

The Freshwater Gastropods of The Ohio: An interim report

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

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KY-DEP

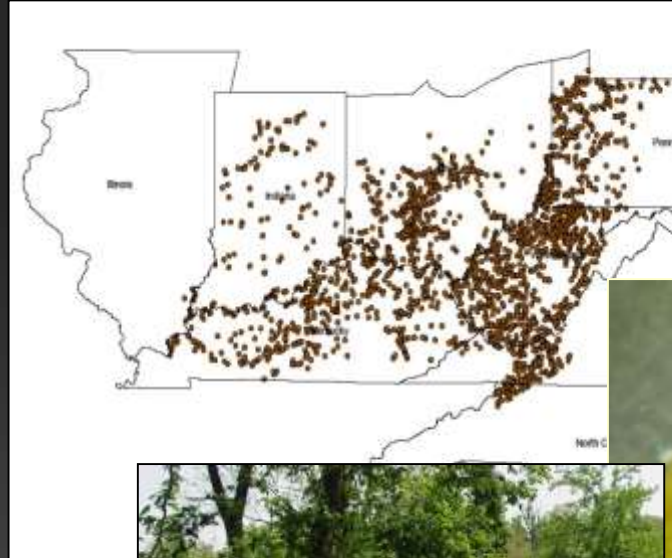
Mark Pyron
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USDA-APHIS-BRS

Richard Kugblenu
SUNY Albany

Jeffrey Bailey & Michael Whitman
WVDEP



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.
- Decentralized.
- Web-based (First book in prep).
- Organized state-by-drainage.
- Underwriting opportunities available!



www.fwgna.org

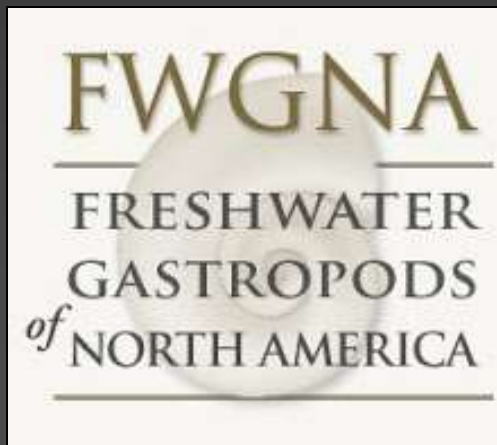


Pleurocera catenaria, SC



For each state...

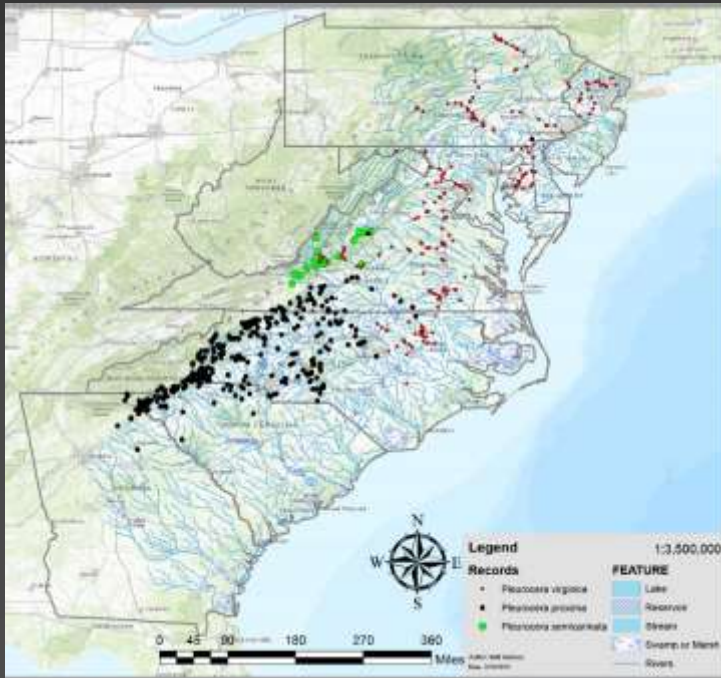
- Introduction & Literature review.
- Survey – State NR agencies, Museums, Original collections.
- Dichotomous key.
- Photo gallery.
- Rank abundance tabulations.



A screenshot of a web browser displaying the FWGNA website. The browser's address bar shows 'http://www.fwgn.org'. The website header includes the FWGNA logo and the text 'FRESHWATER GASTROPODS of NORTH AMERICA'. Navigation links for 'Home', 'States', 'Species', 'Resources', and 'Contact' are visible. The main content area is titled 'FWGNA > Freshwater Gastropods of Virginia' and features a row of four photographs: a red barn by a waterfall, a stone bridge over a river, a red car on a wooden bridge, and a river with yellow flowers. Below the photos is the section 'Virginia (Atlantic)', which contains text about the state's geography, the survey's focus on the eastern 75% of the state, and references to published literature. A sidebar on the right lists navigation options like 'VA Home', 'Methods', 'Acknowledgements', 'References', 'VA Species Gallery', 'Dichotomous Key', 'Results', 'Table 1', 'Table 2', 'Discussion', and 'Recommendations'. At the bottom of the sidebar, there is a quote: 'Like all the biotic elements of Virginia piedmont rivers, Liogloss, Gillia and Somatogyrus have doubtless suffered greatly from the high sedimentation loads that have eroded into their habitats...' followed by a link to 'see Recommendations'. The 'Authors' section lists Robert T. Dillon, Jr. from the Department of Biology at College of Charleston. The browser's status bar at the bottom indicates '100%' zoom.

For each species...

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



http://www.fwgna.org/species/pleuroceridae/g/proxima/ Species Account: Pleurocera...

FWGNA FRESHWATER GASTROPODS of NORTH AMERICA

Home States Species Resources Contact

FWGNA > Species Accounts > Pleuroceridae > *Pleurocera proxima*

***Pleurocera proxima* (Say 1825)**
Goniobasis or "*Elma*" *proxima*

> Habitat & Distribution

P. proxima ranges in the mountains and piedmont from southern Virginia to north Georgia on both sides of the continental divide, inhabiting tributaries of the James River south to the Oconee River on the Atlantic side, the upper New River of the Ohio, and Tennessee River tributaries from the Holston to the Neusee (Dillon & Robinson 2008). Through this vast and rugged territory, populations of *P. proxima* reach maximum abundance in smaller streams with high percent groundwater and good flow over rock & cobble substrate (Fox & Soven 1970; Fox 1971; Dillon & Keffel 2000). Water quality is typically soft and low in nutrients. Conservation Status Rank **FWGNA-1**

> Ecology & Life History

Grazing by populations of pleurocerids can have a significant effect on energy flow in small streams (Dillon 2000: 86 - 91, see also Dillon & Davis 1991). The streams typically inhabited by *P. proxima* can be much poorer in nutrients than those inhabited by almost any other gastropod, but are quite stable and predictable. The snail populations are perennial and temperate, two years being required for maturity (Elliott & Walzer 1967, cycle III of Dillon 2000: 156 - 162). I am not aware of any detailed data on reproductive energetics, but it seems quite likely to me that *P. proxima* populations are S-adapted in the sense of Dillon (2000: 131-138).

The sex ratio seems balanced in some *P. proxima* populations (Dillon 2000: 156 - 158) although female-biased in others. Individual movement seems to average around 10 m/yr upstream and 5 m/yr down, but apparently river barriers may have significant effects (Crutchfield 1966; Dillon 1980a, 1980b; Soven & Knezer 1984). Populations of *P. proxima* often carry high loads of trematode parasites (Lang 1988).

Georgia - FWGGA

The Atlantic drainages of Georgia, comprising approximately 40% of the waters of the state, are presently covered... [→ more](#)

North Carolina - FWGNC

The four ecoregions of North Carolina drain toward the Atlantic through six major river systems... [→ more](#)

South Carolina - FWGSC

Although perhaps not as environmentally heterogeneous as neighboring states, South Carolina does include... [→ more](#)

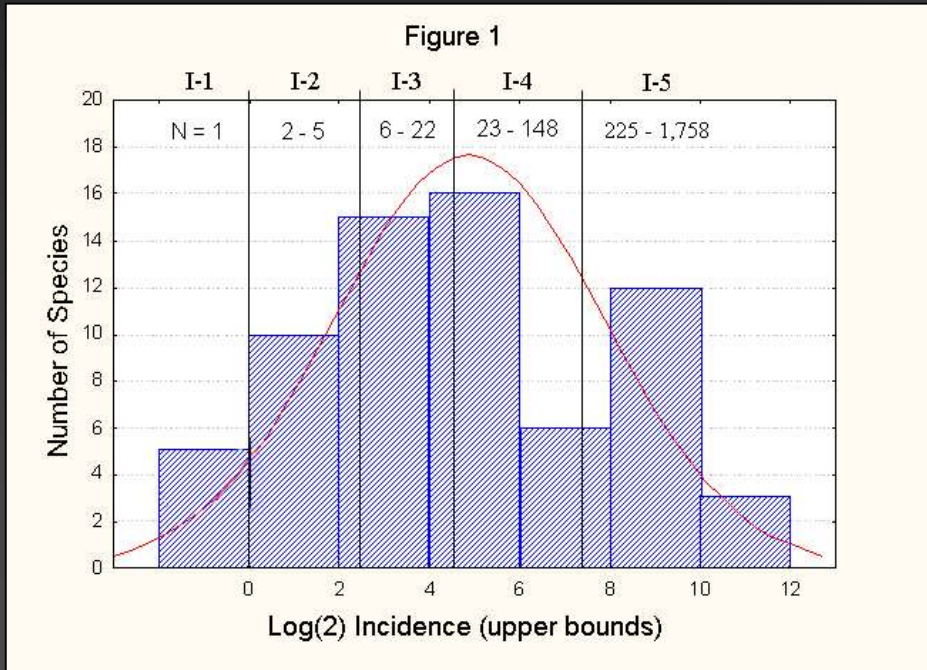
Virginia - FWGVA

The survey reported here is focused on the

100%

For the Continent...

- Total incidence
- Estimate **S**, Statistical estimation of species richness (Colewell 2013)
- FWGNA Incidence ranks



Atlantic drainages, GA to the NY line
11,471 Incidences of 67 species

I-5

I-4

I-3

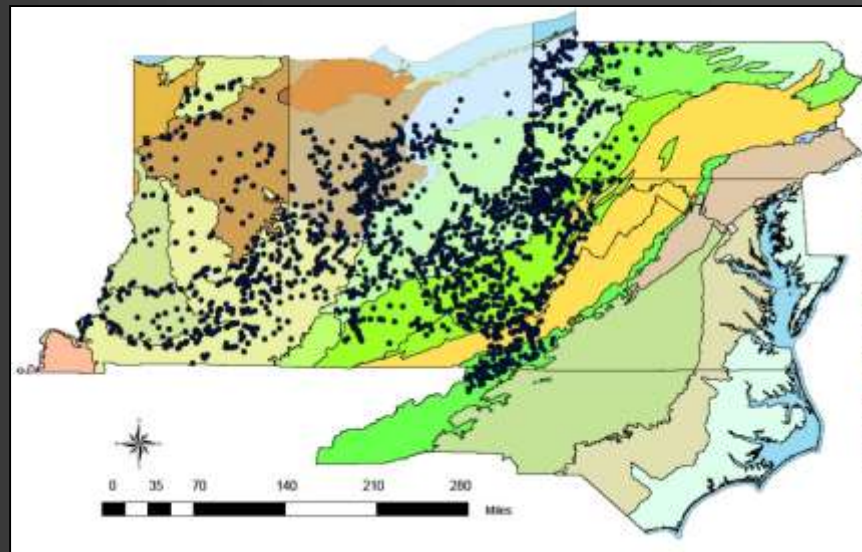
I-2

I-1

Species	GA	SC	NC	VA	MA	Total	Log(2)	FWGNA
Physa acuta	77	162	619	216	700	1760	10.78	I-5
Campeloma decisum	127	167	553	239	89	1167	10.19	I-5
Menetus dilatatus	66	110	485	191	260	1103	10.11	I-5
Ferrissia fragilis	41	80	570	147	161	996	9.96	I-5
Lymnaea columella	63	128	366	118	158	828	9.69	I-5
Helisoma anceps	16	62	306	174	109	663	9.37	I-5
Leptoxis carinata			104	358	139	594	9.21	I-5
Laevapex fuscus	22	87	257	50	36	449	8.81	I-5
Pleurocera proxima	17	61	252	40	1	371	8.54	I-5
Amnicola limosa	65	40	133	34	99	363	8.50	I-5
Lymnaea humilis	1	1	47	97	199	340	8.41	I-5
Helisoma trivolvis	34	53	92	35	110	318	8.31	I-5
Pleurocera catenaria (both)	90	55	147	26		317	8.31	I-5
Lyogyrus granum	33	26	105	69	53	282	8.14	I-5
Ferrissia rivularis			7	52	228	281	8.13	I-5
Gyraulus parvus	22	33	32	37	118	239	7.90	I-5
Pleurocera virginica			32	85	117	225	7.81	I-5
Physa gyrina	1		7	61	80	148	7.21	I-4
Somatogyrus virginicus	33	17	49	7		106	6.73	I-4
Physa pomilia	12	24	19	35	11	97	6.60	I-4
Physa carolinae	20	18	29	21	5	91	6.51	I-4
Planorbula armigera			38	3	20	61	5.93	I-4
Littoridinops tenuipes	4	10	18	7	18	56	5.81	I-4
Bellamyia japonica			13	4	15	20	5.64	I-4
Promenetus exacuus	2	7	19	5	11	44	5.46	I-4
Gillia altilis	1	1	34	2		38	5.25	I-4
Lymnaea cubensis	6	21	13			38	5.25	I-4
Lioplax subcarinata			3	26	7	37	5.21	I-4
Bellamyia chinensis					33	33	5.04	I-4
Viviparus intertextus	3	20	8			31	4.95	I-4
Valvata bicarinata	19	4	5		2	29	4.86	I-4
Fontigens nickliniana				21	5	26	4.70	I-4
Viviparus georgianus	6	7		1	9	23	4.52	I-4
Notogillia sathon	22					22	4.46	I-3
Pleurocera semicarinata				20		20	4.32	I-3
Fontigens bottimeri				2	17	19	4.25	I-3
Valvata tricarinata	1	1		2	15	17	4.09	I-3
Fontigens orolibas				14	2	16	4.00	I-3
Spilochlamys turgida	15					15	3.91	I-3
Hebetancylus excentricus	5	5	3	2		15	3.91	I-3
Helisoma campanulatum					14	14	3.81	I-3
Lymnaea catascopium					14	14	3.81	I-3
Lyogyrus latus	13					13	3.70	I-3
Marstonia halcyon	11					11	3.46	I-3
Pomacea maculata	5	5				10	3.32	I-3
Lymnaea elodes					9	9	3.17	I-3
Gyraulus deflectus				1	8	9	3.17	I-3
Somatogyrus pennsylvanicus					8	8	3.00	I-3
Bithynia tentaculata				5	6	6	2.58	I-3
Pomatiopsis lapidaria				1	5	6	2.58	I-3
Viviparus subpurpureus		5				5	2.32	I-2
Floridobia A	5					5	2.32	I-2
Floridobia waccamaw			4			4	2.00	I-2
Pleurocera floridensis	4					4	2.00	I-2
Fontigens morrisoni				3		3	1.58	I-2
Helisoma eucosmium			3			3	1.58	I-2
Helisoma magnificum			3			3	1.58	I-2
Marstonia agarhecta	3					3	1.58	I-2
Fontigens tartarea				2		2	1.00	I-2
Pomacea paludosa		2				2	1.00	I-2
Biomphalaria obstructa	1	1				2	1.00	I-2
Floridobia floridana	2					2	1.00	I-2
Aplexa hypnorum					1	1	0.00	I-1
Physa vernalis					1	1	0.00	I-1
Potamopyrgus antipodarum					1	1	0.00	I-1
Holsingeria unthinksensis				1		1	0.00	I-1
Marstonia gaddisorum	1					1	0.00	I-1
TOTALS	869	1229	4389	2206	2893	11471		

The Freshwater Gastropods of The Ohio

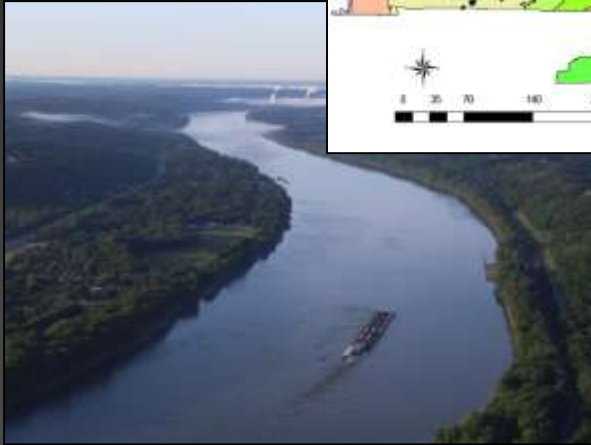
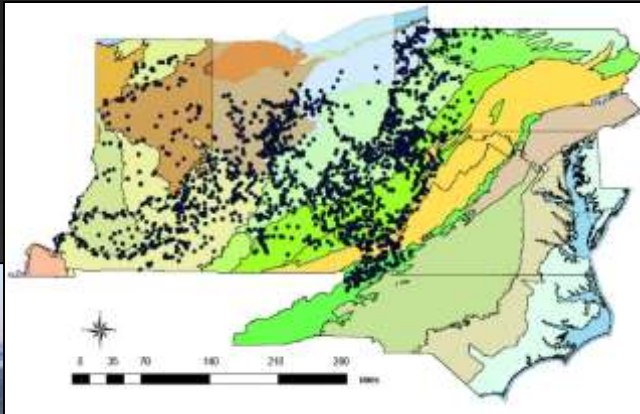
(above the mouth of The Cumberland)



	Agency	Museum	Original Collections	Total Records	Species
PA	120	481	45	646	33
MD	5	6	-	11	5
WV	942	38	75	1,055	22
VA	112	35	193	340	21
NC	44	1	49	94	10
KY	650	159	385	1,194	36
OH	103	717	155	975	31
IN	50	47	334	431	31
Totals	2,026	1,484	1,236	4,746	60



60 species in The Ohio drainage (above The Cumberland)

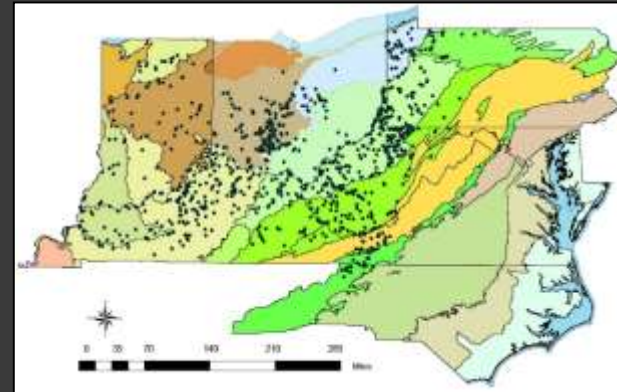


Species	Count	Species	Count
<i>Physa acuta</i>	959	<i>Lithasia verrucosa</i>	9
<i>Ferrissia rivularis</i>	536	<i>Fontigens tartarea</i>	8
<i>Pleurocera semicarinata</i> (3 ssp)	528	<i>Lithasia armigera</i>	8
<i>Lymnaea humilis</i>	406	<i>Marstonia lustrica</i>	8
<i>Helisoma anceps</i>	254	<i>Probythinella lacustris</i>	7
<i>Leptoxis carinata</i>	236	<i>Viviparus georgianus</i>	7
<i>Physa gyrina</i>	219	<i>Fontigens nickliniana</i>	6
<i>Campeloma decisum</i> (2 ssp)	218	<i>Fontigens bottimeri</i>	5
<i>Pleurocera canaliculata</i> (2 ssp)	186	<i>Antroselates spiralis</i>	4
<i>Ferrissia fragilis</i>	134	<i>Aplexa hypnorum</i>	4
<i>Helisoma trivolvis</i>	131	<i>Helisoma campanulata</i>	4
<i>Menetus dilatatus</i>	130	<i>Physa vernalis</i>	4
<i>Lymnaea columella</i>	80	<i>Promenetus exacuus</i>	4
<i>Gyraulus parvus</i>	76	<i>Valvata tricarinata</i>	4
<i>Laevapex fuscus</i>	75	<i>Viviparus subpurpureus</i>	4
<i>Pleurocera simplex</i> (2 ssp)	73	<i>Lyogyrus granum</i>	3
<i>Pleurocera laqueata</i> (2 ssp)	59	<i>Fontigens orolibas</i>	2
<i>Amnicola limosa</i>	54	<i>Lymnaea stagnalis</i>	2
<i>Birgella subglobosa</i>	51	<i>Planorbula armigera</i>	2
<i>Pleurocera proxima</i>	47	<i>Pleurocera gabbiana</i>	2
<i>Lymnaea elodes</i>	33	<i>Fontigens turritella</i>	1
<i>Somatogyrus integra</i>	25	<i>Fontigens cryptica</i>	1
<i>Pleurocera troostiana</i>	24	<i>Gillia altilis</i>	1
<i>Cincinnatia integra</i>	19	<i>Gyraulus circumstriatus</i>	1
<i>Bellamyia japonica</i>	17	<i>Marstonia letsoni</i>	1
<i>Bellamyia chinensis</i>	13	<i>Pleurocera clavaeformis</i>	1
<i>Leptoxis praerosa</i>	13	<i>Pleurocera edgariana</i>	1
<i>Pomatiopsis cincinnatiensis</i>	13	<i>Pleurocera virginica</i>	1
<i>Pomatiopsis lapidaria</i>	11	<i>Rhodacmea eliator</i>	1
<i>Gyraulus deflectus</i>	10		
<i>Lioplax subcarinata</i>	10		

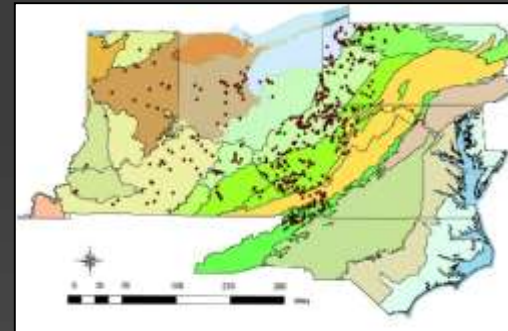
4,746 Records

Four most common species (51% of all incidence)

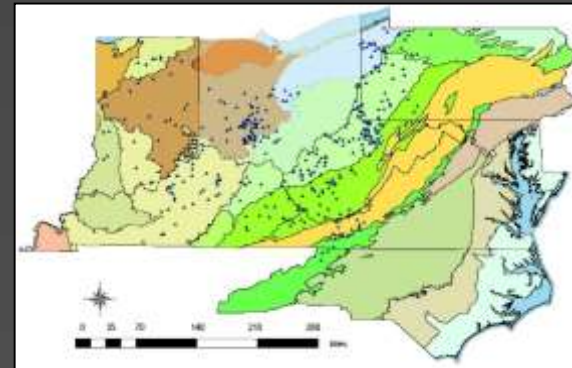
- *Physa acuta* (including *integra*) = 959



- *Ferrissia rivularis* (including *parallela*) = 536

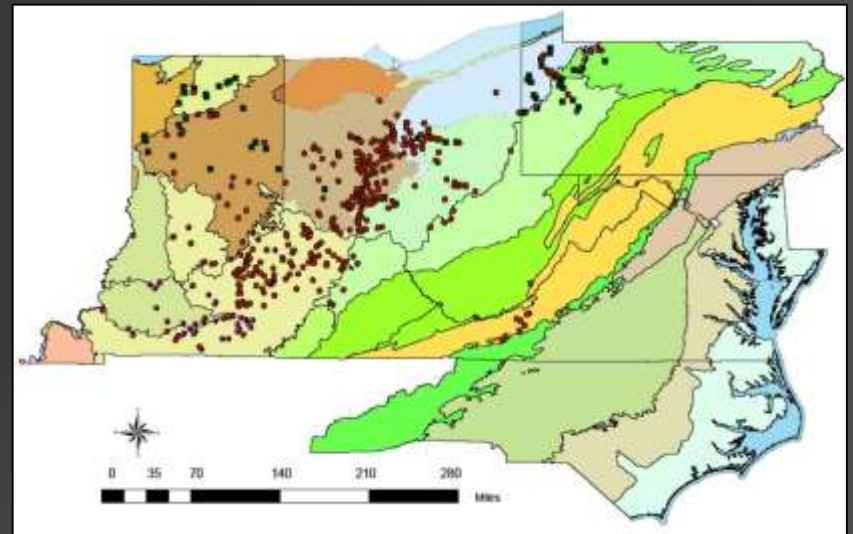


- *Lymnaea humilis* (including *obrussa*, *parva*, etc) = 406



Four most common species (continued)

- *Pleurocera semicarinata* (including *livescens* & *obovata*) = 528



Dillon *Zoological Studies* 2014, 53:31
<http://www.zoologicalstudies.com/content/53/1/31>

Zoological Studies
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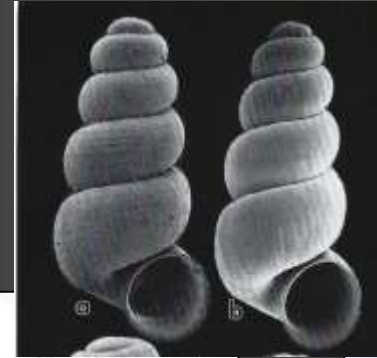
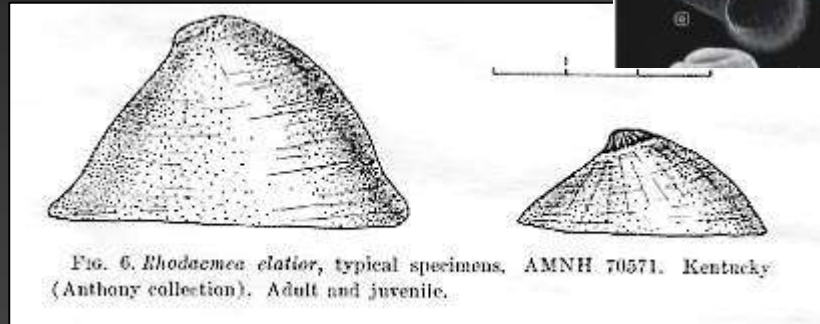
Cryptic phenotypic plasticity in populations of the North American freshwater gastropod, *Pleurocera semicarinata*

Robert T Dillon Jr

Nine species represented
at but a single site

Four species seem to be
legitimately rare

- *Fontigens turritella*
- *Fontigens cryptica*
- *Marstonia letsoni*
- *Rhodacmea eliator*



Marstonia letsoni



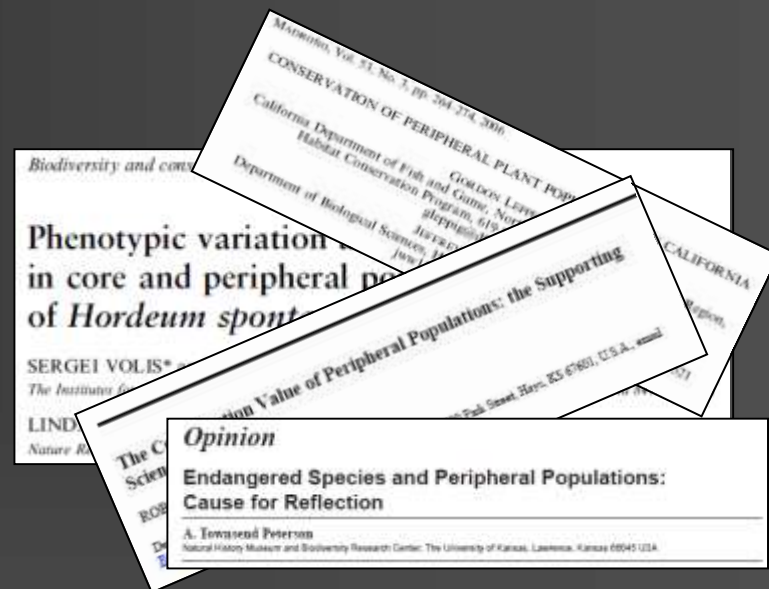
Fontigens cryptica, Bernheim Forest

Nine species represented at a single site (continued)

Five species are “peripheral”

- *Pleurocera virginica*
- *Gillia altilis*
- *Pleurocera clavaeformis*
- *Pleurocera edgariana*
- *Gyraulus circumstriatus*

From the literature of plant
ecology...



P. clavaeformis



P. virginica

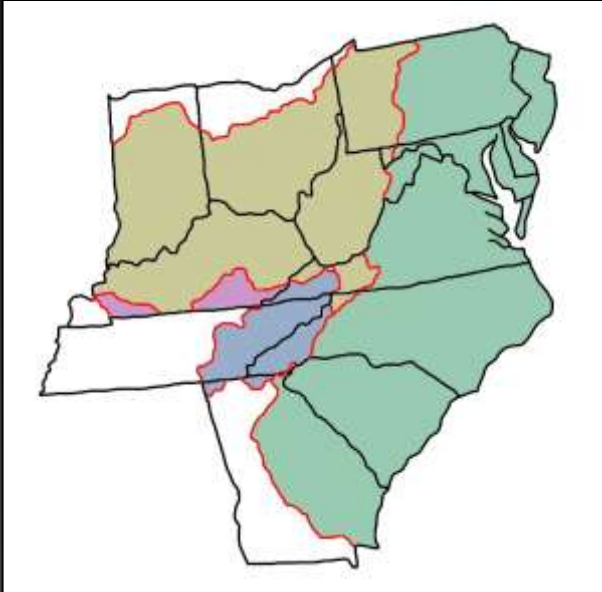


Gillia altilis

Peripheral (p) – a freshwater gastropod species demonstrating below-median incidence within the study area, for which there is some evidence of above-median incidence elsewhere.

Four Regions Combined

18,974 records of 99 species



Species	Ohio	Atlantic	Cumb	E-Tenn	Totals
Physa acuta	959	1971	28	148	3106
Campeloma decisum	218	1255	12	53	1538
Menetus dilatatus	130	1142	12	31	1315
Ferrissia fragilis	134	1068	3	105	1310
Helisoma anceps	254	722	16	62	1054
Lymnaea columella	80	887	4	38	1009
Ferrissia rivularis	536	296	14	93	939
Leptoxis carinata	236	603	6	845	
Lymnaea humilis	406	344	11	64	825
Pleurocera proxima	47	412		148	607
Pleurocera semicarinata	528	20	14		562
Laevapex fuscus	75	466	4	12	557
Helisoma trivolvis	131	333	6	6	476
Physa gyrina	219	148	20	56	443
Amnicola limosa	54	369		2	425
Pleurocera catenaria		339		9	348
Gyraulus parvus	76	251		5	332
Pleurocera simplex	73		60	184	317
Pleurocera clavaeformis	1			290	291
Lyogyrus granum	3	286		1	290
Pleurocera canaliculata	186		15	32	233
Pleurocera virginica	1	224			225
Leptoxis praerosa	13		1	134	148
Pleurocera troostiana	24		10	102	136
Somatogyrus virginicus		115		1	116
Physa carolinae		111			111
Physa pomilia		99		8	107
Pleurocera laqueata	59		19	2	80
Bellamyia japonica	17	57			74
Planorbula armigera	2	62			64
Pleurocera gabbiana	2			60	62
Littoridinops tenuipes		58			58
Birgella subglobosa	51				51
Promenetus exacuouus	4	46			50
Lioplax subcarinata	10	37			47
Bellamyia chinensis	13	33			46
Fontigens nickliniana	6	26		14	46
Io fluviialis				42	42
Lymnaea elodes	33	9			42
Gillia altilis	1	40			41
Lymnaea cubensis		38			38
Viviparus intertextus		37			37
Viviparus georgianus	7	24			31
Valvata bicarinata		29			29
Fontigens orolibas	2	25		1	28
Pomatiopsis cincinnatiensis	13			14	27
Somatogyrus integra	25				25
Fontigens bottimeri	5	19			24
Pomatiopsis lapidaria	11	6		6	23

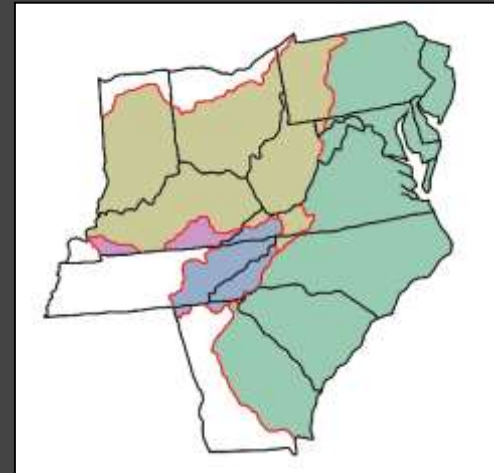
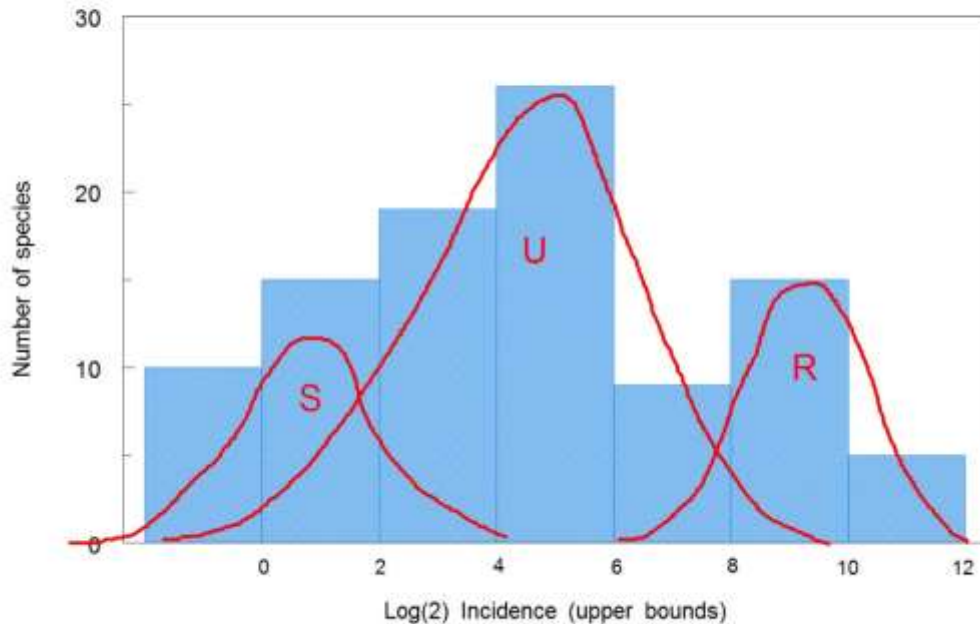
Species	Ohio	Atlantic	Cumb	E-Tenn	Totals
Notogillia sathon		22			22
Valvata tricarinata	4	17			21
Cincinnatiata integra	19				19
Gyraulus deflectus	10	9			19
Hebetancylus excentricus		18			18
Helisoma campanulata	4	14			18
Spilochlamys turgida		15			15
Lymnaea catascopium		14			14
Lyogyrus latus		13			13
Pleurocera modesta				13	13
Lithasia verrucosa	9			3	12
Marstonia halcyon		11			11
Fontigens tartarea	8	2			10
Pomacea maculata		10			10
Viviparus subpurpureus	4	5		1	10
Lithasia armigera	8				8
Marstonia lustrica	8				8
Somatogyrus pennsylvanicus		8			8
Probythinella lacustris	7				7
Bithynia tentaculata		6			6
Holsingeria unthanksensis		1		5	6
Pleurocera edgariana	1		5		6
Aplexa hypnorum	4	1			5
Floridobia A		5			5
Physa vernalis	4	1			5
Antroselates cryptica	4				4
Floridobia waccamaw		4			4
Marstonia arga				4	4
Pleurocera floridensis		4			4
Biomphalaria havanensis		3			3
Clappia umbilicata				3	3
Fontigens morrisoni		3			3
Helisoma eucosmium		3			3
Helisoma magnificum		3			3
Marstonia agarhecta		3			3
Somatogyrus parvus				3	3
Floridobia floridana		2			2
Lymnaea stagnalis	2				2
Melanoides tuberculata		2			2
Pomacea paludosa		2			2
Fontigens cryptica	1				1
Fontigens turritella	1				1
Gyraulus circumstriatus	1				1
Leptoxis crassa				1	1
Marstonia gaddisorum		1			1
Marstonia letsoni	1				1
Marstonia ogmorhapha				1	1
Potamopyrgus antipodarium		1			1
Pyrgophorus parvulus		1			1
Rhodacmea eliator	1				1
TOTALS	4746	12211	254	1763	18974



Four Regions Combined 18,974 records of 99 species

- Mean = 4.68 = 25.6
- SD = 0.312 = 1.24
- Skewness = 0.29
- Kurtosis = - 0.86, platykurtotic

Log-2 Method of Preston (1948)

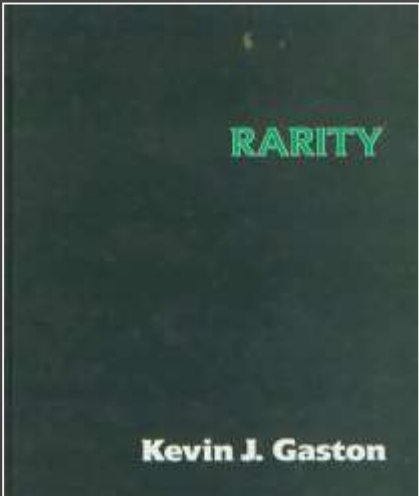


- Still Log(2) bimodal
- **Admixture** of two communities?
- Or maybe three? USR?

What is "Rarity"?"

K. J. Gaston's (1994) concept of rarity

- Rareness most robustly expressed as rank, unweighted by frequency.
- **Rare species** – The X% with the lowest abundances or smallest ranges sizes in the assemblage.
- X = 25, the "quartile definition."
- Abundance rarity and incidence rarity are analytically equivalent.



3. What is rarity?

Table 2.4. The criteria by which a number of studies have been defined as rare species, and the proportion of the total number of species in the assemblage (N) which these comprise (75 Sept.), to illustrate the numbers out of the total assemblage in which rarity was defined. The objectives of the different studies were varied.

Source	Form	N	Criteria	% Rare
Kell and Murray (1962)	Wells	1700	Range that not exceed more than 250 miles in any direction	2.4
Morse (1975)	Palauensis	1100	Size only a few feet	12.8
	Manilla	750		1.2
	Manilla	750		2.3
Kun (1977)	Body	61	Size only a few feet	9.8
	Pericardium dia	173		46.8
Preston (1977)	Count of base site	501	Less than 100 sightings per hour of other values	24.9
	North			
	Shore to	254 (99%)		10.1
	Pore	210 (83%)		81.9
	Radius	207 (82%)		76.8
	Radius	142 (54%)		39.5
Thomas (1978)	North	119 (13)	48.7	
Thomas (1978)	South	154 (42)	27.3	
Thomas (1978)	North	347	Found less than five times	14.9
Wells and Sherman (1981)	Wells	121	Observed at least five times in five consecutive counts	31.2
Wheeler (1981)	Algonquinia	100	Common and very common species accounting for 12% of 477 m grid squares and abundant species are 15% of species	27.0
Wheeler (1981)	North	42	Major species with only a few known populations in the Wells data, or major species the populations of which are geographically unique, individually and depending on number	27.0
Wheeler (1981)	South	54		14.8
Wheeler and Kuhn (1984)	North	10	Collected at one or two sites from a possible 26	30.0
Wheeler and Kuhn (1984)	South	70	Collected at one or two sites from a possible 11	15.0
Wheeler and Kuhn (1984)	North	303	Average density < 1 individual	30.0
Wheeler and Kuhn (1984)	South	41	Not more than 10 individuals or more change in the field	29.2

4. What is rarity?

Table 2.2. Examples of the derivation of rare species (bracketed) using proportion of species (Sp), proportion of sum (Sum) and proportion of maximum (Max) individuals, with on-off pairs of (at 25%), and (at 5%). Data are the mean catches of dung beetles of different species caught per trap in the spring at a site in the Mediterranean, from Lomant and Kirk (1991).

Species	Abundance	Sp	Sum	Max
(1)	1			
(2)	1			
(3)	1			
(4)	1			
(5)	1			
(6)	1			
(7)	1			
(8)	10			
(9)	15			
(10)	15			
(11)	15			
(12)	21			
(13)	28			
(14)	31			
(15)	40			
(16)	67			
(17)	67			
(18)	107			
(19)	130			
(20)	1485			
Total	2281			
(21)	1			
(22)	1			
(23)	1			
(24)	2			
(25)	3			
(26)	3			
(27)	5			
(28)	5			
(29)	7			
(30)	10			
(31)	13			
(32)	18			
(33)	21			
(34)	28			
(35)	31			
(36)	40			
(37)	67			
(38)	67			
(39)	107			
(40)	130			
Total	2281			

- Rarity defined as the bottom quartile by rank abundance (I-1 and I-2).
- Peripheral species marked with suffix “p.”
- Non-apparently rare species marked with an asterisk*.
- An alternative to pseudoscientific systems of “conservation status ranking.”



I-5

I-4

Species	Totals	I-ranks
Physa acuta	3106	I-5
Campeloma decisum	1538	I-5
Menetus dilatatus	1315	I-5
Ferrissia fragilis	1310	I-5
Helisoma anceps	1054	I-5
Lymnaea columella	1009	I-5
Ferrissia rivularis	939	I-5
Leptoxis carinata	845	I-5
Lymnaea humilis	825	I-5
Pleurocera proxima	607	I-5
Pleurocera semicarinata	562	I-5
Laevapex fuscus	557	I-5
Helisoma trivolvis	476	I-5
Physa gyrina	443	I-5
Amnicola limosa	425	I-5
Pleurocera catenaria	348	I-5
Gyraulus parvus	332	I-5
Pleurocera simplex	317	I-5
Pleurocera clavaeformis	291	I-5
Lyogyrus granum	290	I-5
Pleurocera canaliculata	233	I-5
Pleurocera virginica	225	I-5
Leptoxis praeerosa	148	I-5
Pleurocera troostiana	136	I-4
Somatogyrus virginicus	116	I-4
Physa caroliniae	111	I-4
Physa pomilia	107	I-4
Pleurocera laqueata	80	I-4
Bellamya japonica	74	I-4
Planorbula armigera	64	I-4
Pleurocera gabbiana	62	I-4
Littoridinops tenuipes	58	I-4
Birgella subglobosa	51	I-4
Promenetus exacuouus	50	I-4
Lioplax subcarinata	47	I-4
Bellamya chinensis	46	I-4
Fontigens nickliniana	46	I-4
Io fluviialis	42	I-4
Lymnaea elodes	42	I-4
Gillia altilis	41	I-4
Lymnaea cubensis	38	I-4
Viviparus intertextus	37	I-4
Viviparus georgianus	31	I-4
Valvata bicarinata	29	I-4
Fontigens orolibas	28	I-4
Pomatiopsis cincinnatiensis	27	I-4
Somatogyrus integra	25	I-4

I-3

I-2

I-1

Fontigens bottimeri	24	I-3
Pomatiopsis lapidaria	23	I-3
Notogillia sathon	22	I-3
Valvata tricarinata	21	I-3
Cincinnatia integra	19	I-3
Gyraulus deflectus	19	I-3
Hebetancylus excentricus	18	I-3
Helisoma campanulata	18	I-3
Spilochlamys turgida	15	I-3*
Lymnaea catascopium	14	I-3
Lyogyrus latus	13	I-3*
Pleurocera modesta	13	I-3*
Lithasia verrucosa	12	I-3*
Marstonia halcyon	11	I-3*
Fontigens tartarea	10	I-3*
Pomacea maculata	10	I-3
Viviparus subpurpureus	10	I-3
Lithasia armigera	8	I-3*
Marstonia lustrica	8	I-3
Somatogyrus pennsylvanicus	8	I-3*
Probythinella lacustris	7	I-3
Bithynia tentaculata	6	I-3
Holsingeria unthankensis	6	I-3*
Pleurocera edgariana	6	I-3*
Aplexa hypnorum	5	I-2p
Floridobia A	5	I-2
Physa vernalis	5	I-2
Antroselates spiralis	4	I-2
Floridobia waccamaw	4	I-2
Marstonia arga	4	I-2
Pleurocera floridensis	4	I-2p
Biomphalaria havanensis	3	I-2p
Clappia umbilicata	3	I-2
Fontigens morrisoni	3	I-2
Helisoma eucosmium	3	I-2
Helisoma magnificum	3	I-2
Marstonia agarhecta	3	I-2
Somatogyrus parvus	3	I-2
Floridobia floridana	2	I-2p
Lymnaea stagnalis	2	I-2p
Melanoides tuberculata	2	I-2p
Pomacea paludosa	2	I-2p
Fontigens cryptica	1	I-1
Fontigens turritella	1	I-1
Gyraulus circumstriatus	1	I-1p
Leptoxis crassa	1	I-1
Marstonia gaddisorum	1	I-1
Marstonia letsoni	1	I-1
Marstonia ogmorhappe	1	I-1
Potamopyrgus antipodarum	1	I-1p
Pyrgophorus parvulus	1	I-1p
Rhodacmea eliator	1	I-1

Summary

- The 8-state Ohio River drainage (above Paducah) is inhabited by **60 species** of freshwater gastropods.
- Many rare species are **peripheral**. Concept of “non-apparent rarity.”
- The 13-state FWGNA coverage area is inhabited by **99 species**.
- The distribution of incidence abundance is not lognormal (**bimodal?** trimodal?)
- Rarity is not necessarily abnormal, **not necessarily a problem**, not clear that anything can be done, or needs to be done.

