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**

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Species Name</th>
<th>Species Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Fox Squirrel</td>
<td>Long-tailed Shrew</td>
<td>Northern Long-eared Bat</td>
</tr>
<tr>
<td>Northern Flying Squirrel</td>
<td>Northern Water Shrew</td>
<td>Eastern Small-footed Bat</td>
</tr>
<tr>
<td>Rock Vole</td>
<td>West Virginia Water Shrew</td>
<td>Indiana Bat</td>
</tr>
<tr>
<td>Allegheny Woodrat</td>
<td>Maryland Shrew</td>
<td>Little Brown Bat</td>
</tr>
<tr>
<td>Prairie Deer Mouse</td>
<td>Big Brown Bat</td>
<td>Silver-haired Bat</td>
</tr>
<tr>
<td>Appalachian Cottontail</td>
<td>Tricolored Bat</td>
<td>Eastern Spotted Skunk</td>
</tr>
<tr>
<td>North American Least Shrew</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Eastern Fox Squirrel
*Sciurus niger vulpinus*

**CONSERVATION PROFILE**

<table>
<thead>
<tr>
<th>Global Rank</th>
<th>G5T4T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUCN Red List</td>
<td>Not Yet Assessed</td>
</tr>
<tr>
<td>Northeast Region</td>
<td>Not NE Regional SGCN</td>
</tr>
<tr>
<td>Federal Status</td>
<td>Not Listed</td>
</tr>
<tr>
<td>State Rank</td>
<td>S2</td>
</tr>
<tr>
<td>PA Legal Status</td>
<td>Protected</td>
</tr>
<tr>
<td>PA Abundance</td>
<td>Unknown</td>
</tr>
<tr>
<td>PA Short-Term Trend (10 year)</td>
<td>Relatively Stable (&lt;=10% change)</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Primary Macrogroup</th>
<th>Secondary Macrogroup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Hardwood &amp; Conifer</td>
<td></td>
</tr>
</tbody>
</table>

**Habitat:**
Appalachian (Hemlock)-Northern Hardwood Forest

**Specific Habitat Requirements:**
Open, park-like woods with sparse ground cover.
## Eastern Fox Squirrel

### THREATS AND ACTIONS

**Sciurus niger vulpinus**

**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.

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

**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.

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

**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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Current Monitoring Programs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Northern Flying Squirrel
Glaucomys sabrinus

CONSERVATION PROFILE

Global Rank: G5  
IUCN Red List: LC Least Concern  
State Rank: S1  
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
- Macrogoup: Northern Hardwood & Conifer
- Habitat: Appalachian (Hemlock)-Northern Hardwood Forest

Secondary
- Macrogoup: Northern Hardwood & Conifer
- Habitat: 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.
## Northern Flying Squirrel

### Glaucomyys sabrinus

#### 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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>Daylight existing spruce trees or plant 5000 red spruce in next 10 years.</td>
<td>Number of trees planted or number of acres of existing spruce daylighted.</td>
<td>Once every 10 years, assess the number of northern flying squirrels that have hybridized and the amount of spruce habitat generated.</td>
<td>1</td>
</tr>
</tbody>
</table>

**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*.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>Daylight existing spruce trees or plant 5000 red spruce in next 10 years.</td>
<td>Number of trees planted or number of acres of existing spruce daylighted.</td>
<td>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</td>
<td>1</td>
</tr>
</tbody>
</table>

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

**Associated Species:** Snowshoe hare, Yellow-bellied Flycatcher, Blackpoll Warbler
## Northern Flying Squirrel

### Glaucomys sabrinus

#### THREATS AND ACTIONS

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRACS Action 9.0  Planning</strong></td>
<td>Assess the potential for loss of hemlock due to wooly adelgid aphid and proactively replace dead stands with red spruce.</td>
<td>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.</td>
<td>Quantify loss of hemlock stands in primary and secondary stands around known populations; determine survival and growth of red spruce where planted.</td>
<td>Annually for at least 10 years, measure retention of hemlock and growth of red spruce through ground-truthing and remote sensing analysis.</td>
</tr>
<tr>
<td><strong>Action Location:</strong> Physiographic Province: Appalachian Plateaus, Ridge and Valley&lt;br&gt;<strong>Associated Species:</strong> Northern Goshawk, snowshoe hare, aquatic fauna, silver-haired bat, Yellow-bellied Flycatcher.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

#### Specific Threat:

Loss of mature eastern hemlock stands due to hemlock wooly adelgid

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRACS Action 9.0  Planning</strong></td>
<td>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.</td>
<td>Delineate known populations and habitats for primary (1-mile radius) and secondary (5-mile radius) management.</td>
<td>Every 5 years, quantify species richness and age of forest habitat through ground-truthing and remote sensing analysis.</td>
<td>2</td>
</tr>
<tr>
<td><strong>Action Location:</strong> Physiographic Province: Appalachian Plateaus, Ridge and Valley&lt;br&gt;<strong>Associated Species:</strong> Northern Goshawk, snowshoe hare, aquatic fauna, silver-haired bat, Yellow-bellied Flycatcher.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Northern Flying Squirrel**

**Glaucomys sabrinus**

**THREATS AND ACTIONS**

**IUCN Threat:** 1.0 Residential and Commercial Development

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>Identify sites where new development is in close proximity to known populations. Assess habitat quality before and after development.</td>
<td>Amount of suitable habitat lost and maintained.</td>
<td>Every 5 years, determine and monitor trends in habitat loss/gains through ground-truthing and remote sensing analysis.</td>
<td>2</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
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</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
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<td>Amount of suitable habitat lost and maintained.</td>
<td>Every 5 years, determine and monitor trends in habitat loss/gains through ground-truthing and remote sensing analysis.</td>
<td>2</td>
</tr>
</tbody>
</table>

**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*. 

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**Pennsylvania Game Commission**

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**Pennsylvania Fish & Boat Commission**

Published September 2015
Northern Flying Squirrel  
*Glaucomyys 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 a 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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pennsylvania Game Commission annual occupancy surveys</td>
<td>Pennsylvania Game Commission</td>
<td></td>
<td>Nest-box surveys and live-trapping conducted at sites throughout state to assess occupancy and gather samples.</td>
</tr>
</tbody>
</table>
Rock Vole
*Microtus chrotorrhinus*

**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 Macrogroup**: Northern Hardwood & Conifer
- **Secondary 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).
**Rock Vole**

**Microtus chrotorrhinus**

### THREATS AND ACTIONS

**IUCN Threat:** 3.0 Energy Production and Mining

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 11.0 Technical Assistance</td>
<td>Locate and quantify abundance at two sites before and after drilling to determine impacts species caused by fragmentation to this species.</td>
<td>Change in abundance of this species.</td>
<td>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.</td>
<td>3</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Pennsylvania Mammal Atlas</td>
<td>Pennsylvania Game Commission</td>
<td></td>
<td>A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals</td>
</tr>
</tbody>
</table>

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**PENNSYLVANIA GAME COMMISSION**

Published September 2015
Allegheny Woodrat
*Neotoma magister*

**CONSERVATION PROFILE**

<table>
<thead>
<tr>
<th>Category</th>
<th>Status/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Rank</td>
<td>G3G4</td>
</tr>
<tr>
<td>IUCN Red List</td>
<td>NT Near Threatened</td>
</tr>
<tr>
<td>Northeast Region</td>
<td>Very High Concern / High Responsibility</td>
</tr>
<tr>
<td>Federal Status</td>
<td>Not Listed</td>
</tr>
<tr>
<td>State Rank</td>
<td>S2</td>
</tr>
<tr>
<td>PA Legal Status</td>
<td>Threatened</td>
</tr>
<tr>
<td>PA Abundance</td>
<td>Unknown</td>
</tr>
<tr>
<td>PA Short-Term Trend (10 year)</td>
<td>Decline of 11-40%</td>
</tr>
</tbody>
</table>

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

**HABITAT ASSOCIATIONS**

- **Primary**
  - Macrogroup: Central Oak-Pine
  - Habitat: Central Appalachian Dry Oak-Pine Forest

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

**Specific Habitat Requirements:**
Extensive expanses of sandstone and/or limestone rock outcrops in unfragmented oak-hickory forest communities.
## Allegheny Woodrat

**Neotoma magister**

### THREATS AND ACTIONS

<table>
<thead>
<tr>
<th>IUCN Threat:</th>
<th>4.0 Transportation and Service Corridors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Threat:</td>
<td>Habitat fragmentation from railroads and roads which can lead to barriers to dispersal and increased predation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 11.0</td>
<td>Technical Assistance</td>
<td>Review all proposed projects for negative impacts to woodrats, offer siting guidance, and provide Best Management Practices.</td>
<td>Number of projects reviewed that would impact woodrats, and percent that were able to minimize or avoid such impacts.</td>
<td>Monitor woodrat habitat and dispersal corridor fragmentation as related to these projects using desktop reviews or site visits.</td>
</tr>
</tbody>
</table>

**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 |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Threat:</td>
<td>Habitat fragmentation from wind energy infrastructure which can lead to barriers to dispersal and increased predation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
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<tbody>
<tr>
<td>TRACS Action 11.0</td>
<td>Technical Assistance</td>
<td>Review all proposed projects for negative impacts to woodrats, offer siting guidance, and provide Best Management Practices.</td>
<td>Number of projects reviewed that would impact woodrats, and percent that were able to minimize or avoid such impacts.</td>
<td>Monitor woodrat habitat and dispersal corridor fragmentation as related to these projects using desktop reviews or site visits.</td>
</tr>
</tbody>
</table>

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

**Associated Species:** Eastern spotted skunk, eastern small-footed bat, long-tailed shrew
### Allegheny Woodrat

**Neotoma magister**

#### 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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 11.0</td>
<td>Technical Assistance</td>
<td>Minimize or avoid siting proposed mining and quarrying projects within woodrat habitat and dispersal corridors.</td>
<td>Review all proposed projects for negative impacts to woodrats, offer siting guidance, and provide Best Management Practices.</td>
<td>Number of projects reviewed that would impact woodrats, and percent that were able to minimize or avoid such impacts</td>
</tr>
</tbody>
</table>

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

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

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**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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 11.0</td>
<td>Technical Assistance</td>
<td>Minimize or avoid siting proposed oil and gas projects within woodrat habitat and dispersal corridors.</td>
<td>Review all proposed projects for negative impacts to woodrats, offer siting guidance, and provide Best Management Practices.</td>
<td>Number of projects reviewed that would impact woodrats, and percent that were able to minimize or avoid such impacts</td>
</tr>
</tbody>
</table>

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

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

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PENNSYLVANIA GAME COMMISSION
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PENNSYLVANIA FISH & BOAT COMMISSION
Published September 2015
## Allegheny Woodrat

### Neotoma magister

#### THREATS AND ACTIONS

**IUCN Threat:** 8.0 Invasive and Other Problematic Species and Genes

**Specific Threat:** Mortality caused by exposure to raccoon roundworm.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>Decrease or maintain low levels of raccoon roundworm within woodrat habitat and dispersal corridors.</td>
<td>Determine baseline raccoon roundworm levels for each woodrat Conservation Management Area, and apply repeated treatments to five active woodrat sites.</td>
<td>Number of sites that received treatment</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>Increase the number of mast-producing chestnut trees within woodrat habitat and dispersal corridors.</td>
<td>Plant hybrid chestnut trees at five active woodrat sites within the next ten years.</td>
<td>Number of chestnut trees planted and sites receiving treatment.</td>
</tr>
</tbody>
</table>

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

**Associated Species:** Eastern spotted skunk

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PENNSYLVANIA GAME COMMISSION  
PENNSYLVANIA FISH & BOAT COMMISSION  
Published September 2015  
594| Appendix 1.4 Mammals
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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allegheny Woodrat Captive Breeding Program</td>
<td>Delaware Valley University</td>
<td><a href="http://www.delval.edu/news/restoring-the-allegheny-woodrat-population">http://www.delval.edu/news/restoring-the-allegheny-woodrat-population</a></td>
<td>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.</td>
</tr>
<tr>
<td>Developing a Genetic Catalog for Allegheny Woodrat Metapopulations in Pennsylvania: Identifying conservation concerns and guiding management action.</td>
<td>Indiana University of Pennsylvania</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Statewide Allegheny Woodrat Inventory and Monitoring Program</td>
<td>Pennsylvania Game Commission</td>
<td><a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1935066&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1935066&amp;mode=2</a></td>
<td>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.</td>
</tr>
</tbody>
</table>
Prairie Deer Mouse
*Peromyscus maniculatus bairdii*

**CONSERVATION PROFILE**

<table>
<thead>
<tr>
<th>Global Rank</th>
<th>G5</th>
<th>State Rank</th>
<th>S3S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUCN Red List</td>
<td>LC Least Concern</td>
<td>PA Legal Status</td>
<td>Protected</td>
</tr>
<tr>
<td>Northeast Region</td>
<td>Not NE Regional SGCN</td>
<td>PA Abundance</td>
<td>Unknown</td>
</tr>
<tr>
<td>Federal Status</td>
<td>Not Listed</td>
<td>PA Short-Term Trend (10 year)</td>
<td>Decline of 30 - 70%</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Primary</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macrogroup</td>
<td></td>
</tr>
<tr>
<td>Habitat</td>
<td></td>
</tr>
</tbody>
</table>

**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.

*Photo: John Wible*

*Published September 2015*
**Prairie Deer Mouse**

*Peromyscus maniculatus bairdii*

## THREATS AND ACTIONS

<table>
<thead>
<tr>
<th>IUCN Threat:</th>
<th>7.0 Natural System Modifications</th>
</tr>
</thead>
</table>

### Specific Threat:

- Loss of grassland habitat from natural succession and fire suppression.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>Encourage grassland maintenance and restoration through mowing, mechanical shrub and tree removal, or prescribed fire.</td>
<td>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.</td>
<td>The number of Prairie Deer Mouse occupied sites maintained and the number of formerly occupied sites restored.</td>
</tr>
</tbody>
</table>

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

**Associated Species:** North American least shrew

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0</td>
<td>Planning</td>
<td>Encourage municipalities to maintain existing grasslands and agricultural lands as they are, and prevent them from being developed.</td>
<td>By working with county planning departments/commissions, initiate preservation of core agricultural areas at 10 locations known to harbor the Prairie Deer Mouse.</td>
<td>Number of Prairie Deer Mouse populations protected through agricultural preservation.</td>
</tr>
</tbody>
</table>

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

**Associated Species:** North American least shrew
## Threats and Actions

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 101.0</td>
<td>Species Management</td>
<td>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.</td>
<td>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.</td>
<td>Monitor the density ratios of the small mammal community in several experimental populations of the Prairie Deer Mouse using live-tapping techniques.</td>
</tr>
</tbody>
</table>

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

**Associated Species:** North American least shrew

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>At 3 locations where Prairie Deer Mouse exist, reduce the density of non-native competitive mammals by 50% in 1 year.</td>
<td>A reduction in non-native competing species density accomplished through a live trapping and removal regimen.</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

**Associated Species:** North American least shrew
**Prairie Deer Mouse**

**Peromyscus maniculatus bairdii**

### 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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrestrial Small Mammal Database</td>
<td>Pennsylvania Game Commission</td>
<td><a href="http://www.pgc.state.pa.us/">http://www.pgc.state.pa.us/</a></td>
<td>A database compiling all PGC permitted terrestrial small mammal surveys in a standardized format.</td>
</tr>
<tr>
<td>The Pennsylvania Mammal Atlas</td>
<td>Pennsylvania Game Commission</td>
<td></td>
<td>A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals</td>
</tr>
</tbody>
</table>
Appalachian Cottontail  
*Sylvilagus obscurus*

**CONSERVATION PROFILE**

- **Global Rank**: G4
- **State Rank**: S1S2
- **IUCN Red List**: NT Near Threatened
- **Northeast Region**: Very High Concern / Low Responsibility
- **Federal Status**: Not Listed

**PA Legal Status**: Protected

**PA Abundance**: Unknown

**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 Macrogroup**: Central Oak-Pine
- **Secondary 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.
### Appalachian Cottontail

**Sylvilagus obscurus**

#### THREATS AND ACTIONS

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

<table>
<thead>
<tr>
<th><strong>Action</strong></th>
<th><strong>Objective</strong></th>
<th><strong>Measure</strong></th>
<th><strong>Monitoring</strong></th>
<th><strong>Priority</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>Create and protect suitable habitat for Appalachian cottontails.</td>
<td>Amount of habitat at high elevation that has extensive understory cover and is suitable to Appalachian cottontails.</td>
<td>Monitor response of Appalachian cottontails to habitat management practices.</td>
<td>1</td>
</tr>
</tbody>
</table>

- **Action Location:** Physiographic Province: Appalachian Plateaus, New England, Ridge and Valley
- **Associated Species:** Ruffed Grouse, snowshoe hare

<table>
<thead>
<tr>
<th>IUCN Threat:</th>
<th>7.0 Natural System Modifications</th>
</tr>
</thead>
</table>

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

<table>
<thead>
<tr>
<th><strong>Action</strong></th>
<th><strong>Objective</strong></th>
<th><strong>Measure</strong></th>
<th><strong>Monitoring</strong></th>
<th><strong>Priority</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 101 Species Management</td>
<td>Reduce competition with introduced cottontails.</td>
<td>Number of areas with prime Appalachian cottontail habitat that are found to have Appalachian cottontails.</td>
<td>Monitor Appalachian cottontail population dynamics.</td>
<td>1</td>
</tr>
</tbody>
</table>

- **Action Location:** Physiographic Province: Statewide, Ridge and Valley, Appalachian Plateaus, New England
- **Associated Species:** Snowshoe hare

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**PENNSYLVANIA GAME COMMISSION**

**PENNSYLVANIA FISH & BOAT COMMISSION**

Published September 2015

**Appendix 1.4 Mammals**
**Appalachian Cottontail**

* Sylvilagus obscurus

## THREATS AND ACTIONS

**IUCN Threat:** 5.0 Biological Resource Use

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 6.0</td>
<td>Land and Water Rights Acquisition and Protection</td>
<td>Maintain Appalachian cottontail populations.</td>
<td>Abundance of Appalachian cottontail populations that are protected.</td>
<td>Monitor protected areas for Appalachian cottontail population dynamics annually.</td>
</tr>
</tbody>
</table>

Monitor rabbit hunting in areas identified to have ideal Appalachian cottontail habitat and/or confirmed Appalachian cottontail populations until more is known 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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian cottontail head collection</td>
<td>Pennsylvania Game Commission</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td>Lagomorph pellet collection</td>
<td>Pennsylvania Game Commission</td>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>
North American Least Shrew

*Cryptotis parva*

**CONSERVATION PROFILE**

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

**Conservation Goal:**
Identify current extent of the breeding population within Pennsylvania

**HABITAT ASSOCIATIONS**

<table>
<thead>
<tr>
<th>Primary Macrogoup</th>
<th>Secondary Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban/Suburban Built</td>
<td>Developed (NLCD 21-24 &amp; 31)</td>
</tr>
<tr>
<td>Agricultural</td>
<td>Agriculture (NLCD 81-82)</td>
</tr>
</tbody>
</table>

**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).
### North American Least Shrew

#### Cryptotis parva

**THREATS AND ACTIONS**

| IUCN Threat: 7.0 | Natural System Modifications |
| Specific Threat: Loss of suitable maintained habitats. |

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 1.0</td>
<td>Coordination and Administration</td>
<td>Maintain 500 acres of existing manmade habitat through 2015</td>
<td>Acreage of habitat reserved</td>
<td>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.</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Piedmont, Ridge and Valley

**Associated Species:** Terrestrial fauna

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>Decrease overgrazing on 500 acres of core least shrew habitat by 2015</td>
<td>Acreage of habitat reserved</td>
<td>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.</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Piedmont, Ridge and Valley

**Associated Species:** Terrestrial fauna

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**PENNSYLVANIA GAME COMMISSION**

**PENNSYLVANIA FISH & BOAT COMMISSION**

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Published September 2015
### North American Least Shrew

**Cryptotis parva**

#### THREATS AND ACTIONS

| IUCN Threat: | Agriculture and Aquaculture |
| Specific Threat: | Intense farming practices do not allow fields to grow fallow. |

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 1.0</td>
<td>Coordination and Administration</td>
<td>Reserve 500 acres of core least shrew habitat</td>
<td>Acreage of habitat reserved by 2025</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Incentivize farmers who are willing to preserve tracts of suitable least shrew habitat</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Action Location:** Physiographic Province: Piedmont, Ridge and Valley
- **Associated Species:** Terrestrial fauna

| IUCN Threat: | Residential and Commercial Development |
| Specific Threat: | Conversion of natural grasslands, fallow fields, and successional communities to urbanized landscapes. |

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 6.0</td>
<td>Land and Water Rights Acquisition and Protection</td>
<td>Obtain conservation easements for 1,000 acres of habitat within 10 years.</td>
<td>Acreage of habitat preserved</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Engage landowners possessing satisfactory amounts of viable habitat and harboring a breeding population of least shrews to pursue conservation easements.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Action Location:** Physiographic Province: Piedmont, Ridge and Valley
- **Associated Species:** Terrestrial fauna
## North American Least Shrew (Cryptotis parva)

### 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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0 Direct Management of Natural Resources</td>
<td>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)</td>
<td>Density of local least shrew population</td>
<td>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.</td>
<td>2</td>
</tr>
<tr>
<td>Inform the public about the negative impacts generated by feral cat colonies as well as unrestrained house cats</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Objective**
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).

**Monitoring**
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.

**Priority**
2

**Action Location:** Physiographic Province: Piedmont, Ridge and Valley

**Associated Species:** Terrestrial fauna

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**IUCN Threat:** 7.0 Natural System Modifications

**Specific Threat:** Natural succession of old fields.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0 Direct Management of Natural Resources</td>
<td>Alleviate succession on 1000 acres of least shrew habitat</td>
<td>Acreage of habitat prevented from succession</td>
<td>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.</td>
<td>2</td>
</tr>
<tr>
<td>Maintain suitable core habitat by using controlled burns to prevent succession</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Objective**
Alleviate succession on 1000 acres of least shrew habitat.

**Monitoring**
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.

**Priority**
2

**Action Location:** Physiographic Province: Piedmont, Ridge and Valley

**Associated Species:** Terrestrial fauna
## North American Least Shrew

### Cryptotis parva

### Threats and Actions

#### IUCN Threat: 4.0 Transportation and Service Corridors

**Specific Threat:** Genetic and population isolation as dispersal barriers.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0</td>
<td>Planning</td>
<td>Minimize the fragmentation of core least shrew habitat</td>
<td>Acreage of unfragmented habitat</td>
<td>Using PGC terrestrial small mammal survey protocols, conduct presence or absences surveys for least shrews on reserved lands every 10 years.</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0</td>
<td>Planning</td>
<td>Coordinate with commercial developers to mitigate the loss of 500 acres of core habitat within the next 10 years.</td>
<td>Acreage of habitat preserved</td>
<td>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.</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Piedmont, Ridge and Valley

**Associated Species:** Terrestrial fauna
North American Least Shrew

Cryptotis parva

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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 1.0 Coordination and Administration</td>
<td>Detect trends of least shrew populations</td>
<td>Presence or absence of least shrews at site</td>
<td>Using PGC terrestrial small mammal survey protocols, conduct presence or absence surveys for least shrew every 5 years following the 10 year action duration.</td>
<td>3</td>
</tr>
</tbody>
</table>

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

<table>
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</table>
Long-tailed Shrew
*Sorex dispar*

**CONSERVATION PROFILE**

<table>
<thead>
<tr>
<th></th>
<th>Global Rank</th>
<th>State Rank</th>
<th>IUCN Red List</th>
<th>PA Legal Status</th>
<th>PA Abundance</th>
<th>PA Short-Term Trend (10 year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G4</td>
<td>S4</td>
<td>LC Least Concern</td>
<td>Protected</td>
<td>Unknown</td>
<td>Relatively Stable (&lt;=10% change)</td>
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<tr>
<td>Northeast Region</td>
<td>Very High Concern / High Responsibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal Status</td>
<td>Not Listed</td>
<td></td>
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</tr>
</tbody>
</table>

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

**Secondary**
- Macrogroup: Wet Meadow / Shrub Marsh
- Habitat: 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.
## Long-tailed Shrew (Sorex dispar)

### THREATS AND ACTIONS

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

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

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

**Associated Species:** Southern bog lemming, Allegheny woodrat, eastern spotted skunk
### Long-tailed Shrew

**Sorex dispar**

#### 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.

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<tbody>
<tr>
<td>TRACS Action 9.0</td>
<td>Planning</td>
<td>Review all proposed projects for negative impacts to long-tailed shrews, offer siting guidance, and provide Best Management Practices.</td>
<td>Amount of habitat avoided or protected</td>
<td>Survey areas of disturbance resulting from energy production and mining to document presence and absence and other demographic parameters.</td>
</tr>
</tbody>
</table>

**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

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Northern Water Shrew
*Sorex palustris albibarbis*

**Photo:** Charlie Eichelberger

**CONSERVATION PROFILE**

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

**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**

<table>
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<tr>
<th>Macrogroup</th>
<th>Primary</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Northern Hardwood &amp; Conifer</td>
<td>Central Oak-Pine</td>
</tr>
</tbody>
</table>

| 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.).
## Northern Water Shrew

### Sorex palustris albibarbis

### Threats and Actions

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>TRACS Action 2.0</strong> Direct Management of Natural Resources</td>
<td>Install AMD treatment facilities at 5 point sources where Northern Water Shrews once likely existed by 2025.</td>
<td>The number of stream miles that are restored and made suitable for Northern Water Shrews.</td>
<td>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.</td>
<td>2</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Appalachian Plateaus

**Associated Species:** Terrestrial and aquatic species

### IUCN Threat: 9.0 Pollution

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

### Action

**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.

**Objective**

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.

**Measure**

The number of impacts from roads and bridges within 1km of Northern Water Shrew sites, and efforts to reduce the number of these impacts at 10% of the known Northern Watershrew locations by 2025.

**Monitoring**

Monitor water quality parameters upstream and downstream of the repaired impacts, and compare the results to those collected before the repair.

**Priority**

2

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

**Associated Species:** Terrestrial and aquatic species
## Northern Water Shrew

### Sorex palustris albibarbis

### Threats and Actions

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<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specific Threat:</strong> Water pollution, habitat loss from shale gas development.</td>
<td>Minimize direct impacts to Northern Water Shrew occurrences from extraction industry in the next 10 years.</td>
<td>Amount of habitat avoided or protected</td>
<td>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.</td>
<td>2</td>
</tr>
<tr>
<td>TRACS Action 11.0 Technical Assistance</td>
<td></td>
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</tr>
<tr>
<td>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.</td>
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</tr>
<tr>
<td><strong>Action Location:</strong> Physiographic Province: Appalachian Plateaus</td>
<td><strong>Associated Species:</strong> Terrestrial and aquatic species</td>
<td></td>
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### IUCN Threat: 3.0 Energy Production and Mining

### Specific Threat:

- Population declines from periodic severe storms and flood events.

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<tbody>
<tr>
<td>TRACS Action 2.0 Direct Management of Natural Resources</td>
<td>Allow scoured sections to recover for 6-10 years.</td>
<td>Abundance of aquatic macroinvertebrates and streamside vegetation.</td>
<td>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.</td>
<td>3</td>
</tr>
<tr>
<td>Stream channels and riparian corridors scoured by natural phenomena should be left to repair themselves.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Action Location:</strong> Physiographic Province: Appalachian Plateaus, Ridge and Valley</td>
<td><strong>Associated Species:</strong> Terrestrial and aquatic species</td>
<td></td>
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</tbody>
</table>
Northern Water Shrew

Sorex palustris albibarbis

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

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<td><a href="http://www.naturalheritage.state.pa.us/">http://www.naturalheritage.state.pa.us/</a></td>
<td>Since 2012 WPC/PNHP has been actively conducting surveys for this species to identify new populations and determine range extent.</td>
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</tbody>
</table>
CONSERVATION PROFILE

| Global Rank | G5T3 |
| IUCN Red List | Not Yet Assessed |
| Northeast Region | Very High Concern / High Responsibility |
| Federal Status | Not Listed |

State Rank | S2

PA Legal Status | Threatened

PA Abundance | Unknown

PA Short-Term Trend (10 year) |

Conservation Goal:

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

HABITAT ASSOCIATIONS

Primary

- Macrogroup: Northern Hardwood & Conifer
- Habitat: Appalachian (Hemlock)-Northern Hardwood Forest

Secondary

- Macrogroup: Emergent Marsh
- Habitat: 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.
### West Virginia Water Shrew

**Sorex palustris punctulatus**

#### THREATS AND ACTIONS

<table>
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</thead>
<tbody>
<tr>
<td><strong>TRACS Action 100.0</strong> Law and Policy</td>
<td>Prevent the leaching or discharge of chemicals associated with hydraulic fracturing for natural gas into Commonwealth waterways in southwest Pennsylvania</td>
<td>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.</td>
<td>Record the number of environmental violations committed by drilling companies, and monitor overall stream health.</td>
<td>Monitor the chemical and physical properties for streams that could possibly be affected by discharges of hydraulic fracturing fluid.</td>
</tr>
<tr>
<td><strong>Action Location:</strong> Physiographic Province: Appalachian Plateaus</td>
<td><strong>Associated Species:</strong> Terrestrial/ aquatic fauna</td>
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</table>

#### 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.

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<tbody>
<tr>
<td><strong>TRACS Action 2.0</strong> Direct Management of Natural Resources</td>
<td>Mitigate the effects of AMD on water quality within the Laurel Highlands region of southwest Pennsylvania.</td>
<td>Install 5 passive AMD treatment facilities within the Laurel Highlands of southwest Pennsylvania over the next 10 years.</td>
<td>Stream acidity</td>
<td>Following the installation of passive AMD treatment facilities, perform standard water quality tests annually to determine the effectiveness of the treatment.</td>
</tr>
<tr>
<td><strong>Action Location:</strong> Physiographic Province: Appalachian Plateaus</td>
<td><strong>Associated Species:</strong> Aquatic fauna</td>
<td></td>
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</table>
West Virginia Water Shrew  
*Sorex palustris punctulatus*

**THREATS AND ACTIONS**

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</table>
| **Specific Threat:** Severe flooding scours stream channels along with riparian corridors and temporarily destroys habitat.  
**Action:** 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 *S. p. punctulatus* after allowing the disturbed area to recover for 5 years. | 3 |
| Action Location: Physiographic Province: Appalachian Plateaus  
Associated Species: Terrestrial/ aquatic fauna | | | | |

<table>
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| **Specific Threat:** Nonpoint source pollution in the form of highway effluents containing vehicular contaminants and sediments decrease water quality.  
**Action:** Reduce the effects of non-source pollutants from highway effluents on stream water quality within the Laurel Highlands Region of southwest Pennsylvania. | 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 |
| 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).

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Maryland Shrew
*Sorex cinereus fontinalis*

**CONSERVATION PROFILE**

- **Global Rank**: G4Q
- **IUCN Red List**: Not Yet Assessed
- **Northeast Region**: Medium Concern / High Responsibility
- **Federal Status**: Not Listed

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

**State Rank**: S5
**PA Legal Status**: Protected
**PA Abundance**: Unknown
**PA Short-Term Trend (10 year)**: Unknown

**HABITAT ASSOCIATIONS**

- **Primary Macrogroup**: Northern Hardwood & Conifer
- **Secondary 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).
## Maryland Shrew

### Sorex cinereus fontinalis

### 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.

<table>
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<tbody>
<tr>
<td><strong>TRACS Action 9.0</strong> Planning</td>
<td>Coordinate with commercial developers to mitigate the loss of 500 acres of core habitat within the next 10 years.</td>
<td>Acreage of habitat preserved</td>
<td>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.</td>
<td>3</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Piedmont

**Associated Species:** Terrestrial fauna

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**IUCN Threat:** 1.0 Residential and Commercial Development

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

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<tr>
<td><strong>TRACS Action 6.0</strong> Land and Water Rights Acquisition and Protection</td>
<td>Obtain conservation easements for 1,000 acres of habitat within 10 years.</td>
<td>Acreage of habitat preserved</td>
<td>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.</td>
<td>3</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Piedmont

**Associated Species:** Terrestrial fauna
Maryland Shrew  
*Sorex cinereus fontinalis*

## 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

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Big Brown Bat

*Eptesicus fuscus*

**CONSERVATION PROFILE**

- **Global Rank**: G5
- **IUCN Red List**: LC Least Concern
- **Northeast Region**: High Concern / Low Responsibility
- **Federal Status**: Not Listed

**State Rank**: S2S3

**PA Legal Status**: Protected

**PA Abundance**: Unknown

**PA Short-Term Trend (10 year)**: Decline of 30 - 70%

**Conservation Goal:**
Maintain current population levels in Pennsylvania through 2025.

**HABITAT ASSOCIATIONS**

- **Primary**
  - **Macrogroup**: (B,W) Central Oak-Pine
  - **Habitat**: (B,W) Northeastern Interior Dry-Mesic Oak Forest

- **Secondary**
  - **Macrogroup**: (B) Northern Hardwood & Conifer (W) Glade, Barren and Savanna
  - **Habitat**: (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.
Big Brown Bat  
*Eptesicus fuscus*

**THREATS AND ACTIONS**

### IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>Update NWCO regulations for Pennsylvania to distribute to wildlife control professionals and general public.</td>
<td>Number of individuals counted during maternity surveys and/or number of individuals caught per unit of effort during mist-net surveys.</td>
<td>Monitor big brown bats within maternity colonies through Appalachian Bat Counts (summer roost counts) for 5 years.</td>
<td>1</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide  
**Associated Species:** Little brown bat, tricolored bat

### IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0 Direct Management of Natural Resources</td>
<td>Explore the ability of big brown bats to be less severely impacted by <em>Pseudogymnoascus destructans</em> than other species through swabbing and antibody studies.</td>
<td>Number of big brown bats counted during winter hibernacula surveys.</td>
<td>Quantifying number of lesions via UV light technique (Turner et al. 2014).</td>
<td>1</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide  
**Associated Species:** Little brown bat, tricolored bat, Indiana bat, northern long-eared bat

### 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.
**Big Brown Bat**
*Eptesicus fuscus*

### 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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian Bat Count</td>
<td>Pennsylvania Game Commission</td>
<td><a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=712212&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=712212&amp;mode=2</a></td>
<td>Each year, volunteers count bats exiting summer roosts between May 15th and August 1st. Species, type of structure, and weather is recorded.</td>
</tr>
<tr>
<td>Spring emergence mist-netting for bats near and around cave and mine openings.</td>
<td>Pennsylvania Game Commission</td>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>
Tricolored Bat

*Perimyotis subflavus*

**CONSERVATION PROFILE**

<table>
<thead>
<tr>
<th>Global Rank</th>
<th>G3</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUCN Red List</td>
<td>LC Least Concern</td>
</tr>
<tr>
<td>Northeast Region</td>
<td>Very High Concern / Low Responsibility</td>
</tr>
<tr>
<td>Federal Status</td>
<td>Not Listed</td>
</tr>
<tr>
<td>State Rank</td>
<td>S1</td>
</tr>
<tr>
<td>PA Legal Status</td>
<td>Protected</td>
</tr>
<tr>
<td>PA Abundance</td>
<td>Unknown</td>
</tr>
<tr>
<td>PA Short-Term Trend (10 year)</td>
<td>Decline of &gt;90%</td>
</tr>
</tbody>
</table>

**Conservation Goal:**
Maintain or increase current population levels in Pennsylvania through 2025.

**HABITAT ASSOCIATIONS**

**Primary**
- (B,W) Central Oak-Pine

**Secondary**
- (W) Glade, Barren and Savanna
- (W) Central Appalachian Alkaline Glade and Woodland

**Specific Habitat Requirements:**
- (B) Human structures, trees, and cavities.
- (W) Slightly warmer locales from 46-53°F.
### Tricolored Bat

**Perimyotis subflavus**

#### 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).

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 7.0  Law enforcement</td>
<td>Reduce additive loss of fat reserves maximizing survival and reproduction output</td>
<td>Number of hibernacula gated or protected with landowner agreements, along with number of people arrested.</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
<td>1</td>
</tr>
<tr>
<td>Action Location:  Physiographic Province: Statewide</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associated Species:  All hibernating bat species</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**IUCN Threat:** 3.0  Energy Production and Mining

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 100.0  Law and Policy</td>
<td>To reduce overall mortality</td>
<td>Number of wind turbines with higher cut-in speeds</td>
<td>Counting and estimating carcasses found below turbines</td>
<td>1</td>
</tr>
<tr>
<td>Action Location:  Physiographic Province: Appalachian Plateaus, Ridge and Valley</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associated Species:  All bat species</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Tricolored Bat

**Perimyotis subflavus**

**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.

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

**Action Location:** Physiographic Province: Statewide

**Associated Species:** All hibernating bat species

---

**IUCN Threat:** 8.0  Invasive and Other Problematic Species and Genes

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0 Direct Management of Natural Resources</td>
<td>Develop and utilize treatment options to reduce pathogen abundance in situ or reduce quantity of infections caused by pathogen</td>
<td>To eliminate or reduce clinical signs of disease</td>
<td>Number of lesions caused by pathogen or number of bats counted surviving exposure to disease.</td>
<td>Quantifying number of lesions via UV light technique (Turner et al. 2014).</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide

**Associated Species:** All hibernating bat species
Tricolored Bat  
*Perimyotis subflavus*

**THREATS AND ACTIONS**

<table>
<thead>
<tr>
<th>Action Location:</th>
<th>Physiographic Province: Ridge and Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associated Species:</td>
<td>All hibernating bat species</td>
</tr>
</tbody>
</table>

**IUCN Threat: 11.0 Climate Change and Severe Weather**

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>To reduce or eliminate sudden influx of high volumes of water resulting in mass mortality.</td>
<td>Number of documented flood events</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Action Location:</th>
<th>Physiographic Province: Ridge and Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associated Species:</td>
<td>All hibernating bat species</td>
</tr>
</tbody>
</table>

**IUCN Threat: 5.0 Biological Resource Use**

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

<table>
<thead>
<tr>
<th>Action</th>
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<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 11.0</td>
<td>Technical Assistance</td>
<td>To consistently maintain natural, suitable landscape features that perpetuate use and add artificial structures as needed.</td>
<td>Number of natural or artificial roosts available</td>
<td>Perform emergence surveys to quantify use</td>
</tr>
</tbody>
</table>

Promote the use of artificial structures and creation/retention of wildlife trees during forest management projects.

<table>
<thead>
<tr>
<th>Action Location:</th>
<th>Physiographic Province: Statewide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associated Species:</td>
<td>All bat species</td>
</tr>
</tbody>
</table>

**PENNSYLVANIA GAME COMMISSION**

**PENNSYLVANIA FISH & BOAT COMMISSION**

Published September 2015
Tricolored Bat  

**Perimyotis subflavus**

### THREATS AND ACTIONS

#### 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.

<table>
<thead>
<tr>
<th>Action</th>
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</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>To lessen impacts from habitat loss and exclusions from human structures</td>
<td>Number of bat boxes installed or exclusions performed during proper timing</td>
<td>Perform emergence surveys to quantify use</td>
</tr>
</tbody>
</table>

**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.
### Tricolored Bat

**Perimyotis subflavus**

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
</table>
Northern Long-eared Bat
*Myotis septentrionalis*

**CONSERVATION PROFILE**

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

**Conservation Goal:**
Maintain or increase population levels in Pennsylvania through 2025.

**HABITAT ASSOCIATIONS**

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

**Secondary**
- **Macrogroup**: Northern Hardwood & Conifer
- **Habitat**: 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.
## Northern Long-eared Bat

*Myotis septentrionalis*

### Threats and Actions

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

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>Prevent further spread of WNS fungus.</td>
<td>Percentage of historic hibernacula for this species that have been gated.</td>
<td>Conduct hibernacula counts to compare number of hibernating bats before and after gating; continue for 10 years</td>
</tr>
</tbody>
</table>

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: 8.0 Invasive and Other Problematic Species and Genes

#### 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).

<table>
<thead>
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<th>Action</th>
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<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 7.0</td>
<td>Law enforcement</td>
<td>Install bat gates at all caves and mines that have historically contained hibernating individuals of this species.</td>
<td>Percentage of historic hibernacula for this species that have been gated.</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
</tr>
</tbody>
</table>

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

**Northern Long-eared Bat**

### Myotis septentrionalis

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

### Threats and Actions

<table>
<thead>
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<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRACS Action 2.0</strong></td>
<td>Direct Management of Natural Resources</td>
<td>Maintain mature forest habitat and preserve potential roost trees.</td>
<td>Number of hectares of mature forest that have appropriate forest management plans.</td>
<td>Assess population trends, either through mist-netting or acoustic surveys, or through hibernacula counts; continued for 10 years.</td>
</tr>
</tbody>
</table>

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

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

**IUCN Threat:** 5.0 Biological Resource Use

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**IUCN Threat:** 11.0 Climate Change and Severe Weather

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

<table>
<thead>
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<th>Monitoring</th>
<th>Priority</th>
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</thead>
<tbody>
<tr>
<td><strong>TRACS Action 2.0</strong></td>
<td>Direct Management of Natural Resources</td>
<td>Prevent mass mortality of hibernating bats from drowning.</td>
<td>Percentage of caves and mines with previous drowning events that have been modified to minimize potential for future drowning.</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
</tr>
</tbody>
</table>

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

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

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**Pennsylvania Game Commission**

**Pennsylvania Fish & Boat Commission**

Published September 2015
Northern Long-eared Bat

Myotis septentrionalis

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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bat Net and Trap database</td>
<td>Pennsylvania Game Commission</td>
<td><a href="http://www.pgc.state.pa.us/">http://www.pgc.state.pa.us/</a></td>
<td>PGC biologists compile annual data from contractor mist-netting efforts in PA and then report captures per unit of mist-netting effort.</td>
</tr>
</tbody>
</table>
Eastern Small-footed Bat
*Myotis leibii*

**CONSERVATION PROFILE**

<table>
<thead>
<tr>
<th>Global Rank</th>
<th>G3G4</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUCN Red List</td>
<td>LC Least Concern</td>
</tr>
<tr>
<td>Northeast Region</td>
<td>Very High Concern /</td>
</tr>
<tr>
<td></td>
<td>High Responsibility</td>
</tr>
<tr>
<td>Federal Status</td>
<td>Not Listed</td>
</tr>
<tr>
<td>PA Legal Status</td>
<td>Threatened</td>
</tr>
<tr>
<td>PA Abundance</td>
<td>Unknown</td>
</tr>
<tr>
<td>PA Short-Term Trend (10 year)</td>
<td>Decline of 11 - 60%</td>
</tr>
</tbody>
</table>

**Conservation Goal:**
Maintain or increase current population levels in Pennsylvania through 2025.

**HABITAT ASSOCIATIONS**

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

**Secondary**

**Specific Habitat Requirements:**
Summer - deciduous/mixed forested areas containing rock outcrops and talus. Winter - caves & mines, also rock outcrops and talus.
## Eastern Small-footed Bat  
*Myotis leibii*

### THREATS AND ACTIONS

**IUCN Threat:** 8.0 Invasive and Other Problematic Species and Genes

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
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<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>Prevent further spread of WNS fungus.</td>
<td>Percentage of historic hibernacula for this species that have been gated.</td>
<td>Conduct hibernacula counts to compare number of hibernating bats before and after gating; continue for 10 years</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>Maintain mature forest habitat and preserve potential roost sites.</td>
<td>Number of hectares/areas of forested habitat with abundant rocky outcrops and loose rocks that have appropriate forest management plans.</td>
<td>Assess population trends, either through mist-netting or acoustic surveys, or through hibernacula counts; continued for 10 years</td>
</tr>
</tbody>
</table>

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

**Associated Species:** Northern long-eared bat, Allegheny woodrat
**Eastern Small-footed Bat**

*Myotis leibii*

## Threats and Actions

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>Prevent disturbance of this species at summer roosts.</td>
<td>Number of sites containing forested habitat with abundant rocky outcrops and loose rocks that have appropriate forest management plans.</td>
<td>Assess population trends, either through mist-netting or acoustic surveys, or through hibernacula counts; continued for 10 years.</td>
<td>2</td>
</tr>
</tbody>
</table>

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

**Associated Species:** Allegheny woodrat

### IUCN Threat: 3.0 Energy Production and Mining

### Specific Threat:

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 101.0 Species Management</td>
<td>Prevent rockslides near known summer roost sites for this species.</td>
<td>Percentage of known roost sites that have been assessed and protected from disturbance that might cause rockslides.</td>
<td>Assess frequency of rockslides, either through annual visits or using aerial photos.</td>
<td>3</td>
</tr>
</tbody>
</table>

**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.

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**Published September 2015**
**Eastern Small-footed Bat**

**Myotis leibii**

### 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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Minimize the number of bats killed by collisions with cars.</td>
<td>Visit sites with known high road mortality and compare number of bats killed before and after site modification.</td>
<td>Determine number of bats killed by direct collisions with cars, compare numbers before and after site modifications.</td>
<td>3</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bat Net and Trap database</td>
<td>Pennsylvania Game Commission</td>
<td><a href="http://www.pgc.state.pa.us/">http://www.pgc.state.pa.us/</a></td>
<td>PGC biologists compile annual data from contractor mist-netting efforts in PA and then report captures per unit of mist-netting effort.</td>
</tr>
</tbody>
</table>
Indiana Bat
Myotis sodalis

CONSERVATION PROFILE

Global Rank: G2
IUCN Red List: EN Endangered
State Rank: S1
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
Macrogroup:
(B) Northern Hardwood & Conifer
(W) Central Oak-Pine
Habitat:
(B) South-Central Interior Mesophytic Forest
(W) Northeastern Interior Dry-Mesic Oak Forest

Secondary
Macrogroup:
(B,W) Central Oak-Pine
Habitat:
(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.
## Indiana Bat

### Myotis sodalis

**Threats and Actions**

<table>
<thead>
<tr>
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<th>Objective</th>
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<tbody>
<tr>
<td><strong>Specific Threat:</strong> 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)</td>
<td>Reduce additive loss of fat reserves maximizing survival and reproduction output</td>
<td>Number of hibernacula gated or protected with landowner agreements, along with number of people arrested.</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
<td>1</td>
</tr>
</tbody>
</table>

**Action**
- **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.

**Objective**
- Reduce additive loss of fat reserves maximizing survival and reproduction output

**Measure**
- Number of hibernacula gated or protected with landowner agreements, along with number of people arrested.

**Monitoring**
- Monitoring changes in abundance via trapping or internal counts

**Associated Species:** All hibernating bat species

**IUCN Threat:** Human Intrusions and Disturbance

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

<table>
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<tbody>
<tr>
<td><strong>Specific Threat:</strong> Removal of mature trees to maintain younger forests limits potential roosting sites.</td>
<td>To consistently maintain natural, suitable landscape features that perpetuate use and add artificial structures as needed.</td>
<td>Number of natural or artificial roosts available</td>
<td>Perform emergence surveys to quantify use</td>
<td>1</td>
</tr>
</tbody>
</table>

**Action**
- **TRACS Action 9.0** Planning
- Promote the use of artificial structures and creation/retention of wildlife trees during forest management projects

**Objective**
- To consistently maintain natural, suitable landscape features that perpetuate use and add artificial structures as needed.

**Measure**
- Number of natural or artificial roosts available

**Monitoring**
- Perform emergence surveys to quantify use

**Associated Species:** All bat species

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**PENNSYLVANIA FISH & BOAT COMMISSION**

Published September 2015
### Indiana Bat

**Myotis sodalis**

#### THREATS AND ACTIONS

**IUCN Threat:** 3.0 Energy Production and Mining

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

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<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>To reduce overall mortality</td>
<td>Number of wind turbines with higher cut-in speeds</td>
<td>Counting and estimating carcasses found below turbines</td>
<td>1</td>
</tr>
</tbody>
</table>

**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.

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</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>To reduce the destruction of, or alteration of specific conditions within locations used to hibernate</td>
<td>Number of hibernacula gated</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
<td>1</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide

**Associated Species:** All hibernating bat species
## Indiana Bat

*Myotis sodalis*

### Threats and Actions

**Indiana Bat**

**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.

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<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>To lessen impacts from habitat loss and exclusions from human structures</td>
<td>Number of bat boxes installed or exclusions performed during proper timing</td>
<td>Perform emergence surveys to quantify use</td>
</tr>
</tbody>
</table>

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*).

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<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>To eliminate or reduce clinical signs of disease</td>
<td>Number of lesions caused by pathogen or number of bats counted surviving exposure to disease.</td>
<td>Quantifying number of lesions via UV light technique (Turner et al. 2014.)</td>
</tr>
</tbody>
</table>

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

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## THREATS AND ACTIONS

### Indiana Bat  
*Myotis sodalis*

**IUCN Threat:** 11.0 Climate Change and Severe Weather  

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

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<tbody>
<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>To reduce or eliminate sudden influx of high volumes of water resulting in mass mortality.</td>
<td>Number of documented flood events</td>
</tr>
</tbody>
</table>

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.

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<tbody>
<tr>
<td>TRACS Action 101.0</td>
<td>Species Management</td>
<td>To reduce predation-related mortality</td>
<td>Number of predators removed from problematic area</td>
</tr>
</tbody>
</table>

Trap and relocate/remove problematic individuals.

**Action Location:** Physiographic Province: Statewide  
**Associated Species:** All hibernating bat species
### Indiana Bat

**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.

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

**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.

<table>
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</thead>
<tbody>
<tr>
<td>TRACS Action 9.0</td>
<td>Planning</td>
<td>To reduce or eliminate mortality</td>
<td>Number of dead bats verified</td>
<td>Determine number of bats killed by direct collisions with cars, compare numbers before and after site modifications.</td>
</tr>
<tr>
<td>Identify road sections with high bat mortality from direct collisions. Add vegetation or barriers to direct bats over oncoming cars.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide

**Associated Species:** All bat species

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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**

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian Bat Count</td>
<td>Pennsylvania Game Commission</td>
<td><a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=712212&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=712212&amp;mode=2</a></td>
<td>Each year, volunteers count bats exiting summer roosts between May 15th and August 1st. Species, type of structure, and weather is recorded.</td>
</tr>
</tbody>
</table>

PENNSYLVANIA GAME COMMISSION

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Published September 2015
Little Brown Bat
*Myotis lucifugus*

**CONSERVATION PROFILE**

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

**Conservation Goal:**
Maintain or increase current population levels in Pennsylvania through 2025.

**HABITAT ASSOCIATIONS**

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

### Little Brown Bat

*Myotis lucifugus*

**IUCN Threat:** 8.0 Invasive and Other Problematic Species and Genes

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

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<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>To eliminate or reduce clinical signs of disease</td>
<td>Number of lesions caused by pathogen or number of bats counted surviving exposure to disease.</td>
<td>Quantifying number of lesions via UV light technique (Turner et al. 2014).</td>
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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.

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

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*PENNSYLVANIA FISH & BOAT COMMISSION*  
*WILDLIFE ACTION PLAN*

Published September 2015
## Little Brown Bat

*Myotis lucifugus*

### THREATS AND ACTIONS

<table>
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<tr>
<th>IUCN Threat:</th>
<th>6.0  Human Intrusions and Disturbance</th>
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<tbody>
<tr>
<td>Specific Threat:</td>
<td>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)</td>
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</table>

**Action**

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<tbody>
<tr>
<td>TRACS Action 7.0</td>
<td>Reduce additive loss of fat reserves maximizing survival and reproduction output</td>
<td>Number of hibernacula gated or protected with landowner agreements, along with number of people arrested.</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
<td>1</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide

**Associated Species:** All hibernating bat species

---

**IUCN Threat:** 3.0  Energy Production and Mining

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

**Action**

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<tbody>
<tr>
<td>TRACS Action 9.0</td>
<td>To reduce overall mortality</td>
<td>Number of wind turbines with higher cut-in speeds</td>
<td>Counting and estimating carcasses found below turbines</td>
<td>1</td>
</tr>
</tbody>
</table>

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

**Associated Species:** All bat species
## THREATS AND ACTIONS

**Little Brown Bat**

### Myotis lucifugus

#### 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.

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<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>To reduce the destruction of, or alteration of specific conditions within locations used to hibernate</td>
<td>Number of hibernacula gated</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
<td>1</td>
</tr>
</tbody>
</table>

Action Location: Physiographic Province: Statewide

Associated Species: All hibernating bat species

#### 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.

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<tbody>
<tr>
<td>TRACS Action 2.0 Direct Management of Natural Resources</td>
<td>To lessen impacts from habitat loss and exclusions from human structures</td>
<td>Number of bat boxes installed or exclusions performed during proper timing</td>
<td>Perform emergence surveys to quantify use</td>
<td>1</td>
</tr>
</tbody>
</table>

Action Location: Physiographic Province: Statewide

Associated Species: All bat species

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PENNSYLVANIA GAME COMMISSION

PENNSYLVANIA FISH & BOAT COMMISSION

Published September 2015
## Little Brown Bat

### Myotis lucifugus

### THREATS AND ACTIONS

**IUCN Threat:** 5.0  Biological Resource Use

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

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</thead>
<tbody>
<tr>
<td>TRACS Action 9.0  Planning</td>
<td>To consistently maintain natural, suitable landscape features that perpetuate use and add artificial structures as needed.</td>
<td>Number of natural or artificial roosts available</td>
<td>Perform emergence surveys to quantify use</td>
<td>2</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide

**Associated Species:** All bat species

### IUCN Threat: 3.0  Energy Production and Mining

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

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</thead>
<tbody>
<tr>
<td>TRACS Action 9.0  Planning</td>
<td>To maintain healthy supporting habitat</td>
<td>Number of forest acres removed for well pads or documented spills.</td>
<td>Quantifying acres of forest preserved by relocation well pads.</td>
<td>2</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Appalachian Plateaus

**Associated Species:** All bat species
### 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)

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<tbody>
<tr>
<td>TRACS Action 6.0</td>
<td>Land and Water Rights Acquisition and Protection</td>
<td>Reduce additive loss of fat reserves maximizing survival and reproduction output</td>
<td>Number of bats counted at commercialized hibernacula</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
</tr>
</tbody>
</table>

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

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<tr>
<td>TRACS Action 2.0</td>
<td>Direct Management of Natural Resources</td>
<td>To reduce or eliminate sudden influx of high volumes of water resulting in mass mortality.</td>
<td>Number of documented flood events</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
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</table>

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
## Little Brown Bat

### Myotis lucifugus

### THREATS AND ACTIONS

**IUCN Threat:** 8.0 Invasive and Other Problematic Species and Genes

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

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</thead>
<tbody>
<tr>
<td>TRACS Action 101.0 Species Management</td>
<td>Trap and relocate/remove problematic individuals.</td>
<td>To reduce predation-related mortality</td>
<td>Number of predators removed from problematic area</td>
<td>Monitoring changes in abundance via trapping or internal counts</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide

**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.

<table>
<thead>
<tr>
<th>Action</th>
<th>Objective</th>
<th>Measure</th>
<th>Monitoring</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 9.0 Planning</td>
<td>Identify road sections with high bat mortality from direct collisions. Add vegetation or barriers to direct bats over oncoming cars.</td>
<td>To reduce or eliminate mortality</td>
<td>Number of dead bats counted</td>
<td>Determine number of bats killed by direct collisions with cars, compare numbers before and after site modifications.</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Statewide

**Associated Species:** All bat species

### 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.
Little Brown Bat  
*Myotis lucifugus*

**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**

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian Bat Count</td>
<td>Pennsylvania Game Commission</td>
<td><a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=712212&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=712212&amp;mode=2</a></td>
<td>Each year, volunteers count bats exiting summer roosts between May 15th and August 1st. Species, type of structure, and weather is recorded.</td>
</tr>
</tbody>
</table>
Silver-haired Bat
*Lasionycteris noctivagans*

Photo: Cal Butchkoski

**CONSERVATION PROFILE**

**Global Rank**
- G5

**IUCN Red List**
- LC Least Concern

**Northeast Region**
- Very High Concern / Low Responsibility

**Federal Status**
- Not Listed

**State Rank**
- S1

**PA Legal Status**
- Protected

**PA Abundance**
- Unknown

**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**

- Macrogroup: Northern Hardwood & Conifer
  - Habitat: Appalachian (Hemlock)-Northern Hardwood Forest

**Secondary**

- Specific Habitat Requirements:
  - Maternity roost (data deficient in Pennsylvania)- 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.
Silver-haired Bat

Lasionycteris noctivagans

THREATS AND ACTIONS

<table>
<thead>
<tr>
<th>Action</th>
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<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 6.0</td>
<td>Land and Water Rights Acquisition and Protection</td>
<td>Identify and protect woodlots used by silver-haired bats as maternity roosts.</td>
<td>The number of silver-haired roost trees identified and the habitats surrounding them adequately protected.</td>
<td>Perform emergence surveys to quantify use</td>
</tr>
</tbody>
</table>

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: 5.0 Biological Resource Use

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

---

IUCN Threat: 3.0 Energy Production and Mining

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

<table>
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</table>

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

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Lead Agency</th>
<th>Hyperlink</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bat Net and Trap database</td>
<td>Pennsylvania Game Commission</td>
<td><a href="http://www.pgc.state.pa.us/">http://www.pgc.state.pa.us/</a></td>
<td>PGC biologists compile annual data from contractor mist-netting efforts in PA and then report captures per unit of mist-netting effort.</td>
</tr>
<tr>
<td>The Pennsylvania Mammal Atlas</td>
<td>Pennsylvania Game Commission</td>
<td></td>
<td>A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals</td>
</tr>
</tbody>
</table>
Eastern Spotted Skunk
*Spilogale putorius*

**Photo: Bob Gress**

**CONSERVATION PROFILE**

<table>
<thead>
<tr>
<th>Global Rank</th>
<th>G4</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUCN Red List</td>
<td>LC Least Concern</td>
</tr>
<tr>
<td>Northeast Region</td>
<td>Very High Concern /</td>
</tr>
<tr>
<td></td>
<td>Low Responsibility</td>
</tr>
<tr>
<td>Federal Status</td>
<td>Not Listed</td>
</tr>
<tr>
<td>PA Legal Status</td>
<td>Protected</td>
</tr>
<tr>
<td>PA Abundance</td>
<td>&lt; 5 individuals</td>
</tr>
<tr>
<td>PA Short-Term Trend (10 year)</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

**Conservation Goal:**
Establish one self-sustaining population of eastern spotted skunks in Pennsylvania by 2025

**HABITAT ASSOCIATIONS**

<table>
<thead>
<tr>
<th>Macrogroup</th>
<th>Central Oak-Pine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat</td>
<td>Central Appalachian Pine-Oak</td>
</tr>
<tr>
<td></td>
<td>Rocky Woodland</td>
</tr>
</tbody>
</table>

**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).
## Eastern Spotted Skunk

### Spilogale putorius

### THREATS AND ACTIONS

#### IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

#### Specific Threat: Mortality from natural predation

<table>
<thead>
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</thead>
<tbody>
<tr>
<td><strong>TRACS Action 9.0</strong> Planning</td>
<td>Create or improve spotted skunk habitat</td>
<td>Conduct habitat enhancement projects that create dense understory and closed canopy at three sites known to support eastern spotted skunk populations</td>
<td>Number of sites treated</td>
<td>Conduct skunk and habitat surveys one year pre- and biennially post-treatment for ten years to determine success of enhancement projects</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
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<th>Priority</th>
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</thead>
<tbody>
<tr>
<td><strong>TRACS Action 8.0</strong> Outreach</td>
<td>Reduce incidental take of spotted skunk by stakeholders (trappers)</td>
<td>Provide stakeholders with Best Management Practices, including techniques to reduce the incidental take of eastern spotted skunks</td>
<td>Number of incidental spotted skunk mortalities</td>
<td>Conduct stakeholder surveys biennially for ten years to determine if new practices were implemented and whether the practices have reduced incidental take</td>
</tr>
</tbody>
</table>

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

**Associated Species:** Allegheny woodrat
## Eastern Spotted Skunk  

**Spilogale putorius**

### THREATS AND ACTIONS

| IUCN Threat: | 4.0 Transportation and Service Corridors |
| Specific Threat: | Mortality from vehicle collision |

#### Action

<table>
<thead>
<tr>
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<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACS Action 11.0</td>
<td>Technical Assistance</td>
<td>Review all proposed projects for negative impacts to eastern spotted skunks, offer siting guidance, and provide Best Management Practices</td>
<td>Number of projects reviewed that would impact eastern spotted skunks, and percent that were able to minimize or avoid such impacts</td>
<td>Inventory active eastern spotted skunk sites to determine if there are any projects impacting them</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>TRACS Action 8.0</td>
<td>Outreach</td>
<td>Provide stakeholders with Best Management Practices and guidance to modify farming practices and/or enhance habitat for eastern spotted skunk</td>
<td>Number of stakeholders engaged, and percent that implemented practices</td>
<td>Conduct stakeholder surveys one year post-meeting to determine if practices were implemented and, if so, conduct surveys for spotted skunk presence</td>
</tr>
</tbody>
</table>

**Action Location:** Physiographic Province: Appalachian Plateaus, Ridge and Valley  
**Associated Species:** Eastern cottontail
Eastern Spotted Skunk

**Spilogale putorius**

**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.

<table>
<thead>
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<tbody>
<tr>
<td>TRACS Action 11.0 Technical Assistance</td>
<td>Review all proposed projects for negative impacts to eastern spotted skunks, offer siting guidance, and provide Best Management Practices.</td>
<td>Number of projects reviewed that would impact eastern spotted skunks, and percent that were able to minimize or avoid such impacts.</td>
<td>Inventory active eastern spotted skunk sites to determine if there are any projects impacting them</td>
<td>3</td>
</tr>
</tbody>
</table>

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

Mammals

**Eastern Fox Squirrel**


**Northern Flying Squirrel**


**Rock Vole**


**Allegheny Woodrat**


**Prairie Deer Mouse**


REFERENCES


Appalachian Cottontail


North American Least Shrew


**REFERENCES**

**Long-tailed Shrew**


Kirkland, G. L., Jr. 1981. *Sorex dispar* and *Sorex gaspensis*. Mammalian Species **155**:1-4


**Northern Water Shrew**


**West Virginia Water Shrew**


REFERENCES

Maryland Shrew


Big Brown Bat


Tricolored Bat


Northern Long-eared Bat


**Eastern Small-footed Bat**


**Indiana Bat**


REFERENCES


Little Brown Bat


Silver-haired Bat


Eastern Spotted Skunk

REFERENCES


