



P E N N S Y L V A N I A  
W I L D L I F E A C T I O N P L A N

2015–2025

## Species of Greatest Conservation Need Species Accounts

### Appendix 1.4F-Mussels

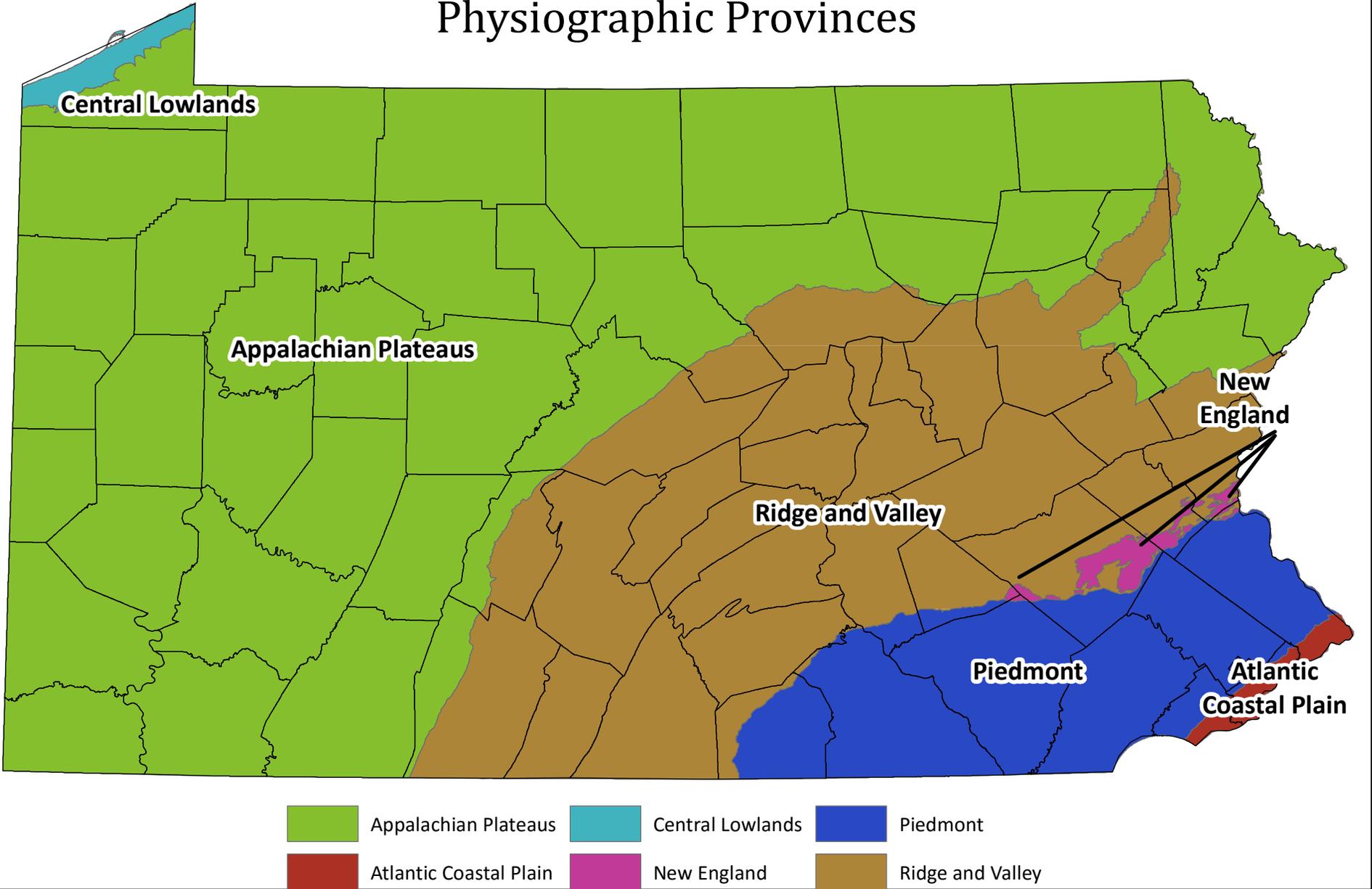
- *Freshwater Mussel Species of Greatest Conservation Need*
- *Maps: Physiographic Provinces and HUC Watersheds*
- *Species Accounts (Click species name below or bookmark to navigate to species account)*

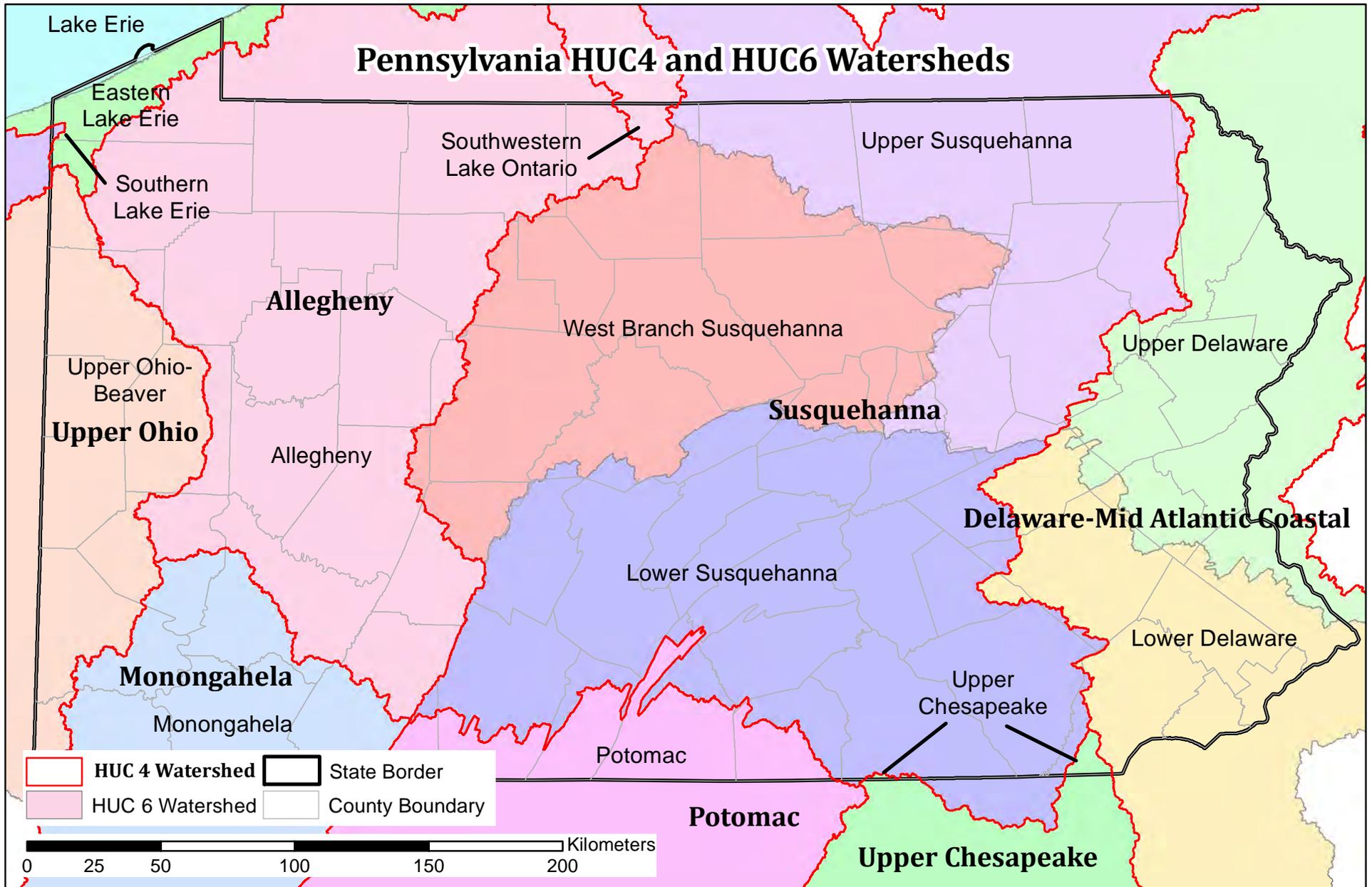
#### FRESHWATER MUSSELS

Dwarf Wedgemussel	Round Hickorynut	Pistolgrip	
Northern Riffleshell	Sheepnose	o	'U
Snuffbox	Clubshell	k	"
Eastern Pearlshell	Rabbitsfoot		

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

# Physiographic Provinces

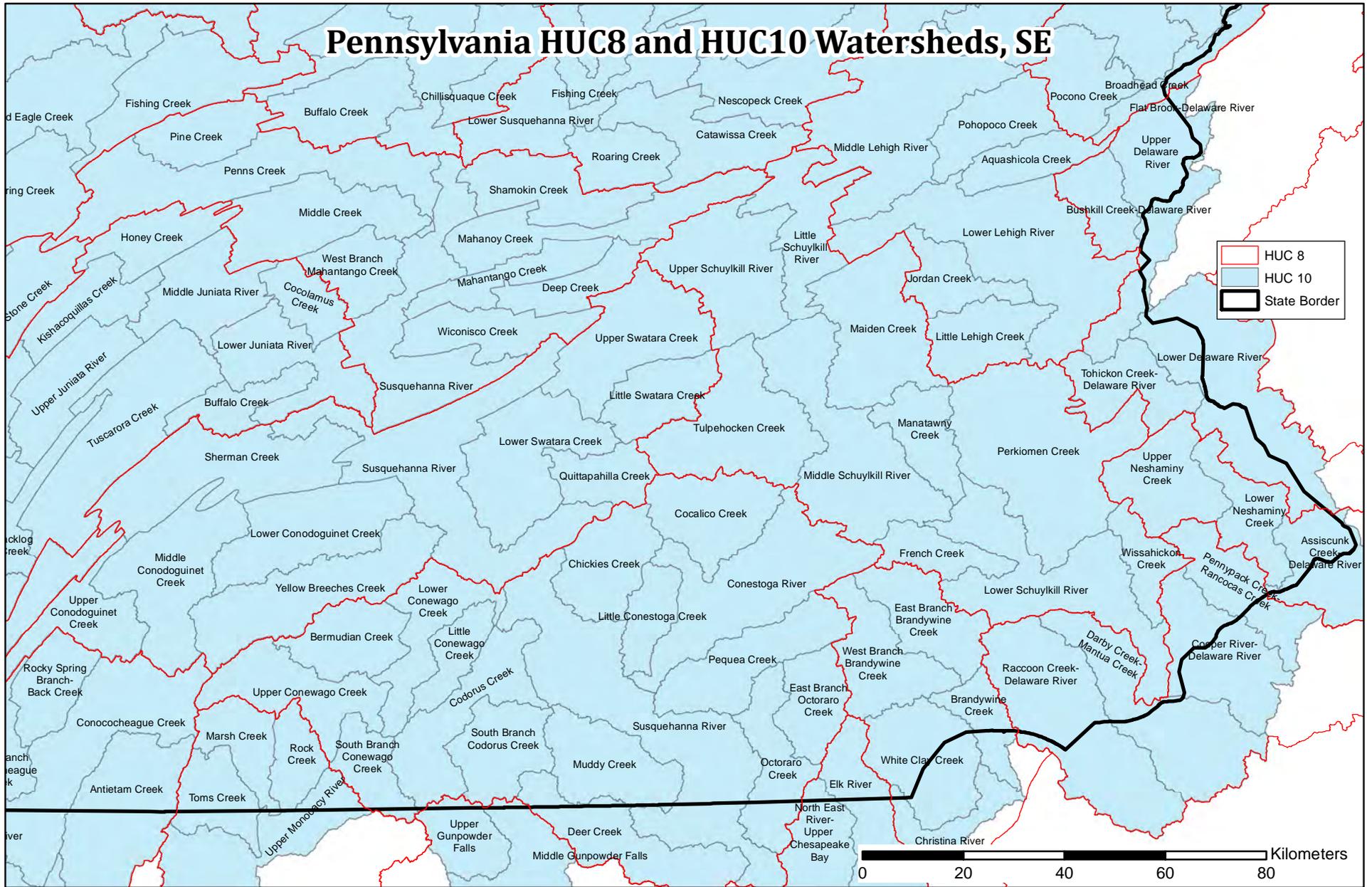




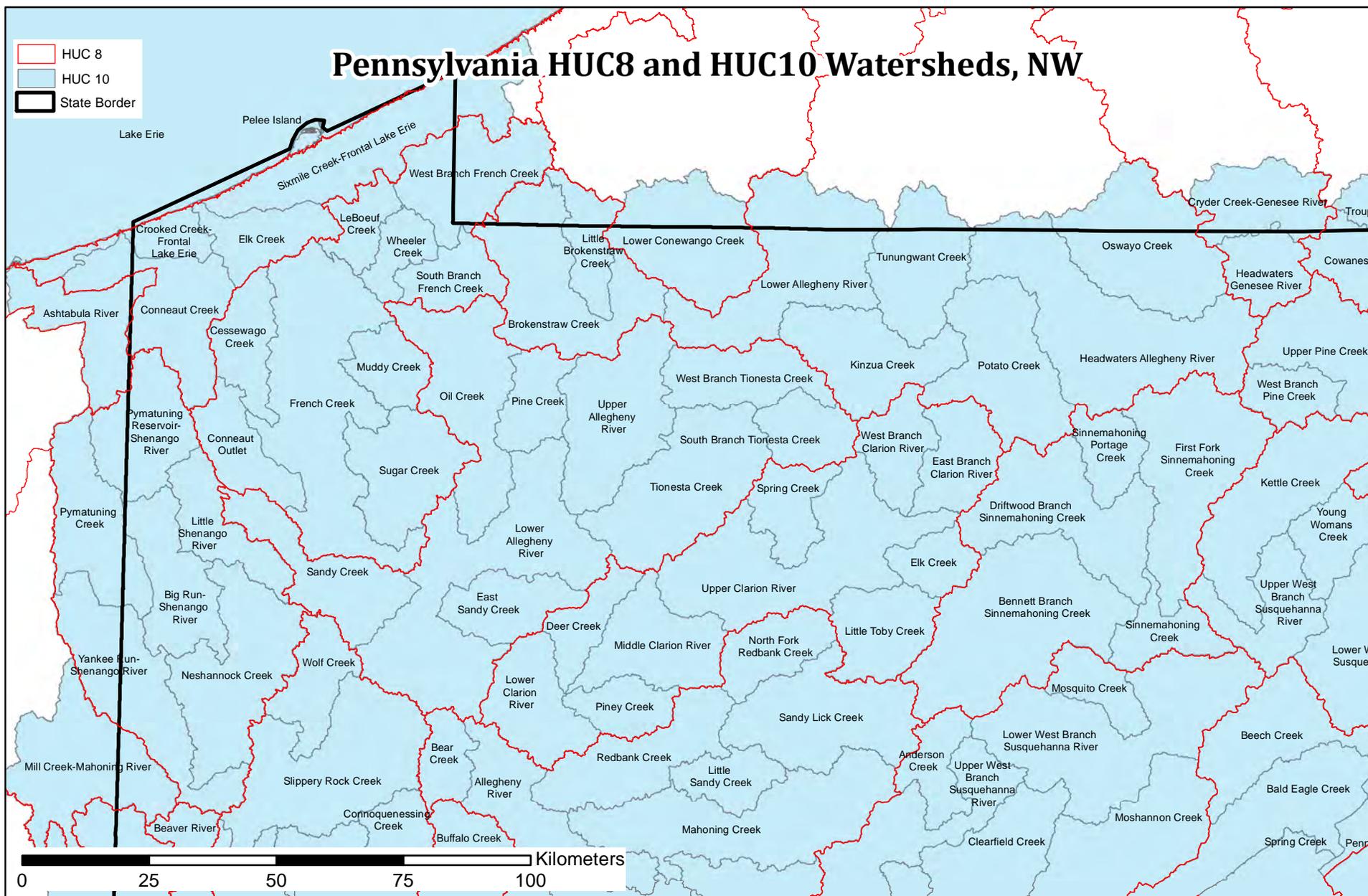




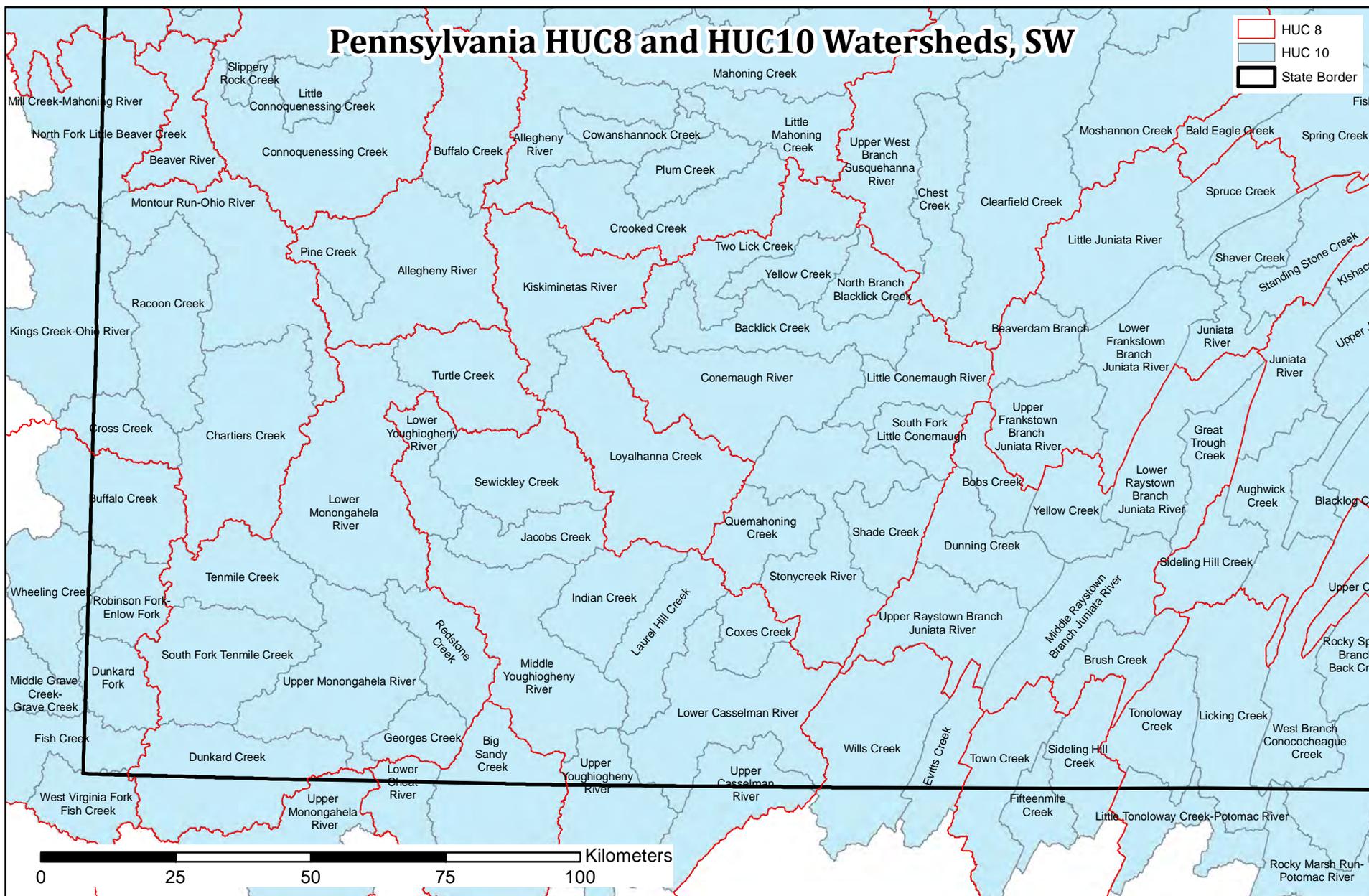
# Pennsylvania HUC8 and HUC10 Watersheds, SE



# Pennsylvania HUC8 and HUC10 Watersheds, NW



# Pennsylvania HUC8 and HUC10 Watersheds, SW



# Dwarf Wedgemussel

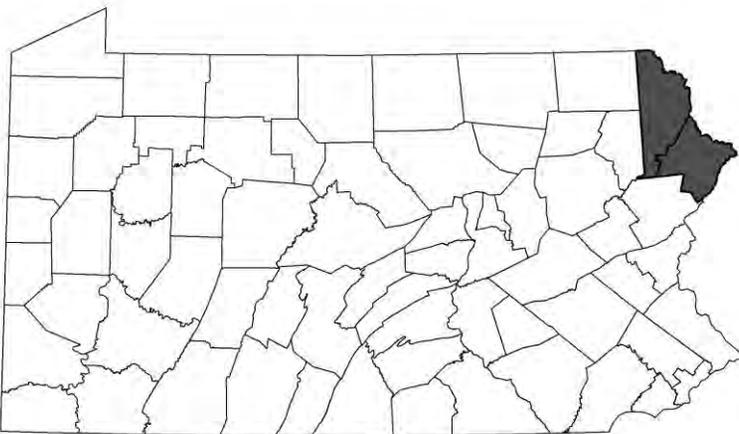
*Alasmidonta heterodon*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G1G2</b>	State Rank	<b>S1</b>
IUCN Red List	<b>VU Vulnerable</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Very High Concern / High Responsibility</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Endangered</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of dwarf wedgemussel in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Large Rivers</b>	

Habitat **Warm, Large River**

### Specific Habitat Requirements:

Medium Rivers.

**THREATS AND ACTIONS**

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Water management in New York's Pepacton and Cannonsville Reservoirs.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Implement the Dwarf Wedgemussel Management Plan.	In the next two years develop a water management plan that will protect the full life-history of the species.	Development of a water management plan	Suitable habitat availability; <i>A. heterodon</i> population (abundance).	1

Action Location: HUC8 Watershed: U. Delaware, Mid. Delaware-Mongaup-Broadhead

Associated Species: Host fish, other fish and mussels.

IUCN Threat: 8.0 Invasive and Other Problematic Species and Genes

Specific Threat: Invasive species, Didymo (*Didymosphenia polymorpha*).

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Education and outreach.	Educational kiosks, signage, gear cleaning stations, felt sole wader ban	At least one kiosk explaining the Didymo threat, 2 or more cleaning stations, and a ban of the use of felt sole waders.	Construction of kiosks and cleaning station along with a ban on the use of felt sole waders.	2

Action Location: HUC8 Watershed: U. Delaware, Mid. Delaware-Mongaup-Broadhead

Associated Species: Darter hosts, eastern pearlshell and its salmonid hosts (e.g., eastern brook trout).

**THREATS AND ACTIONS**

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3

Action Location: HUC8 Watershed: U. Delaware, Mid. Delaware-Mongaup-Broadhead

Associated Species: Host fish, other fish and mussels.

**RESEARCH NEEDS**

1. Determine a federal water quality standard for chloride that is protective of this species.

**SURVEY NEEDS**

1. Determine the extent of dwarf wedgemussel distribution in the upper Delaware River. USGS and the Western Pennsylvania Conservancy (WPC) have detected the dwarf wedgemussel in the Upper Delaware River nearly to the confluence of the East and West Branch Delaware rivers. Working with the National Park Service and USGS, additional surveys targeting specific habitats are necessary to determine the range of the mussel's distribution.
2. Address data gaps in the Delaware River from the Delaware Water Gap downstream to Trenton, New Jersey. Collate existing data (USGS, Delaware Estuary Program, etc.) and determine existing data gaps that occur along the mainstream Delaware River and target these gaps with additional qualitative surveys to detect dwarf wedgemussel.
3. Survey Princess Run near Kunkletown, PA.

**MONITORING PROGRAMS**

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

# Northern Riffleshell

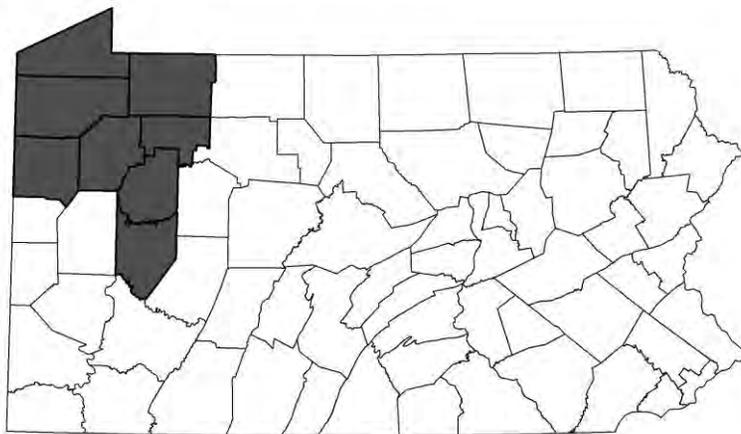
*Epioblasma torulosa rangiana*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G2</b>	State Rank	<b>S2</b>
IUCN Red List	<b>NE Not Evaluated</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Endangered</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of northern riffleshell in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Large Rivers</b>	<b>Medium Rivers</b>
Habitat	<b>Warm, Large River</b>	<b>Warm, Medium River</b>

### Specific Habitat Requirements:

Medium Rivers.

## THREATS AND ACTIONS

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Altered flow regimes, Allegheny River and Shenango River basin water management.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Develop Shenango and Allegheny River conservation flow management plan.	Development of a water management plan.	Implementation of recommendations.	1

Continue to work with the U.S. Army Corps of Engineers (Pittsburgh District) and PADCNR on flow management via the Kinzua Reservoir and the Pymatuning and Shenango River Lake reservoirs.

Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish, mussels, and invertebrates.

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Disturbances during bridge construction projects.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration	Coordination.	Continued coordination with state and local authorities.	Continued coordination.	1

Coordinate with PennDOT, permitting agencies, counties, and municipalities to avoid, minimize, or mitigate impacts to mussels during bridge projects.

Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish, mussels, and invertebrates.

THREATS AND ACTIONS

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Open-cut pipeline stream crossings.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Coordinate with developers and permitting agencies via the environmental review process to avoid, minimize, or mitigate impacts to mussels during pipeline stream crossings.	Coordination.	Continued coordination with developers and permitting agencies.	Continued coordination.	2
Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3
Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta				
Associated Species: Host fish, other fish and mussels.				

**THREATS AND ACTIONS**

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Sedimentation and eutrophication.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Implement Ag. Best Management Practices (BMPs).	Develop list of priority parcels for outreach and BMP implementation for French Creek watershed.	List of priority parcels.	Number of priority parcels where BMPs are either planned or implemented.	3

Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish and mussels.

**RESEARCH NEEDS**

1. Determine a federal water quality standard for chloride that is protective of this species.

**SURVEY NEEDS**

1. No new surveys anticipated.

**MONITORING PROGRAMS**

Program Name	Lead Agency	Hyperlink	Description
Hunter Station Mussel Relocation Pilot Study	Pennsylvania Fish and Boat Commission		Stocking density, survival, and growth are being assessed using 3x4 factorial complete random block design wherein a total of 90 mussels are placed into a staked grid at three sites on the Shenango River and two sites on Conewango Creek.

# Snuffbox

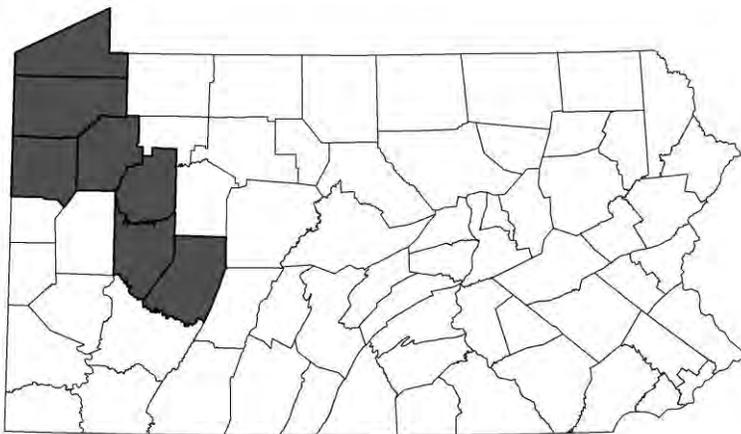
*Epioblasma triquetra*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G3</b>	State Rank	<b>S2</b>
IUCN Red List	<b>NE Not Evaluated</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Endangered</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of snuffbox in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Medium Rivers</b>	<b>Small Rivers</b>
Habitat	<b>Warm, Medium River</b>	<b>Low Gradient, Cool, Small River</b>

### Specific Habitat Requirements:

Medium Rivers.

**THREATS AND ACTIONS**

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Altered flow regimes, Allegheny River and Shenango River basin water management.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Develop Shenango and Allegheny River conservation flow management plan.	Development of a water management plan.	Implementation of recommendations.	1

Continue to work with the U.S. Army Corps of Engineers (Pittsburgh District) and PADCNr on flow management via the Kinzua Reservoir and the Pymatuning and Shenango River Lake reservoirs.

Action Location: HUC8 Watershed: French, Shenango

Associated Species: Host fish, other fish, mussels, and invertebrates.

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Sedimentation due to agricultural and livestock farming in the French Creek and Shenango River basins.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Develop list of priority parcels for outreach and BMP implementation for French Creek watershed.	List of priority parcels.	Number of priority parcels where BMPs are either planned or implemented.	2

Action Location: HUC8 Watershed: French, Shenango

Associated Species: Host fish, other fish and mussels.

**THREATS AND ACTIONS**

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3

Action Location: HUC8 Watershed: French, Shenango

Associated Species: Host fish, other fish and mussels.

**RESEARCH NEEDS**

1. Determine a federal water quality standard for chloride that is protective of this species.

**SURVEY NEEDS**

1. No new surveys anticipated.

**MONITORING PROGRAMS**

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

# Eastern Pearlshell

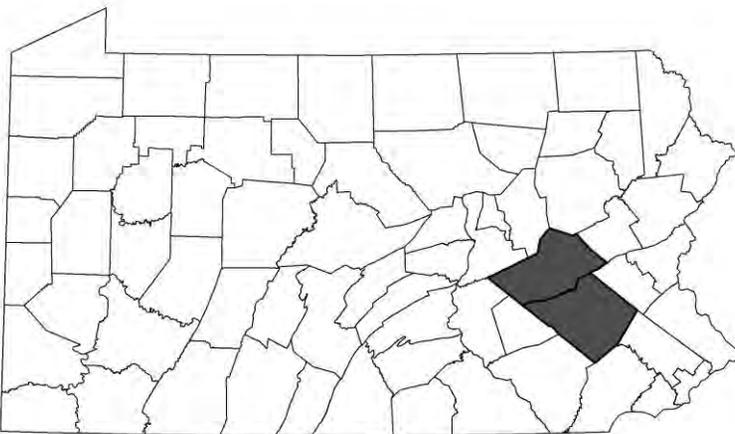
*Margaritifera margaritifera*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G4</b>	State Rank	<b>S1S2</b>
IUCN Red List	<b>EN Endangered</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>High Concern / Low Responsibility</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Not Listed</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of eastern pearlshell in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Headwaters and Creeks</b>	
Habitat	<b>Low Gradient, Cool, Headwaters and Creeks</b>	

### Specific Habitat Requirements:

Headwaters and creeks with suitable eastern brook trout habitat.

THREATS AND ACTIONS

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Flow alteration and catastrophic failure.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Talk with DCNR.	Speaking with someone from DCNR.	Obtaining dam resiliency information.	1

Learn about the life expectancy of the Locust Lake dam.

Action Location: HUC10 Watershed: Little Schuylkill R., U. Delaware R. (U. Delaware)

Associated Species: Salmonid host fish (e.g., eastern brook trout)

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Agricultural practices (e.g., livestock management) near Locust Lake.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	In the next two years identify potential funding sources and then reach out and try to engage landowners.	Line up funding sources and contact landowners.	Landowner willingness to implement BMPs (then note Yes/No). Cows being removed from stream and maintenance of BMPs.	1

Establish contact with landowners and engage them on their willingness to adopt stream crossing BMPs for agricultural lands. If willing, implement BMPs for stream crossings and establish streambank fencing, tree plantings, etc.

Action Location: HUC10 Watershed: Little Schuylkill R.

Associated Species: Salmonid host fish (e.g., eastern brook trout)

**THREATS AND ACTIONS**

IUCN Threat: 11.0 Climate Change and Severe Weather

Specific Threat: Flooding events.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Coordinate flood kill investigations with DCNR.	Coordination	Making contact	Documentation of flood-related kill.	3
Action Location: HUC10 Watershed: Little Schuylkill R., U. Delaware R. (U. Delaware)				
Associated Species: Salmonid host fish (e.g., eastern brook trout)				

IUCN Threat: 11.0 Climate Change and Severe Weather

Specific Threat: Climate change and associated changes in precipitation and temperature.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 8.0 Outreach If effects of climate change are realized, then discussions with state and provincial (Canadian) partners in cooler climates should be pursued to ascertain if these northern populations could be augmented or restored using Pennsylvania stock. Pennsylvania habitat would have been determined unsuitable for this species.	Coordination.	Making contact	Movement of mussels from Pennsylvania.	3
Action Location: HUC10 Watershed: Little Schuylkill R., U. Delaware R. (U. Delaware)				
Associated Species: Salmonid host fish (e.g., eastern brook trout)				

**RESEARCH NEEDS**

1. Evaluate reintroduction and augmentation efforts. The need for this research is dependent upon the results of an ongoing Western Pennsylvania Conservancy study (2014-2015).

## SURVEY NEEDS

1. A State and Tribal Wildlife Grant project is scheduled to be completed in 2015. Pending the outcome of this work, no surveys are anticipated.

## MONITORING PROGRAMS

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

# Round Hickorynut

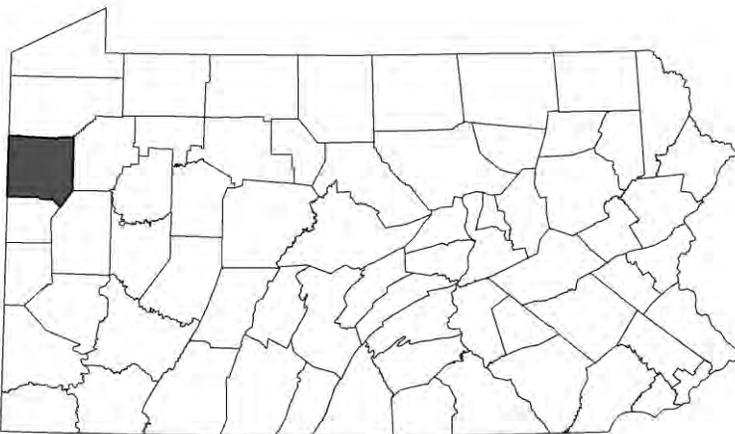
*Obovaria subrotunda*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G4</b>	State Rank	<b>S1</b>
IUCN Red List	<b>NT Near Threatened</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Not Listed</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of round Hickorynut in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Medium Rivers</b>	<b>Small Rivers</b>
Habitat	<b>Warm, Medium River</b>	<b>Moderate Gradient, Cool, Small River</b>

### Specific Habitat Requirements:

Large Rivers.

**THREATS AND ACTIONS**

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Altered flow regimes, Shenango River basin water management.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Develop Shenango and Allegheny River conservation flow management plan.	Development of a water management plan.	Implementation of recommendations.	1
Continue to work with the U.S. Army Corps of Engineers (Pittsburgh District) and PADCNR on Pymatuning and Shenango River Lake reservoirs flow management issues.				
Action Location: HUC8 Watershed: Shenango				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Open-cut pipeline stream crossngs.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration	Coordination.	Continued coordination with developers and permitting agencies.	Continued coordination.	1
Coordinate with developers and permitting agencies via the environmental review process to avoid, minimize, or mitigate impacts to mussels during pipeline stream crossings.				
Action Location: HUC8 Watershed: Shenango				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

**THREATS AND ACTIONS**

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3

Action Location: HUC8 Watershed: Shenango

Associated Species: Host fish, other fish and mussels.

**RESEARCH NEEDS**

- 2. If appropriate and necessary, develop protocols for population augmentation via captive propagation and streamside infestations.
- 1. Determine if there are proximate causes for the decline of this species in the Shenango River near Shenango River Lake. If causes are identified, then evaluate for conservation actions to address specific threats.
- 3. Determine a federal water quality standard for chloride that is protective of this species.

**SURVEY NEEDS**

- 1. Conduct a mussel survey of Crooked Creek, a historical round hickorynut stream. Crooked Creek was last surveyed by Bogan and Proch in the 1990s. An updated survey is necessary to determine the composition and extent of the existing mussel fauna, identify threats, and to identify restoration opportunities.

**MONITORING PROGRAMS**

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

# Sheepnose

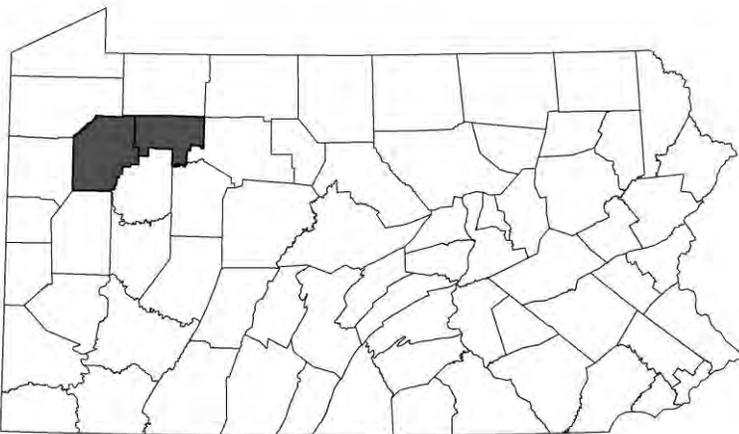
*Plethobasus cyphus*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G3</b>	State Rank	<b>S1S2</b>
IUCN Red List	<b>NT Near Threatened</b>	PA Legal Status	<b>Threatened</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Threatened</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of sheepnose in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Northern Swamp</b>	
Habitat	<b>North-Central Appalachian Acidic Swamp</b>	

### Specific Habitat Requirements:

Large Rivers.

**THREATS AND ACTIONS**

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Open-cut pipeline stream crossings.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Coordinate with developers and permitting agencies via the environmental review process to avoid, minimize, or mitigate impacts to mussels during pipeline stream crossings.	Coordination.	Continued coordination with developers and permitting agencies.	Continued coordination.	1

Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish, mussels, and invertebrates.

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Disturbances during bridge construction projects.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Coordinate with PennDOT, permitting agencies, counties, and municipalities to avoid, minimize, or mitigate impacts to mussels during bridge projects.	Coordination.	Continued coordination with state and local authorities.	Continued coordination.	1

Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish, mussels, and invertebrates.

**THREATS AND ACTIONS**

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3

Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish and mussels.

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Altered flow regimes, Allegheny River basinwater management.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Continue to work with the U.S. Army Corps of Engineers (Pittsburgh District) on flow management via the Kinzua Reservoir.	Develop Allegheny River conservation flow management plan.	Development of a water management plan.	Implementation of recommendations.	3

Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish, mussels, and invertebrates.

**RESEARCH NEEDS**

1. Identify host fish species for the sheepnose. Watters et al. (2009) noted only two known hosts - central stoneroller (*Camptostoma anomalum*) and sauger (*Sander canadensis*). Additional cyprinids or percids are suspected to be hosts given the small, lanceolate conglutinates that the sheepnose expels to attract host fish.
2. Upon completion of a distribution survey, determine the factors that influence the distribution of sheepnose in the Allegheny River.
3. Concurrent with a distribution study, conduct a Sheepnose population status in the Allegheny River including demographics, genetics, etc.

**SURVEY NEEDS**

1. Determine the extent of sheepnose distribution in the Allegheny River. sheepnose is currently known from the vicinity of Franklin and Oil City extending upstream to Tionesta. The actual extent of the species distribution is unknown but needs to be determined in order to begin to identify and address any threats.
2. Surveys are encompassed as part of Ohio River mussel survey (2015-2018).

**MONITORING PROGRAMS**

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

# Clubshell

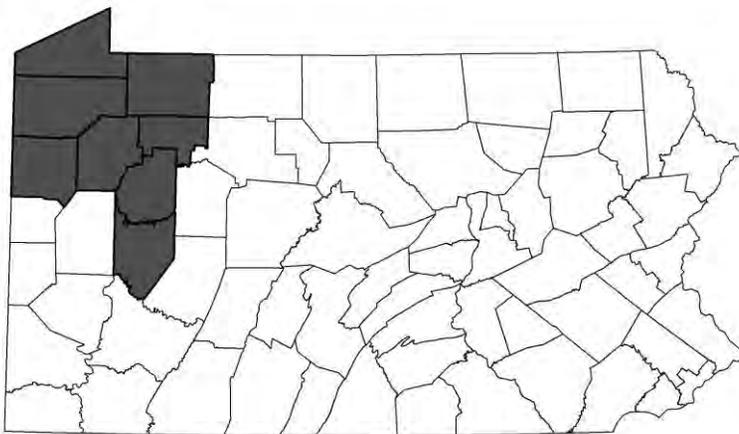
*Pleurobema clava*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G2</b>	State Rank	<b>S2</b>
IUCN Red List	<b>CR Critically Endangered</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Endangered</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of clubshell in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Large Rivers</b>	<b>Headwaters and Creeks</b>
Habitat	<b>Warm, Large River</b>	<b>Low Gradient, Warm, Headwaters and Creeks</b>

### Specific Habitat Requirements:

Medium Rivers.

**THREATS AND ACTIONS**

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Open-cut pipeline stream crossings.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Coordinate with developers and permitting agencies via the environmental review process to avoid, minimize, or mitigate impacts to mussels during pipeline stream crossings.	Coordination.	Continued coordination with developers and permitting agencies.	Continued coordination.	1
Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Disturbances during bridge construction projects.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Coordinate with PennDOT, permitting agencies, counties, and municipalities to avoid, minimize, or mitigate impacts to mussels during bridge projects.	Coordination.	Continued coordination with state and local authorities.	Continued coordination.	1
Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

## THREATS AND ACTIONS

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Altered flow regimes, Allegheny River and Shenango River basin water management.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Develop Shenango and Allegheny River conservation flow management plan.	Development of a water management plan.	Implementation of recommendations.	2

Continue to work with the U.S. Army Corps of Engineers (Pittsburgh District) and PADCNr on flow management via the Kinzua Reservoir and the Pymatuning and Shenango River Lake reservoirs.

Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish, mussels, and invertebrates.

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3

Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish and mussels.

## THREATS AND ACTIONS

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Sedimentation and eutrophication.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Implement Ag. Best Management Practices (BMPs).	Develop list of priority parcels for outreach and BMP implementation for French Creek watershed.	List of priority parcels.	Number of priority parcels where BMPs are either planned or implemented.	3

Action Location:

Associated Species: Host fish, other fish and mussels.

## RESEARCH NEEDS

1. Assess the ecological capacity of Neshannock Creek to support a freshwater mussel community, including a clubshell population. This should be determined following completion of a mussel community survey. This information would assist with evaluating whether this creek could become an additional receiving stream for adults or propagated juveniles.
2. Determine a federal water quality standard for chloride that is protective of this species.

## SURVEY NEEDS

1. Conduct a mussel survey of Neshannock Creek, a historical stream. Recent mussel surveys by the Western Pennsylvania Conservancy have documented a few individual mussels during opportunistic surveys. A systematic survey of Neshannock Creek is appropriate to determine the presence of clubshell or its habitat and to identify potential areas for restoration.
2. Conduct survey of suitable habitat in Loyalhanna River Watershed.

## MONITORING PROGRAMS

Program Name	Lead Agency	Hyperlink	Description
Hunter Station Mussel Relocation Pilot Study	Pennsylvania Fish and Boat Commission		Stocking density, survival, and growth are being assessed using 3x4 factorial complete random block design wherein a total of 90 mussels are placed into a staked grid at three sites on the Shenango River and two sites on Conewango Creek.

# Rabbitsfoot

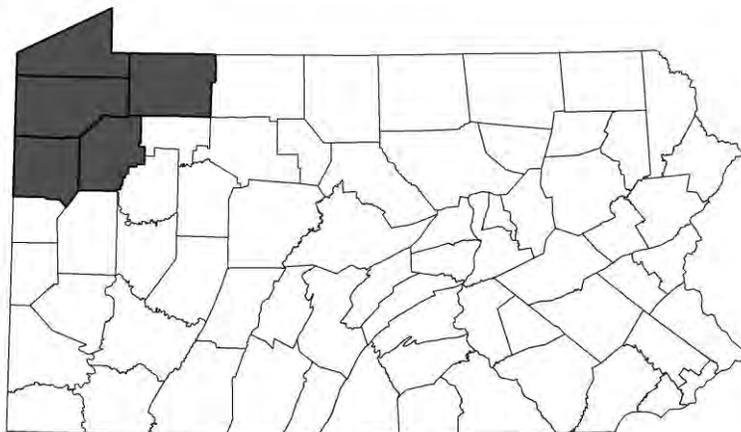
*Quadrula cylindrica cylindrica*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G3</b>	State Rank	<b>S1S2</b>
IUCN Red List	<b>NT Near Threatened</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Threatened</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of rabbitsfoot in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Large Rivers</b>	<b>Medium Rivers</b>
Habitat	<b>Warm, Large River</b>	<b>Warm, Medium River</b>

### Specific Habitat Requirements:

Medium Rivers.

## THREATS AND ACTIONS

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Altered flow regimes, Shenango River basinwater management.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Develop Shenango and Allegheny River conservation flow management plan.	Development of a water management plan.	Implementation of recommendations.	1
Continue to work with the U.S. Army Corps of Engineers (Pittsburgh District) and PA DCNR on flow management via the Kinzua Reservoir and the Pymatuning and Shenango River Lake reservoirs.				
Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Sedimentation from agricultural runoff and livestock farming in the French Creek and Shenango River basins.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Develop list of priority parcels for outreach and BMP implementation for French Creek watershed.	List of priority parcels.	Number of priority parcels where BMPs are either planned or implemented.	2
Implement Ag. Best Management Practices (BMPs).				
Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta				
Associated Species: Host fish, other fish and mussels.				

## THREATS AND ACTIONS

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3

Action Location: HUC8 Watershed: French, Mid. Allegheny-Tionesta

Associated Species: Host fish, other fish and mussels.

## RESEARCH NEEDS

1. Determine a federal water quality standard for chloride that is protective of this species.

## SURVEY NEEDS

1. Determine the extent of rabbitfoot distribution in the Allegheny River. The Allegheny River mussel community has been well-surveyed but the habitats for this particular species generally occurs near the banks and has been under-sampled due to survey designs intended to sample cross-sections of the river.
2. Determine the extent of rabbitfoot distribution in the Shenango River upstream of Kidds Mill Road. The Shenango River mussel community has been well-surveyed (Nelson & Vilella 2010) but the habitat for this particular species generally occurs near the banks and has been under-sampled due to survey designs intended to sample cross-sections of the river. USFWS has proposed designating as critical habitat the portion of the Shenango River downstream of Kidds Mill Road (RF 32). Determining the actual extent of the species distribution in the Shenango River will inform PFBC and USFWS protection efforts.
3. Surveys are encompassed as part of Ohio River mussel survey (2015-2018).

## MONITORING PROGRAMS

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

# Pistolgrip

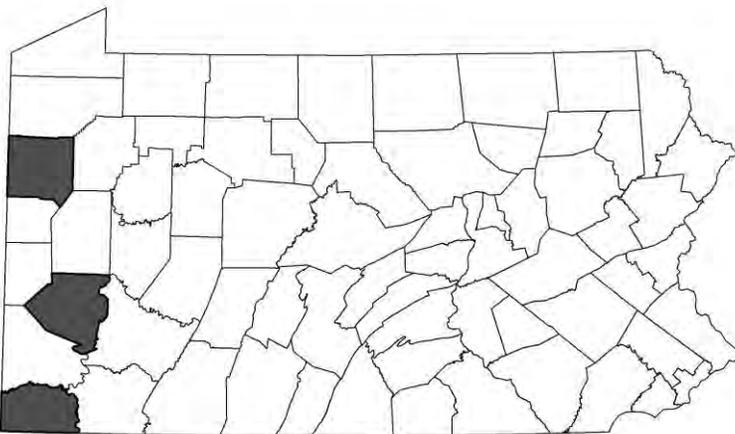
*Quadrula verrucosa*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G4G5</b>	State Rank	<b>S1</b>
IUCN Red List	<b>NE Not Evaluated</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Not Listed</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of pistolgrip in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Headwaters and Creeks</b>	<b>Small Rivers</b>
Habitat	<b>Low Gradient, Warm, Headwaters and Creeks</b>	<b>Low Gradient, Warm, Small River</b>

### Specific Habitat Requirements:

Medium Rivers.

**THREATS AND ACTIONS**

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Altered flow regimes, Shenango River basinwater management.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources  Continue to work with the U.S. Army Corps of Engineers (Pittsburgh District) and PADCNr on Pymatuning and Shenango River Lake reservoir flow management.	Develop Shenango and Allegheny River conservation flow management plan.	Development of a water management plan.	Implementation of recommendations.	1
Action Location: HUC8 Watershed: Shenango, U. Ohio				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Open-cut pipeline stream crossngs.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration  Coordinate with developers and permitting agencies via the environmental review process to avoid, minimize, or mitigate impacts to mussels during pipeline stream crossings.	Coordination.	Continued coordination with developers and permitting agencies.	Continued coordination.	1
Action Location: HUC8 Watershed: Shenango, U. Ohio				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

### THREATS AND ACTIONS

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3

Action Location: HUC8 Watershed: Shenango, U. Ohio

Associated Species: Host fish, other fish and mussels.

### RESEARCH NEEDS

1. Develop protocols for population augmentation via captive propagation and streamside infestations.
2. Determine a federal water quality standard for chloride that is protective of this species.

### SURVEY NEEDS

1. Determine the extent of pistolgrip distribution in the Ohio River's Dashields pool. The pistolgrip was detected during a 2014 pre-dredging survey. The extent of the species distribution in the Dashields pool is unknown.
2. Beaver River mussel surveys. Using systematic qualitative surveys, determine what, if any, distribution the pistolgrip may have in the Beaver River (Beaver and Lawrence Counties, Pennsylvania). The survey would begin at the river's formation at the confluence of the Shenango and Mahoning Rivers and proceed systematically downriver to the confluence with the Ohio River.

### MONITORING PROGRAMS

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

# Salamander Mussel

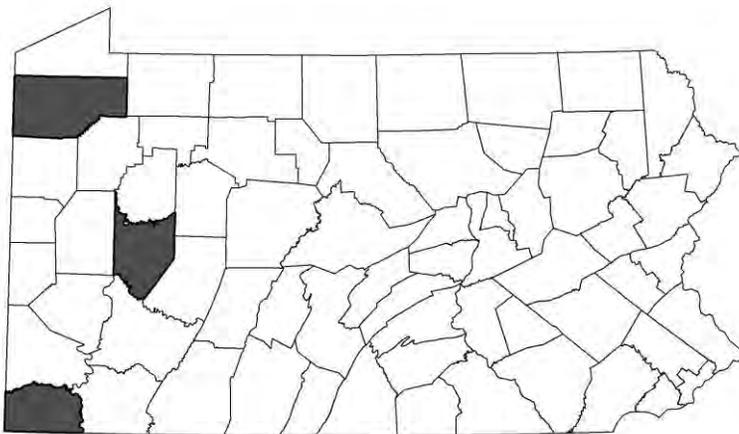
*Simpsonaias ambigua*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



■ Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G3</b>	State Rank	<b>S1</b>
IUCN Red List	<b>NE Not Evaluated</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Not Listed</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of salamander mussel in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Large Rivers</b>	<b>Small Rivers</b>
Habitat	<b>Warm, Large River</b>	<b>Moderate Gradient, Warm, Small River</b>

### Specific Habitat Requirements:

Large Rivers, with shelter rock.

THREATS AND ACTIONS

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Open-cut pipeline stream crossings.

Action	Objective	Measure	Monitoring	Priority
<p>TRACS Action 1.0 Coordination and Administration</p> <p>Coordinate with developers and permitting agencies via the environmental review process to avoid, minimize, or mitigate impacts to mussels during pipeline stream crossings.</p> <p>Action Location: HUC8 Watershed: Lwr Allegheny, Mid. Allegheny-Redbank</p> <p>Associated Species: Host fish, other fish, mussels, and invertebrates.</p>	<p>Coordination.</p>	<p>Continued coordination with developers and permitting agencies.</p>	<p>Continued coordination.</p>	<p>1</p>

IUCN Threat: 3.0 Energy Production and Mining

Specific Threat: Commercial sand and gravel dredging.

Action	Objective	Measure	Monitoring	Priority
<p>TRACS Action 11.0 Technical Assistance</p> <p>Continue development of the Significant Mussel Resource concept for the Adaptive Management Group, develop state-listed mussel consultation process.</p> <p>Action Location: HUC8 Watershed: Lwr Allegheny, Mid. Allegheny-Redbank</p> <p>Associated Species: Host fish, other fish and mussels.</p>	<p>To establish protection for concentrations of non-listed species and a consultation process for state-listed species.</p>	<p>Completion of SMR classification system and final state-listed species consultation process.</p>	<p>Completion of Significant Mussel Resource classification system, development of a state-listed mussel species consultation process.</p>	<p>1</p>

**THREATS AND ACTIONS**

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3

Action Location: HUC8 Watershed: Lwr Allegheny, Mid. Allegheny-Redbank

Associated Species: Host fish, other fish and mussels.

**RESEARCH NEEDS**

1. Determine the status of the salamander mussel host, the mudpuppy (*Necturus maculosus*), in the Allegheny River, Ohio River, French Creek, and Dunkard Creek.
2. If appropriate and necessary, develop protocols for population augmentations via captive propagation and streamside infestations.
3. Experiment with the use of artificial habitat for mudpuppy (*Necturus maculosus*) host and salamander mussels.

**SURVEY NEEDS**

1. Conduct a salamander mussel survey in Conneaut Creek, Erie County, Pennsylvania. The Ohio portion of this stream has been reported to harbor salamander mussels. A systematic qualitative survey targeting shelter rock habitats beginning at the Pennsylvania border and moving upstream would be appropriate to 1) detect occurrences, 2) detect presence/absence of mudpuppy (*Necturus maculosus*) hosts, and 3) map actual and potential habitat that could be targeted for protection or restoration.

**MONITORING PROGRAMS**

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

# Rayed Bean

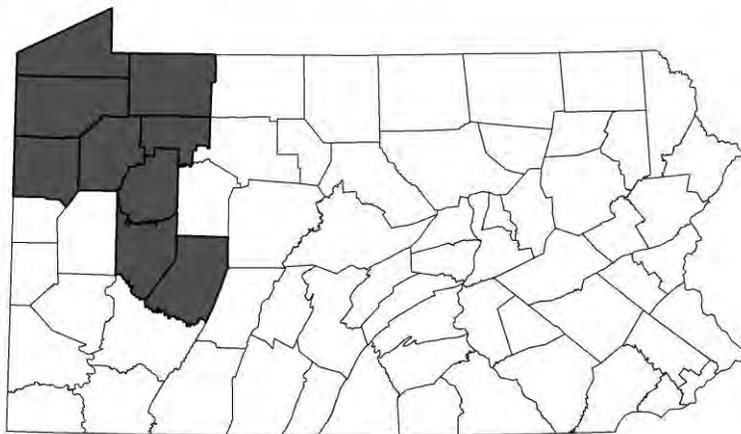
*Villosa fabalis*

Nevin Welte

PA Fish & Boat Commission/ Western Pennsylvania Conservancy



Photo: Nevin Welte



Documented Presence

## CONSERVATION PROFILE

Global Rank	<b>G1G2</b>	State Rank	<b>S1S2</b>
IUCN Red List	<b>EN Endangered</b>	PA Legal Status	<b>Endangered</b>
Northeast Region	<b>Not NE Regional SGCN</b>	PA Abundance	<b>Unknown</b>
Federal Status	<b>Endangered</b>	PA Short-Term Trend (10 year)	<b>Unknown</b>

### Conservation Goal:

Maintain and protect extant populations of rayed bean in the Commonwealth and provide sufficient distribution to adequately secure the species and allow its removal from the Pennsylvania list of endangered species.

## HABITAT ASSOCIATIONS

	Primary	Secondary
Macrogroup	<b>Large Rivers</b>	<b>Small Rivers</b>
Habitat	<b>Warm, Large River</b>	<b>Low Gradient, Cool, Small River</b>

### Specific Habitat Requirements:

Medium Rivers.

**THREATS AND ACTIONS**

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Open-cut pipeline stream crossings.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Coordinate with developers and permitting agencies via the environmental review process to avoid, minimize, or mitigate impacts to mussels during pipeline stream crossings.	Coordination.	Continued coordination with developers and permitting agencies.	Continued coordination.	1

Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta, Mid. Allegheny-Redbank

Associated Species: Host fish, other fish, mussels, and invertebrates.

IUCN Threat: 4.0 Transportation and Service Corridors

Specific Threat: Disturbances during bridge construction projects.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 1.0 Coordination and Administration Coordinate with PennDOT, permitting agencies, counties, and municipalities to avoid, minimize, or mitigate impacts to mussels during bridge projects.	Coordination.	Continued coordination with state and local authorities.	Continued coordination.	1

Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta, Mid. Allegheny-Redbank

Associated Species: Host fish, other fish, mussels, and invertebrates.

THREATS AND ACTIONS

IUCN Threat: 7.0 Natural System Modifications

Specific Threat: Altered flow regimes, Allegheny River basinwater management.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources	Develop Allegheny River conservation flow management plan.	Development of a water management plan.	Implementation of recommendations.	2
Continue to work with the U.S. Army Corps of Engineers (Pittsburgh District) and PADCNR on flow management via the Kinzua Reservoir.				
Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta, Mid. Allegheny-Redbank				
Associated Species: Host fish, other fish, mussels, and invertebrates.				

IUCN Threat: 9.0 Pollution

Specific Threat: Single catastrophic event, unregulated or poorly regulated discharges.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 11.0 Technical Assistance Mussel kill investigation.	Investigate incidents, pursue damages if appropriate, and restore streams.	2 or fewer kill investigations.	Effectiveness of any actions depends upon the cessation of the pollutant(s) and elimination of the threat.	3
Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta, Mid. Allegheny-Redbank				
Associated Species: Host fish, other fish and mussels.				

**THREATS AND ACTIONS**

IUCN Threat: 2.0 Agriculture and Aquaculture

Specific Threat: Sedimentation and eutrophication.

Action	Objective	Measure	Monitoring	Priority
TRACS Action 2.0 Direct Management of Natural Resources Implement Ag. Best Management Practices (BMPs).	Develop list of priority parcels for outreach and BMP implementation for French Creek watershed.	List of priority parcels.	Number of priority parcels where BMPs are either planned or implemented.	3

Action Location: HUC8 Watershed: Mid. Allegheny-Tionesta, Mid. Allegheny-Redbank

Associated Species: Host fish, other fish and mussels.

**RESEARCH NEEDS**

1. Continue to research the identification of host fish species for the rayed bean.
2. If appropriate and necessary, develop protocols for population augmentations via captive propagation and streamside infestations.
3. Determine a federal water quality standard for chloride that is protective of this species.

**SURVEY NEEDS**

1. Conduct additional surveys of Conewango Creek near Russell, Pennsylvania. The Western Pennsylvania Conservancy (Meyer 2010) recently conducted a qualitative survey of Conewango Creek. The WPC survey indicated a diverse Conewango Creek mussel fauna but did not detect rayed bean. Additional, but targeted, qualitative searches near its historical location at Russell, Pennsylvania (Ortmann 1919) are warranted to determine the probable presence/absence of this species in Conewango Creek.

**MONITORING PROGRAMS**

Program Name	Lead Agency	Hyperlink	Description
No Current Monitoring Programs			

## REFERENCES

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### Mussels

#### Dwarf Wedgemussel

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* **8**:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

#### Northern Riffleshell

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* **8**:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

#### Snuffbox

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* **8**:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

#### Eastern Pearlshell

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* **8**:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

Western Pennsylvania Conservancy. 2015. Assessment of Eastern Pearl Shell distributions, populations, genetic diversity and habitat. A State and Tribal Wildlife Grants (# F13AF00473) project administered by the Pennsylvania Fish and Boat Commission. Harrisburg, Pennsylvania.

#### Round Hickorynut

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* **8**:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

## REFERENCES

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### Sheepnose

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* 8:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

Watters, G. T., M. A. Hoggarth, and D. H. Stansbery. 2009. *The Freshwater Mussels of Ohio*. The Ohio State University Press, Columbus, Ohio.

### Clubshell

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* 8:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

### Rabbitsfoot

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Nelson II, R. G. and R. F. Vilella. 2010. Assess the presence and potential habitat for reintroduction of priority freshwater mussel species in the Shenango River. 2010 Final Report. USGS Leetown Science Center, Kearneysville, West Virginia.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* 8:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

### Pistolgrip

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* 8:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

### Salamander Mussel

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* 8:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

## REFERENCES

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### Rayed Bean

Meyer, E.S. 2010. Freshwater Mussel Survey of Conewango Creek. Final Report. State and Tribal Wildlife Grant Project T-26-R-1. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.

NatureServe. 2015. Biotics Database. Arlington, VA. Available from <http://www.natureserve.org/>.

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III: Systematic account of the genera and species. *Memoirs of the Carnegie Museum* 8:xvi-384.

PNHP (Pennsylvania Natural Heritage Program). 2015. Pennsylvania Mussel Database. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania.