylvania and determine if this species' range overlaps with *S. p. albibarbis* (Hart 2010).

2. Identify the extent of genetic differentiation between *S. p. punctulatus* and *S. p. albibarbis*.

3. Determine population densities relative to available habitat.

SURVEY NEEDS

1. Conduct surveys for this species along the Allegheny Front and within the Allegheny Mountain section northward of the current range to determine if there is range overlap with *S. p. albibarbis*.

2. Use mark and recapture methods in conjunction with low impact surveys (live traps) at known locations to determine population densities (Hart 2010).

MONITORING PROGRAMS

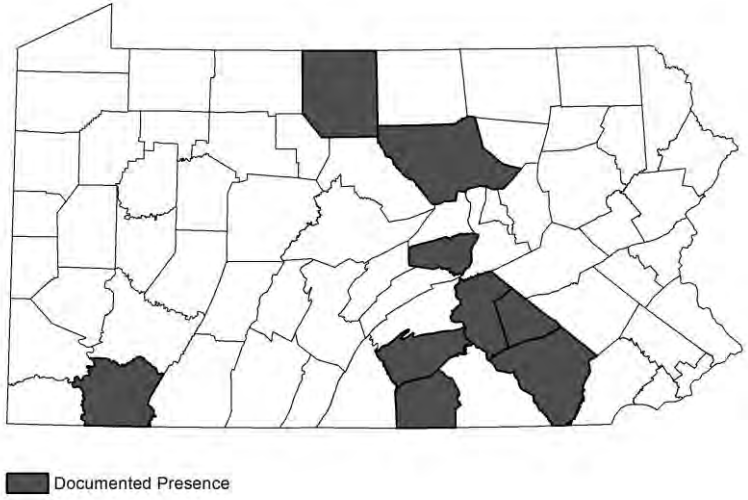
Program Name	Lead Agency	Hyperlink	Description
Pennsylvania Natural Heritage Inventories	Pennsylvania Natural Heritage Program/Western Pennsylvania Conservancy	http://www.naturalheritage.state.pa.us/	Since 2012 WPC/PNHP has been actively conducting surveys for this species to identify new populations and determine range extent.
Terrestrial Small Mammal Database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	A database compiling all PGC permitted terrestrial small mammal surveys in a standardized format.
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

Maryland Shrew

Sorex cinereus fontinalis

Joe Wisgo
PA Natural Heritage Program/ Western Pennsylvania Conservancy

Photo: John Wible



CONSERVATION PROFILE

Global Rank	**G4Q**	State Rank	**S5**
IUCN Red List	**Not Yet Assessed**	PA Legal Status	**Protected**
Northeast Region	**Medium Concern / High Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Unknown**

Conservation Goal:

Maintain existing populations of this species in south-central and southeastern Pennsylvania through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Northern Hardwood & Conifer**	
Habitat	**Appalachian (Hemlock)-Northern Hardwood Forest**	

Specific Habitat Requirements:

Found in multiple habitats, but prefers those that are moist including sedge-grass meadows, woodlands, and hedgerows in early successional areas (Merritt 1987). This species is seldom captured on ridge tops or elevations above 300 m (Genoways & Brenner 1985).

THREATS AND ACTIONS

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Commercial construction of industrial centers that destroy large tracts of core habitat and supporting landscapes.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Coordinate with developers and private industry to avoid large scale destruction of core habitats in south central and southeast Pennsylvania. Promote the preservation of undeveloped lands to retain core and supporting landscapes. Action Location: Physiographic Province: Piedmont Associated Species: Terrestrial fauna	Coordinate with commercial developers to mitigate the loss of 500 acres of core habitat within the next 10 years.	Acreage of habitat preserved	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for S. c. fontinalis on preserved lands every 5 years following the 10 year action duration.	3

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Conversion of natural lands and successional habitats to urbanized landscapes.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 6.0 Land and Water Rights Acquisition and Protection Engage landowners possessing satisfactory amounts of viable habitat in south central and southeastern Pennsylvania to pursue conservation easements. Action Location: Physiographic Province: Piedmont Associated Species: Terrestrial fauna	Obtain conservation easements for 1,000 acres of habitat within 10 years.	Acreage of habitat preserved	Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for *S. c. fontinalis* on eased lands every 5 years following the 10 year action duration.	3

RESEARCH NEEDS

2. Determine the ecological relationships between this species and *S. c. cinereus* (Whitaker & Hamilton 1998).

1. Define the northern and westernmost range of this species within Pennsylvania.

SURVEY NEEDS

1. Initiate surveys for this species beginning at the periphery of the known range in southeast Pennsylvania and extend surveys north and west to determine the range extent within Pennsylvania.

MONITORING PROGRAMS

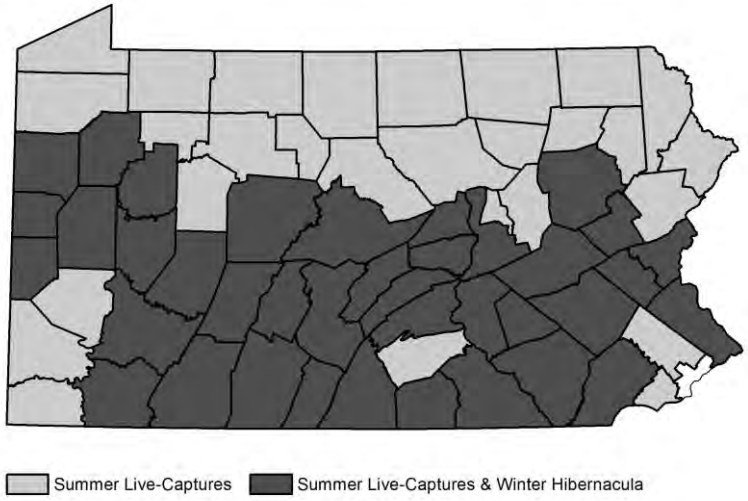
Program Name	Lead Agency	Hyperlink	Description
Terrestrial Small Mammal Database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	A database compiling all PGC permitted terrestrial small mammal surveys in a standardized format.
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

Big Brown Bat

Eptesicus fuscus

Michael R. Scafini
Pennsylvania Game Commission

Photo: Tony Ross



CONSERVATION PROFILE

Global Rank	**G5**	State Rank	**S2S3**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**High Concern / Low Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of 30 - 70%**

Conservation Goal:

Maintain current population levels in Pennsylvania through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**(B,W) Central Oak-Pine**	**(B) Northern Hardwood & Conifer** **(W) Glade, Barren and Savanna**
Habitat	**(B,W) Northeastern Interior Dry-Mesic Oak Forest**	**(B) South-Central Interior Mesophytic Forest** **(W) Central Appalachian Alkaline Glade and Woodland**

Specific Habitat Requirements:

(B) Human structures, trees, and other hollow spaces.
(W) Human structures, caves, mines, tunnels, and other structures.

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Improper exclusion and/or removal within roosting structures.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Create guidance, regulations, and instructions for Nuisance Wildlife Control Operators (NWCO) and the general public for proper venting and exclusion of big brown bats from structures, including time of year restrictions. Action Location: Physiographic Province: Statewide Associated Species: Little brown bat, tricolored bat	Update NWCO regulations for Pennsylvania to distribute to wildlife control professionals and general public.	Number of individuals counted during maternity surveys and/or number of individuals caught per unit of effort during mist-net surveys.	Monitor big brown bats within maternity colonies through Appalachian Bat Counts (summer roost counts) for 5 years.	1

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Direct mortality from white-nose syndrome (*Pseudogymnoascus destructans*).

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Develop and utilize treatment options to reduce pathogen abundance in situ or reduce quantity of infections caused by this pathogen. Action Location: Physiographic Province: Statewide Associated Species: Little brown bat, tricolored bat, Indiana bat, northern long-eared bat	Explore the ability of big brown bats to be less severely impacted by *Pseudogymnoascus destructans* than other species through swabbing and antibody studies.	Number of big brown bats counted during winter hibernacula surveys.	Quantifying number of lesions via UV light technique (Turner et al. 2014).	1

RESEARCH NEEDS

1. Research the ability of big brown bats to be less severely impacted by *Pseudogymnoascus destructans* than other species, such as their ability to create antibodies towards the disease.

SURVEY NEEDS

1. Continued hibernacula surveys to monitor population trends.
2. Continued summer maternity and roost surveys.
3. Continued spring emergence and fall swarming surveys.

MONITORING PROGRAMS

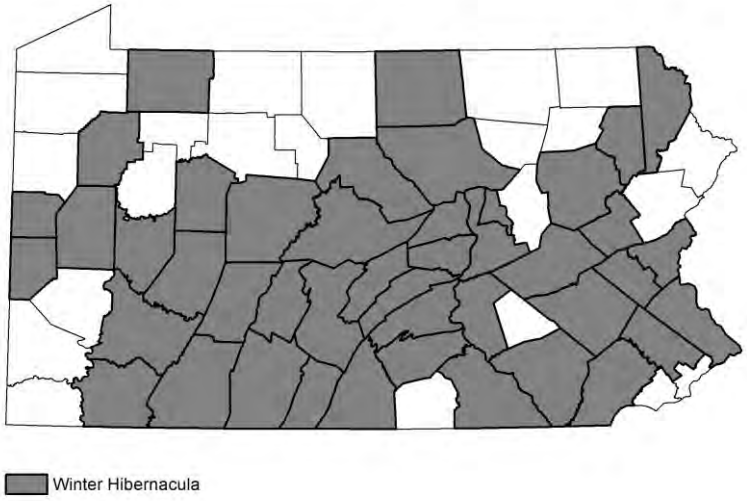
Program Name	Lead Agency	Hyperlink	Description
Appalachian Bat Count	Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt?open=514&objID=712212&mode=2	Each year, volunteers count bats exiting summer roosts between May 15th and August 1st. Species, type of structure, and weather is recorded.
North American Bat Monitoring Program (NABat)	U.S. Geological Survey	https://www.fort.usgs.gov/science-tasks/2457	A statistically rigorous and nationally coordinated bat monitoring program for determining the impacts of the many stressors on bat populations and the efficacy of conservation management actions.
Spring emergence mist-netting for bats near and around cave and mine openings.	Pennsylvania Game Commission		Each year, between April 15th and May 15th PGC personnel mist-net for bats emerging from hibernation and traveling to roosting and/or foraging areas.
Winter hibernacula surveys	USFWS; Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt/document/1373295/71401-12z_pdf	Each year, between Jan 1st and March 15th, PGC personnel and other qualified individuals survey cave, mines, and tunnels for bats. Bat species and location, cave and roost temperatures, and presence of WNS is recorded.

Tricolored Bat

Perimyotis subflavus

Gregory G. Turner
Pennsylvania Game Commission

Photo: Cal Butchkoski



CONSERVATION PROFILE

Global Rank	**G3**	State Rank	**S1**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**Very High Concern / Low Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of >90%**

Conservation Goal:

Maintain or increase current population levels in Pennsylvania through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**(B,W) Central Oak-Pine**	**(W) Glade, Barren and Savanna**
Habitat	**(B)Central Appalachian Dry Oak-Pine Forest(W)Northeastern Interior Dry-Mesic Oak Forest**	**(W) Central Appalachian Alkaline Glade and Woodland**

Specific Habitat Requirements:

(B) Human structures, trees, and cavities.
(W) Slightly warmer locales from 46-53˚F.

THREATS AND ACTIONS

IUCN Threat: 6.0 Human Intrusions and Disturbance

Specific Threat: Recreational and commercial caving causes disturbances that lead to direct mortality and lower fecundity of adult females, and exacerbates problems caused by white-nose syndrome (WNS).

Action	Objective	Measure	Monitoring	Priority
TRACS Action 7.0 Law enforcement Enforce protections afforded hibernation sites and seek a caving season to further limit disturbance at important sites; install bat gates. Action Location: Physiographic Province: Statewide Associated Species: All hibernating bat species	Reduce additive loss of fat reserves maximizing survival and reproduction output	Number of hibernacula gated or protected with landowner agreements, along with number of people arrested.	Monitoring changes in abundance via trapping or internal counts	1

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Large-scale wind farms have been documented to directly cause mortality.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 100.0 Law and Policy Produce regulation or develop cooperative agreements enacting operation guidelines (curtailment) to limit bat mortality Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley Associated Species: All bat species	To reduce overall mortality	Number of wind turbines with higher cut-in speeds	Counting and estimating carcasses found below turbines	1

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Mining and quarrying cause direct mortality, alter microclimates of hibernacula, and remove roosting and foraging habitat.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Retain openings and structural integrity of abandoned mines that are used by bats, and erect bat-friendly gates to protect sites. Action Location: Physiographic Province: Statewide Associated Species: All hibernating bat species	To reduce the destruction of, or alteration of specific conditions within locations used to hibernate	Number of hibernacula gated	Monitoring changes in abundance via trapping or internal counts	1

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Direct mortality from white-nose syndrome (*Pseudogymnoascus destructans*).

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Develop and utilize treatment options to reduce pathogen abundance in situ or reduce quantity of infections caused by pathogen Action Location: Physiographic Province: Statewide Associated Species: All hibernating bat species	To eliminate or reduce clinical signs of disease	Number of lesions caused by pathogen or number of bats counted surviving exposure to disease.	Quantifying number of lesions via UV light technique (Turner et al. 2014).	2

THREATS AND ACTIONS

IUCN Threat: 11.0 Climate Change and Severe Weather

Specific Threat: Flooding can drown and kill hibernating bats in subterranean environments.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Identify hibernacula with greatest potential for flooding and then attempt to minimize potential for drowning by providing drainage or modifying site to shift bats to areas that are less prone to flooding. Action Location: Physiographic Province: Ridge and Valley Associated Species: All hibernating bat species	To reduce or eliminate sudden influx of high volumes of water resulting in mass mortality.	Number of documented flood events	Monitoring changes in abundance via trapping or internal counts	3

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: Removal of mature trees to maintain younger forests limits potential roosting sites.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Promote the use of artificial structures and creation/retention of wildlife trees during forest management projects Action Location: Physiographic Province: Statewide Associated Species: All bat species	To consistently maintain natural, suitable landscape features that perpetuate use and add artificial structures as needed.	Number of natural or artificial roosts available	Perform emergence surveys to quantify use	3

THREATS AND ACTIONS

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Permanent loss of forested habitat reduces foraging quality and quantity, reduces or eliminates roosting. Improper exclusion of maternity colonies and young results in direct mortality and lower recruitment into breeding population.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	To lessen impacts from habitat loss and exclusions from human structures	Number of bat boxes installed or exclusions performed during proper timing	Perform emergence surveys to quantify use	3

Promote the use of artificial structures and develop guidelines to improve exclusion techniques to limit mortality

Action Location: Physiographic Province: Statewide

Associated Species: All bat species

RESEARCH NEEDS

1. Determine where surviving bats are located, if large distance migration between summer and winter habitat is typical, and if consolidation to core areas is occurring.

2. Determine if juveniles born since WNS arrival are surviving and if infection levels are decreasing in survivors.

3. Determine what impact various types of forest management (including prescribed fire) have on spring, summer, and autumn populations. What types of forest management are beneficial? What mitigation techniques might reduce/minimize impacts?

SURVEY NEEDS

1. Continue to monitor known hibernation sites prioritized by use either before or after WNS.

2. Monitor infection loads from WNS via UV light to see if decreases are occurring.

3. Monitor any newly discovered maternity colonies for persistence and growth.

MONITORING PROGRAMS

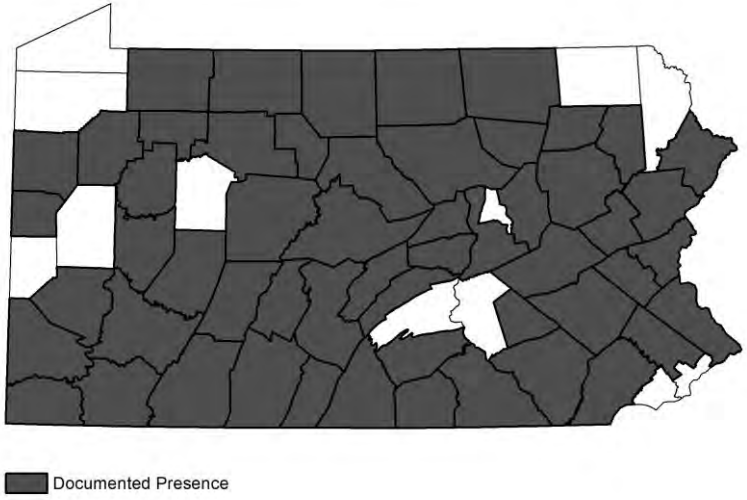
Program Name	Lead Agency	Hyperlink	Description
North American Bat Monitoring Program (NABat)	U.S. Geological Survey	https://www.fort.usgs.gov/science-tasks/2457	A statistically rigorous and nationally coordinated bat monitoring program for determining the impacts of the many stressors on bat populations and the efficacy of conservation management actions.
Winter hibernacula surveys	USFWS; Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt/document/1373295/71401-12z_pdf	Each year, between Jan 1st and March 15th, PGC personnel and other qualified individuals survey cave, mines, and tunnels for bats. Bat species and location, cave and roost temperatures, and presence of WNS is recorded.

Northern Long-eared Bat

Myotis septentrionalis

Howard P. Whidden
East Stroudsburg University

Photo:Greg Turner



CONSERVATION PROFILE

Global Rank	**G1G2**	State Rank	**S1**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**Very High Concern / Low Responsibility**	PA Abundance	**Unknown**
Federal Status	**Threatened**	PA Short-Term Trend (10 year)	**Decline of >90%**

Conservation Goal:

Maintain or increase population levels in Pennsylvania through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Central Oak-Pine**	**Northern Hardwood & Conifer**
Habitat	**Northeastern Interior Dry-Mesic Oak Forest**	**Appalachian (Hemlock)-Northern Hardwood Forest**

Specific Habitat Requirements:

Summer - deciduous/mixed forested areas containing mature trees with exfoliating bark/snags, also human structures. Winter – caves and mines.

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Direct mortality from white-nose syndrome (Pseudogymnoascus destructans).

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Prevent further spread of WNS fungus.	Percentage of historic hibernacula for this species that have been gated.	Conduct hibernacula counts to compare number of hibernating bats before and after gating; continue for 10	1
Limit access to caves, mines, and other areas, and enforce decontamination procedures to prevent spread of WNS fungus.					

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Little brown bat, Indiana bat, eastern small-footed bat, tricolored bat, big brown bat

IUCN Threat: 6.0 Human Intrusions and Disturbance

Specific Threat: Recreational and commercial caving causes disturbances that lead to direct mortality and lower fecundity of adult females, and exacerbate problems caused by white-nose syndrome (WNS)

Action		Objective	Measure	Monitoring	Priority
TRACS Action 7.0	Law enforcement	Install bat gates at all caves and mines that have historically contained hibernating individuals of this species.	Percentage of historic hibernacula for this species that have been gated.	Monitoring changes in abundance via trapping or internal counts	1
Enforce protections afforded hibernation sites and seek a caving season to further limit disturbance at important sites; install bat gates.					

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Little brown bat, Indiana bat, eastern small-footed bat, tricolored bat, big brown bat

THREATS AND ACTIONS

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: Removal of mature trees to maintain younger forests limits potential roosting sites.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Maintain mature forest habitat and preserve potential roost trees.	Number of hectares of mature forest that have appropriate forest management plans.	Assess population trends, either through mist-netting or acoustic surveys, or through hibernacula counts; continued for 10 years.	2
Establish forest management practices that maintain mature interior forest habitat and creation/retention of wildlife trees.					

Action Location: Physiographic Province: Appalachian Plateaus, New England, Piedmont, Ridge and Valley

Associated Species: Northern flying squirrel, eastern small-footed bat

IUCN Threat: 11.0 Climate Change and Severe Weather

Specific Threat: Flooding can drown and kill hibernating bats in subterranean environments

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Prevent mass mortality of hibernating bats from drowning.	Percentage of caves and mines with previous drowning events that have been modified to minimize potential for future drowning.	Monitoring changes in abundance via trapping or internal counts	3
Identify hibernacula with greatest potential for flooding and then attempt to minimize potential for drowning by providing drainage or modifying site to shift bats to areas that are less prone to flooding.					

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Little brown bat, Indiana bat, eastern small-footed bat, tricolored bat, big brown bat

RESEARCH NEEDS

1. Determine post-WNS population trends, over-winter strategies that permit avoidance and survival of WNS, and current distribution in PA to identify areas with the highest local abundance of this species to prioritize conservation efforts.

2. Determine what impact various types of forest management (including prescribed fire) have on spring, summer, and autumn populations of these bats. Can some types of forest management be beneficial? What mitigation techniques might reduce/minimize impacts?

3. Identify specific characteristics of preferred summer roost trees, especially trees used by reproductive females.

SURVEY NEEDS

1. Continued hibernacula surveys to monitor population trends.

2. Continued mist-netting surveys to determine current distribution and abundance in the state.

3. Radio telemetry studies to identify characteristics of preferred summer roost trees, especially trees used by reproductive females.

MONITORING PROGRAMS

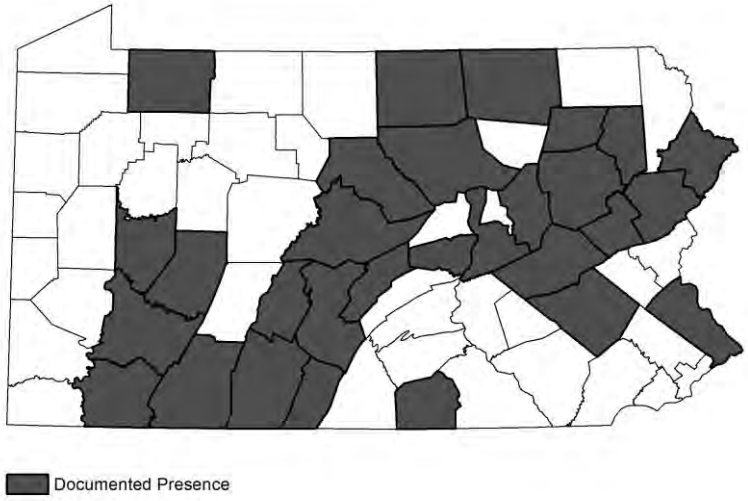
Program Name	Lead Agency	Hyperlink	Description
Bat Net and Trap database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	PGC biologists compile annual data from contractor mist-netting efforts in PA and then report captures per unit of mist-netting effort.
North American Bat Monitoring Program (NABat)	U.S. Geological Survey	https://www.fort.usgs.gov/science-tasks/2457	A statistically rigorous and nationally coordinated bat monitoring program for determining the impacts of the many stressors on bat populations and the efficacy of conservation management actions.
Winter hibernacula surveys	USFWS; Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt/document/1373295/71401-12z_pdf	Each year, between Jan 1st and March 15th, PGC personnel and other qualified individuals survey cave, mines, and tunnels for bats. Bat species and location, cave and roost temperatures, and presence of WNS is recorded.

Eastern Small-footed Bat

Myotis leibii

Howard P. Whidden
East Stroudsburg University

Photo:Greg Turner



CONSERVATION PROFILE

Global Rank	**G3G4**	State Rank	**S2**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Threatened**
Northeast Region	**Very High Concern / High Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of 11 - 60%**

Conservation Goal:

Maintain or increase current population levels in Pennsylvania through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Central Oak-Pine**	
Habitat	**Northeastern Interior Dry-Mesic Oak Forest**	

Specific Habitat Requirements:

Summer - deciduous/mixed forested areas containing rock outcrops and talus. Winter - caves & mines, also rock outcrops and talus.

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Direct mortality from white-nose syndrome (*Pseudogymnoascus destructans*).

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Prevent further spread of WNS fungus.	Percentage of historic hibernacula for this species that have been gated.	Conduct hibernacula counts to compare number of hibernating bats before and after gating; continue for 10	1
Limit access to caves, mines, and other areas, and enforce decontamination procedures to prevent spread of WNS fungus.					
Action Location:	Physiographic Province: Appalachian Plateaus, Ridge and Valley				
Associated Species:	Little brown bat, Indiana bat, northern long-eared bat, Perimyotis subflavus, big brown bat				

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: Loss of roosting and foraging habitat due to habitat disturbance and loss.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	Maintain mature forest habitat and preserve potential roost sites.	Number of hectares/areas of forested habitat with abundant rocky outcrops and loose rocks that have appropriate forest management plans.	Assess population trends, either through mist-netting or acoustic surveys, or through hibernacula counts; continued for 10 years.	2
Establish forest management practices that protect forested areas with abundant rocky outcrops and loose rocks.					
Action Location:	Physiographic Province: Appalachian Plateaus, Ridge and Valley				
Associated Species:	Northern long-eared bat, Allegheny woodrat				

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Mining and quarrying cause direct mortality, alter hibernation sites, and remove roosting and foraging habitat.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Establish land use practices that minimize disturbance to forested areas containing abundant rocky outcrops and loose rocks.	Prevent disturbance of this species at summer roosts.	Number of sites containing forested habitat with abundant rocky outcrops and loose rocks that have appropriate forest management plans.	Assess population trends, either through mist-netting or acoustic surveys, or through hibernacula counts; continued for 10 years.	2

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Allegheny woodrat

IUCN Threat: 10.0 Geological Events

Specific Threat: Loss of roosting habitat and direct mortality.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 101.0 Species Management Identify areas with greatest potential for serving as summer roost sites and then limit recreational activity that could disturb rocks and lead to landslides.	Prevent rockslides near known summer roost sites for this species.	Percentage of known roost sites that have been assessed and protected from disturbance that might cause rockslides.	Assess frequency of rockslides, either through annual visits or using aerial photos.	3

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Allegheny woodrat

THREATS AND ACTIONS

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Vehicular impacts cause mortality, new roads cause increased fragmentation and permanent loss of foraging and roosting habitat.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 101.0 Species Management Identify road sections with high bat mortality from direct collisions. Add vegetation or barriers to direct bats over oncoming cars.	Minimize the number of bats killed by collisions with cars.	Visit sites with known high road mortality and compare number of bats killed before and after site modification.	Determine number of bats killed by direct collisions with cars, compare numbers before and after site modifications.	3

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Eastern red bat, hoary bat, silver-haired bat, northern long-eared bat, little brown bat, Indiana bat, tricolored bat, big brown bat

RESEARCH NEEDS

1. Determine current distribution in PA to identify areas with the highest local abundance of this species to prioritize conservation efforts.

2. Identify specific characteristics of preferred summer roost sites, especially areas used by reproductive females.

3. Determine population trends through continued hibernacula surveys, including the identification of smaller hibernacula and hibernacula other than typical caves and mines.

SURVEY NEEDS

1. Continued hibernacula surveys to monitor population trends.

2. Continued mist-netting surveys to determine current distribution and abundance in the state.

3. Radio telemetry studies to identify characteristics of preferred summer roost sites, especially trees used by reproductive females.

MONITORING PROGRAMS

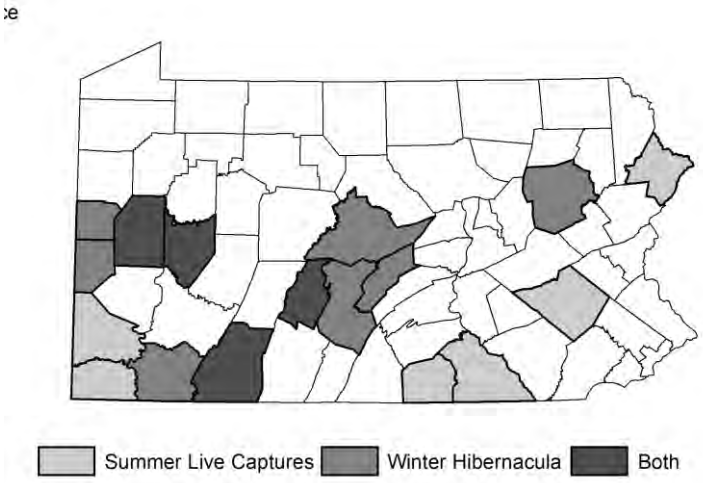
Program Name	Lead Agency	Hyperlink	Description
Bat Net and Trap database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	PGC biologists compile annual data from contractor mist-netting efforts in PA and then report captures per unit of mist-netting effort.
North American Bat Monitoring Program (NABat)	U.S. Geological Survey	https://www.fort.usgs.gov/science-tasks/2457	A statistically rigorous and nationally coordinated bat monitoring program for determining the impacts of the many stressors on bat populations and the efficacy of conservation management actions.
Winter hibernacula surveys	USFWS; Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt/document/1373295/71401-12z_pdf	Each year, between Jan 1st and March 15th, PGC personnel and other qualified individuals survey cave, mines, and tunnels for bats. Bat species and location, cave and roost temperatures, and presence of WNS is recorded.

Indiana Bat

Myotis sodalis

Gregory G. Turner
Pennsylvania Game Commission

Photo: Greg Turner



CONSERVATION PROFILE

Global Rank	**G2**	State Rank	**S1**
IUCN Red List	**EN Endangered**	PA Legal Status	**Endangered**
Northeast Region	**Very High Concern / Low Responsibility**	PA Abundance	**Unknown**
Federal Status	**Endangered**	PA Short-Term Trend (10 year)	**Decline of >90%**

Conservation Goal:

Maintain or increase current population levels in Pennsylvania through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**(B) Northern Hardwood & Conifer** **(W) Central Oak-Pine**	**(B,W) Central Oak-Pine**
Habitat	**(B) South-Central Interior Mesophytic Forest** **(W) Northeastern Interior Dry-Mesic Oak Forest**	**(B) Northeastern Interior Dry-Mesic Oak Forest** **(W) Allegheny-Cumberland Dry Oak Forest and Woodland**

Specific Habitat Requirements:

(B) Riparian, bottomland or upland forests, old fields and pastures. Many roosts include shagbark and shell bark hickories. Proximate to hibernation area for males and typically forests with lots of shagbark hickories for maternity sites in flood-prone areas with moist soils, but also documented on top of ridges in PA and WV.
(W) Caves and mines where temps range from 42-51˚F.

THREATS AND ACTIONS

IUCN Threat: 6.0 Human Intrusions and Disturbance

Specific Threat: Recreational and Commercial caving causes disturbances that lead to direct mortality and lower fecundity of adult females, and exacerbate problems caused by White-nose syndrome (WNS)

Action	Objective	Measure	Monitoring	Priority
TRACS Action 7.0 Law enforcement Enforce protections afforded hibernation sites and seek a caving season to further limit disturbance at important sites; install bat gates. Action Location: Physiographic Province: Statewide Associated Species: All hibernating bat species	Reduce additive loss of fat reserves maximizing survival and reproduction output	Number of hibernacula gated or protected with landowner agreements, along with number of people arrested.	Monitoring changes in abundance via trapping or internal counts	1

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: Removal of mature trees to maintain younger forests limits potential roosting sites.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Promote the use of artificial structures and creation/retention of wildlife trees during forest management projects Action Location: Physiographic Province: Statewide Associated Species: All bat species	To consistently maintain natural, suitable landscape features that perpetuate use and add artificial structures as needed.	Number of natural or artificial roosts available	Perform emergence surveys to quantify use	1

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Large-scale wind farms have been documented to directly cause mortality

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Produce regulation or develop cooperative agreements enacting operation guidelines (curtailment) to limit bat mortality	To reduce overall mortality	Number of wind turbines with higher cut-in speeds	Counting and estimating carcasses found below turbines	1

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: All bat species

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Mining and quarrying cause direct mortality, alter microclimates of hibernacula, and remove roosting and foraging habitat.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Retain openings and structural integrity of abandoned mines that are used by bats, and erect bat-friendly gates to protect.	To reduce the destruction of, or alteration of specific conditions within locations used to hibernate	Number of hibernacula gated	Monitoring changes in abundance via trapping or internal counts	1

Action Location: Physiographic Province: Statewide

Associated Species: All hibernating bat species

THREATS AND ACTIONS

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Permanent loss of forested habitat reduces foraging quality and quantity, reduces or eliminates roosting. Improper exclusion of maternity colonies and young results in direct mortality and lower recruitment into breeding population.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	To lessen impacts from habitat loss and exclusions from human structures	Number of bat boxes installed or exclusions performed during proper timing	Perform emergence surveys to quantify use	1

Promote the use of artificial structures and develop guidelines to improve exclusion techniques to limit mortality

Action Location: Physiographic Province: Statewide

Associated Species: All bat species

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Direct mortality from white-nose syndrome (*Pseudogymnoascus destructans*).

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	To eliminate or reduce clinical signs of disease	Number of lesions caused by pathogen or number of bats counted surviving exposure to disease.	Quantifying number of lesions via UV light technique (Turner et al. 2014).	2

Develop and utilize treatment options to reduce pathogen abundance in situ or reduce quantity of infections caused by pathogen

Action Location: Physiographic Province: Statewide

Associated Species: All hibernating bat species

THREATS AND ACTIONS

IUCN Threat: 11.0 Climate Change and Severe Weather

Specific Threat: Flooding can drown and kill hibernating bats in subterranean environments

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	To reduce or eliminate sudden influx of high volumes of water resulting in mass mortality.	Number of documented flood events	Monitoring changes in abundance via trapping or internal counts	3
Identify hibernacula with greatest potential for flooding and then attempt to minimize potential for drowning by providing drainage or modifying site to shift bats to areas that are less prone to flooding.				
Action Location: Physiographic Province: Ridge and Valley				
Associated Species: All hibernating bat species				

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Predation by feral cats, raccoons, and owls.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 101.0 Species Management	To reduce predation-related mortality	Number of predators removed from problematic area	Monitoring changes in abundance via trapping or internal counts	3
Trap and relocate/remove problematic individuals.				
Action Location: Physiographic Province: Statewide				
Associated Species: All hibernating bat species				

THREATS AND ACTIONS

IUCN Threat: 6.0 Human Intrusions and Disturbance

Specific Threat: Some commercial application of mines for storage and office use create noise, light, and climate variations that may impact hibernation.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 6.0	Land and Water Rights Acquisition and Protection	To retain ideal microclimate features preferred by the species and to minimize disturbance reducing fat stores.	Number of bats counted at hibernacula associated with commercial activity	Monitoring changes in abundance via trapping or internal counts	3
Work with landowners to establish timeframes to minimize activities that cause disturbance and to set aside areas of high animal use.					

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: All hibernating bat species

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Vehicular impacts documented to cause mortality, new roads cause increased fragmentation and permanent loss of foraging and roosting habitat.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 9.0	Planning	To reduce or eliminate mortality	Number of dead bats verified	Determine number of bats killed by direct collisions with cars, compare numbers before and after site modifications.	3
Identify road sections with high bat mortality from direct collisions. Add vegetation or barriers to direct bats over oncoming cars.					

Action Location: Physiographic Province: Statewide

Associated Species: All bat species

Indiana Bat *Myotis sodalis*

RESEARCH NEEDS

1. Determine where surviving bats are located and if consolidation to core areas is occurring.

2. Determine if juveniles born since WNS arrival are surviving and if infection levels are decreasing in survivors.

3. Determine what impact various types of forest management (including prescribed fire) have on spring, summer, and autumn populations of these bats. Can some types of forest management be beneficial? What mitigation techniques might reduce/minimize impacts?

SURVEY NEEDS

1. Continue to monitor known hibernation sites prioritized by use either before or after WNS.

2. Monitor infection loads from WNS via UV light to see if decreases are occurring.

3. Monitor any newly discovered maternity colonies for persistence and growth.

MONITORING PROGRAMS

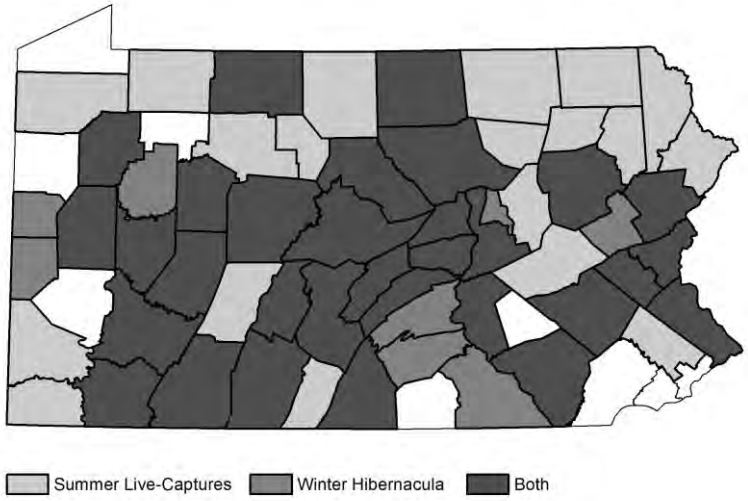
Program Name	Lead Agency	Hyperlink	Description
Appalachian Bat Count	Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt?open=514&objID=712212&mode=2	Each year, volunteers count bats exiting summer roosts between May 15th and August 1st. Species, type of structure, and weather is recorded.
North American Bat Monitoring Program (NABat)	U.S. Geological Survey	https://www.fort.usgs.gov/science-tasks/2457	A statistically rigorous and nationally coordinated bat monitoring program for determining the impacts of the many stressors on bat populations and the efficacy of conservation management actions.
Winter hibernacula surveys	USFWS; Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt/document/1373295/71401-12z_pdf	Each year, between Jan 1st and March 15th, PGC personnel and other qualified individuals survey cave, mines, and tunnels for bats. Bat species and location, cave and roost temperatures, and presence of WNS is recorded.

Little Brown Bat

Myotis lucifugus

Gregory G. Turner
Pennsylvania Game Commission

Photo: Greg Turner



CONSERVATION PROFILE

Global Rank	**G3**	State Rank	**S1**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**Very High Concern / Low Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of >90%**

Conservation Goal:

Maintain or increase current population levels in Pennsylvania through 2025.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**(B) Central Oak-Pine** **(W) Subterranean**	**(B) Northern Hardwood & Conifer**
Habitat	**(B) Northeastern Interior Dry-Mesic Oak Forest** **(W) Cave, Karst & Mines**	**(B) Appalachian (Hemlock)-Northern Hardwood Forest**

Specific Habitat Requirements:

(B) Various habitats, from forested to urban/human structures.
(W) Primarily caves and mines but also minimal use in rock fissures and human structures such as ditches and tunnels where more stable temps in 40-50˚F range are found.

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Direct mortality from white-nose syndrome (*Pseudogymnoascus destructans*).

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	To eliminate or reduce clinical signs of disease	Number of lesions caused by pathogen or number of bats counted surviving exposure to disease.	Quantifying number of lesions via UV light technique (Turner et al. 2014).	1

Develop and utilize treatment options to reduce pathogen abundance in situ or reduce quantity of infections caused by pathogen

Action Location: Physiographic Province: Statewide

Associated Species: All hibernating bat species

IUCN Threat: 6.0 Human Intrusions and Disturbance

Specific Threat: Some commercial application of mines for storage and office use create noise, light, and climate variations that may impact hibernation.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 6.0	Land and Water Rights Acquisition and Protection	To retain ideal microclimate features preferred by the species and to minimize disturbance reducing fat stores.	Number of bats counted at hibernacula associated with commercial activity	Monitoring changes in abundance via trapping or internal counts	1

Work with landowners to establish timeframes to minimize activities that cause disturbance and to set aside areas of high animal use.

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: All hibernating bat species

THREATS AND ACTIONS

IUCN Threat: 6.0 Human Intrusions and Disturbance

Specific Threat: Recreational and commercial caving causes disturbances that lead to direct mortality and lower fecundity of adult females, and exacerbate problems caused by White-nose syndrome (WNS)

Action	Objective	Measure	Monitoring	Priority
TRACS Action 7.0 Law enforcement Enforce protections afforded hibernation sites and seek a caving season to further limit disturbance at important sites; install bat gates. Action Location: Physiographic Province: Statewide Associated Species: All hibernating bat species	Reduce additive loss of fat reserves maximizing survival and reproduction output	Number of hibernacula gated or protected with landowner agreements, along with number of people arrested.	Monitoring changes in abundance via trapping or internal counts	1

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Large-scale wind farms have been documented to directly cause mortality

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Produce regulation or develop cooperative agreements enacting operation guidelines (curtailment) to limit bat mortality Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley Associated Species: All bat species	To reduce overall mortality	Number of wind turbines with higher cut-in speeds	Counting and estimating carcasses found below turbines	1

THREATS AND ACTIONS

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Mining and quarrying cause direct mortality, alter microclimates of hibernacula, and remove roosting and foraging habitat.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Retain openings and structural integrity of abandoned mines that are used by bats, and erect bat-friendly gates to protect. Action Location: Physiographic Province: Statewide Associated Species: All hibernating bat species	To reduce the destruction of, or alteration of specific conditions within locations used to hibernate	Number of hibernacula gated	Monitoring changes in abundance via trapping or internal counts	1

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Permanent loss of forested habitat reduces foraging quality and quantity, reduces or eliminates roosting. Improper exclusion (or razing of structure) of maternity colonies and young results in direct mortality and lower recruitment into breeding population.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Promote the use of artificial structures and develop guidelines to improve exclusion techniques to limit mortality Action Location: Physiographic Province: Statewide Associated Species: All bat species	To lessen impacts from habitat loss and exclusions from human structures	Number of bat boxes installed or exclusions performed during proper timing	Perform emergence surveys to quantify use	1

THREATS AND ACTIONS

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: Logging causes loss of older forests with more potential roosting sites.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Promote the use of artificial structures and creation/retention of wildlife trees during forest management projects Action Location: Physiographic Province: Statewide Associated Species: All bat species	To consistently maintain natural, suitable landscape features that perpetuate use and add artificial structures as needed.	Number of natural or artificial roosts available	Perform emergence surveys to quantify use	2

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Loss of forested habitat reduces foraging quality and quantity, reduces or eliminates roosting.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Reduce site contamination as possible and utilize open areas to avoid forest removal when possible. Action Location: Physiographic Province: Appalachian Plateaus Associated Species: All bat species	To maintain healthy supporting habitat	Number of forest acres removed for well pads or documented spills.	Quantifying acres of forest preserved by relocation well pads.	2

THREATS AND ACTIONS

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Commercial caving causes disturbances that lead to direct mortality and lower fecundity of adult females, and exacerbate problems caused by White-nose syndrome (WNS)

Action		Objective	Measure	Monitoring	Priority
TRACS Action 6.0	Land and Water Rights Acquisition and Protection	Reduce additive loss of fat reserves maximizing survival and reproduction output	Number of bats counted at commercialized hibernacula	Monitoring changes in abundance via trapping or internal counts	2

Work with commercial cave operators to restrict visitation at known hibernacula when hibernating bats present.

Action Location: Physiographic Province: Statewide

Associated Species: All hibernating bat species

IUCN Threat: 11.0 Climate Change and Severe Weather

Specific Threat: Flooding can drown and kill hibernating bats in subterranean environments

Action		Objective	Measure	Monitoring	Priority
TRACS Action 2.0	Direct Management of Natural Resources	To reduce or eliminate sudden influx of high volumes of water resulting in mass mortality.	Number of documented flood events	Monitoring changes in abundance via trapping or internal counts	3

Identify hibernacula with greatest potential for flooding and then attempt to minimize potential for drowning by providing drainage or modifying site to shift bats to areas that are less prone to flooding.

Action Location: Physiographic Province: Ridge and Valley

Associated Species: All hibernating bat species

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Predation by feral cats, raccoons, and owls.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 101.0 Species Management Trap and relocate/remove problematic individuals. Action Location: Physiographic Province: Statewide Associated Species: All hibernating bat species	To reduce predation-related mortality	Number of predators removed from problematic area	Monitoring changes in abundance via trapping or internal counts	3

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Vehicular impacts documented to cause mortality, new roads cause increased fragmentation and permanent loss of foraging and roosting habitat.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Identify road sections with high bat mortality from direct collisions. Add vegetation or barriers to direct bats over oncoming cars. Action Location: Physiographic Province: Statewide Associated Species: All bat species	To reduce or eliminate mortality	Number of dead bats counted	Determine number of bats killed by direct collisions with cars, compare numbers before and after site modifications.	3

RESEARCH NEEDS

1. Determine where surviving females at known maternity sites are hibernating and if movement to core areas is occurring.

2. Determine if juveniles born since WNS arrival are surviving.

3. Determine if infection levels are decreasing in survivors.

SURVEY NEEDS

1. Continue to monitor known hibernation sites prioritized by use either before or after WNS.
2. Monitor infection loads from WNS via UV light to see if decreases are occurring.
3. Monitor any newly discovered maternity colonies for persistence and growth.

MONITORING PROGRAMS

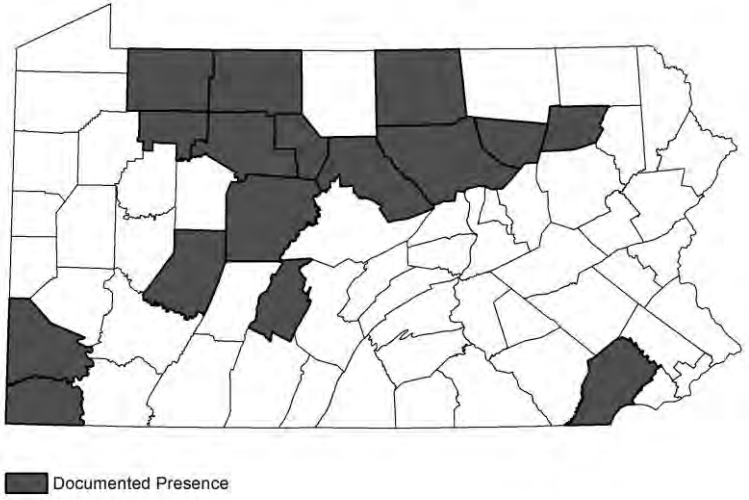
Program Name	Lead Agency	Hyperlink	Description
Appalachian Bat Count	Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt?open=514&objID=712212&mode=2	Each year, volunteers count bats exiting summer roosts between May 15th and August 1st. Species, type of structure, and weather is recorded.
North American Bat Monitoring Program (NABat)	U.S. Geological Survey	https://www.fort.usgs.gov/science-tasks/2457	A statistically rigorous and nationally coordinated bat monitoring program for determining the impacts of the many stressors on bat populations and the efficacy of conservation management actions.
Winter hibernacula surveys	USFWS; Pennsylvania Game Commission	http://www.portal.state.pa.us/portal/server.pt/document/1373295/71401-12z_pdf	Each year, between Jan 1st and March 15th, PGC personnel and other qualified individuals survey cave, mines, and tunnels for bats. Bat species and location, cave and roost temperatures, and presence of WNS is recorded.

Silver-haired Bat

Lasionycteris noctivagans

Charlie Eichelberger
PA Natural Heritage Program/ Western Pennsylvania Conservancy

Photo: Cal Butchkoski



CONSERVATION PROFILE

Global Rank	**G5**	State Rank	**S1**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**Very High Concern / Low Responsibility**	PA Abundance	**Unknown**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Decline of 11-40% to Stable**

Conservation Goal:

By 2025, determine the distribution of the breeding population in Pennsylvania, model suitable habitat, and map important migratory corridors.

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Northern Hardwood & Conifer**	
Habitat	**Appalachian (Hemlock)-Northern Hardwood Forest**	

Specific Habitat Requirements:

Maternity roost (data deficient in Pennslyvania)- deciduous forest with adjacent agricultural fields. Resident male habitat - coniferous and mixed forests adjacent to wetlands and open water bodies, or high deciduous upland forests. Migration - various habitats.

THREATS AND ACTIONS

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: The only known maternity colony within the state occurs in fragmented woodlots currrently under threat of harvest.

Action		Objective	Measure	Monitoring	Priority
TRACS Action 6.0	Land and Water Rights Acquisition and Protection	Identify and protect woodlots used by silver-haired bats as maternity roosts.	The number of silver-haired roost trees identified and the habitats surrounding them adequately protected.	Perform emergence surveys to quantify use	1
In areas where maternity sites for silver-haired bats have been documented, work with landowners to protect existing important roost trees and other trees with favorable roosting characteristics, including live and dead trees with sloughing bark or crevices, and encouraging the eventual replacement of these trees by promoting species known to serve as favorable roost trees (e.g. shagbark hickory).					

Action Location: Physiographic Province: Appalachian Plateaus

Associated Species: All Pennsylvania bat species

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Large-scale wind farms have been documented to directly cause mortality

Action		Objective	Measure	Monitoring	Priority
TRACS Action 100.0	Law and Policy	Reduce mortality of silver-haired bats at wind energy facilities.	Number of silver-haired bats counted at operating wind facilities using the methods outlined in the amended Pennsylvania Game Commission Wind Energy Voluntary Cooperation Agreement (2013).	Counting and estimating carcasses found below turbines	2
Produce regulation or develop cooperative agreements enacting operation guidelines (curtailment) to limit bat mortality					

Action Location: Physiographic Province: Statewide

Associated Species: Little brown bat, Indiana bat, eastern small-footed bat, tricolored bat, northern long-eared bat, big brown bat, eastern red bat, hoary bat, Seminole bat, evening bat

Silver-haired Bat *Lasionycteris noctivagans*

RESEARCH NEEDS

1. How prevalent and consistent are reproducing colonies/individuals of silver-haired bats in Pennsylvania?

2. What are the ecological needs and spatial use of Pennsylvania's reproducing colonies/individuals of silver-haired bats?

3. What cumulative impacts are Pennsylvania's wind facilities having on reproducing and migrating populations of silver-haired bats?

SURVEY NEEDS

1. Determine where reproducing colonies/individuals of silver-haired bats exist in Pennsylvania.

2. Determine the locations of important migratory corridors in Pennsylvania for silver-haired bats

MONITORING PROGRAMS

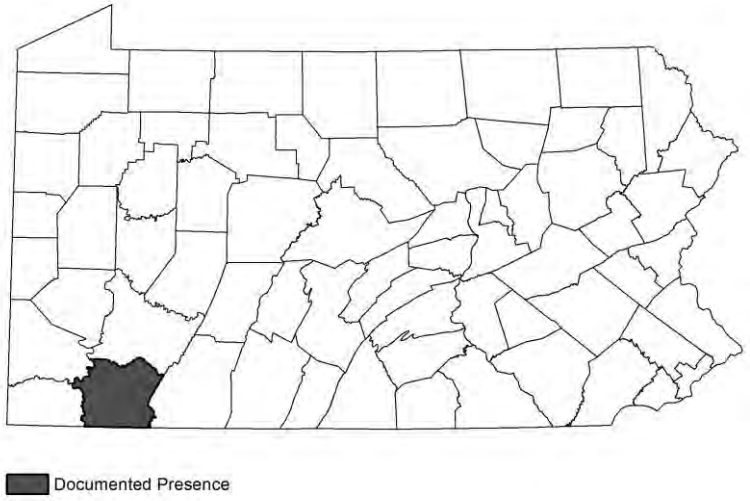
Program Name	Lead Agency	Hyperlink	Description
Bat Net and Trap database	Pennsylvania Game Commission	http://www.pgc.state.pa.us/	PGC biologists compile annual data from contractor mist-netting efforts in PA and then report captures per unit of mist-netting effort.
North American Bat Monitoring Program (NABat)	U.S. Geological Survey	https://www.fort.usgs.gov/science-tasks/2457	A statistically rigorous and nationally coordinated bat monitoring program for determining the impacts of the many stressors on bat populations and the efficacy of conservation management actions.
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

Eastern Spotted Skunk

Spilogale putorius

Lindsey M. Heffernan
Pennsylvania Game Commission

Photo: Bob Gress



CONSERVATION PROFILE

Global Rank	**G4**	State Rank	**S2**
IUCN Red List	**LC Least Concern**	PA Legal Status	**Protected**
Northeast Region	**Very High Concern / Low Responsibility**	PA Abundance	**< 5 individuals**
Federal Status	**Not Listed**	PA Short-Term Trend (10 year)	**Unknown**

Conservation Goal:

Establish one self-sustaining population of eastern spotted skunks in Pennsylvania by 2025

HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	**Central Oak-Pine**	
Habitat	**Central Appalachian Pine-Oak Rocky Woodland**	

Specific Habitat Requirements:

Pine and hardwood forests with rocky outcrops, dense understory, closed canopy, vines, and steep slopes (Reed and Kennedy 2000, Lesmeister et al. 2008, Lesmeister et al. 2013); reverting fields and hedgerows with coarse woody debris (Butfiloski and Swaygnham 2005).

THREATS AND ACTIONS

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Mortality from natural predation

Action	Objective	Measure	Monitoring	Priority
TRACS Action 9.0 Planning Create or improve spotted skunk habitat	Conduct habitat enhancement projects that create dense understory and closed canopy at three sites known to support eastern spotted skunk populations	Number of sites treated	Conduct skunk and habitat surveys one year pre- and biennially post-treatment for ten years to determine success of enhancement projects	3

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Allegheny woodrat

IUCN Threat: 5.0 Biological Resource Use

Specific Threat: Mortality from incidental take by trappers

Action	Objective	Measure	Monitoring	Priority
TRACS Action 8.0 Outreach Reduce incidental take of spotted skunk by stakeholders (trappers)	Provide stakeholders with Best Management Practices, including techniques to reduce the incidental take of eastern spotted skunks	Number of incidental spotted skunk mortalities	Conduct stakeholder surveys biennially for ten years to determine if new practices were implemented and whether the practices have reduced incidental take	3

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Allegheny woodrat

THREATS AND ACTIONS

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Mortality from vehicle collision

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Minimize or avoid siting future projects in areas known to support eastern spotted skunk populations	Review all proposed projects for negative impacts to eastern spotted skunks, offer siting guidance, and provide Best Management Practices	Number of projects reviewed that would impact eastern spotted skunks, and percent that were able to minimize or avoid such impacts	Inventory active eastern spotted skunk sites to determine if there are any projects impacting them	3

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Allegheny woodrat

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Habitat modification and lower food availability due to some agricultural management practices.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 8.0 Outreach Partner with stakeholders (farmers/producers) to create or improve spotted skunk habitat	Provide stakeholders with Best Management Practices and guidance to modify farming practices and/or enhance habitat for eastern spotted skunk	Number of stakeholders engaged, and percent that implemented practices	Conduct stakeholder surveys one year post-meeting to determine if practices were implemented and, if so, conduct surveys for spotted skunk presence	3

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Eastern cottontail

THREATS AND ACTIONS

IUCN Threat: 1.0 Residential and Commercial Development

Specific Threat: Habitat loss and a reduction of dense vegetative cover from residential and commercial development.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Minimize or avoid siting future projects in areas known to support eastern spotted skunk populations.	Review all proposed projects for negative impacts to eastern spotted skunks, offer siting guidance, and provide Best Management Practices.	Number of projects reviewed that would impact eastern spotted skunks, and percent that were able to minimize or avoid such impacts.	Inventory active eastern spotted skunk sites to determine if there are any projects impacting them	3

Action Location: Physiographic Province: Appalachian Plateaus, Ridge and Valley

Associated Species: Allegheny woodrat

RESEARCH NEEDS

1. Determine the current location and distribution of eastern spotted skunks in Pennsylvania.

2. Characterize eastern spotted skunk habitat use, home ranges, and dispersal in Pennsylvania.

SURVEY NEEDS

1. Conduct surveys to determine eastern spotted skunk presence/absence in Pennsylvania. Surveys should target late September to early May when detection is highest (Hackett et al. 2007).

2. Conduct mark-recapture studies at active eastern spotted skunks sites to determine baseline population parameters such as number of breeding individuals and survival.

3. Apply tracking collars (preferably GPS) to a subset of eastern spotted skunks to analyze habitat use, home ranges, and dispersal.

MONITORING PROGRAMS

Program Name	Lead Agency	Hyperlink	Description
Eastern Spotted Skunk Presence Surveys			Camera trap surveys for spotted skunk began in 2012, after the capture of a skunk by a wildlife consultant in Fayette County.
The Pennsylvania Mammal Atlas	Pennsylvania Game Commission		A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals

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