

Appendix 1. Amphibians and reptiles observed in Muddy Creek, Erie National Wildlife Refuge-Seneca Division. See Figure 1 for site locations. Several mink, beaver and other mammals were also observed.

Common/ Scientific Name	Stage	Number	Site	Notes
Mudpuppy <i>Necturus maculosus</i>	adult	2	4	photos of second individual caught on right bank
	adult	7	5	fish mortalities from slime layer; do not hold with fishes
Unknown salamander <i>Ambyostoma</i> sp.?	adult	1	3	observed in water (see photo)
Northern leopard frog <i>Rana pipiens</i>	adult	1	7	individual on bank
	adult	1	2	calls from male heard
Green frog <i>Rana clamitans</i>	adult	1	7	caught on right bank at first riffle
	adult	3	8	observed on left bank
	adult	2	alt 3	observed on right bank at corner pool
	sub-adult	1	alt 4	observed on left bank above wood
	adult	1	alt 4	observed on left bank above wood
	adult	1	10	observed on bank
Bull frog <i>Rana catesbiana</i>	adult	1	2	calls from male heard
	adult	1	3	observed on bank
unknown tadpoles possibly <i>Rana sylvatica</i>	juv	many	3	many small black young in small isolated pool on right bank
	juv	many	alt 3?	many small black young in small isolated pool on right bank
Spiny softshell turtle <i>Apalone spinifera</i>	adult	4	2	observed on left bank descending steep bank
	adult	1	16	dead on right bank in slack water
	adult	1	6	large individual observed in water; too fast to catch
	adult	1	18	large individual observed in water; too fast to catch

Appendix 1. Continued.				
Snapping turtle <i>Chelydra serpentina</i>	adult	1	8	large individual on right bank; steep incline over silt 200 m below site 8 (see photos)
	adult	1	6-7	small individual caught in water (see photos)
	adult	1	8	small individual caught in water
	adult	1	17	large individual swimming in water; much algal growth on carapace

Appendix 3. Habitats and distributions of live freshwater mussel species found in Muddy Creek, Erie National Wildlife Refuge-Seneca Division, by Mohler et al. (2003). Habitat and distribution information is from Burch (1975). R = river.

Common/Scientific Name	Habitat	Distribution
Mucket <i>Actinonaias ligamentina</i>	A river species in riffles and runs	Mississippi R. basin from NY & MN to AR; St. Lawrence R. basin in tributaries from MI to NY
Elktoe <i>Alasmodonta marginata</i>	Medium-sized streams in gravel or mixed sand and gravel	Upper Mississippi basin in Cumberland, Tennessee & Ohio river systems; St. Lawrence basin from Lake Huron to the Ottawa R.; Susquehanna R. basin
Three-ridge mussel <i>Amblema plicata</i>	Rivers and impoundments in sand, mud, or gravel	Mississippi R. basin from western NY to MN & eastern KS; Gulf basin rivers from central TX to Yellow R. of FL; St. Lawrence R. basin (except L. Superior basin); Red R. of the North, Winnipeg R.
Cylindrical papershell <i>Anodontoides ferrusacianus</i>	Small creeks and the headwaters of larger streams in mud and sand	Mississippi R. basin from PA to TN west to MN & CO; St. Lawrence R. & Great Lakes; Nelson, Albany & Ottawa river basins in Canada
Spike <i>Elliptio dilatata</i>	Small to large streams; occasionally lakes in mud or gravel	Apalachicola R. basin; Altamaha R. basin in GA to St. Lawrence R. basin; parts of interior Canada and Hudson Bay basins
Northern riffleshell <i>Epioblasma torulosa</i>	Medium to large rivers in gravel riffles	Ohio R. basin into southwestern MI and Wabash R. of IN (<i>Dysnomia</i> in ref.)

Appendix 3. Continued.		
Snuffbox mussel <i>Epioblasma triquetra</i>	Medium to large rivers in clear, gravel riffles	Western NY & southern Ontario, west to WI, IA & eastern NE, south to OK, east to northern AL, TN & WV (<i>Dysnomia</i> in ref.)
Long-solid mussel <i>Fusconaia subrotunda</i>	Large rivers in gravel	Cumberland, Tennessee & Ohio R. basins
Plain pocketbook <i>Lampsilis cardium</i>	Small creeks to large rivers in mud, sand, or gravel	No species by this/similar name in Burch (1975), but it is a good species name.
Wavy-rayed lampmussel <i>Lampsilis fasciola</i>	Medium-sized streams in gravel riffles	Scattered in the Great Lakes and their drainages
Pocketbook <i>Lampsilis ovata</i>	Large rivers in coarse sand or gravel	Hudson Bay, Mississippi & St. Lawrence drainages; Red, Winnipeg & Nelson basins of Canada; exotic in Potomac R. in MD
Fatmucket <i>Lampsilis siliquoidea</i>	Lakes and small to medium-sized streams in mud, sand, or gravel	Mississippi R. basin from NY to MN; south to AR but not in Tennessee & Cumberland R. basins; widely distributed in the Central Interior Basin of Canada, MT & eastern CO
Creek heelsplitter <i>Lasmigona compressa</i>	Creeks and the headwaters of small to medium rivers in fine gravel or sand; rarely found in larger rivers	Canada Interior Basin & the upper Mississippi, Ohio & St. Lawrence R. basins; from Saskatchewan to NE and eastward to Quebec & VT; Hudson R. basin, NY
Fluted-shell mussel <i>Lasmigona costata</i>	Medium to large rivers in sand, mud, or fine gravel; slow to moderate flow	Mississippi & St Lawrence basins; Hudson Bay basin; Tombigbee R. in MS

Appendix 3. Continued.		
Black sandshell <i>Ligumia recta</i>	Medium to large rivers in riffles or raceways in gravel or firm sand	Mississippi R. basin from PA to MN south to OK & AL; St. Lawrence R. basin; Winnipeg and Red R. basins in Canada
Clubshell mussel <i>Pleurobema clava</i>	Medium to large rivers in gravel or mixed gravel and sand	Cumberland, Tennessee & Ohio R. basins; Maumee basin; western NY; selected locations in IA, MN & NE
Round pigtoe <i>Pleurobema sintoxia</i>	Medium to large rivers in mud, sand, or gravel	No species by this/similar name in Burch (1975), but it is a good species name.
Kidney shell <i>Ptychobranhus fasciolaris</i>	Medium to large rivers in gravel	Cumberland, Tennessee & Ohio R. basins; MI, KS, AR, OK & LA
Giant floater <i>Pyganodon grandis</i>	Ponds, lakes, sluggish mud-bottomed pools of creeks and rivers; other habitats as well	Throughout Mississippi, Missouri & St. Lawrence basins; Canadian Interior basin from western Ontario to Alberta; Gulf of Mexico basin from LA to TX (<i>Anodonta</i> in ref.)
Rabbitsfoot mussel <i>Quadrula cylindrical</i>	Medium to large rivers in mixed sand and gravel	Cumberland, Tennessee & Ohio R. basins; west to NE & south to AR & OK
Squawfoot mussel <i>Strophitus undulates</i>	Small to medium-sized streams; occasionally large rivers in mud, sand, or gravel	Lake Winnipeg to Central TX; Atlantic drainages; Savannah R. basin of SC to St. Lawrence R. basin and Nova Scotia; Nelson R. basin of western Ontario to Saskatchewan
Rayed bean mussel <i>Villosa fabalis</i>	Lakes and small to large streams in sand or gravel	Ohio R. basin & Rouge R. basin in MI; Duck R. & upper Tennessee R.

Appendix 4. Habitats and distributions of host fishes and Pennsylvania-listed fishes collected in Muddy Creek, Erie National Wildlife Refuge-Seneca Division (this study). Habitat and distribution information are from Smith (1985). PE = PA endangered; PT = PA threatened; PC = concern the species will become endangered or threatened.

Common/Scientific Name	Habitat	Distribution
Ohio lamprey (PC) <i>Ichthyomyzon bdellium</i>	Juveniles in small- or mid-size streams; adults in larger creeks or small rivers	Ohio R. drainage, including Tennessee, Wabash (IL, IN) and Allegheny Rivers
Bowfin (PC) <i>Amia calva</i>	Slow parts of larger streams and in lakes with abundant vegetation and clear or moderately turbid water	WI to TX, gulf coast to southern FL; north along Atlantic coast throughout Great Lakes
Brindled madtom (PT) <i>Noturus miurus</i>	Lower reaches of streams, usually below riffles, often in weedy areas. Soft bottoms with mud or debris	Great Lakes, Mississippi and Ohio basin to Gulf of Mexico between the Pearl and Mississippi Rivers
White sucker (H) <i>Catostomus commersoni</i>	Ubiquitous in freshwater from small creeks to large lakes	Much of North America from Labrador to Yukon; south to British Columbia and NM; east to northern GA; north along Atlantic coast to Nova Scotia
Northern hogsucker (H) <i>Hypentelium nigricans</i>	Riffles and pools of clear, warm, rocky streams with considerable gradient	Mississippi R. drainages from LA north; southern Great Lakes drainages; upper Atlantic drainages from Hudson R. to GA
Golden redhorse (H) <i>Moxostoma erythrurum</i>	Moderate-sized to large streams with some current.	Mississippi R. and southern Great Lakes drainages from NY to MN to OK to AL; Roanoke to James R. Atlantic drainages
Central stoneroller (H) <i>Campostoma anomalum</i>	Streams with riffles (most abundant), pools and considerable current	Central U.S. from NY to WI and south into southern Mexico and northern GA
Common carp (H) <i>Cyprinus carpio</i>	Lakes, ponds and larger streams, often with dense aquatic vegetation	Native to Europe and Asia; introduced throughout North America

<p>Appendix 4. Continued.</p> <p>Common shiner (H) <i>Luxilus cornutus</i></p>	<p>Small- to moderate-sized streams</p>	<p>Quebec to Saskatchewan in southern Canada; south in the Mississippi and Ohio drainages to KS and MO; Atlantic coast to the James River, VA</p>
<p>Spotfin shiner (H) <i>Cyprinella spiloptera</i></p>	<p>Lakes and small to moderately large streams. Tolerant of silty and turbid conditions</p>	<p>Ohio River basin from north AL to Wabash River in IN and east IL; east to western NY/PA; Great Lakes from east MI to St. Lawrence River; south on Atlantic coast to Potomac River basin</p>
<p>Bluntnose minnow (H) <i>Pimephales notatus</i></p>	<p>Lakes, ponds and streams; often abundant in weedy areas. Tolerates silt and organic enrichment</p>	<p>Lake Champlain to the Dakotas; southern Canada to gulf coast in LA, MI and AL</p>
<p>Fathead minnow (H) <i>Pimephales promelas</i></p>	<p>Tolerate wide conditions, but prefer ponds and slower streams</p>	<p>Middle North America from Great Slave Lake & Hudson Bay south to Chihuahua, Mexico. Widely introduced</p>
<p>Creek chub (H) <i>Semotilus atromaculatus</i></p>	<p>Small- to moderate-sized streams with gravel for spawning. Sometimes occurs in standing waters</p>	<p>Southeastern Canada and the Great Plains; south to east TX and the FL Panhandle; north on the Atlantic slope to Maritime Provinces, Canada</p>
<p>Rock bass (H) <i>Ambloplites rupestris</i></p>	<p>Many lake and stream habitats, but especially in rocky-bottom streams of moderate size with much shelter and considerable current and along gravelly or rocky shores of lakes</p>	<p>New England across south Canada to Red River of the North; west of Appalachian Divide, ranges south to the Tennessee River; east of Mississippi and Missouri Rivers. Widely introduced</p>

<p>Appendix 4. Continued</p> <p>Pumpkinseed (H) <i>Lepomis gibbosus</i></p>	<p>Wide variety of streams to slower parts of large rivers, ponds and lakes</p>	<p>Atlantic coast from New Brunswick to northeastern GA; southern Ontario to Lake Winnipeg (but not Lake Superior); south to northeast MO, IL, southern IN and OH. Widely introduced</p>
<p>Bluegill (H) <i>Lepomis macrochirus</i></p>	<p>Standing or slow-moving water with vegetation or other shelter</p>	<p>Southeastern U.S. and Mississippi Valley from OK to SD; south Wisconsin to Great Lakes and NY drainages of St. Lawrence River; TX to peninsular FL; north on Atlantic coast to NC. Widely introduced</p>
<p>Green sunfish (H) <i>Lepomis cyanellus</i></p>	<p>Small streams and ditches to larger rivers, lakes and ponds. Needs aquatic vegetation for shelter and is tolerant of silt</p>	<p>Mississippi Valley and Great Lakes from west NY to WI; south to NM and northern Mexico. Widely introduced</p>
<p>Smallmouth bass (H) <i>Micropterus dolomieu</i></p>	<p>Streams with slow to moderate current or standing water with rocky shores and shelter. Prefers cooler, clearer water than largemouth bass</p>	<p>North central U.S. & south Canada from Dakotas to St. Lawrence River basin; south in Mississippi River valley to Tennessee River drainage in north AL</p>
<p>Black crappie (H) <i>Pomoxis nigromaculatus</i></p>	<p>Lakes, ponds and slower parts of streams. Less tolerant of silt and turbidity than white crappie and more likely found in clear water with abundant vegetation</p>	<p>St. Lawrence River valley of southern Quebec to southeast Manitoba; south to eastern Dakotas and east TX; east along gulf coast to peninsular FL; north along Atlantic coast to Great Lakes region</p>

<p>Appendix 4. Continued.</p> <p>Eastern sand darter (PE) <i>Ammocrypta pellucida</i></p>	<p>Moderate-sized streams with clean, sandy (no silt) bottoms</p>	<p>East of Mississippi River from southern IL and KY through the Mississippi, Ohio and Great Lakes drainages to southern MI, southern Ontario and tributaries of southern Lake Erie; scattered in St. Lawrence River tributaries; not found in Lake Ontario</p>
<p>Rainbow darter (H) <i>Etheostoma caeruleum</i></p>	<p>Small creeks to moderate-sized rivers in riffles with gravel and cobble</p>	<p>Ozarks of north AR and MO and in Mississippi River basin to MN, WI and northern IL; Tennessee and Ohio River basins Great Lakes drainages except Superior and east Ontario.</p>
<p>Bluebreast darter (PT) <i>Etheostoma camurum</i></p>	<p>Fast flowing, deep riffles of larger streams with low turbidity, large cobbles and sandy gravel</p>	<p>Tributaries of Tennessee River in southern TN and NC; north through KY; IN, OH and WV; Allegheny River and its tributary French Creek</p>
<p>Banded darter (H) <i>Etheostoma zonale</i></p>	<p>Moderate-sized streams and small rivers with moderate to swift current. Usually found over gravel, cobble and boulders but sometimes on mud or sand</p>	<p>Mississippi watershed from south MN to northern IL; eastern OK, AR, LA and MS north through TN and OH to west NY. Introduced to Susquehanna and Savannah Rivers on Atlantic coast</p>
<p>Logperch (H) <i>Percina caprodes</i></p>	<p>Slower waters of streams and lakes, often over sand</p>	<p>Hudson Bay drainage south in Mississippi River basin to LA, including Tennessee River basin; Great Lakes east to Ottawa River and Lake Champlain</p>

Appendix 4. Continued.		
Gilt darter (PT) <i>Percina evides</i>	Moderately-fast deep runs and slow riffles of larger streams; prefers loose gravel and boulders	Mississippi R. drainage to AR, TN, MN, Allegheny River in PA, NY
Longhead darter (PT) <i>Percina macrocephala</i>	Moderate-sized to large, clear streams over gravel and cobbles. Perhaps a midwater species in pools with considerable current	Upper Tennessee River and southern tributaries of Ohio River; Sciotto River, Ohio and Allegheny River, NY and PA
Blackside darter (H) <i>Percina maculate</i>	Small- to moderate-sized streams with some current, considerable shelter (brush, vegetation, overhanging banks), and sand or gravel bottom	Southeastern Saskatchewan in a band through southern Great Lakes and west NY; south in Mississippi Valley to eastern OK and LA; east on the gulf coast to the Mobile Bay drainage
Mottled sculpin (H) <i>Cottus bairdi</i>	Lakes and cool streams	Eastern Canada south to TN, AL and Mobile River drainages. Disjunct populations in Rocky Mountains of north U.S. and southern Canada

Appendix 5. Pennsylvania and Federal species listing codes and status definitions.

	Pennsylvania
PE	<i>Endangered</i> – All species declared by: 1) the Secretary of the United States Department of the Interior to be threatened with extinction and appear on the Endangered Species List or Native Endangered Species List published in the Federal Register; or 2) have been declared by the Pennsylvania Fish Commission Executive Director to be threatened with extinction and appear on the Pennsylvania Endangered Species List published by the Pennsylvania Bulletin.
PT	<i>Threatened</i> - All species declared by: 1) the Secretary of the United States Department of the Interior to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on the Threatened Species List published in the Federal Register; or 2) have been declared by the Pennsylvania Fish Commission, Executive Director to be in such small numbers throughout their range that they may become endangered if their environment worsens and appear on the Pennsylvania Threatened Species List published by the Pennsylvania Bulletin.
PC	<i>Candidate</i> – Animals that could become endangered or threatened in the future. All of these are uncommon, have restricted distribution or are at risk because of certain aspects of their biology.
	Federal
LE	<i>Listed Endangered</i> - A species which is in danger of extinction throughout all or a significant portion of its range.
C	<i>Candidate</i> – for listing.