

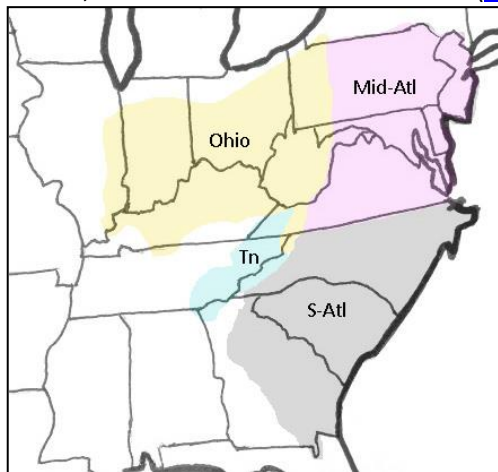
The Biogeography of North American Freshwater Gastropods, v1.0

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Note: The analysis that follows was first published on 11Jan19 as a Discussion page on the Freshwater Gastropod of The Ohio web resource ([html](#)). Although rendered obsolete by the publication of FWGNA Biogeography v2.0 ([html](#)) in 2022, it remains interesting for the stacked-matrix analytical methodology employed.

The 70 gastropod species and subspecies we have recovered from the waters of the Ohio River above the mouth of the Tennessee/Cumberland are tabulated by state in Table 1. Then combining subspecies, the 64 species are ordered by their number of incidences in our 5,250-record database in Table 2, giving common synonyms and overall (15-state) FWGNA incidence ranks.

Dillon and colleagues (2019a) also reported 70 species and subspecies of freshwater gastropods inhabiting Atlantic drainages from Georgia to the New York line. This fauna may be dividable into a set of cosmopolitan species, a set of endemics or near-endemics, and a set of species demonstrating north-south regionalism. And a survey of the freshwater gastropods inhabiting East Tennessee is also available online, from the FWGTN web resource ([Dillon & Kohl 2013](#)). The list of 40 species and subspecies



recovered by Dillon & Kohl also included cosmopolitan and endemic elements, as well as a set of species which, when compared to the Atlantic drainage fauna, demonstrated an east-west regionalism.

With the addition of survey results from the Ohio drainages, we can now examine the distribution of the North American gastropod fauna for evidence of both north-south and east-west regionalism simultaneously. And let us combine subspecies for a continental-scale analysis, bringing the lists down to 64 species for The Ohio, 69 for the Atlantic drainages, and 39 for Tennessee.

Next let us subdivide the 69-species Atlantic drainage fauna into South-Atlantic and Mid-Atlantic halves at north latitude 36.54°, the North Carolina / Virginia line. We find that 18 species are unique to the South-Atlantic and 12 unique to the Mid-Atlantic, with an overlap of 39 species. The 18 uniquely South-Atlantic species will be set aside for the present analysis.

Then of the 69 – 18 = 51 Atlantic species remaining, 33 are shared with the drainages of The Ohio. Let us call these 33 species “cosmopolitan” at the scale of the present analysis: extending (at minimum) from the Carolinas both north and west across the eastern continental divide. Then 64 – 33 = 31 Ohio drainage species demonstrate some degree of regionalism. These 31 species are classified in Figure 2.

The figure below lists 16 species as occurring in Ohio drainages only. These are 4 pulmonates (in red font) and 12 prosobranchs (in black) that have not been previously recorded by FWGNA surveys of any

other region – 9 hydrobioids, 3 pleurocerids, 2 lymnaeids, 1 planorbid and 1 ancyliid. We should hasten to stipulate that we have not published any results from the Great Lakes drainages to the north nor Mississippi drainages to the west, so these 16 species are not necessarily endemic to drainages of The Ohio. They are not, in any case, shared with drainages of the Atlantic or East Tennessee.

A set of 6 Ohio species, all pulmonates, are shared with Mid-Atlantic states, but not with other regions (pushing the single NW Pennsylvania population of *Pleurocera virginica* aside as accidental). And compared with drainages of The Ohio, the Mid-Atlantic states have six unique species, 2 pulmonates and 4 prosobranchs. This is a clear demonstration of East/West regionalism in the freshwater gastropods of North America. The phenomenon might best be characterized as a gradual turnover of pulmonates proceeding east, slightly net negative, and an abrupt discontinuity of prosobranchs, strikingly net negative.

Ohio only	<i>Lymnaea stagnalis</i> <i>Lymnaea caperata</i> <i>Gyraulus circumstriatus</i> <i>Rhodacmea filosa</i> <i>Pleurocera semicarinata</i> <i>Lithasia geniculata</i> <i>Lithasia armigera</i> <i>Birgella subglobosa</i> <i>Somatogyrus integra</i> <i>Marstonia lustrica</i> <i>Marstonia scalariformis</i> <i>Cincinnatia integra</i> <i>Probythinella emarginata</i> <i>Antroselates spiralis</i> <i>Fontigens cryptica</i> <i>Fontigens turritella</i>	Ohio/Mid-Atlantic	Mid-Atlantic only
Ohio/Tennessee	<i>Pleurocera canaliculata</i> <i>Pleurocera simplex</i> <i>Pleurocera laqueata</i> <i>Pleurocera troostiana</i> <i>Leptoxis praerosa</i> <i>Lithasia verrucosa</i> <i>Pomatiopsis cincinnatiensis</i> ↓ (<i>Pleurocera clavaeformis</i>) ↓ (<i>Pleurocera gabbiana</i>)	33 Cosmopolitan Species Shared with South Atlantic	
Tennessee Only	<i>Pleurocera modesta</i> <i>Pleurocera catenaria</i> <i>Io fluvialis</i> <i>Leptoxis crassa</i> <i>Somatogyrus parvulus</i> <i>Somatogyrus virginicus</i> <i>Clappia umbilicata</i> <i>Marstonia arga</i> <i>Marstonia ogmorhaphae</i> <i>Holsingeria unthinksensis</i> <i>Physa pomilia</i>		

The figure above also shows that the Ohio fauna shares a set of 7 species, almost all pleurocerids, with Tennessee drainages to the south (pushing down the New/Kanawha populations of *Pleurocera clavaeformis* and *P. gabbiana* as accidental). And the Tennessee list includes 13 species (6 pleurocerids, 6 hydrobioids, 1 pulmonate) not found in Ohio drainages. This is a clear demonstration of North/South regionalism in the freshwater gastropods of North America. The phenomenon might best be characterized as a gradual turnover in prosobranchs heading south, net neutral, and an abrupt discontinuity of pulmonates, strikingly net negative.

Narrowing our focus to biogeographic patterns within the Ohio River basin, we notice that the distributions of many freshwater gastropods seem to reflect ecoregional distinctions. The northern Glaciated Central Lowlands host quite a few species not found elsewhere in the basin, including *Marstonia lustrica*, *Lymnaea stagnalis*, *Physa vernalis*, *Aplexa hypnorum*, *Helisoma campanulata*, *Gyraulus deflectus*, and *G. circumstriatus*. Proceeding into the southern Glaciated Central Lowlands, we add *Viviparus georgianus*, *Probythinella emarginata*, *Cincinnatia integra*, and *Lymnaea elodes*. *Pleurocera troostiana* is restricted to the Unglaciated Interior Low Plateau. *Pleurocera simplex* and *P. laqueata* range through the Unglaciated Interior Low Plateau, extending into the Appalachian Plateau.

We were surprised to discover populations indistinguishable from *Pleurocera simplex* and *P. troostiana* of East Tennessee as far north as Kentucky. Goodrich (1940) gave the range of *Pleurocera* ("*Goniobasis*") *simplex* as "headwaters of Tennessee River system in Virginia, Tennessee and North Carolina; Beaver Fork of Bluestone River of Kanawha River, Mercer County, West Virginia." He seems to have identified Kentucky and Middle Tennessee populations as "*Goniobasis ebenum*," which he considered to range through "Cumberland River above the Falls; Smith's Shoals, Pulaski County, KY; springs and small streams of this river (The Cumberland) downstream to Dickson County, TN." And indeed, Branson (1987) and Branson, Batch & Call (1987) listed *Goniobasis ebenum* prominently in the Kentucky malacofauna, neglecting *simplex* entirely.

Our observations suggest that populations bearing shells of the *simplex* morphology intergrade smoothly with those bearing shells of the *ebenum* morphology as stream size increases. We here consider *ebenum* (Lea 1841) a subspecies of *simplex* (Say 1825) and suggest that *P. simplex* (now more broadly understood) extends through tributaries of the Kentucky and Green Rivers almost as far north as The Ohio River, as well as throughout the Cumberland drainage.

Our understanding of *Pleurocera troostiana* has also improved significantly in recent years. Goodrich (1940) considered "*Goniobasis troostiana* (Lea 1839)" endemic to its East Tennessee type locality, Moss Creek in Jefferson County. But our surveys of East Tennessee (Dillon & Kohl 2013) revealed that many more broadly-distributed species were junior synonyms of *troostiana*, the distinctions resting on phenotypically-plastic elements of the shell.

In the present survey, we report pleurocerid populations indistinguishable from *troostiana* through central and western Kentucky as far north as the Ohio River. In this region they have historically been identified as *Goniobasis* (or *Elimia*) *plicata-striata*, *G. curryana*, and *G. curryana lyoni* (Bickel 1968, Branson 1987). We suggest that all of these specific nomina: *plicata-striata* (Wetherby 1876), *curryana* (Lea 1841), and *lyoni* (Lea 1863), are junior synonyms of *troostiana* (Lea 1839) or *laqueata* (Say 1829).

- Bickel, D. (1968) *Goniobasis curreyana lyoni*, a pleurocerid snail of west-central Kentucky. *Nautilus* 82: 13 - 18.
- Branson, B.A. (1987) Keys to the aquatic Gastropoda known from Kentucky. *Trans. KY Acad. Sci.* 48: 11 – 19.
- Branson, B.A., D.L. Batch and S.M. Call (1987) Distribution of aquatic snails (Mollusca: Gastropoda) in Kentucky with notes on fingernail clams (Mollusca: Sphaeriidae: Corbiculidae) *Trans. KY Acad. Sci.* 48: 62 – 70.
- Dillon, R.T., Jr., M.J. Ashton, W.K. Reeves, T.P. Smith, T.W. Stewart, & B.T. Watson (2019a) Atlantic drainages, Georgia through Pennsylvania. *Freshwater Gastropods of North America*, Volume 1. FWGNA Press. 199 pp.
- Dillon, R. T., Jr. & M. Kohl (2013) The Freshwater Gastropods of Tennessee. Internet address: <http://www.fwgna.org/FWGTN>

Table 1. The 70 species and subspecies of freshwater gastropods inhabiting tributaries of The Ohio above ORM 920. Note that the row totals do not sum because of double-counting at state lines.

Species	IL	IN	KY	OH	MD	NC	NY	PA	TN	VA	WV	Total
<i>P. physa acuta</i>	85	97	258	194	2	12	3	10	3	40	256	1010
<i>Ferrissia rivularis</i>	20	16	66	37		24	1	120	1	53	196	529
<i>Lymnaea humilis</i>	11	37	80	74	2	3		56	1	29	117	406
<i>Pleurocera semicarinata semicarinata</i>	13	13	133	200							5	358
<i>Helisoma anceps</i>	9	6	67	67	1	4		29		28	47	257
<i>Campeloma decisum decisum</i>	61	34	70	53		4	1	35		14	16	251
<i>Leptoxis carinata</i>						21				96	118	235
<i>P. physa gyrina</i>	11	6	83	38		1		36	1	5	48	228
<i>Pleurocera canaliculata canaliculata</i>	89	50	96	30				1			20	188
<i>Helisoma trivolvis</i>	40	11	46	38			2	29		2	9	177
<i>Pleurocera semicarinata livescens</i>	44	44		2				52				141
<i>Ferrissia fragilis</i>	4	9	23	12			1	27		5	73	140
<i>Menetus dilatatus</i>	6	9	64	24		1		26		2	35	140
<i>Lymnaea columella</i>	6	13	22	7			1	12		11	19	90
<i>Pleurocera canaliculata acuta</i>	19	21	43	2				4			2	90
<i>Gyraulus parvus</i>	2	5	11	25			1	20			18	82
<i>Laevapex fuscus</i>	3	2	41	2				21		6	6	79
<i>Pleurocera simplex ebumum</i>			55						2	2		59
<i>Ammicola limosa</i>	2	2	5	8	1	1	1	36			6	56
<i>Birgella subglobosa</i>	9	24	36	17				3			8	56
<i>Pleurocera laqueata laqueata</i>			56									56
<i>Lithasia armigera</i>	39	13	31	4							4	45
<i>Pleurocera proxima</i>						20				24		44
<i>Lithasia verrucosa</i>	28	14	25	3				1			2	37
<i>Somatogyrus integra</i>	12	4	12					21				37
<i>Viviparus subpurpureus</i>	33	17	14									37
<i>Lymnaea elodes</i>	1	15	1	9				7				33
<i>Pleurocera semicarinata obovata</i>	8	5	26									33
<i>Pleurocera simplex simplex</i>			15						2	8	7	32
<i>Pleurocera troostiana</i>			28						3			31
<i>Viviparus georgianus</i>	24	11	12					1				30
<i>Cincinnatia integra</i>	4	4	6	9			1	3				24
<i>Lioplax subcarinata</i>	12	9	14									21
<i>Bellamya chinensis</i>	4	3	3	1				8			1	20
<i>Bellamya japonica</i>	1	2		13				2				18
<i>Leptoxis praerosa</i>	3	6	9							2	1	16
<i>Pomatiopsis lapidaria</i>	2		3	2				5		4		16
<i>Pomatiopsis cincinnatiensis</i>		6	2	4							1	13
<i>Gyraulus deflectus</i>		6					1	4				11
<i>Viviparus intertextus</i>	11	6	3									11
<i>Pleurocera shenandoa</i>										9	1	10
<i>Fontigens orolibas</i>										8		8
<i>Fontigens tartarea</i>											8	8
<i>Marstonia lustrica</i>				3				5				8
<i>Campeloma decisum crassulum</i>	1	3	7									7
<i>P. robythinella emarginata</i>	1	2	3	4							1	7
<i>Fontigens nickliniana</i>										5	1	6
<i>Fontigens bottimeri</i>					5							5
<i>Helisoma campanulata</i>	2							3				5
<i>Promenetus exacuus</i>				2			1	2				5
<i>Valvata tricarinata</i>				3			1	1				5
<i>Antroselates spiralis</i>		1	3									4
<i>Aplexa hypnorum</i>				2				2				4
<i>P. physa vernalis</i>				1				3				4
<i>Fontigens cryptica</i>		1	2									3
<i>Lithasia geniculata geniculata</i>	3		3									3
<i>Lyogyrus granum</i>			1					1		1		3
<i>Lymnaea stagnalis</i>		1						1				2
<i>Planorbula armigera</i>				1				1				2
<i>Pleurocera clavaeformis clavaeformis</i>										2		2
<i>Pleurocera gabbiana</i>										2		2
<i>Pleurocera laqueata alveare</i>			2									2
<i>Fontigens turritella</i>											1	1
<i>Gyraulus circumstriatus</i>								1				1
<i>Lymnaea caperata</i>	1	1										1
<i>Lymnaea catasopium</i>							1					1
<i>Marstonia pachyta angulobasis</i>			1									1
<i>Marstonia scalariformis</i>	1	1										1
<i>Pleurocera virginica</i>								1				1
<i>Rhodacmea filosa</i>			1									1
Totals	625	530	1482	891	11	91	16	690	13	358	1027	5250

Table 2. The 64 species of freshwater gastropods recovered from the drainages of The Ohio upstream from ORM 920, ranked by records in the FWGO database. Also given are common synonyms and overall (15-state) FWGNA incidence ranks.

Species	Records	FWGNA	Common synonyms
<i>Physa acuta</i>	1010	I-5	<i>Physella heterostropha</i> , <i>P. integra</i>
<i>Pleurocera semicarinata semicarinata</i>	358	532	<i>Goniobasis semicarinata</i> , <i>Elimia semicarinata</i>
<i>P. semicarinata livescens</i>	141		<i>Goniobasis livescens</i> , <i>Elimia livescens</i>
<i>P. semicarinata obovata</i>	33		<i>Lithasia obovata</i>
<i>Ferrissia rivularis</i>	529	I-5	<i>Ferrissia parallela</i>
<i>Lymnaea humilis</i>	406	I-5	<i>Galba</i> or <i>Fossaria humilis</i> , <i>obrussa</i> , <i>parva</i> , <i>modicella</i> ,
<i>Pleurocera canaliculata acuta</i>	90	278	<i>Pleurocera acuta</i>
<i>P. canaliculata canaliculata</i>	188		<i>Pleurocera nobile</i>
<i>Campeloma decisum decisum</i>	251	258	<i>Campeloma rufum</i> , <i>C. limosa</i> , <i>C. integra</i>
<i>C. decisum crassulum</i>	7		<i>Campeloma crassulum</i>
<i>Helisoma anceps</i>	257	I-5	
<i>Leptoxis carinata</i>	235	I-5	<i>Leptoxis virgata</i>
<i>Physa gyrina</i>	228	I-5	<i>Physella gyrina</i> , <i>P. ancillaria</i>
<i>Helisoma trivolvis</i>	177	I-5	<i>Planorbella trivolvis</i> , <i>P. pilsbryi</i>
<i>Ferrissia fragilis</i>	140	I-5	<i>F. walkeri</i>
<i>Menetus dilatatus</i>	140	I-5	<i>Micromenetus dilatatus</i>
<i>Pleurocera simplex ebenum</i>	59	91	<i>Goniobasis ebenum</i> , <i>Elimia ebenum</i>
<i>P. simplex simplex</i>	32		<i>Goniobasis simplex</i> , <i>Elimia simplex</i>
<i>Lymnaea columella</i>	90	I-5	<i>Pseudosuccinea columella</i>
<i>Gyraulus parvus</i>	82	I-5	
<i>Laevapex fuscus</i>	79	I-5	<i>L. diaphanus</i>
<i>Pleurocera laqueata laqueata</i>	56	58	<i>Goniobasis laqueata</i> , <i>Elimia laqueata</i>
<i>P. laqueata alveare</i>	2		<i>Pleurocera alveare</i>
<i>Amnicola limosa</i>	56	I-5	
<i>Birgella subglobosa</i>	56	I-4	
<i>Lithasia armigera</i>	45	I-4	
<i>Pleurocera proxima</i>	44	I-5	<i>Goniobasis proxima</i> , <i>Elimia proxima</i>
<i>Lithasia verrucosa</i>	37	I-4	<i>L. salebrosa</i>
<i>Somatogyrus integra</i>	37	I-4	
<i>Viviparus subpurpureus</i>	37	I-4	
<i>Lymnaea elodes</i>	33	I-4	<i>Stagnicola elodes</i> , <i>S. exilis</i> , <i>S. reflexa</i> , <i>Lymnaea palustris</i>
<i>Pleurocera troostiana</i>	31	I-5	<i>Goniobasis</i> or <i>Elimia troostiana</i> , <i>arachnoidea</i> , <i>porrecta</i> ,
<i>Viviparus georgianus</i>	30	I-4	
<i>Cincinnatia integra</i>	24	I-4	<i>Cincinnatia cincinnatiensis</i>
<i>Lioplax subcarinata</i>	21	I-4	
<i>Cipangopaludina chinensis</i>	20	i-4	<i>Bellamyia chinensis</i> , <i>C. maleata</i>
<i>Cipangopaludina japonica</i>	18	I-4	<i>Bellamyia japonica</i>
<i>Leptoxis praerosa</i>	16	I-5	<i>Anculosa subglobosa</i>
<i>Pomatiopsis lapidaria</i>	16	not ranked	
<i>Pomatiopsis cincinnatiensis</i>	13	I-3	
<i>Gyraulus deflectus</i>	11	I-3p	
<i>Viviparus intertextus</i>	11	I-4	
<i>Pleurocera shenandoa</i>	10	I-3	
<i>Fontigens orolibas</i>	8	I-4	
<i>Fontigens tartarea</i>	8	not ranked	
<i>Marstonia lustrica</i>	8	I-3p	<i>Amnicola lustrica</i>
<i>Probythinella emarginata</i>	7	I-3*	<i>Amnicola emarginata</i>
<i>Fontigens nickliniana</i>	6	I-4	
<i>Fontigens bottimeri</i>	5	I-3	
<i>Helisoma campanulata</i>	5	I-3p	<i>Planorbella campanulata</i>
<i>Promenetus exacuus</i>	5	I-4	
<i>Valvata tricarinata</i>	5	I-3p	
<i>Antroselates spiralis</i>	4	not ranked	
<i>Aplexa hypnorum</i>	4	I-3p	<i>Aplexa elongata</i>
<i>Physa vernalis</i>	4	I-3*	
<i>Fontigens cryptica</i>	3	not ranked	
<i>Lithasia geniculata geniculata</i>	3	I-2	
<i>Lyogyrus granum</i>	3	I-5	<i>Lyogyrus pupoideus</i> , <i>L. walkeri</i> , <i>Amnicola grana</i>
<i>Lymnaea stagnalis</i>	2	I-2p	
<i>Planorbula armigera</i>	2	I-4	
<i>Pleurocera clavaeformis clavaeformis</i>	2	I-5	<i>Goniobasis clavaeformis</i> , <i>Elimia clavaeformis</i>
<i>Pleurocera gabbiana</i>	2	I-4	
<i>Fontigens turritella</i>	1	not ranked	
<i>Gyraulus circumstriatus</i>	1	I-1p	
<i>Lymnaea caperata</i>	1	I-1p	
<i>Lymnaea catascopium</i>	1	I-3p	<i>Stagnicola catascopium</i> , <i>S. emarginata</i>
<i>Marstonia pachyta angulobasis</i>	1	I-1	
<i>Marstonia scalariformis</i>	1	I-1	
<i>Pleurocera virginica</i>	1	I-5	<i>Elimia virginica</i>
<i>Rhodacmea filosa</i>	1	I-1	
Sum	5250		