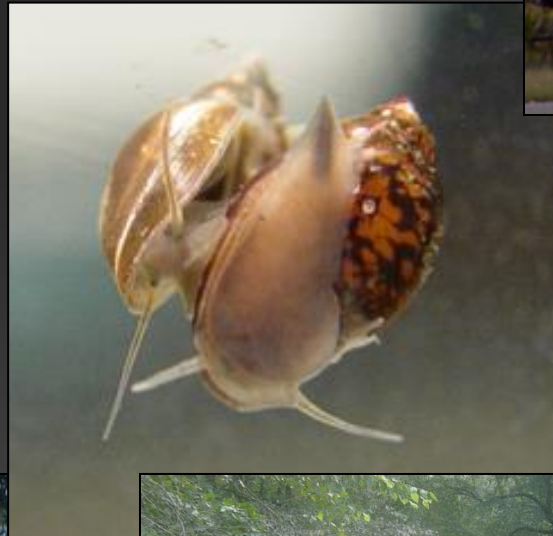


The Freshwater Gastropods of South Carolina: A stultifyingly boring review of a justifiably obscure fauna.

Dr. Robert T. Dillon, Jr.
Freshwater Gastropods of North America Project



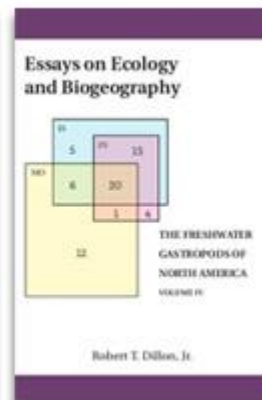
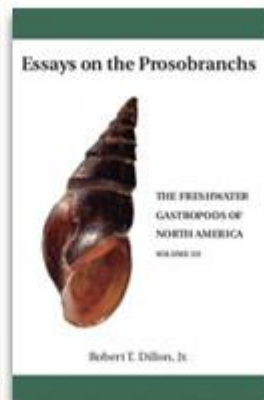
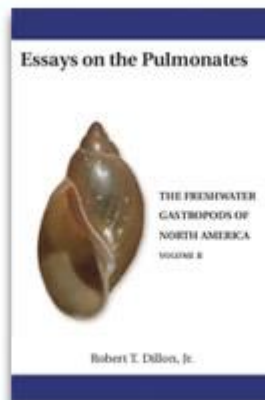
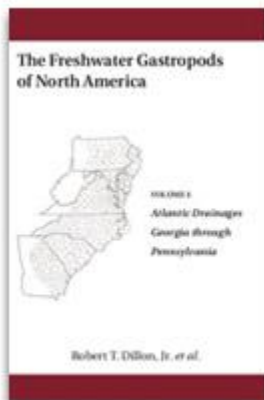
Freshwater Gastropods of North America Project

- A long-term, collaborative effort to inventory and monograph all 15 families of freshwater snails north of Mexico.
- Established 1998.
- Organized state-by-drainage.
- Primarily web-based.
- www.fwgna.org
- First four volumes published 2019!

FWGNA
FRESHWATER
GASTROPODS
of NORTH AMERICA

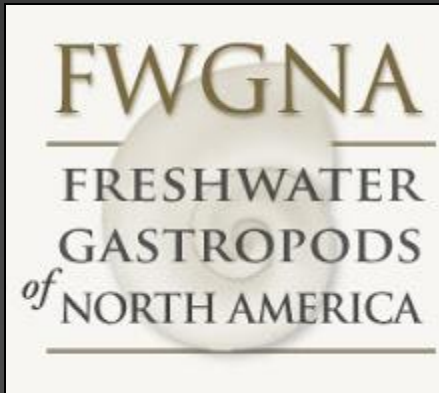


Pleurocera catenaria



For each state...

- Introduction & Literature review.
- Survey – State NR agencies, Museums, Original collections.
- Dichotomous key.
- Photo gallery.
- Rank abundance tabulations.



South Carolina

Like most of the United States, at no time in its history has South Carolina seen a comprehensive survey of its freshwater gastropods.

Although perhaps not as environmentally heterogeneous as neighboring states, South Carolina does include some land form diversity. The state has traditionally been divided into three physiographic provinces, corresponding closely with US Forest Service "Ecoregions" as well as with USDA plant hardiness zones. The (rather low) fall line runs diagonally across the middle of the state, from Cheraw in the northeast, through the capital city of Columbia, to Augusta (GA) in the southwest. Thus the state may be divided into its Atlantic Coastal Plain Province in the southeast and its Piedmont Province through most of the northwest. The three most northwestern counties of the state contact a third physiographic province, the Blue Ridge. In South Carolina the Blue Ridge Province is equivalent to the "Central Appalachian Broadleaf Forest" ecoregion, and to USDA plant hardiness zone 7a (average annual minimum temperature 0 - 5 degrees C). The Piedmont is equivalent to the "Southeastern Mixed Forest" ecoregion, or USDA zone 7b (5 - 10 degrees C). The Coastal Plain is equivalent to the "Outer Coastal Plain Mixed Forest" ecoregion and primarily zone 8a (10 - 15 degrees C). There is a small strip of USDA plant hardiness zone 8b (average annual minimum temperature 15 - 20 degrees C) along the southern coast.

The surface geology of South Carolina is almost entirely sedimentary and quite sandy, with small regions of Paleozoic granite in the extreme northwest. There are three major river systems, all of which originate in the mountains of western North Carolina and flow southeast to the Atlantic: the Pee Dee, the Broad/Catawba/Santee, and the Savannah. The state also contains several smaller coastal plain drainages: the Black, the Ashley/Cooper, the Ashepool/Combahee/Edisto and the Coosawhatchie.

The state was deforested by timber interests beginning in the early eighteenth century, and intensive row crop agriculture through the ensuing 200 years led to severe erosion. Although today's land use practices are much improved, most South Carolina rivers now carry heavy burdens of sediment, and solid substrate is rare (Harding et al. 1998). The first half of the twentieth century saw most of the major rivers impounded for hydroelectric power. The "Santee-Cooper Project" created Lakes Marion and Moultrie, diverting most of the flow of the

FWGSC

SC Home

- > Methods
- > Acknowledgements
- > References

SC Species Gallery

Dichotomous Key

Results

Discussion

Synthesis

Among the more interesting findings of the present survey is the apparent independence of freshwater gastropod distribution and river drainage. Individual examination of the range maps for all species collected in this study does not reveal a single instance where a species seems constrained to a river system or set of tributaries...

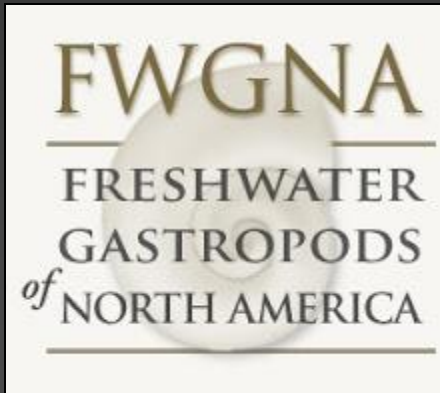
— see Discussion

Authors

Robert T. Dillon, Jr.
Department of Biology
College of Charleston
Charleston, SC 29424

For each species...

- Figures
- Habitat & distribution
- Ecology & life history
- Taxonomy & systematics
- Range maps
- Bibliography



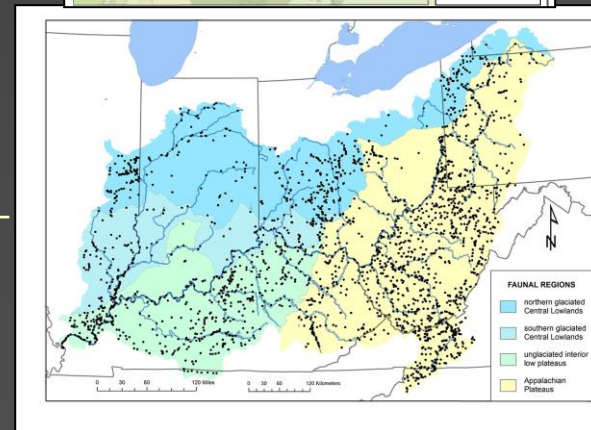
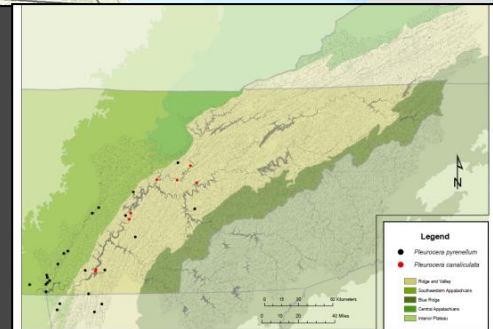
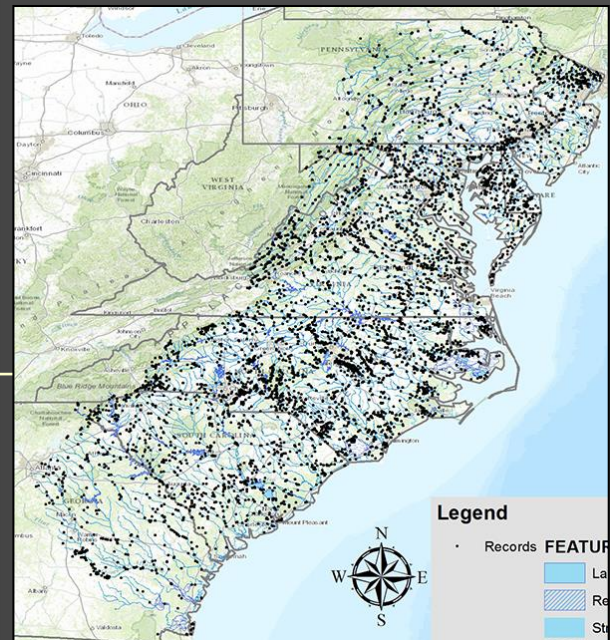
A screenshot of a web browser displaying the FWGNA website. The browser's address bar shows the URL 'http://www.fwgn.org/species/pleuroceridae/g_prox.html'. The page header includes the FWGNA logo and navigation links for Home, States, Species, Resources, and Contact. The breadcrumb trail reads 'FWGNA > Species Accounts > Pleuroceridae > Pleurocera proxima'. The main content area is titled 'Pleurocera proxima (Say 1825)' and includes a photograph of the snail with a 1 mm scale bar. Below the photo is a section for 'Habitat & Distribution' with descriptive text and a map of the Eastern United States showing the species' range. Another section, 'Ecology & Life History', provides details on the snail's biology. On the right side, there are three regional sections: 'Georgia - FWGGA' with a photo of a pond, 'North Carolina - FWGNC' with a photo of a lake, and 'South Carolina - FWGSC' with a photo of a pond. A 'Virginia - FWGVA' section is partially visible at the bottom right with a photo of a red barn. The browser's status bar at the bottom indicates a 100% zoom level.

FWGNA



FRESHWATER GASTROPODS of NORTH AMERICA

	Online	Records	Sites	Species
FWGSC	Dillon & Stewart 2003	1,836	498	35
FWGNC (Atlantic)	Dillon, Watson & Stewart 2006	4,418	2,271	36
FWGGA (Atlantic)	Dillon, Reeves & Stewart 2007	875	264	39
FWGVA (Atlantic)	Dillon, Watson & Stewart 2009	2,294	973	40
East Tennessee (+ Va, NC, Ga)	Dillon & Kohl 2011	1,674	767	39
Mid-Atlantic (De,Md,WV,Pa,NJ)	Dillon, Ashton, Smith 2013	2,905	938	41
The Ohio (9 states)	Dillon et al. 2019	5,250	2,536	70
Online totals		19,252	8,247	113



FWGNA Incidence Ranking

- Substitute for NatureServe conservation status
- 15-state region, 102 species (combining subspecies)
- Gaston's (1994) quartile system
- Peripheral species, non-apparently rarity.

Table 2. The 102 species of freshwater gastropods inhabiting Atlantic drainages from Georgia to the New York line, Ohio drainages above ORM 920, and drainages of the Tennessee River above the Alabama line, ranked by their incidence over the 15-state region. The six species marked in yellow were excluded from the analysis. Then the rightmost column shows incidence ranks, with a "p" indicating a peripheral species, and an asterisk* indicating non-apparent rarity.

Species	FWGO	FWG-AD	FWGTN	Totals	FWGNA
Physa acuta	1010	2056	153	3219	I-5
Campelema decisum (2 ssp)	258	1264	53	1575	I-5
Menetus dilatatus					42
Ferrissia fragilis					42
Helisma anceps					41
Lymnaea columella					41
Ferrissia rivularis					37
Leptoxis carinata					38
Lymnaea humilis					25
Pleurocera proxima					8
Laevaepe fuscus					37
Pleurocera semicarinata (3 ssp)					10
Helisma trivolvis					13
Physa gyrina					29
Amnicola limosa					5
Gyraulus parvus					24
Pleurocera catenaria (2 ssp)					22
Pleurocera canaliculata (3 ssp)					5
Lyogyrus granum					11
Pleurocera clavaeformis (2 ssp)					20
Pleurocera simplex (2 ssp)					5
Pleurocera virginica					1
Leptoxis praeorosa					15
Pleurocera troostiana					14
Somatogyrus virginicus					14
Physa caroliniae					13
Physa pomilia					11
Bellamyia japonica					10
Planorbula armigera					8
Pleurocera gabbiana					8
Pleurocera laqueata (2 ssp)					8
Lioplax subcarinata					7
Littoridinops tenuipes					7
Viviparus georgianus					7
Birgella subglobosa					4
Bellamyia chinensis					1
Promenerus exacuatus					5
Viviparus intertextus					5
Fontignis nickliniana					4
Lithasia armigera					4
Viviparus subpurpureus					4
Marstonia arga					4
Pleurocera floridensis					4
Biomphalaria havanensis					3
Clappia umbilicata					3
Helisma eucosmium					3
Helisma magnificum					3
Lithasia geniculata					3
Marstonia agarheta					3
Potamopyrgus antipodarum					3
Somatogyrus parvulus					3
Floridobia floridana					2
Lymnaea stagnalis					2
Melanoides tuberculata					2
Pomacea paludosa					2
Gyraulus circumstriatus					1

FWGNA > Synthesis



Synthesis V3.0

As of 4/June 19, the complete 15-state FWGNA database contains 19,643 records. The 102 species (with their 9 additional subspecies) that comprise the freshwater gastropod fauna of this vast and ecologically diverse region are not all equally common.

In recent years a widespread practice has developed of prioritizing species for conservation purposes by a system of "status ranks." The nonprofit environmental organization "NatureServe," for example, prioritizes the worldwide biota globally (G-ranks), nationally (N-ranks) or regionally (S-ranks) into five categories: 1 = critically imperiled, 2 = imperiled, 3 = vulnerable, 4 = apparently secure, and 5 = secure. The International Union for the Conservation of Nature also uses five ranks: CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened and LC = least concern. A system of four ranks was advocated in the spurious review of Johnson et al. (2013), E = endangered, T = threatened, V = vulnerable, and CS = currently stable. A review of the many methods by which species have been categorized according to perceived conservation concern has been offered by Munton (1987).



Although the appeal of such systems to the natural resource agencies charged with protection of potentially endangered species is undeniable, such concepts as "threat" or "peril" or "endangerment" are by their nature entirely subjective. And although some connection is almost certainly made between conservation status rank and rarity in the minds of natural

FWGNA

Introduction

- > Version history
- > Version 3.0
- > Rarity
- > Peripheral Species
- > Pseudo-rarity, Non-apparent rarity

> Future Prospects

> Essays

> References

Results

- > Table 1
- > Table 2

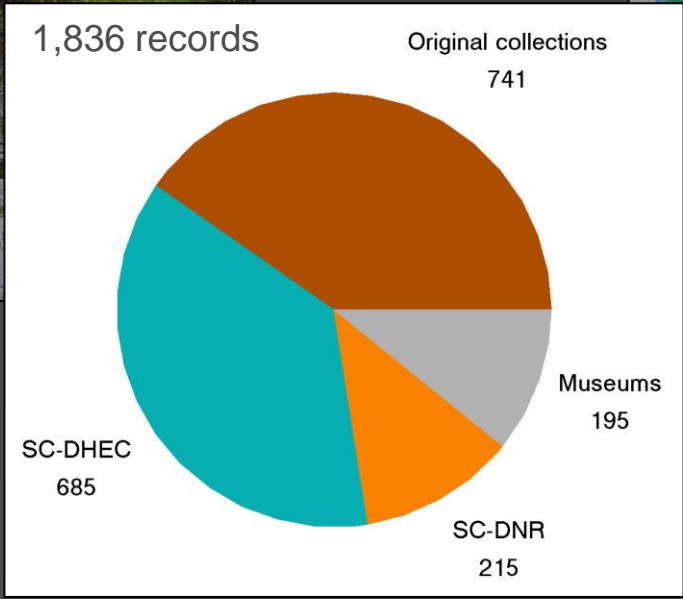
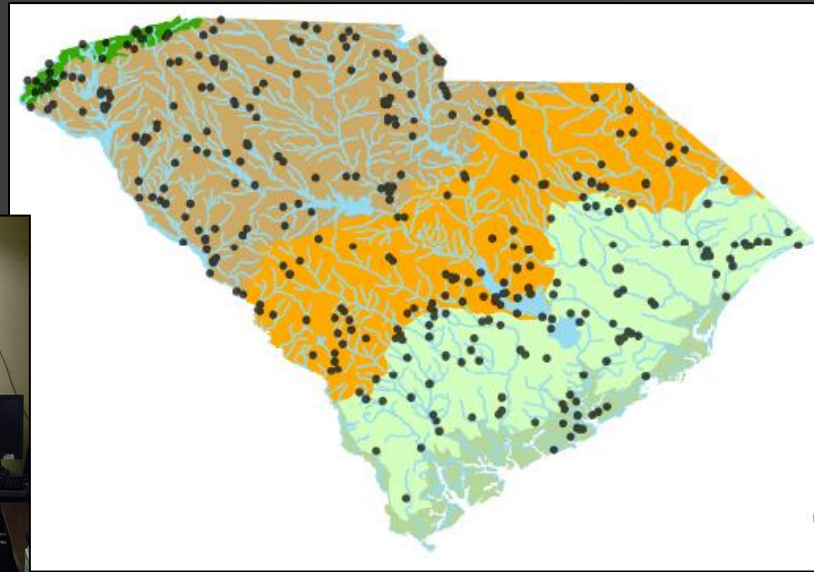
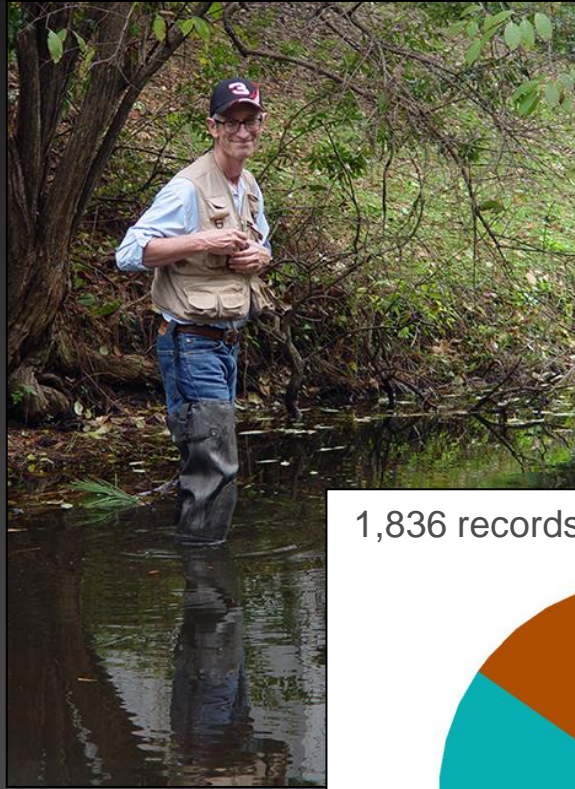
...Although the appeal of such systems to the natural resource agencies charged with protection of potentially endangered species is undeniable, such concepts as "threat" or "peril" or "endangerment" are by their nature entirely subjective.

— see Introduction

Author

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Coordinator, FWGNA Project
P.O. Box 31532

FWGSC Methods



David Eargle, DHEC

35 species in South Carolina

- I-5, top quartile = 15
- I-4, second quartile = 12
- Peripheral (p) = 8
- **Non-native / Invasive = 7**



Species	SC	FWGNA
Physa acuta	349	I-5
Campeloma decisum	250	I-5
Lymnaea columella	175	I-5
Menetus dilatatus	138	I-5
Ferrissia fragilis	134	I-5
Helisoma anceps	113	I-5
Laevapex fuscus	101	I-5
Pleurocera proxima	99	I-5
Pleurocera catenaria (2 ssp)	78	I-5
Helisoma trivolvis	63	I-5
Amnicola limosa	47	I-5
Physa carolinae	38	I-4
Gyraulus parvus	36	I-5
Lyogyrus granum	29	I-5
Physa pomilia	26	I-4
Viviparus intertextus	26	I-4
Somatogyrus virginicus	25	I-4

Lymnaea cubensis	21	I-4
Bellamyia japonica	16	I-4
Littoridinops tenuipes	11	I-4
Promenetus exacuus	9	I-4
Viviparus georgianus	9	I-4
Hebetancylus excentricus	8	I-3p
Ferrissia rivularis	5	I-5
Pomacea maculata	5	I-3p
Viviparus subpurpureus	5	I-3p
Lymnaea humilis	4	I-5
Valvata bicarinata	4	I-4
Lioplax subcarinata	3	I-4
Gillia altilis	2	I-4
Pomacea paludosa	2	I-2p
Biomphalaria obstructa	2	I-2p
Melanoides tuberculata	1	I-2p
Valvata tricarinata	1	I-3p
Pyrgophorus parvulus	1	I-1p
Totals	1,836	

Prosobranchs

- Gills
- Inhabit cleaner, more oxygenated water.
- Heavy shells, operculum
- Slow growth, live several years
- Sexes separate



Pleuroceridae

- Clean, flowing water
- Midlands, upstate



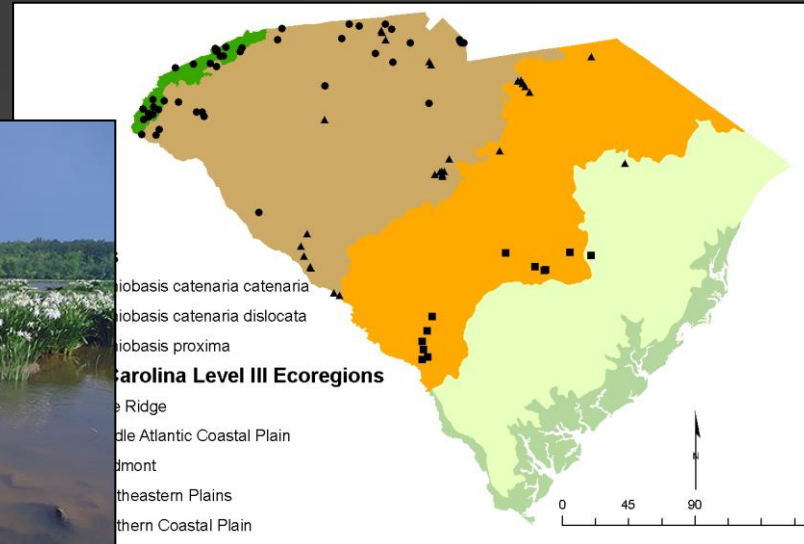
Pleurocera proxima



P. catenaria dislocata

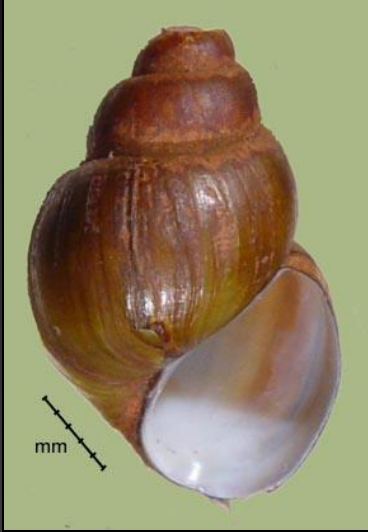


P. catenaria catenaria



Viviparidae

- Bear crawl-away young.
- Slower-flowing waters
- Can filter-feed.



Campeloma decisum

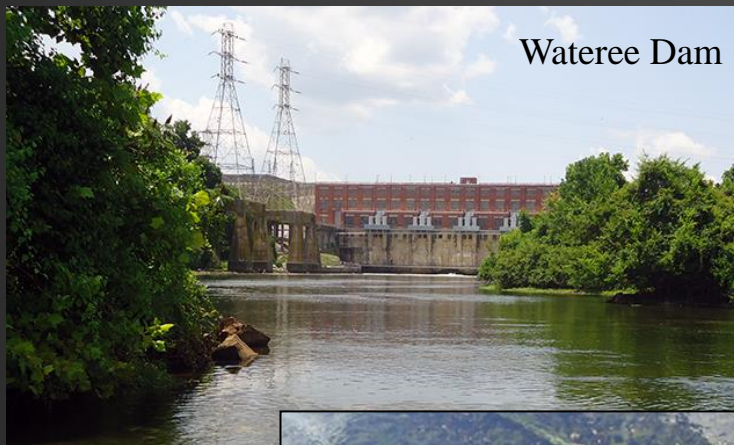


Viviparus intertextus



Lioplax subcarinata

Invasive viviparids



Wateree Dam



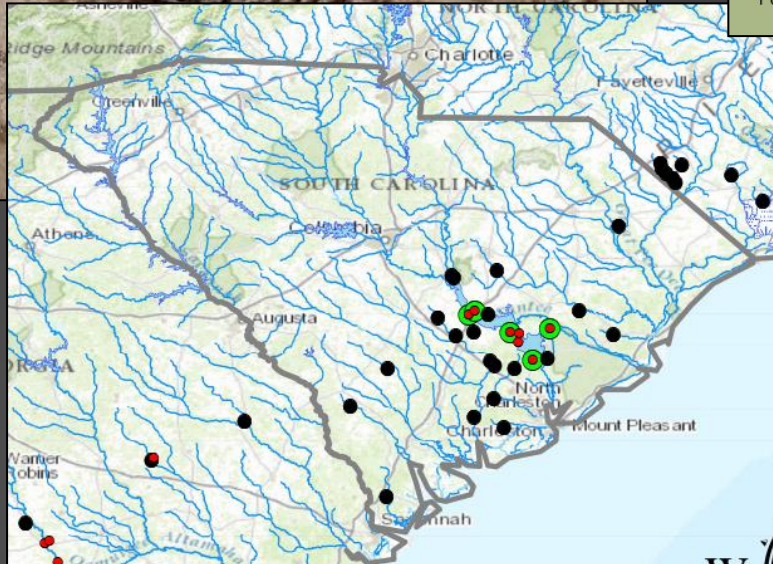
Viviparus georgianus



Viviparus subpurpureus



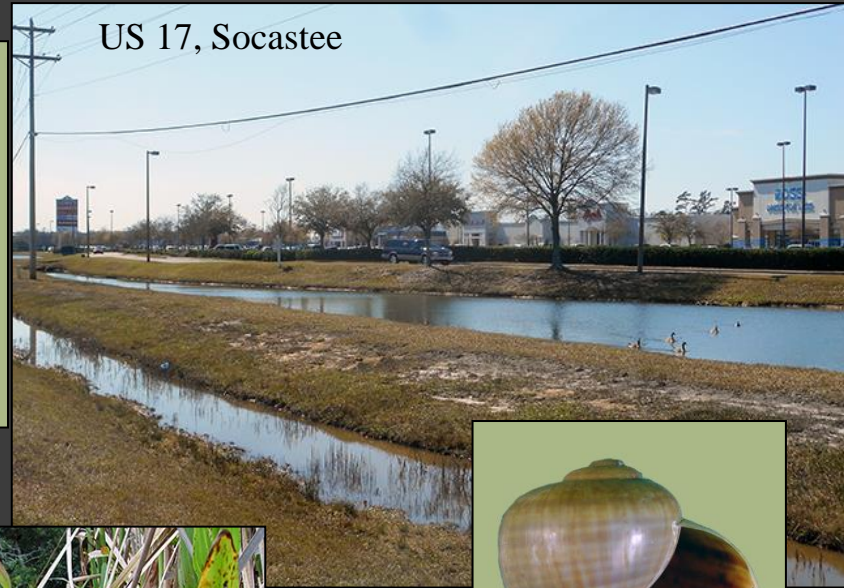
Bellamyia japonica



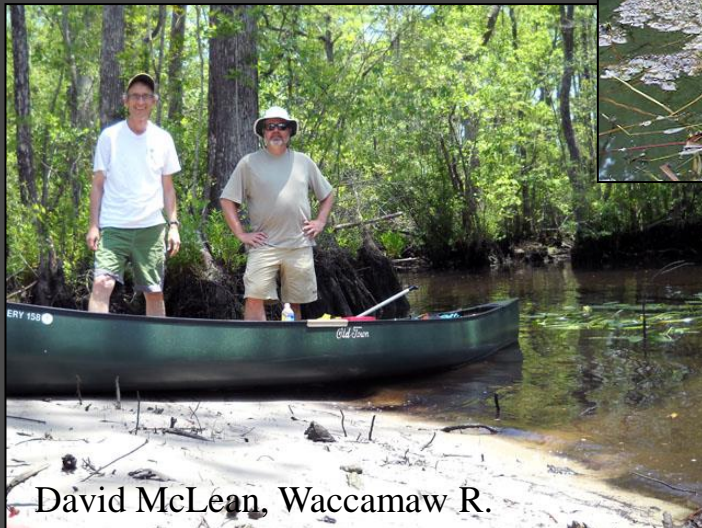
Invasive ampullariids



Pomacea maculata



Pomacea paludosa



Lotic-water Hydrobiids



Somatogyrus virginicus



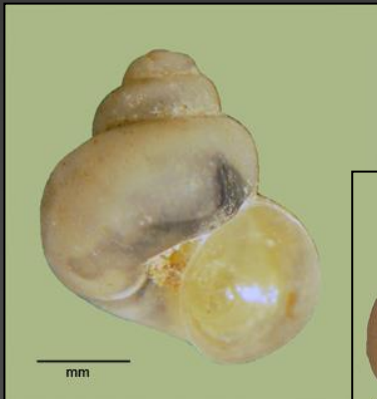
Gillia atilis



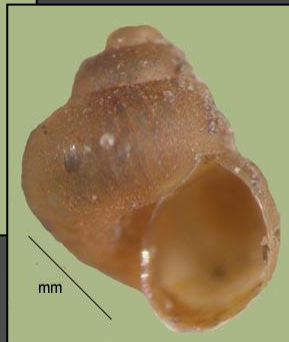
Lentic-water Hydrobiids



Pyrgophorus parvulus



Ammicola limosa



Lyogyrus granum



Littoridinops tenuipes

Pulmonates

- No gills – breathe over mantle cavity.
- May inhabit stagnant, even polluted water.
- Lightly shelled, no operculum.
- Grow quickly, often multiple generations / yr.
- Hermaphroditic, can self-fertilize.



Lymnaeidae



Lymnaea columella

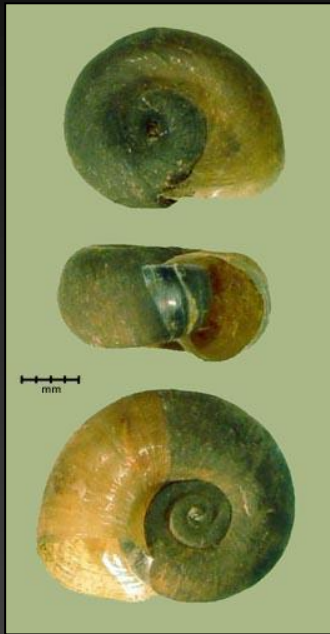


Lymnaea cubensis



Lymnaea humilis

Planorbidae, the larger ones...



Helisoma trivolvis



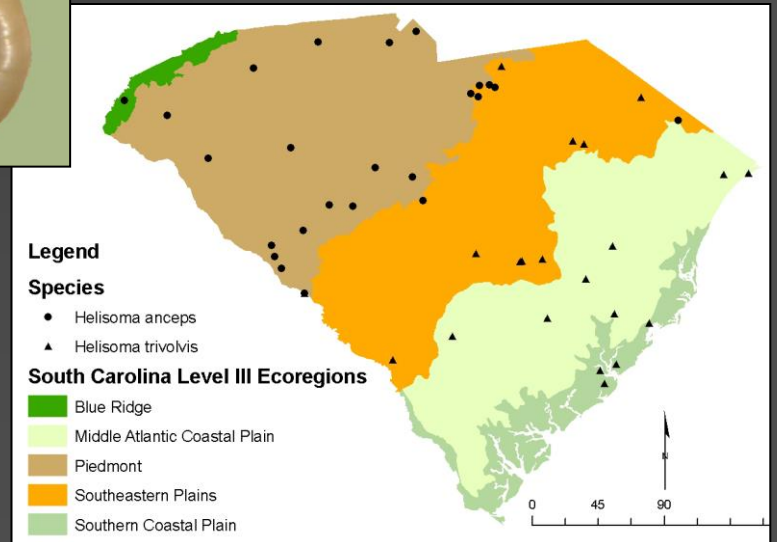
Helisoma anceps



*Biomphalaria
havanensis*



Elizabeth Gooding at Hilton Head



Planorbids, the smaller ones...



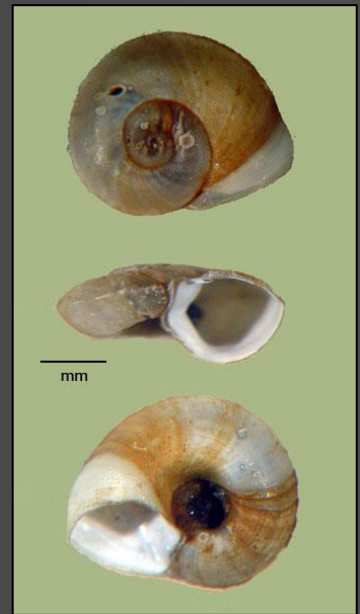
Lake Moultrie



Gyraulus parvus



Menetus dilatatus

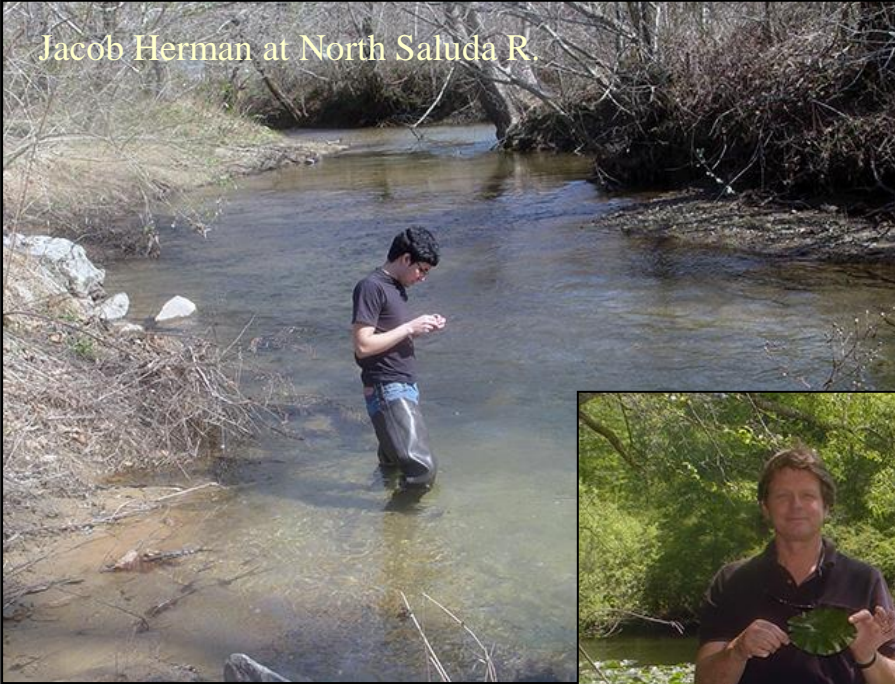


Promenetus exacuus



Ancylidae

Jacob Herman at North Saluda R.

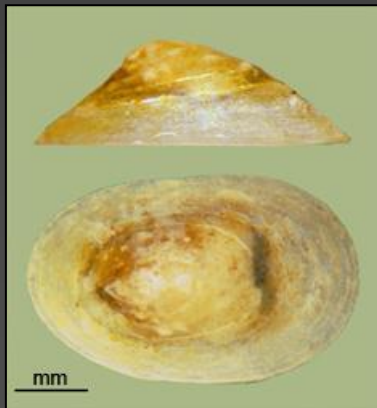


Laevapex fuscus



Ferrissia fragilis

John Wise at the Black R



Ferrissia rivularis

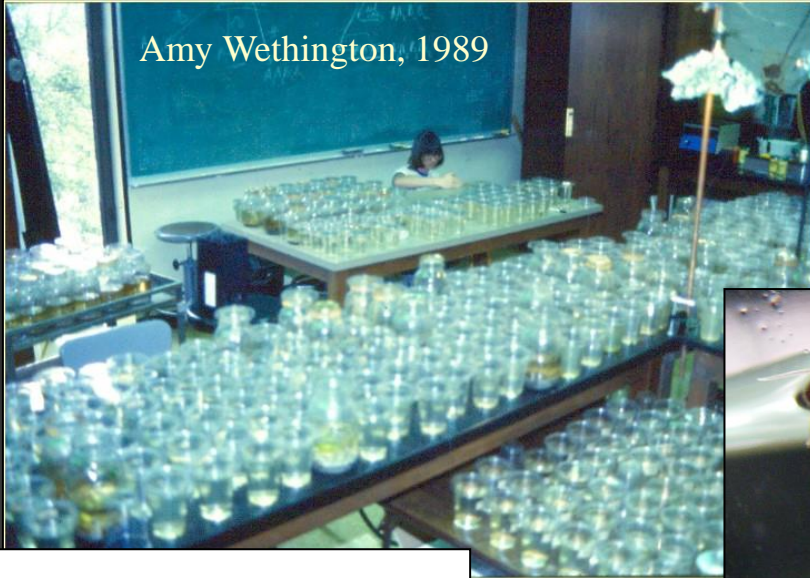


Hebetancylus excentricus

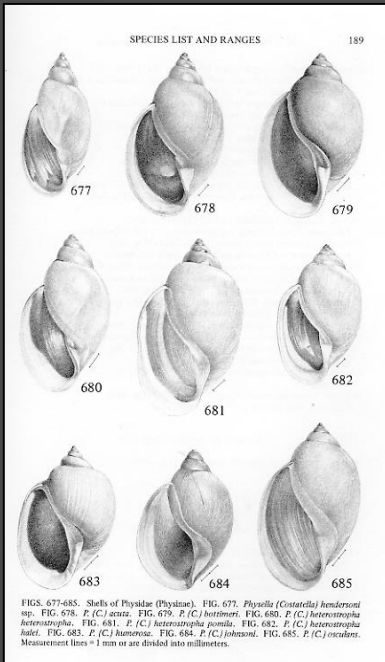
Physidae

Physa acuta, The World's most Cosmopolitan freshwater Gastropod

Amy Wethington, 1989



Physa acuta



FIGS. 677-685. Shells of Physidae (Physinae). FIG. 677. *Physella (Castella) hendersoni* sp. FIG. 678. *P. (C.) acuta*. FIG. 679. *P. (C.) birtimeri*. FIG. 680. *P. (C.) heterostrophia heterostrophia*. FIG. 681. *P. (C.) heterostrophia pumila*. FIG. 682. *P. (C.) heterostrophia kalet*. FIG. 683. *P. (C.) humerosa*. FIG. 684. *P. (C.) johnsoni*. FIG. 685. *P. (C.) ocularis*. Measurement lines = 1 mm or are divided into millimeters.

Invertebrate Biology (21(7): 226-234, © 2002 American Microscopical Society, Inc.

Populations of the European freshwater pulmonate *Physa acuta* are not reproductively isolated from American *Physa heterostrophia* or *Physa integra*

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²Department of Biological Sciences, Biochemistry, and Systematics, University of Alabama, Tuscaloosa, AL 35487, USA

Abstract. It has long been speculated that *Physa acuta*, a pulmonate snail widespread and invasive in fresh waters of the old world, may have originated in North America. But the identification of a new-world cognate has been complicated by the confused systematics and taxonomy of the Physidae in America. More than 40 species of physids are currently recognized in the United States, many with variable and overlapping morphology. We have previously established that promoting reproductive isolation is negligible among physid snails. Here we report the results from reciprocal crosses each involving 2 populations of the widespread American species *Physa heterostrophia* and *Physa integra*, both with each other and with *P. acuta*, designed to compare measures of reproductive success between species and between populations within species. Samples of *P. acuta* were collected from France and Ireland, *P. heterostrophia* from eastern Pennsylvania and South Carolina, and *P. integra* from southern Indiana and northern Michigan. The 6 interpopulation crosses varied quite significantly in their survival, age at first reproduction, parental fecundity, F₁ viability, and F₁ fertility under our culture conditions. Measures of survival and reproduction in the 6 interpopulation crosses were generally intermediate, but in no case significantly worse than the more poorly performing control. Thus we were unable to detect evidence of reproductive isolation among our 6 populations of snails from 2 continents. All should be referred to the oldest available name, *P. acuta*.

Additional key words: Gastropoda, Physidae, snails, invasion, hybridization

The most abundant and widespread freshwater gastropods of North America belong to the pulmonate family Physidae (Burch 1982). In certain lakes and quiet rivers, grazing by physid snails may demonstrably affect the biomass and composition of epiphytic algae and macrophytes, exerting indirect effects throughout the ecosystem (Decker & Wilton 1972, Shelton 1987, Lowe & Hunter 1988, Swaminathan & Haugland 1989, Brown et al. 1994). Physid snails themselves may comprise a substantial portion of the diet of a variety of fishes (Martin et al. 1992; Turner 1996, McCallum et al. 1998), crayfishes (Chantreuil et al. 1990, DeWitt et al. 1999; Turner et al. 1999; McCutty & Fisher 2000), and other predators (Kottem & Schreiber 1985, Brown & Strouse 1988). North American physid populations have served as model organisms for analytical studies of interspecific competition (Brown 1982), life history evolution (Rollo & Hawry-

luk 1988; Crowl & Cowich 1990), and population genetics (Dillon & Wethington 1995). The ecology of physid snails has been reviewed (Dillon 2000). *Physa (Physella) heterostrophia* (Say 1817) has been called "the most misunderstood mollusk in America" (Baker 1928). It is certainly among the most common and widely distributed, its subspecies together ranging from the Atlantic provinces of Canada south to the Bahamas and west through the Mississippi drainage to Kansas and Texas (Burch & Borchman 1980; Clarke 1981). Described from Philadelphia by Thomas Say (1817), *P. heterostrophia* was the first North American physid to reach formal description. Almost equally common and widely distributed is *Physa (Physella) integra* (Halterners 1841), whose 3 subspecies generally range across more northern and western regions of North America: Quebec and Manitoba south to Kentucky and Colorado (Burch & Borchman 1980; Wu 1989). Haldeman first described *P. integra*, published in an 1842 publication, with "Scit to me from Indiana by Mr. Say" as its geographical distribution. The type locality must almost certainly be



Duck Pond, North Park Circle

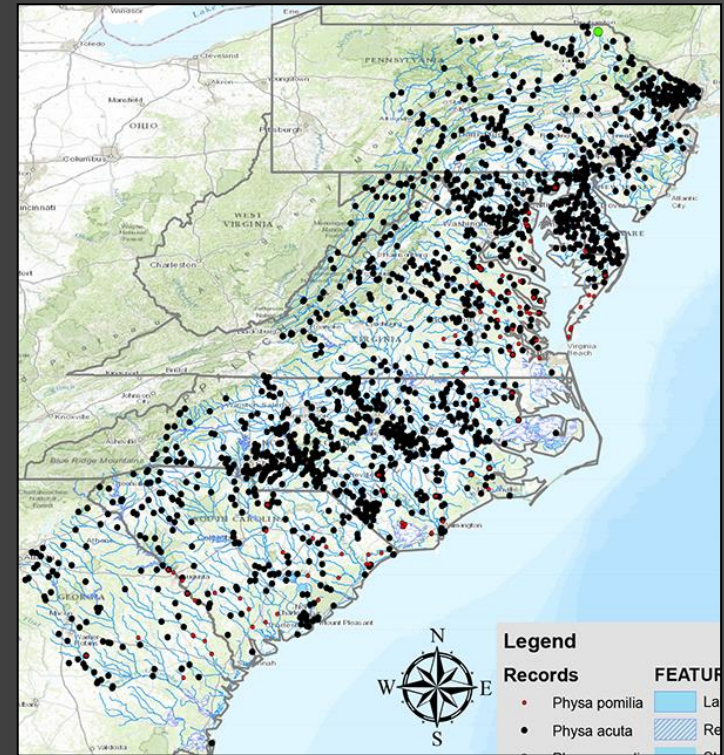
¹ Author for correspondence. Ph: 843/553-8080; Fax: 843/553-5425; E-mail: DillonR@cofc.edu

Physidae

Physa pomilia, The most misunderstood freshwater gastropod in America



Combahee R at Yemassee



MALACOLOGIA, 2007, 49(2): 283-292

EMPIRICAL ESTIMATES OF REPRODUCTIVE ISOLATION AMONG THE FRESHWATER PULMONATE SNAILS *PHYSA ACUTA*, *P. POMILIA*, AND *P. HENDERSONI*

Robert T. Dillon, Jr.¹, John D. Robinson^{1,2} & Amy R. Wethington¹

ABSTRACT

Physa hendersoni collected from its type locality near Yemassee, South Carolina, and *Physa pomilia* from its type locality near Claborn, Alabama, both display the penial morphology that has been characterized as "type-bc" by Te (1978, 1980). Mate choice tests returned no evidence of premating reproductive isolation between these two populations, and no-choice breeding experiments confirmed outcross fecundity, F1 viability and F1 fertility comparable to incross controls. Significant premating reproductive isolation was documented, however, between the *P. hendersoni* population and a population of *Physa acuta* from Charleston, South Carolina, bearing the "type-c" penial morphology. No-choice breeding experiments involving *P. acuta* and *P. hendersoni* yielded a mixture of hybrid and selfed progeny, the hybrids apparently sterile. Thus the nomen *Physa hendersoni* is a junior synonym of *P. pomilia*, whereas *P. pomilia* and *P. acuta* are distinct biological species.

Key words: Gastropoda, Pulmonata, *Physella*, speciation, mate choice, allozyme electrophoresis.

INTRODUCTION

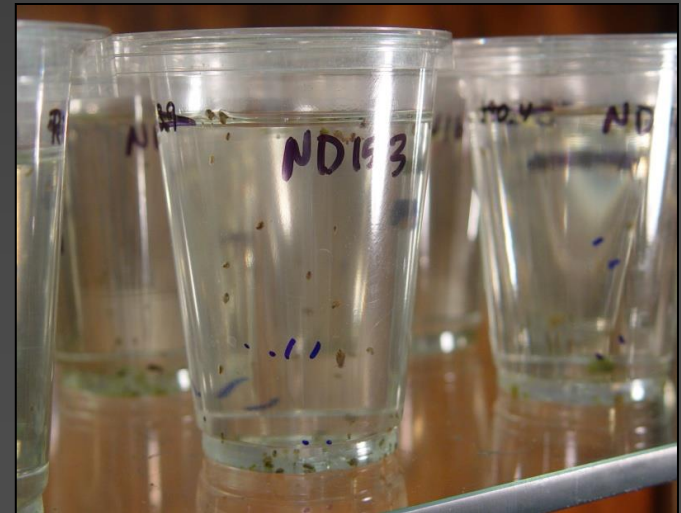
The most influential classification system for the Physidae at present is that of George Te (1978, 1980; Burch, 1989). Te recognized approximately 40 species and subspecies of physids in North America, divided into genera and subgenera by penial morphology. Experimental breeding studies have subsequently suggested, however, that Te's estimate of specific diversity may have been too high. Among the nominal species bearing the penial morphology Te characterized as "type-c", *Physa cubensis*, *P. heterostropha*, *P. nigra*, and *P. virgata* have all recently been synonymized under *P. acuta*, described from France prior to any American physid (Dillon et al., 2002, 2005a; Paransse & Pontier, 2003). Among the nominal species bearing Te's "penial complex type-b", recent research has suggested that *P. ancillaria*, *P. aurea*, *P. microstrata*, *P. carneri*, *P. sayi* and *P. utahensis* may all be junior synonyms of *P. gyrina* (Dillon & Wethington, 2005a, b). Reproductive isolation seems to be complete, however, between physids bearing type-b and type-c penial complexes (Dillon et al., 2004).

No attention has yet been directed, however, toward reproductive relationships in physids bearing the penial complex characterized by Te (1978) as "type-bc," intermediate between the two more common morphologies discussed above. We attributed the type-bc penis to a set of four species inhabiting the American South, including *Physa hendersoni*, originally described by Clench (1925) as a subspecies of *P. pomilia* (Conrad, 1834). Te's observations suggested to him that *P. pomilia* had a type-c penis, however, which led him to propose that *P. pomilia* be considered a subspecies of the widespread *P. heterostropha*, which has subsequently been synonymized under *P. acuta*. To raise *P. hendersoni* to the full species level, listed its range as extending from "West Virginia, Tennessee, and Missouri south to the Carolinas, Mississippi, and Florida", and recognized several subspecies within it (Burch, 1989).

Wethington (2003) has reported, however, that specimens freshly collected from the type locality of *Physa pomilia* bear a type-bc penial complex, not type-c as suggested by Te. Molecular data further demonstrate a close genetic similarity between *P. hendersoni* and *P.*



Physa pomilia



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Physidae

Physa carolinae, The best freshwater gastropod, anywhere!

Johns Island



Francis Marion at Jamestown



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Genetic and morphological characterization of the Physidae of South Carolina (Gastropoda: Pulmonata: Basommatophora), with description of a new species

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ABSTRACT
 Recent systematic studies of reproductive isolates have distinguished three physid species in South Carolina: the cosmopolitan *Physa* snail, bearing one pair of shell knobs, and two non-reproductive species bearing unidirectional paired shells: *Physa carolinae* and *Physa* "Species X". Here we describe "Species X" as *Physa gyryna*, an inhabitant of floodplain swamps and ditches of a varied or interstitial character, ranging through coastal plain and lower piedmont regions from Virginia to Florida. *Physa carolinae* may be distinguished from *P. physa* by its larger adult size, more slender and longer shell, and unidirectional pigmentation. A sample of *P. carolinae* from the South Carolina piedmont was genetically distinct from *P. physa* and divergent from random populations of *P. acuta* and *P. physa* for both COI and 16S mitochondrial genes. The two lineages under which a widespread and generally abundant freshwater gastropod such as *P. carolinae* might evolve in little more than about 200 years are reviewed.

Additional keywords: Taxonomy, Phylogeny, Gastropoda, *Physa*, *Physa acuta*, *Physa physa*, mtDNA sequence, COI, 16S.

INTRODUCTION
 Pulmonate gastropods of the family Physidae are a common element of the freshwater biotas in South Carolina and throughout North America. Longstanding taxonomic confusion has, however, impeded any real advance in our understanding of their ecology and distribution. The initial monographic review of the family was that of Haldeman (1842), who recognized 12 species in the United States, only one of which ranged into South Carolina, *Physa heterostropha* (Say, 1817). Buisson's (1960) monograph included 20 specific physid systems in two genera (*Physa* and *Budania*), three of which might potentially inhabit South Carolina: *Physa gyrina* (Say, 1821) and *Physa aculeata* (Say, 1820) in addition to *P. heterostropha*. Conradi (1963) recognized as valid only 17 physid species in eastern North America, two of which he attributed to South Carolina: *Physa gyrina* and *P. physa* (Conrad, 1834). Only four species were listed as confirmed for the state by Mearns (1911): *P. gyrina*, *P. physa*, *P. heterostropha* and *P. rubicosa* (Pfeiffer, 1830). Walker (1913) catalogued 77 species native to the family Physidae of North America, approximately half of which were in synonymy at the time, but did not provide ranges.

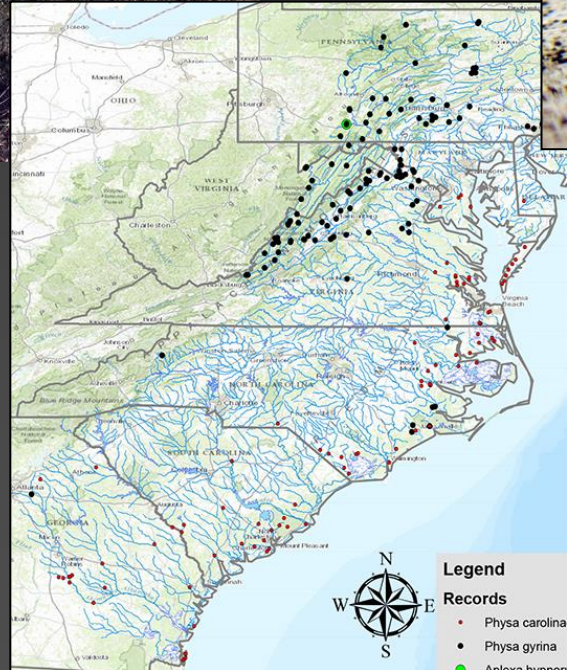
The most influential twentieth century monograph of the American Physidae was that of Pilsbry (1905). He recognized approximately 49 species and subspecies, classified by general morphology into four genera: *Physa* (sensu stricto), *Physella*, *Aplexa*, and *Stenophysa*. In (in March, 1905) listed three species whose ranges might include South Carolina: *Physella gyrina* (with several subspecies), *Physella heterostropha* (Conrad, 1834), and *Physella heterostropha physa*.

Recent studies of genetics, morphology, and reproductive biology have shown, however, that the number of valid North American species in the family Physidae has been overestimated. Worthington and Lyle (2007) have proposed a return to the two-genus classification of the Physidae, *Aplexa* and *Physa*, the former with one North American species and the latter with approximately ten. *Physa heterostropha* and *P. rubicosa* have been shown to be junior synonyms of the cosmopolitan *P. acuta* (Dugrenard, 1935), and *P. heterostriata* a junior synonym of *P. physa* (Dillon et al., 2005; Frazee and Poirier, 2005; Worthington, 2004; Dillon et al., 2007; Worthington and Lyle, 2007). No population of bona fide *P. gyrina* has been confirmed from South Carolina (unpublished observations).

During preliminary surveys of mtDNA sequence divergence among South Carolina populations of *Physa* snails, Worthington (2004) distinguished a population of *Physa* from Johns Island (Charleston County) bearing elongate shells and duck bodies. This population, previously referred to *Physa heterostropha physa* (PMT) by Dillon and Worthington (1995), was phenotypically distinct from known *P. acuta* conspecifics, with a genetic



Physa carolinae



Huger Landing