

Checklist of the freshwater snails (Mollusca: Gastropoda) of Pennsylvania, USA

Ryan Evans^{1,3} and Sally Ray²

ABSTRACT

Despite a high degree of imperilment, freshwater snails have received little attention from conservation scientists. We collected museum records and conducted field studies in order to develop a species checklist for Pennsylvania. Our research reports 63 species of freshwater snails for the Commonwealth of Pennsylvania. We hope this information will make the group more visible to state agencies and stimulate additional research.

¹ Pennsylvania Natural Heritage Program, Pittsburgh office, 209 Fourth Ave, Pittsburgh, PA, 15222

² Pennsylvania Natural Heritage Program, Middletown office, 208 Airport Drive, Middletown office, 17057

³ Current Address: Kentucky State Nature Preserves Commission, 801 Schenkel Lane, Frankfort, KY 40601

Keywords: Gastropoda, snails, Pennsylvania, conservation

INTRODUCTION

Freshwater mollusks are one of the most highly imperiled groups of organisms in North America today (Ricciardi and Rasmussen, 1999). Within the past 20 years, freshwater mussel research in the United States has increased and has provided valuable new information on the conservation status, biology, and ecology of species. While there is a growing body of knowledge regarding freshwater gastropods (see information reviews in Dillon, 2000; Smith, 2001), information on the conservation status of United States species is poorly known (Bogan, 1997). Approximately 600 species of freshwater snails occur in the United States. Forty-two species are thought to be extinct (Turgeon et al., 1998), 24 species are considered threatened or endangered and 11 species are currently listed as candidates for federal protection under the Endangered Species Act (USFWS, 2006).

A basic knowledge of the state fauna does not exist in many parts of the United States. Too few trained malacologists, several taxonomic issues, and a general lack of interest by state agencies have resulted in a poor knowledge of our freshwater snail fauna. However, in recent years, there have been an increasing number of studies that have documented or reported on the freshwater snail fauna for some states: Connecticut (Jokinen, 1987), Iowa (Stewart, 2006), Maine (Martin, 1999), Missouri (Wu *et al.*, 1997), New York (Jokinen, 1992), and Virginia (Stewart and Dillon, 2004) are visible examples.

Although a number of professional and amateur malacologists have collected freshwater gastropods in Pennsylvania over the past 150 years, there has never been a comprehensive, published list of species for the state. The goals in this study were to

gather museum records for the Commonwealth of Pennsylvania and to supplement the list through field collections in order to develop a checklist of the state fauna.

METHODS

Museum Records

Several major collections were accessed for Pennsylvania records, though only the Carnegie Museum of Natural History collection was physically visited. Typically museum records were requested or obtained through searches from the respective institution website. Museum record searches were done for: The Academy of Natural Sciences, Philadelphia (ANSP); Bell Museum at the University of Minnesota (BMNH); California Academy of Sciences (CAS); Carnegie Museum of Natural History, Pittsburgh (CMNH); Delaware Museum of Natural History, Wilmington (DMNH); The Field Museum, Chicago (FM); Florida Museum of Natural History, Gainesville (FLMNH); Frost Museum at Pennsylvania State University, State College (PSU); Illinois Natural History Survey, Illinois (INHS); Ohio State University Museum (OSUM), and Smithsonian Museum, Washington, D.C. (SMNH). Museum records were maintained in a Filemaker Pro database.

Field Sampling

Field sampling was carried out from March 2003 to June 2006. Sampling was focused in streams of various drainage orders in Pennsylvania, although there was some opportunistic sampling in lakes, wetlands, and other habitats. We generally attempted to sample in streams of the highest habitat and water quality. The goal at each site was to maximize species richness and not total population abundance; sampling typically commenced until no new species were being collected. We sampled in all major drainage basins in the state across its 67 counties (Figures 1A and 1B). Collections were made in available microhabitats (backwaters, undercut banks, cobble flats, mud flats, etc) and substrates (woody debris, trash, large rocks, cobbles, silt/sand edges).

Taxonomy

Specimens were generally placed directly in 70% ethanol in the field. Hydrobiidae was first relaxed using menthol crystals prior to fixing in 70% ethanol (Dillon, 2005). Hand collecting, handheld sieves, and d-frame nets were used in wadable areas; some SCUBA diving was done in the lower Allegheny River. Shell morphology was typically used to identify most families, while penial sheath morphology were used to identify species of *Physa* and Hydrobiidae. Nomenclature follows ICZN (1998), Turgeon *et al.* (1998), Smith (2000) and Dillon *et al.* (2002). All specimens collected in the course of our field study have been or will be deposited at Carnegie Museum of Natural History in Pittsburgh, PA.

RESULTS

A total of 442 collections were made from 2003 – 2006. From the results of field sampling and gathering of museum records viewed to be valid, 63 nominal species in 9 families of freshwater snails are believed to have existed or are currently found in Pennsylvania (Table 1). We believe that records for several species are in error.

-----TABLE 1 HERE-----

Recent New Records for Pennsylvania (this study)

Ancylidae: *Ferrissia fragilis*
Ferrissia parallelus

Physidae: *Physa vernalis*

Planorbidae: *Gyraulus circumstriatus*

Erroneous or Questionable records for Pennsylvania Freshwater Snails

Campeloma crassula Rafinesque 1819. Records were listed for this species from Pennsylvania (ANSP 365189, 365190, 365191). According to Burch (1980), this is a midwestern species unlikely to be found in Pennsylvania. We considered records of this species in the state to be *Campeloma decisum*.

Elimia semicarinata (Say 1829). This species does not occur as far east as Pennsylvania according to Burch (1980). Records from Shenango (labeled as Chenango) River (ANSP 364269) and Eighteenmile Creek, Erie County (ANSP 364270, 364271) are likely misidentified specimens of *Elimia livescens*.

Fontigens antroecetes Hubricht 1957. Records listed for this species from Pennsylvania from the Smithsonian Museum (SMNH 522087; 522846; 853173) are likely misreported *Fontigens orolibas* (Hershler *et al.*, 1990).

Somatogyrus depressus (= *S. integer*), (Tryon 1862). Ortmann reported this species from the Allegheny River (CMNH 62.7485). There is great uncertainty of the taxonomy within the genus *Somatogyrus* and there is a lack of characters to consistently differentiate many taxa (Walker, 1915; Watson, 2000). Until there is better taxonomic information available, we are using the name applied by Ortmann in earlier Pennsylvania collections, which is *Somatogyrus integra* (Say 1829).

Viviparus contectus (Millet 1813). This is a European species that was reported to occur in Philadelphia (Bailey, 1909). It is unclear whether this is actually *Viviparus contectus* or *Viviparus georgianus*, which has been documented to occur in Philadelphia (ANSP 98696, 105814, 105977) and the Lehigh River (CMNH 62.12838).

DISCUSSION

This study reported 63 nominal taxa of freshwater snails from Pennsylvania. In adjacent states, Jokinen (1992) reported 63 species from New York. Taylor (2005) reported records for 25 species from West Virginia, although this total was likely low as the fauna reported was missing common species such as *Gyraulus deflectus* and members of the Valvatidae or Hydrobiidae. Because recent survey efforts by the authors have focused on streams and rivers, comprehensive distribution data for lakes, wetlands and other non-riverine habitats is sorely needed in order to corroborate historical records in these habitats.

Because many museums in the country have done little active curation with freshwater snails, there are likely misidentifications and unidentified specimens in the collections. We screened records carefully, but visits to museums to verify specimens are certainly needed in order to refine this list.

It should be noted that the majority of the species on the list are those currently accepted by Turgeon *et al.* (1998) and do not necessarily represent valid taxa. We have taken a conservative approach in reporting taxa; should future anatomical, breeding and molecular studies provide definitive taxonomic resolution in these groups, there will be a need to reevaluate specimens collected in this study as well as museum records in order to refine the list reported here. There is currently uncertainty in the taxonomy of *Amnicola decisus* (Burch, 1982), *Campeloma*, *Galba*, *Somatogyrus*, and several others. Although we reported on several species of *Galba* in this study, the taxonomy within the genus is in a highly confused state. Given that extreme phenotypic variation has been reported within the pulmonates (Dillon *et al.* (2002); Britton and McMahon (2004); McMahon (2004)), we believe Burch (1982) currently provides a good approach to this difficult group, with *Galba exigua*, *G. modicella*, *G. obrussa*, and *G. rustica* all grouped into a *Galba obrussa* group. In a recently prepared state list for Iowa, Stewart (2006) grouped all *Galba* as one group and all *Campeloma* as one group pending future taxonomic resolutions. While we did report *Campeloma rufum* from the state from a museum record, it was largely a relic of the taxonomic system we attempted to follow (Turgeon *et al.* (1998)) and does not necessarily validate the presence of the taxa within the Commonwealth. In the course of lab identification of specimens, we typically assigned all specimens of *Campeloma* under *Campeloma decisum*.

Physidae is another family in which the taxonomy remains in a confused state, particularly in the genus *Physa*. Numerous names have been applied to members of the group, and the species we report from Pennsylvania may or may not prove to be valid; *Physa ancillaria* may, in fact, simply be a phenotypical variant of *Physa gyrina* (Dillon and Wethington, 2004). This study reports on the first record for *Physa vernalis* for Pennsylvania. This species has been reported from other northeastern states and is of high global conservation concern (NatureServe Explorer, 2006).

Pennsylvania has recently developed a Comprehensive Wildlife Conservation Strategy (PFBC/PGC, 2005). In this document, freshwater snails were included as part of the long-term strategy for protection. This is a promising step to the conservation of aquatic gastropods in Pennsylvania, and despite the listing of 9 species as being considered Vulnerable or higher in the Pennsylvania Wildlife Strategy, distribution information is certainly lacking for many species. Additional inventory efforts of freshwater snails will be needed to help identify key species and populations for these sorts of efforts. We hope that the information presented in this paper will be useful to resource managers. Comments are welcomed on this list.

ACKNOWLEDGMENTS

We would like to thank The Wild Resources Conservation Program of the Pennsylvania Department of Conservation and Natural Resources for funding this study. Persons that helped provide records, specimens, or field support include Charles Bier, Jeremy Deeds, Zachary Horn, Matt Kowalski, Patricia Morrison, Betsy Nightingale, Elizabeth Skinner, Tamara Smith, Andrew Turner, and Mary Walsh. Special thanks goes to Dr. Tim Pearce (Section of Mollusks, Carnegie Museum of Natural History) for allowing liberal access to the specimen collection and Jack Ray, who provided boat equipment and assisted with sampling in many streams in eastern Pennsylvania.

LITERATURE CITED

- Bailey, J.T. 1909. *Viviparus* in Philadelphia. *Nautilus* 23(4): 60.
- Bogan, A.E. 1997. The silent extinction. *American Paleontologist* 5(1): 2-4.
- Britton, D.K., and R.F. McMahon. 2004. Environmentally and genetically induced shell-shape variation in the freshwater pond snail *Physa (Physella) virgata*. *American Malacological Bulletin* 19(1/2): 93-100.
- Brooks, S.T. 1927. The geographical distribution of the Pleuroceridae of Pennsylvania. Master's Thesis, University of Pittsburgh. 1-59, + 3 appendices, + 15 plates.
- Burch, J.B. 1980. North American freshwater snails: species list, ranges, and illustrations. *Walkerana* 1(3): 215 pages.
- Burch, J.B. 1982. North American freshwater snails: identification keys, generic synonymy, supplemental notes, glossary, references, index. *Walkerana* 1(4): 148 pages.
- Caffrey, G.W. 1911. The molluscan fauna of Northampton County, Pennsylvania. *Nautilus* 25(3): 26-29.
- Clapp, G.H. 1895. Mollusks of Allegheny Co., Pennsylvania. *Nautilus* 8(10): 116.

- Dillon, R.T. 2000. The ecology of freshwater mollusks. Cambridge University Press,, Cambridge, England. xii + 509.
- Dillon, R.T. 2005. Freshwater Gastropods. Pages 130-138 in Sturm, C.F., Pearce, T., and A. Valdes (eds). Freshwater gastropods. American Malacological Society, Philadelphia.
- Dillon, R.T., A.R. Wethington, Rhett, J.M., and T.P. Smith. 2002. Populations of the European freshwater pulmonate *Physa acuta* are not reproductively isolated from American *Physa heterostropha* or *Physa integra*. Invertebrate Biology 121: 226-234.
- Dillon, R.T., and A.R. Wethington. 2004. No-choice mating experiments among six nominal taxa of the subgenus *Physella* (Basommatophora: Physidae). *Heldia* 6:1-10.
- Heilman, R.A. 1951. The mollusks of Dauphin County, Pennsylvania. *Nautilus* 64(3): 100-101.
- Heilman, R.A. 1952. The mollusks of Berks County, Pennsylvania. *Nautilus* 65(3): 103-104.
- Hershler, R., Holsinger, J.R., and L. Hubricht. 1990. A revision of the North American freshwater snail genus *Fontigens* (Prosobranchia: Hydrobiidae). Smithsonian Contributions to Zoology No. 509. iii + 49 pp.
- ICZN (International Commission on Zoological Nomenclature). 1998. Opinion 1896. *Galba* Schrank, 1803 (Mollusca, Gastropoda): *Buccinum truncatum* Müller, 1774 designated as the type species. *Bulletin of Zoological Nomenclature* 55: 123.
- Jokinen, E.H. 1987. The freshwater snails of Connecticut. State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, Bulletin 109. vii + 83 pp.
- Jokinen, E.H. 1992. The freshwater snails of New York State. *Bulletin of the New York State Museum* 482: 1-112.
- Long, B. 1912. *Lymnaea auricularia* near Philadelphia. *Nautilus* 26(3): 27-29.
- Martin, S.M. 1999. Freshwater snails (Mollusca: Gastropoda) of Maine. *Northeastern Naturalist* 6(1): 39-88.

- McMahon, R.F. 2004. A 15-year study of interannual shell-shape variation in a population of freshwater limpets (Pulmonata: Basommatophora: Ancyliidae). *American Malacological Bulletin* 19(1/2): 101-110.
- NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>. Accessed 20-June, 2006.
- Pennsylvania Fish and Boat Commission and Pennsylvania Game Commission (PFBC/PGC). 2005. Pennsylvania Comprehensive Wildlife Conservation Strategy. Version 1.0. 763 pp. + 5 appendices.
- Ricciardi, A. and J.B. Rasmussen. 1999. Extinction rates of North American freshwater fauna. *Conservation Biology* 13(5): 1220-1222.
- Rhoads, S.N. 1899. On a recent collection of Pennsylvanian mollusks from the Ohio River system below Pittsburg. *Nautilus* 12(12): 133-138.
- Schick, M. 1895. Mollusk fauna of Philadelphia and environs. *Nautilus* 8(12): 133-140.
- Smith, D.G. 2000. Notes on the taxonomy of introduced *Bellamyia* (Gastropoda: Viviparidae) species in northeastern North America. *Nautilus* 114: 31-37.
- Smith, D.G. 2001. Mollusca. Pages 327-400 *in* Pennak's Freshwater Invertebrates of the United States: Porifera to Crustacea. Fourth edition. John Wiley and Sons, New York. x + 638 pages.
- Stewart, T.W. 2006. The freshwater gastropods of Iowa (1821-1998): species composition, geographic distributions, and conservation concerns. *American Malacological Bulletin* 21(1/2): 59-75.
- Stewart, T.W., and R.T. Dillon. 2004. Species composition and geographic distribution of Virginia's freshwater gastropod fauna: A review of historical records. *American Malacological Bulletin* 19(1/2): 79-92.
- Taylor, R. 2005. Preliminary analysis of the status of aquatic snails in West Virginia. Presentation at the Second Biennial Freshwater Mollusk Conservation Society Conference, St. Paul, Minnesota.
- Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Mollusks, 2nd edition. American Fisheries Society, Special Publication 26, Bethesda, Maryland.

- US Fish and Wildlife Service (USFWS). 2006. USFWS Threatened and Endangered Species System (TESS). Available at: http://ecos.fws.gov/tess_public/StartTESS.do. Accessed 20-June-2006.
- Walker, B. 1902. A revision of the carinate valvatas of the United States. *Nautilus* 15(11): 121-125.
- Walker, B. 1904. New species of *Somatogyrus*. *Nautilus* 17(12): 133-142, + 5 plates.
- Walker, B. 1915. Apical characters in *Somatogyrus*, with descriptions of three new species. *Nautilus* 24(4): 37-41.
- Watson, C. 2000. Results of a survey for selected species of Hydrobiidae (Gastropoda) in Georgia and Florida. Pp. 233-244 in Tankersley, R.A., Warmolts, D.I., Watters, G.T., Armitage, B.J., Johnson, P.D., and R.S. Butler (eds.). *Freshwater Mollusk Symposia Proceedings*. Ohio Biological Survey, Columbus, Ohio. xxi + 274 pp.
- Wu, S.K., Oesch, R.D., and M.E. Gordon. 1997. Missouri aquatic snails. Missouri Department of Conservation, Natural History Series No. 5. 97 pp.

Table 1. List of the freshwater snail species of Pennsylvania. See list of museums in Methods section for list of museum collection abbreviations. Records listed as “Evans *et al.*” were collected by the authors in the course of conducting this study or were contributed as specimens to this study.

Scientific Name	Common Name	Record Source
Order Basommatophora		
Ancyliidae		
<i>Ferrissia fragilis</i> (Tryon, 1863)	fragile ancyliid	Evans <i>et al.</i>
<i>Ferrissia parallelus</i> (Haldeman, 1841)	oblong ancyliid	Evans <i>et al.</i>
<i>Ferrissia rivularis</i> (Say, 1817)	creeping ancyliid	Clapp (1895); Schick (1895); Rhoads (1899); Caffrey (1911); Heilman (1951); Heilman (1952); ANSP; CMNH; DMNH; OSUM; Evans <i>et al.</i>
<i>Laevapex diaphanus</i> (Haldeman, 1841)	cymbal ancyliid	Rhoads (1899); ANSP; CMNH; Evans <i>et al.</i>
<i>Laevapex fuscus</i> (C.B. Adams, 1841)	dusky ancyliid	CMNH; DMNH; Evans <i>et al.</i>
Lymnaeidae		
<i>Galba exigua</i> (I. Lea, 1841)	none	Heilman (1951); Heilman (1952); CMNH
<i>Galba humilis</i> (Say, 1822)	marsh galba	Schick (1895); ANSP; CMNH; DMNH; OSUM
<i>Galba modicella</i> (Say, 1825)	rock galba	Heilman (1952); CMNH; FMNH; Evans <i>et al.</i>
<i>Galba obrussa</i> (Say, 1825)	golden galba	Heilman (1951); Heilman (1952); Evans <i>et al.</i> ; ANSP; CMNH
<i>Galba parva</i> (I. Lea, 1841)	pygmy galba	Clapp (1895); Heilman (1951); CMNH; Evans <i>et al.</i>
<i>Galba rustica</i> (I. Lea, 1841)	none	CMNH; Evans <i>et al.</i>
<i>Lymnaea stagnalis</i> Linnaeus, 1758	swamp lymnaea	ANSP; CMNH; Evans <i>et al.</i>
<i>Pseudosuccinea columella</i> (Say, 1817)	mimic lymnaea	Rhoads (1899); Heilman (1951); Heilman (1952); ANSP; CMNH; DMNH; Evans <i>et al.</i>
<i>Radix auricularia</i> (Linnaeus, 1758)	big-eared radix	Long (1912); ANSP; CMNH; SMNH
<i>Stagnicola caperata</i> (Say, 1829)	wrinkled marshsnail	DMNH; FMNH
<i>Stagnicola catascopium</i> (Say, 1817)	woodland pondsnail	Schick (1895); Caffrey (1911); ANSP; CMNH; DMNH; FMNH; Evans <i>et al.</i>
<i>Stagnicola elodes</i> (Say, 1821)	marsh pondsnail	ANSP; CMNH; Evans <i>et al.</i>
<i>Stagnicola emarginata</i> (Say, 1821)	St. Lawrence pondsnail	CMNH; Heilman (1951); Heilman (1952)

Planorbidae

<i>Gyraulus circumstriatus</i> (Tryon, 1866)	disc gyro	Evans <i>et al.</i>
<i>Gyraulus deflectus</i> (Say, 1824)	flexed gyro	Schick (1895); Caffrey (1911); Heilman (1951); ANSP; CMNH; DMNH; FMNH; Evans <i>et al.</i>
<i>Gyraulus parvus</i> (Say, 1817)	ash gyro	Schick (1895); Heilman (1951); Heilman (1952); ANSP; CMNH; FMNH; Evans <i>et al.</i>
<i>Helisoma anceps</i> (Menke, 1830)	two-ridge rams horn	Heilman (1951); Heilman (1952); Evans <i>et al.</i> ; ANSP; CMNH; DMNH; FMNH
<i>Micromenetus dilatatus</i> (Gould, 1841)	bugle sprite	Clapp (1895); Schick (1895); Evans <i>et al.</i>
<i>Planorbella campanulata</i> (Say, 1821)	bellmouth rams-horn	Caffrey (1911); Heilman (1951); Heilman (1952); Evans <i>et al.</i> ; CMNH; FMNH
<i>Planorbella trivolvis</i> (Say, 1817)	marsh rams-horn	Schick (1895); Rhoads (1899); Heilman (1952); Evans <i>et al.</i> ; ANSP; CMNH; DMNH; FMNH; OSUM
<i>Planorbula armigera</i> (Say, 1821)	thicklip rams-horn	Schick (1895); Evans <i>et al.</i> ; CMNH; FMNH;
<i>Promenetus exacuus</i> (Say, 1821)	sharp sprite	Schick (1895); ANSP; CMNH; DMNH

Physidae

<i>Aplexa elongata</i> (Say, 1821)	lance aplexa	Schick (1895); PNHP
<i>Physa</i> (= <i>Physella</i>) <i>acuta</i> (Draparnaud, 1805)	European physa	Schick (1895); Rhoads (1899); Caffrey (1911); Heilman (1951); ANSP; CMNH; FMNH; Evans <i>et al.</i> ; SMNH
<i>Physa</i> (= <i>Physella</i>) <i>ancillaria</i> (Say, 1825)	pumpkin physa	Schick (1895); Caffrey (1911); ANSP; CMNH; DMNH; Evans <i>et al.</i>
<i>Physa</i> (= <i>Physella</i>) <i>gyrina</i> (Say, 1821)	tadpole physa	Heilman (1951); ANSP; CMNH; DMNH; Evans <i>et al.</i>
<i>Physa skinneri</i> Taylor, 1954	glass physa	ANSP
<i>Physa vernalis</i> Taylor and Jokinen, 1984	vernal physa	Evans <i>et al.</i>

Order Neotaenioglossa

Bithyniidae

<i>Bithynia tentaculata</i> (Linnaeus, 1758)	mud bithynia	CMNH
--	--------------	------

Hydrobiidae

<i>Ammicola decisus</i> Haldeman, 1845	none	Caffrey (1911)
<i>Ammicola limosus</i> (Say, 1817)	mud amnicola	Schick (1895); Caffrey (1911); CMNH; Heilman (1952); Evans <i>et al.</i>
<i>Birgella subglobosus</i> (Say, 1825)	globe siltsnail	OSUM
<i>Cincinnatia integra</i> (Say, 1829)	midland siltsnail	Evans <i>et al.</i>
<i>Fontigens nickliniana</i> (I. Lea, 1838)	watercress snail	Hershler <i>et al.</i> (1990); Evans <i>et al.</i> ; CMNH; FMNH; SMNH
<i>Fontigens orolibas</i> Hubricht, 1957	Blue Ridge springsnail	Hershler <i>et al.</i> (1990)
<i>Gillia altilis</i> (I. Lea, 1841)	buffalo pebblesnail	Schick (1895); Caffrey (1911); ANSP; FMNH
<i>Lyogyrus granum</i> (Say, 1822)	squat duskysnail	Schick (1895); Caffrey (1911); ANSP; CMNH; SMNH
<i>Lyogyrus pupoideus</i> (Gould, 1841)	pupa duskysnail	Evans <i>et al.</i>
<i>Pyrgulopsis lustrica</i> (Pilsbry, 1890)	boreal marstonia	CMNH
<i>Somatogyrus integra</i> (Say, 1829)	Ohio pebblesnail	CMNH; Evans <i>et al.</i>
<i>Somatogyrus pennsylvanicus</i> Walker, 1904	shale pebblesnail	Walker (1904); Evans <i>et al.</i>

Pleuroceridae

<i>Elimia livescens</i> (Menke, 1830)	liver elimia	Brooks (1927); ANSP; CMNH; FMNH; OSUM; Evans <i>et al.</i> ; SMNH
<i>Elimia virginica</i> (Say, 1817)	Piedmont elimia	Schick (1895); Caffrey (1911); Brooks (1927); Heilman (1951); Heilman (1952); Evans <i>et al.</i> ; ANSP; CMNH; INHS; OSUM
<i>Leptoxis carinata</i> (Bruguière, 1792)	crested mudalia	Brooks (1927); Evans <i>et al.</i> ; Heilman (1951); CMNH; FMNH; OSUM
<i>Leptoxis dilatata</i> (Conrad, 1835)	seep mudalia	Brooks (1927); ANSP
<i>Lithasia obovata</i> (Say, 1829)	Shawnee rocksnail	Brooks (1927); CMNH; FMNH; Evans <i>et al.</i>
<i>Pleurocera acuta</i> Rafinesque, 1831	sharp hornsail	Brooks (1927); Evans <i>et al.</i> ; FMNH;
<i>Pleurocera canaliculata</i> (Say, 1821)	silty hornsail	Clapp (1895); Rhoads (1899); Brooks (1927); Evans <i>et al.</i>

Pomatiopsidae

<i>Pomatiopsis lapidaria</i> (Say, 1817)	slender walker	Schick (1895); Caffrey (1911); ANSP; FMNH
--	----------------	---

Valvatidae

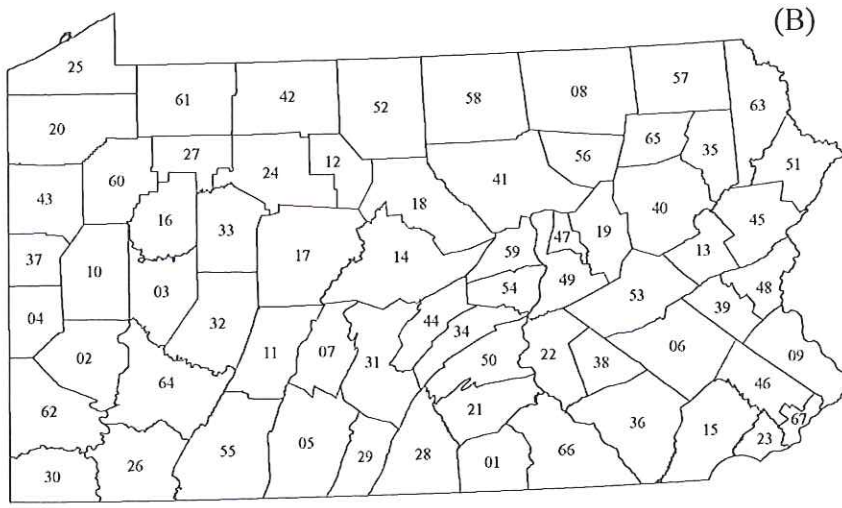
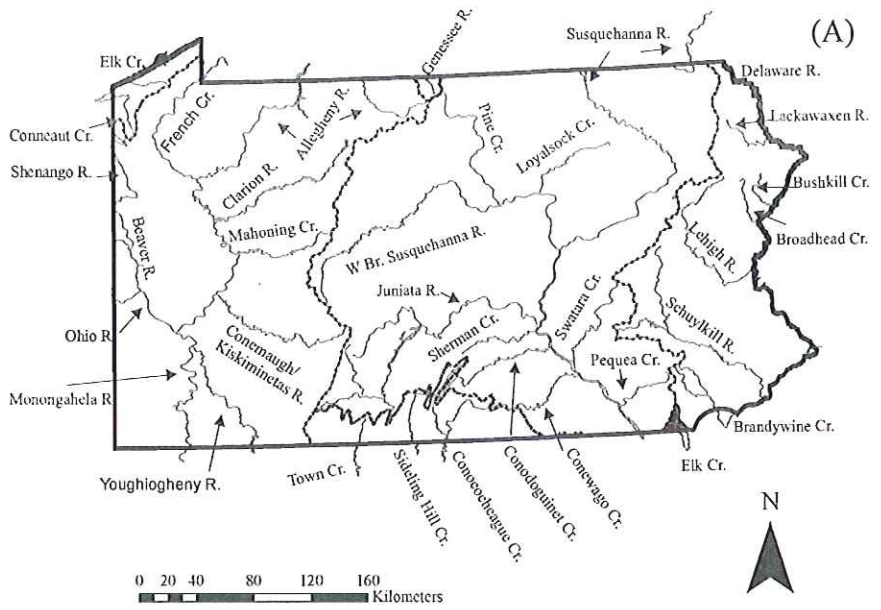
<i>Valvata bicarinata</i> I. Lea, 1841	two-ridge valvata	Schick (1895); Rhoads (1899); Walker (1902); Caffrey (1911); FMNH
<i>Valvata sincera</i> Say, 1824	mossy valvata	CMNH

<i>Valvata tricarinata</i> (Say, 1817)	threeridge valvata	Schick (1895); Caffrey (1911); Heilman (1952); ANSP; BMNH; CMNH; FMNH
--	--------------------	---

Viviparidae

<i>Bellamyia chinensis malleata</i> (Reeve, 1863)	Chinese mysterysnail	ANSP; Evans <i>et al.</i>
<i>Bellamyia japonica</i> (von Martens, 1861)	Japanese mysterysnail	ANSP
<i>Campeloma decisum</i> (Say, 1816)	pointed campeloma	Schick (1895); Rhoads (1899); Caffrey (1911); Heilman (1951); Heilman (1952); FMNH; OSUM; Evans <i>et al.</i>
<i>Campeloma rufum</i> (Haldeman, 1841)	unnamed campeloma	ANSP
<i>Lioplax subcarinata</i> (Say, 1816)	ridged lioplax	Schick (1895); Caffrey (1911); ANSP; CMNH; FMNH
<i>Viviparus georgianus</i> (I. Lea, 1834)	banded mysterysnail	ANSP; CMNH

Figure 1. The major drainage basins (A) and counties (B) of Pennsylvania.



- | | | | | | |
|--------------|----------------|----------------|--------------------|------------------|------------------|
| 1: Adams | 14: Centre | 27: Forest | 40: Luzerne | 53: Schuylkill | 66: York |
| 2: Allegheny | 15: Chester | 28: Franklin | 41: Lycoming | 54: Snyder | 67: Philadelphia |
| 3: Armstrong | 16: Clarion | 29: Fulton | 42: McKean | 55: Somerset | |
| 4: Beaver | 17: Clearfield | 30: Greene | 43: Mercer | 56: Sullivan | |
| 5: Bedford | 18: Clinton | 31: Huntingdon | 44: Mifflin | 57: Susquehanna | |
| 6: Berks | 19: Columbia | 32: Indiana | 45: Monroe | 58: Tioga | |
| 7: Blair | 20: Crawford | 33: Jefferson | 46: Montgomery | 59: Union | |
| 8: Bradford | 21: Cumberland | 34: Juniata | 47: Montour | 60: Venango | |
| 9: Bucks | 22: Dauphin | 35: Lackawanna | 48: Northampton | 61: Warren | |
| 10: Butler | 23: Delaware | 36: Lancaster | 49: Northumberland | 62: Washington | |
| 11: Cambria | 24: Elk | 37: Lawrence | 50: Perry | 63: Wayne | |
| 12: Cameron | 25: Erie | 38: Lebanon | 51: Pike | 64: Westmoreland | |
| 13: Carbon | 26: Fayette | 39: Lehigh | 52: Potter | 65: Wyoming | |