Newsletter of the Freshwater Mollusk Conservation Society
Vol. 22 – No. 3 ISSN 2689-2936 September 2020

FMCS will NOT Hold an In-Person Symposium in 2021

As a result of discussions among members of the 2021 Local Planning Committee and the Executive Committee, the decision has been made that FMCS will **not** hold an in-person Symposium during 2021, either in Portland, Oregon, or elsewhere. Given the present state of COVID-19-related issues, and the uncertainties surrounding possible travel restrictions, group gathering prohibitions, and agency budget constraints, we recognized that it will not be possible to gather together any time soon in the way we have at past Symposia.

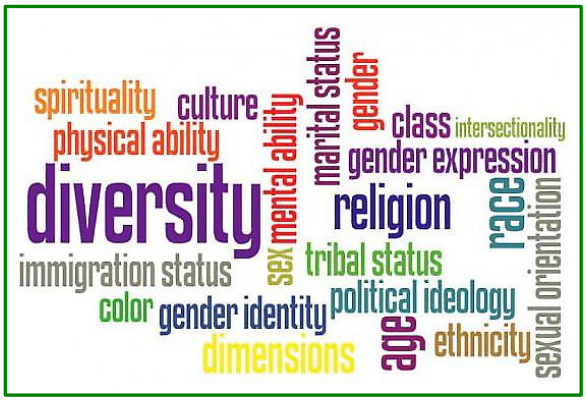
But all may not be lost for 2021! With the decision made not to assemble for a regular Symposium, we are exploring a variety of options for holding some sort of

virtual conference or Symposium next year. Any plans for a virtual gathering during 2021, and plans for future FMCS events, will be announced via email, the Unio listserve, on our social media sites, and in *Ellipsaria*. Stay tuned, and Stay Safe.

Society News

Necessary Growing Pains

Tamara Smith, Chair of the FMCS Diversity, Equity, and Inclusion (DE&I) Committee



Following the tragic death of George Floyd, the FMCS Executive Committee and the DE&I Committee wanted to express our support for racial equality and justice. We, like other professional societies, wrote a statement that was emailed to the membership and is posted below.

We found that writing this statement together, in itself, was part of the work necessary for growth. We also recognized that, sometimes, that work needs to be uncomfortable. We quickly realized that our statement was not going to be perfect and that there was something more important than the words; we wanted to commit to action. While the statement focuses on racial injustices, it generated a spirited discussion about the intersectionality of injustices to Black, Brown, and Indigenous People of Color, the LGBTQ+ community, people with disabilities, and other marginalized groups. We hope that reposting this statement in our society newsletter will encourage all FMCS members to join in this important discussion as we work towards an equitable future in science, and in society.

FMCS Position Statement on Social Injustice

The Freshwater Mollusk Conservation Society (FMCS) recognizes many social prejudices and inequalities have occurred for far too long in the United States and elsewhere. The Black Lives Matter movement has, once again, brought issues of racism and discrimination to the forefront of a global conversation and, as a society, we cannot sit idly by and remain quiet if we expect change to occur. Many of our Black, Indigenous, and People of Color (BIPOC) and LGBTQ+ colleagues, students, neighbors, families, and friends are affected by these discriminations. Like many other aquatic science societies, including the American Fisheries Society and the Society of Freshwater Science, FMCS stands in solidarity in support of movements to fight the oppression against underrepresented groups. FMCS condemns social injustices and supports the advancement of equality, diversity and inclusion in the workplace and beyond. Natural resources and the career opportunities they provide are for everyone. All are welcome.

Regrettably, there are far too many inexcusable barriers impeding fellow humans from sharing the same experiences so many of us take for granted. Many of our non-BIPOC members do not worry about the color of their skin when doing research, enjoying public spaces, or sleeping in our homes the way so many BIPOC and underrepresented groups in America do. In order to demand change, we have to rise above the hate, stand together in support, and work collectively in creating a more equitable world. We challenge each of our members to be inclusive, mentor those outside of our academic bubble, and expand opportunities to groups that are underrepresented. Let us all commit to change.

The FMCS Executive Committee and Diversity and Inclusion Committee feel strongly that our Society cannot remain inactive at this moment if we are authentic in our commitment to equity. We recognize that we have a lot of work to do. We encourage all members to educate themselves on how racism and bigotry are at work in the institutions we are a part of, and what we might be able to do to fix it. Conservation and environmental history include racism, bigotry, and systemic oppression, and we want to begin the work to fight this structural problem starting with our Society. As researchers, we are skilled at finding information, and on this subject, it is no different. We [the FMCS Executive Committee and FMCS Diversity and Inclusion Committee] encourage every member to read anti-racist works like *How to Be an Anti-Racist* by Kendi X. Ibram and *White Fragility* by Robin Diangelo. Additionally, we encourage all to read the firsthand accounts of how our colleagues are directly affected by these social prejudices and inequalities by simply following the hashtag #BlackintheIvory and #ShutDownSTEM (no Twitter account needed to read).

FMCS will continue to explore ways to recruit and retain minorities in our society and increase their accessibility to our meetings. We will seek out other professional aquatic societies on identifying ways we can grow, not just as single societies, but as a collective group. We will start to foster those relationships and create a more inclusive atmosphere that will begin to build trust and ultimately lead to tangible action items. The FMCS Diversity and Inclusion Committee is committed to sending our members a demographic survey that we encourage you to complete. We will develop plans and resources to infuse our institution with equity and inclusiveness actions over the coming years, which we will share on our website, journal, social media, and other outlets. We call on all members of our Society to join us in difficult conversations to make our institution stronger and more equitable. It's the FMCS Executive Committee and FMCS Diversity and Inclusion Committee's responsibility to use our privilege for good in this moment.

As a society, we have and will continue to reflect how FMCS operates and will work on recognizing and eliminating our biases. We are resolved in continuing to make more concerted efforts in the uncomfortable conversations around race and inequality. We will be committed to these ideals to help make our communities a safer space for all.

On behalf of the Freshwater Mollusk Conservation Society,

Jeremy Tiemann, President

Heidi Dunn, Past-President

Janet Clayton, Secretary

Tamara Smith, DE&I Chair

Stephen McMurray, President Elect

Alan Christian, Treasurer

Last Call for 2021 Officer Nominations

Final call for nominees! We are seeking nominations for President-Elect, Secretary, and Treasurer of our Society.

If you have been looking for more ways to be involved in FMCS, this is a fantastic opportunity for you! Serving as an officer is an excellent way to expand your professional network and further develop leadership skills. For any FMCS member, this is a chance to contribute your experience in shaping and moving our society forward.

The Nominations Committee will select the two candidates willing to run for each office who receive the most nominations for that office. The position statements from the candidates will be posted in the December issue of *Ellipsaria*, and on the FMCS website in January 2021. Voting will be done through the FMCS website and the results will be announced early next year.

Send your nominations to Wesley Daniel by email at wdaniel@usgs.gov . If you have any questions, please contact Wesley by email or call him at 225-953-2935. The deadline for nominations is **October 5, 2020**.

Update on Professional Certification Program

The Professional Development Committee is close to finalizing the Mollusk Professional Certification Guidelines. We have asked the Diversity and Inclusion Committee to help ensure the draft Guidelines are aligned with the mission of the Society to cultivate a society built on mutual respect and strive for a welcoming environment. We are working to finalize a working draft to distribute to the FMCS Executive Committee and third-party reviewers very soon!

It is important to call attention to the fact that this Certification is not intended to certify an individual's ability, nor is it an endorsement for an individual's specific knowledge, skills, or competency in any facet of mollusk science. An individual meeting the Certification requirements will indicate that person has demonstrated a minimum standard of experience and education as a freshwater aquatic mollusk biologist and/or professional.

If you would like to participate in the Professional Development Committee or provide feedback on the Certification Guidelines, please contact Becca (beccawint6@gmail.com) or Amanda (arosenberger@tntech.edu).

Call for Formal Change Petitions Concerning Scientific and Common Names

The Gastropod and Bivalve working groups of the FMCS Common and Scientific Names Subcommittee will review proposed changes to their respective lists of scientific and common names for the United States and Canada during a virtual meeting to be held in mid-April 2021. For names to be considered, a formal petition must be received by 15 January 2021 (≈ 90 days before the committee meetings). Any FMCS member may submit a proposed new name or name change following the committee rules and using the submission form found on the Names page on the FMCS website (https://molluskconservation.org/MServices_Names.html). If multiple petitions are received for the same name or names, the working group chairs may require petitioners to combine their submittals for the sake of brevity. Questions or comments can be submitted to the working group chairs: John Harris (omibob1@gmail.com) chairs the bivalve subcommittee, and Paul Johnson (paul.johnson@dcnr.alabama.gov) chairs the gastropod subcommittee.

Upcoming Meetings

September 14 - 25, 2020 –American Fisheries Society virtual meeting https://afsannualmeeting.fisheries.org/

October 25 – 28, 2020 – Southeastern Association of Fish and Wildlife Agencies 74th Annual Conference, virtual conference. http://www.seafwa.org/conference/overview/

March 21 – 26, 2021 – National Shellfisheries Association 113th Annual Meeting, Sheraton Charlotte Hotel, Charlotte, North Carolina, USA. https://www.shellfish.org/annual-meeting

~~**April 11 – 15, 2021** – FMCS 12th Biennial Symposium, Portland, Oregon, USA. Theme: *Mountains to Sea and Mollusks Between*. https://www.molluskconservation.org/EVENTS/2021SYMPOSIUM/2021_FMCS_SYMPOSIUM.html~~ **CANCELED** -- See aericle on Page 1

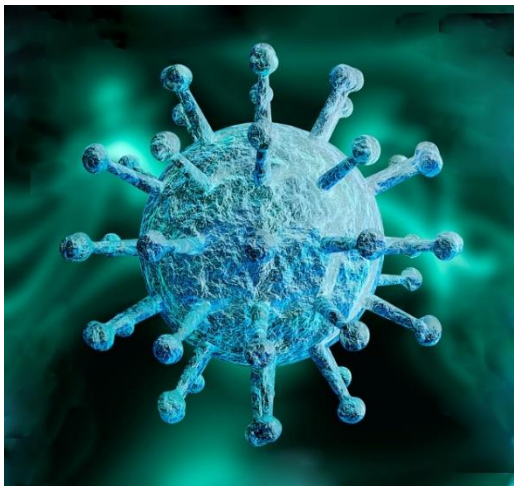
May 23 – 27, 2021 – Society for Freshwater Science Annual Meeting, Philadelphia, Pennsylvania, USA. Theme: *Freshwater Science in a Time of Transformation* http://sfsannualmeeting.org/

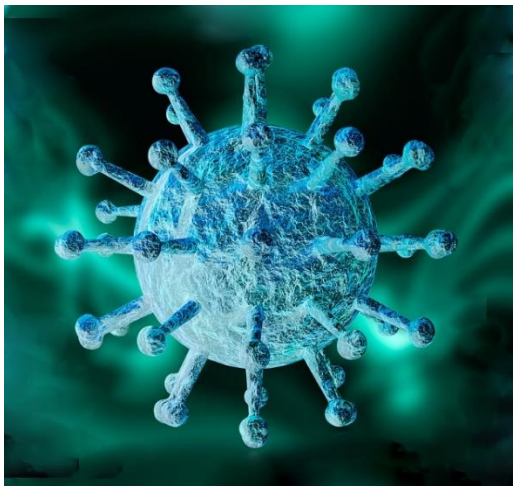
Summer (?) 2021 – American Malacological Society Annual Meeting, [dates and location not yet posted] http://www.malacological.org/

September 5 – 9, 2021 – Ninth European Congress of Malacological Societies (EUROMAL 2@2@), Prague, Czech Republic www.euromal.cz.

Summer (?) 2022 – Society for Conservation Biology North American Sectional Meeting, [dates and location not yet posted] http://scbnorthamerica.org/index.php/naccb

Spring ? 2023 – FMCS Biennial Symposium, Michigan (?) [Dates, Location, and Theme not yet determined]





Contributed Articles

The following articles have been contributed by FMCS members and others interested in freshwater mollusks. These contributions are incorporated into Ellipsaria *without peer review and with minimal editing. The opinions expressed are those of the authors.*

Reproductive Isolation Between *Lithasia* Populations of the *geniculata* and *duttoniana* Forms in the Duck River, Tennessee

Robert T. Dillon, Jr., Freshwater Gastropods of North America Project.
P.O. Box 31532, Charleston, South Carolina, USA 29417 dillonr@fwgna.org

Goodrich (1940) recognized two species of *Lithasia* in the Duck River – the famous populations of *Lithasia geniculata* (with three subspecies) which he featured in his landmark (1934) study on shell morphology in the Pleuroceridae, and the only-slightly-less famous *Lithasia duttoniana*. Populations of *Lithasia geniculata* inhabit midstream high-current areas down almost the entire length of the river, bearing smooth shells in the headwaters at DRM 275, developing bumpy shoulders in the lower reaches (Dillon 2020). Populations that Goodrich identified as *Lithasia duttoniana* only inhabit lower reaches of the Duck River, from about DRM 186 to the mouth, generally reaching higher densities at the stream margins. Their shells are not bumpy so much as carinate or slightly spiny, bearing more acute protuberances around a periphery lower on the shell whorl.

Minton and Lydeard (2003) conducted an extensive survey of mtDNA sequence variation across a broad sample of North American *Lithasia* populations, ultimately reporting CO1 sequence data from 27 populations representing 11 nominal species and subspecies. The four unique sequences they obtained from 19 Duck River snails (1 *jayana*, 4 *duttoniana*, 1 *geniculata geniculata*, 7 *geniculata fuliginosa*, and 6 *geniculata pinguis*, in 9 Genbank submissions) did not resolve into any consistent clades. Thus Minton and Lydeard synonymized all Duck River populations under a single specific nomen, *Lithasia fuliginosa*. Minton and colleagues (2008) went on to lump Duck River *Lithasia* populations of all historic nomina into a single study of shell morphological variation down the entire length of the river.

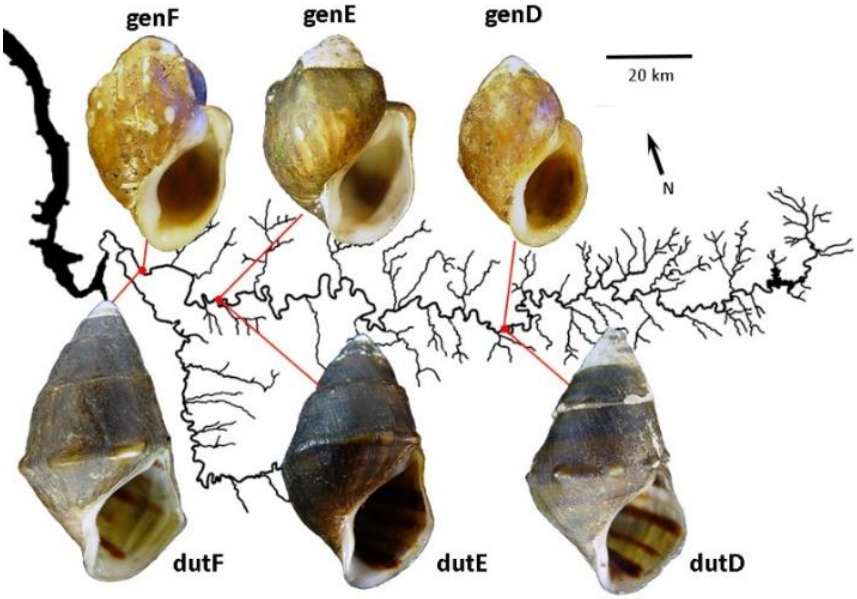


Figure 1. The Duck River of Middle Tennessee, showing sample sites. The shell length of dutF is 24.6 mm; the other shells are to scale.

Dillon (2020) has recently reported the results of a survey of allozyme variation in a set of seven *L. geniculata* populations incidentally sampled during a 2000-02 survey of the Duck River unionid mussel fauna by Ahlstedt and colleagues (2017), transmitted by P. D. Johnson. Samples of *Lithasia* bearing the *duttoniana* shell morphology were also collected with the *geniculata* samples at the three lowest sample sites, site D from the Fountain Creek confluence (TNC94, 35.5695, -86.9682), site E from Wright Bend (TNC110, 35.8267, -87.6657), and site F at the Watered Hollow boat launch (35.9322, -87.7475). See Figure 1.

Here I report a survey of allozyme variation in Duck River *Lithasia* of the *duttoniana* form, conducted alongside the study of the *geniculata* form reported by Dillon (2020). A sample of ten *duttoniana* individuals from site E (dutE) was also analyzed along with the samples from pinA and genE referenced in my 2020 study and screened for polymorphism at 17 enzyme loci using the methods of Dillon (1982, 1985, 1992). And again, as reported in 2020, allozyme variation interpretable as the product of codominant Mendelian inheritance was discovered at just three loci: mannose phosphate isomerase (Mpi) on buffers TrisCit6 and TEB8, octopine dehydrogenase (Odh) on buffers TrisCit6 and Poulik, and hexanol dehydrogenase (Hexdh) on buffers TEB8 and Poulik. Genetic variation was subsequently assessed at these three loci only for the remainder of the populations and individuals.

Gene frequencies in *geniculata*-form and *duttoniana*-form samples were strikingly different at all three sites where they were collected together (Table 1). The frequency of Hexdh99 ranged from 0.214 – 0.426 in *duttoniana* sampled from sites D, E, and F, while rising no higher than 0.015 in co-occurring *geniculata*. The Fisher's exact probability that genF and dutF were drawn from the same population of Hexdh alleles was 0.0003, and much lower comparing *geniculata* and *duttoniana* at sites D and E. The absence of Odh114 and Odh111 (together) in *geniculata* was also extremely significant (Fisher's exact $p < 0.0001$ at sites E and F), as well as the near absence of Mpi91 in *duttoniana* sampled from the same sites. The (Nei 1978) genetic distances among samples genD, genE, and genF ranged from 0.096 - 0.227, and those among samples dutD, dutE, and dutF ranged from 0.107 - 0.245, showing no overlap with the 0.276 - 0.360 range of between-group genetic distances. This constitutes strong evidence of reproductive isolation between *Lithasia* populations of the *geniculata* and *duttoniana* forms in the Duck River.

Table 1. Gene frequencies at three allozyme-encoding loci in three Duck River populations of *Lithasia geniculata* and co-occurring populations bearing the *duttoniana* shell form.

	Fountain Cr. conf.		**Wright Bend**		**Watered Hollow**	
	genD	**dutD**	**genE**	**dutE**	**genF**	**dutF**
Odh	32	34	49	44	33	35
114	0.0	0.0	0.0	0.011	0.0	0.129
112	0.547	0.456	0.582	0.239	0.561	0.057
111	0.0	0.059	0.0	0.136	0.0	0.186
109	0.453	0.485	0.418	0.614	0.439	0.629
Mpi	32	34	49	44	33	35
97	0.0	0.0	0.0	0.0	0.015	0.0
94	1.00	0.985	0.867	1.00	0.667	0.986
91	0.0	0.0	0.133	0.0	0.318	0.014
90	0.0	0.015	0.0	0.0	0.0	0.0
Hexdh	25	34	41	37	33	35
99	0.0	0.426	0.012	0.432	0.015	0.214
93	1.00	0.574	0.988	0.568	0.985	0.786

These results have important implications. In recent years, at least four separate studies have returned evidence of double-digit mtDNA sequence divergence within pleurocerid populations: Dillon & Frankis (2004) Dillon and Robinson (2009, 2016), and Whelan and Strong (2016). Such results, termed "mitochondrial superheterogeneity" by Dillon (2019), have been interpreted both as evidence that pleurocerid populations are highly fragmented, and that they are extraordinarily old.

In the Duck River, however, a pair of reproductively isolated *Lithasia* species apparently demonstrate no mtDNA sequence divergence at all. It is certainly possible that *Lithasia* populations of the *geniculata* and *duttoniana* forms have speciated so recently that no mtDNA sequence divergence has as yet accumulated. The interspecific levels of allozyme divergence reported here are as strikingly low as their COI sequence divergence (e.g., Dillon 1984). It is also possible that the CO1 sequences shared by both species (GenBank AF435744 and variants) are ancestral to the genus *Lithasia*, preserved by populations of both species in parallel for millions of generations after their divergence.

In either case, the results presented here, together with those such as have been reported by Dillon and Robinson (2009) and Whelan and Strong (2016), should strongly caution workers relying on so-called "DNA Barcoding" methods to work out specific relationships among populations of freshwater gastropods.

References:

Ahlstedt, S. A., J. R. Powell, R. S. Butler, M. T. Fagg, D. W. Hubbs, S. F. Novak, S. R. Palmer & P. D. Johnson. 2017. Historical and current examination of freshwater mussels (Bivalvia: Margaritiferidae: Unionidae) in the Duck River basin Tennessee, USA. *Malacological Review* 45:1-163.

Dillon, R. T., Jr. 1982. *The correlates of divergence in isolated populations of the freshwater snail, Goniobasis proxima* (Say). Ph.D. Dissertation, The University of Pennsylvania.

Dillon, R.T., Jr. 1984. Geographic distance, environmental difference, and divergence between isolated populations. *Systematic Zoology* 33:69-82.

Dillon, R. T., Jr. 1985. Correspondence between the buffer systems suitable for electrophoretic resolution of bivalve and gastropod isozymes. *Comparative Biochemistry and Physiology* 82B:643-645.

Dillon, R. T., Jr. 1992. Electrophoresis IV, nuts and bolts. *World Aquaculture* 23(2):48-51.

Dillon, R.T., Jr. 2019. Mitochondrial superheterogeneity: What we know. Pp 145 - 153 in *The Freshwater Gastropods of North America Volume 3, Essays on the Prosobranchs*. FWGNA Press, Charleston.

Dillon, R. T., Jr. 2020. Population genetic survey of *Lithasia geniculata* in the Duck River, Tennessee. *Ellipsaria* 22(2):19 – 21.

Dillon R. T., Jr. and R. C. Frankis. 2004. High levels of DNA sequence divergence in isolated populations of the freshwater snail, Goniobasis. *American Malacological Bulletin* 19:69 – 77.

Dillon, R. T., Jr. and J. D. Robinson. 2009. The snails the dinosaurs saw: Are the pleurocerid populations of the Older Appalachians a relict of the Paleozoic Era? *Journal of the North American Benthological Society* 28:1 – 11.

Dillon, R. T., Jr. and J. D. Robinson. 2016. The hazards of DNA barcoding, as illustrated by the pleurocerid gastropods of East Tennessee. *Ellipsaria* 18(1):22-24.

Goodrich, C. 1934. Studies of the gastropod family Pleuroceridae - I. *Occasional Papers of the Museum of Zoology, University of Michigan* 286: - 17.

Goodrich, C. 1940. The Pleuroceridae of the Ohio River drainage system. *Occasional Papers of the Museum of Zoology, University of Michigan* 417:1 - 21.

Minton, R. L., A. P. Norwood and D. M. Hayes. 2008. Quantifying phenotypic gradients in freshwater snails: a case study in Lithasia (Gastropoda: Pleuroceridae). *Hydrobiologia* 605:173 – 182.

Minton, R. L. and C. Lydeard. 2003. Phylogeny, taxonomy, genetics, and global heritage ranks of an imperiled, freshwater snail genus *Lithasia* (Pleuroceridae). *Molecular Ecology* 12:75-87.

Nei, M. 1978 Estimation of average heterozygosity and genetic distance from a small number of individuals. *Genetics* 89:583–590.

Whelan, N.V. and E. E. Strong. 2016. Morphology, molecules and taxonomy: extreme incongruence in pleurocerids (Gastropoda, Cerithiodea, Pleuroceridae). *Zoologica Scripta* 45:62 – 87.

Natural Hosts for St. Croix River *Epioblasma triquetra*, *Fusconaia flava*, *Pleurobema sintoxia*, *Strophitus undulatus*, and *Theliderma metanevra*

Mark Hove[1,4], **Katrina Carrow**[1], **Sam Taylor**[1], **Joel Donna**[2,3], **Christopher Rounds**[1], **Susan Binkley**[3], **Susan Deetz**[3], **Amy Rager**[3], **John Loegering**[3], **Dennis Zerwas, Jr.**[3], and **Dan Hornbach**[4]
Corresponding author – mark_hove@umn.edu

[1] University of Minnesota (UMN), St. Paul, Minnesota
[2] University of Wisconsin, River Falls, Wisconsin
[3] Minnesota Master Naturalist Program, UMN Extension, St. Paul, Minnesota
[4] Macalester College, St. Paul, Minnesota

Accurate glochidia host information supports rare mussel conservation efforts. This information also can be used to propagate juvenile mussels (e.g., Eckert 2014, Hubbs 2018). One of the strongest forms of evidence for glochidia-host relationships comes from recovering and identifying juveniles from naturally-infested fishes. The purpose of this study was to determine natural glochidial hosts by collecting and identifying juvenile mussels recovered from fishes living around a diverse mussel bed.

We followed standard methods (Hove et al. 2016) during this study. On 16 July 2019, we collected fishes from the St. Croix River in Chisago County, Minnesota, and held them in species-specific aquaria at the UMN. Juvenile mussels released by these fishes were photographed with a scanning electron microscope. The glochidial shells of each juvenile were measured from the micrographs and those dimensions were compared with those of known reference glochidia we had measured during earlier studies. Possible identities of unknown juveniles were selected from mussel species that have glochidia of similar sizes and shapes (Watters et al. 2009), and are known to occur in the St. Croix River (Hornbach et al. 2018) (Table 1). Reference glochidia used in this study came from mussel species collected from the following Minnesota streams or rivers: Big Fork River (Koochiching County), Big Sandy River watershed (Aitkin County), Chanarambia Creek (Pipestone County), Kanaranzi Creek (Rock County), Kohlman Creek (Ramsey County), Mississippi River (Aitkin County), Prairie Creek (Aitkin County), St. Croix River (Chisago County), Sunrise River (Chisago County), or Turtle Creek (Freeborn County). We used shell dimension data of glochidia from the known mussel species to develop discriminant functions to differentiate among species and to identify the glochidial shells on the unknown juveniles. Mussel and fish nomenclature follow Williams et al. (2017) and Page et al. (2013), respectively.

No juvenile mussels or glochidia were recovered from one *Notropis volucellus* (Mimic Shiner), two *Pimephales promelas* (Fathead Minnow), or one *Micropterus dolomieu* (Smallmouth Bass) included in this study. We recovered seven juvenile mussels from naturally infested *Percina caprodes* (Logperch) and 16 juvenile mussels from *Cyprinella spiloptera* (Spotfin Shiner). Using discriminant analyses, we identified seven *Epioblasma triquetra* from three *P. caprodes*; and two *Fusconaia flava*, twelve *Pleurobema sintoxia*, one *Strophitus undulatus*, and one *Theliderma metanevra* from 29 *C. spiloptera* (Table 2).

Table 1. Reference glochidia shell dimensions from mussels collected from Big Fork River (BF), Big Sandy River watershed (BS), Chanarambia Creek (C), Kanaranzi Creek (Ka), Kohlman Creek (Ko), Mississippi River (M), Prairie Creek (P), St. Croix River (SC), Sunrise River (S), or Turtle Creek (T). We used Tukey HSD (JMP v.14) test to determine that shell dimension means with different column superscripts were significantly different (P<0.05).

Species	Height ± 1 std dev (µ)	Length ± 1 std dev (µ)	Hinge length ± 1 std dev (µ)
Glochidia similar in size and shape to *Epioblasma triquetra* and *Theliderma metanevra*			
Amblema plicata (SC)	233±8[a]	217±6[a]	141±5[b]
Eurynia dilatata (SC)	232±12[a]	221±7[a]	149±5[a]
Epioblasma triquetra (SC)	207±4[b]	204±5[b]	143±5[b]
Theliderma metanevra (SC)	208±5[b]	188±7[c]	86±4[d]
Toxolasma parvum (C,Ka,Ko)	198±9[c]	176±10[d]	100±7[c]
Glochidia similar in size and shape to *Fusconaia flava* and *Pleurobema sintoxia*			
Fusconaia flava (SC)	167±5[a]	171±7[a]	137±8[a]
Pleurobema sintoxia (SC)	166±6[a]	167±5[b]	122±3[b]
Similar in size and shape to *Strophitus undulatus*			
Lasmigona compressa (BF,BS,M,P,T)	269±14[a]	302±53[a]	227±14[a]
Strophitus undulatus (S,SC)	298±13[b]	363±17[b]	265±20[b]

Table 2. Glochidial shell dimensions from juvenile mussels released by naturally-infested fishes in the St. Croix River and results of the discriminant analysis identifications.

Height ± 1 std dev (µ)	Length ± 1 std dev (µ)	Hinge length ± 1 std dev (µ)	Discriminant analysis prediction probability
Juveniles from *Percina caprodes*			
208	200	143	100% *Epioblasma triquetra*
210	201	143	99% *Epioblasma triquetra*, 1% *Eurynia dilatata*
214	207	140	82% *Epioblasma triquetra*, 10% *Amblema plicata*, 8% *Eurynia dilatata*
215	202	144	94% *Epioblasma triquetra*, 4% *Eurynia dilatata*, 2% *Amblema plicata*
211	198	150	100% *Epioblasma triquetra*
206	196	142	100% *Epioblasma triquetra*
211	198	145	99% *Epioblasma triquetra*, 1% *Eurynia dilatata*

Table 2. (continued)

Height ± 1 std dev (µ)	Length ± 1 std dev (µ)	Hinge length ± 1 std dev (µ)	Discriminant analysis prediction probability
Juveniles from *Cyprinella spiloptera*			
159	154	130	95% *Fusconaia flava*, 5% *Pleurobema sintoxia*
153	152	124	80% *Pleurobema sintoxia*, 20% *Fusconaia flava*
159	165	127	90% *Pleurobema sintoxia*, 10% *Fusconaia flava*
166	165	132	91% *Fusconaia flava*, 9% *Pleurobema sintoxia*
151	154	121	98% *Pleurobema sintoxia*, 2% *Fusconaia flava*
193	173	84	96% *Theliderma metanevra*, 4% *Toxolasma parvum*
145	158	122	100% *Pleurobema sintoxia*
153	161	128	89% *Pleurobema sintoxia*, 11% *Fusconaia flava*
148	154	122	98% *Pleurobema sintoxia*, 2% *Fusconaia flava*
160	159	133	96% *Fusconaia flava*, 4% *Pleurobema sintoxia*
296	371	285	100% *Strophitus undulatus*
153	158	125	92% *Pleurobema sintoxia*, 8% *Fusconaia flava*
156	156	114	100% *Pleurobema sintoxia*

During this study, we identified previously unknown natural hosts for two mussel species, confirmed natural hosts for three others, and broadened our understanding of suitable host relationships. To our knowledge, this study is the first to show that *Cyprinella spiloptera* can serve as a natural host for *Theliderma metanevra* and *Strophitus undulatus*. *Percina caprodes* has previously been found to be a natural host for *Epioblasma triquetra* (Van Susteren et al. 2015), and *C. spiloptera* has previously been found to be a natural host for *Fusconaia flava* and *Pleurobema sintoxia* (Boyer et al. 2011). Laboratory studies have shown that *C. spiloptera* is a suitable host for *Toxolasma metanevra* (Hove et al. 1997, Crownhart et al. 2006, Fritts et al. 2012) and for *Strophitus undulatus* (Hove 1995, Hove et al. 1997, Cliff et al. 2001).

Literature cited

Boyer, S. L., A. A. Howe, N. W. Juergens, and M. C. Hove. 2011. A DNA-barcoding approach to identifying juvenile freshwater mussels (Bivalvia: Unionidae) recovered from naturally infested fishes. *Journal of the North American Benthological Society* 30(1):182-194.

Cliff, M., M. Hove, and M. Haas. 2001. Creeper glochidia appear to be host generalists. *Ellipsaria* 3(1):18–19.

Crownhart, A., B. Sietman, M. Hove, and N. Rudh. 2006. *Quadrula metanevra* glochidia metamorphose on select minnow species. *Ellipsaria* 8(3):6.

Eckert, N. 2014. Mussel cage harvest yields bumper crop at Genoa NFH. *Genoa News and Notes*, p. 4.

Fritts, A. K., B. E. Sietman, M. C. Hove, N. E. Rudh, J. M. Davis, and D. J. Heath. 2012. Early life history and conservation status of the monkeyface, *Theliderma metanevra* (Mollusca: Bivalvia) in Minnesota and Wisconsin. *Walkerana* 15(2):99-112.

Hornbach, D., D. Allen, M. Hove, and K. MacGregor. 2018. Long-term decline of native freshwater mussel assemblages in a US Wild and Scenic River. *Freshwater Biology* 63(3):243-263.

Hove, M. C. 1995. Early life history research on the squawfoot, *Strophitus undulatus*. *Triannual Unionid Report* 7:28.

Hove, M. C., R. A. Engelking, M. E. Peteler, E. M. Peterson, A. R. Kapuscinski, L. A. Sovell, and E. R. Evers. 1997. Suitable fish hosts for glochidia of four freshwater mussels. Pages 21–25 *in* K. S. Cummings, A. C. Buchanan, C. A. Mayer, and T. J. Naimo, editors. *Conservation and Management of Freshwater Mussels II: Initiatives for the future*. Proceedings of an Upper Mississippi River Conservation Committee Symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee Rock Island, Illinois, 293 pages.

Hove, M. C., B. E. Sietman, M. S. Berg, E. C. Frost, K. Wolf, T. R. Brady, S. L. Boyer, and D. J. Hornbach. 2016. Early life history of the sheepnose (*Plethobasus cyphyus*) (Mollusca: Bivalvia: Unionoida). *Journal of Natural History* 50(9-10):523-542.

Hubbs, D. 2018. 2017 Tennessee's Mollusk Recovery Program achievements. *Ellipsaria* 20(2):29-32.

Page, L. M., H. Espinosa-Pérez, L. T. Findley, C. R. Gilbert, R. N. Lea, N. E. Mandrak, R. L. Mayden, and J. S. Nelson. 2013. *Common and scientific names of fishes from the United States, Canada, and Mexico, 7th edition.* American Fisheries Society, Special Publication 34, Bethesda, Maryland.

Van Susteren, G., M. Hove, B. Sietman, M. Berg, and D. Hornbach. 2015. Snuffbox (*Epioblasma triquetra*) metamorphose on naturally infested logperch. *Ellipsaria* 17(1):20-21.

Watters, G. T., M. A. Hoggarth, and D. H. Stansbery. 2009. *The freshwater mussels of Ohio*. The Ohio State University Press, Columbus, Ohio. 421 pages

Williams, J. D., A. E. Bogan, R. S. Butler, K. S. Cummings, J. T. Garner, J. L. Harris, N. A. Johnson, and G. T. Watters. 2017. A revised list of the freshwater mussels (Mollusca: Bivalvia: Unionida) of the United States and Canada. *Freshwater Mollusk Biology and Conservation* 20(2):33-58.

First Confirmed Records of Two Limnic/ Freshwater Mollusks (Gastropoda and Bivalvia) in Santa Catarina State/ SC, Central Southern Brazil

A. Ignacio Agudo-Padrón and **Francisco Carneiro**, Project Avulsos Malacológicos - AM, P.O. Box 010, 88010-970 Centro, Florianópolis, Santa Catarina/ SC, Brazil – ignacioagudo@gmail.com; fecbio@gmail.com; http://noticias-malacologicas-am.webnode.pt/

The inventory of non-marine mollusks (land/ terrestrial and limnic/ freshwater species) present in State of Santa Catarina/ SC, Brazil, (Agudo-Padrón 2018, 2020) continues to grow. This report adds two new freshwater/ limnic species for this little geographical territory, bringing the known total to 254 species (85 limnic/ freshwater, 3 amphibious/ limnophiles, and 166 terrestrial forms).

Once again, these new records come from the hydrographic region of the Itajaí River (Agudo-Padrón 2011). The Itajaí River, in the central-eastern portion of the State, is the largest hydrographic basin/watershed in the State of Santa Catarina/ SC with a direct discharge in the South Atlantic Ocean (black outline around the red sector on Figure 1), The basin, which occupies 16.15% of the State and 0.6% of the entire Brazilian territory, is located between the geographical coordinates 26°41'54'' – 27°41'02''S/48°39'39" – 50°07'07''W (Gerber et al. 2018).

On May 20, 2020, the second author of this report (F.C.) forwarded for determination some photographs of abundant post-larval limnic mussels/ naiads collected during a biotic sampling campaign held in the area of local Small Hydroelectric Power Plants (Pequenas Centrais Hidrelétricas - PCHs). The specimens in question (dead shells, mainly) were obtained with the aid of Surber Sampler for Benthos (specific portable Granulometric Laboratory Analysis Sieve for Benthic Macrofauna Retention, of 20cm in diameter and Stainless Steel Wire Cloth with 08mm and 01mm apertures) (Figure 1).

These shells were found in a riverside sector of the Rio Benedito hydrographic microbasin (Figure 1), located in the Benedito Novo Municipal District, geographical domain of the Itajaí River Basin Valley in the Blumenau Micro-region (~ 26°47'08.9"S/49°25'36.9"W), Malacological Region 6 of Santa Catarina State/ SC (Agudo-Padrón 2018:58-Figure 1). The environment was composed of many exposed rocks, with sandy substrate on its bed and some soil deposits found only on the banks (where there is little current), with preserved riparian forest without adjacent polluting sources (Figure 1).

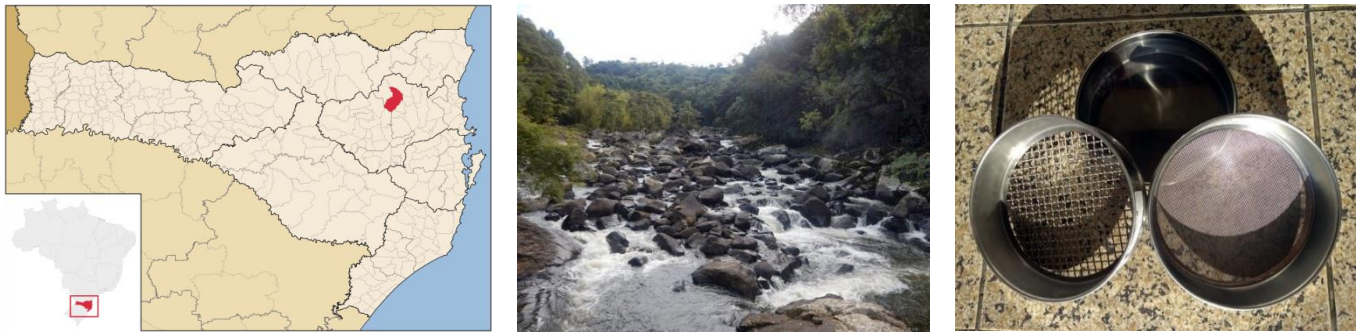


Figure 1. Location (map – red color) of the Benedito Novo Municipal District in the Itajaí Basin Valley region of Santa Catarina State/ SC, general view of the collection area in Rio Benedito Microbasin, and Surber Sampler for Benthos sampling device used to collect these shells.

These animals have been identified as native limnic/ freshwater mussels/ naiads Hyriidae *Rhipidodonta hylaea* (d'Orbigny, 1835) (Figure 2), a new record of the species from Santa Catarina State/ SC. The specimens are being deposited in the Malacological Collection of the Regional University Foundation of Blumenau - FURB, Blumenau/ SC (~ Voucher FURB-MO ? = pending registration number).

Eight other limnic/ freshwater malacofauna species previously verified in the State territory (Agudo-Padrón 2018, 2020) were also found in the locality: native pulmonate snail Lymnaeidae *Pseudosuccinea* (- *Lymnaea*) *columella* (Say, 1817); amphibian/ limnophile semislug *Omalonyx* sp.; native mussel/ naiads Hyriidae *Diplodon charruana* (d'Orbigny, 1835), *Diplodon delodontus* (Lamarck, 1819) and *Diplodon rhuacoicus* (d'Orbigny, 1835); native pea clams *Eupera bahiensis* (Spix, 1827) and *Eupera platensis* Doello-Jurado, 1921; as well as native clams Cyrenidae *Cyanocyclas limosa* (Maton, 1809).

Figure 2. Young and post-larval specimens of native mussels/ naiads Hyriidae *Rhipidodonta hylaea* (d'Orbigny, 1835) collected in the Rio Benedito Microbasin of the Benedito Novo Municipal District of Santa Catarina State/ SC.

More recently, on July 07, 2020, the second author forwarded for determination some photographs of an very curious and minute freshwater gastropod/ snail (Figure 3). The specimen in question (rolled shell), collected using the same equipment as in the previous case (Figure 1), comes from a stream with an unknown name located next to the BR-470 (26°52'18.5"S/49°01'21.3"W) in the Gaspar Municipal District (26°55'51"S/48°57'32"W) (Figure 3), also in the Itajaí River Basin Valley.

The stream bed was well silted, with a very poorly consolidated substrate composed of sand mixed with clay, with more muddy points usually in the curves of its bed, well uneven due to silting There was little riparian forest, the presence of many herbs and some trees along its flow.

This specimen has been confirmed by us as an rare limnic/ freshwater microsnail Tateidae *Potamopyrgus* (- *Lyrodes*) aff. *peteningensis* (Gould, 1852) (Figure 3), a new record of genus and species from Santa Catarina State/ SC. The shell is being deposited in the Malacological Collection of the Regional University Foundation of Blumenau - FURB, Blumenau/ SC (~ Voucher FURB-MO ? = pending registration number).

The sympatric limnic/ freshwater malacofauna occurring in the locality included five species, all previously verified in the State territory (Agudo-Padrón 2018, 2020): native operculate snail Ampullariidae *Pomacea sordida* Swainson, 1823; panamerican pulmonate snail Planorbidae *Biomphalaria straminea* (Dunker, 1848); south american giant mussel/ naiad Mycetopodidae *Anodontites trapesialis* (Lamarck, 1819); native freshwater mussel/ naiad Hyriidae *Diplodon rhuacoicus* (d'Orbigny, 1835); as well as native pea clams *Eupera bahiensis* (Spix, 1827).

The Rio Benedito microbasin continues to be particularly interesting for important regional malacological discoveries in the State (Agudo-Padrón and Carneiro 2019).

Figure 3. Location (map – red color) of the Gaspar Municipal District in the Itajaí Basin Valley region of Santa Catarina State/ SC, specimen of limnic/ freshwater microsnail Tateidae *Potamopyrgus* (- *Lyrodes*) aff. *peteningensis* (Gould, 1852), and a general view of the collection area (unknown stream name).

References:

Agudo-Padrón, A.I. 2011. About the threatened freshwater mollusk fauna of the Itajaí-Açu River Basin Valley, Santa Catarina's State, SC, Central Southern Brazil. *Ellipsaria*, 13(4):33-37.

Agudo-Padrón, A.I. 2018. Revised and updated systematic inventory of non-marine molluscs occurring in the state of Santa Catarina/SC, central southern Brazil region. *Advances in Environmental Studies*, 2(1):54-60. Available online at: https://scholars.direct/Articles/environmental-studies/aes-2-007.pdf?jid=environmental-studies&fbclid=IwAR0jVKm3aMwsKV0gxiVCuJd2HT1pxo4xFjf4Y91atMhChKfmIYYqd9Ww3z4

Agudo-Padrón, A.I. 2020. Additions to the systematic inventory of non-marine molluscs occurring in the state of Santa Catarina/SC, central southern Brazil region. *Advances in Environmental Studies*, 4(1): 261-270. Available online at: https://scholars.direct/Articles/environmental-studies/aes-4-027.php?jid=environmental-studies&fbclid=IwAR3loMgNGxQK6kAwSHuOKw3_XgQvvjOYVkBh6FSBcxKjlC5KGV9lv6Q8mOs

Agudo-Padrón, A.I. and Carneiro, F. 2019. First confirmed record of the native freshwater mussel Hyriidae *Diplodon* (- *Rhipidodonta*) *suavidicus* (Lea, 1856) in Santa Catarina State, Central Southern Brazil. *Ellipsaria*, 21(4):13-15.

Gerber, D.; Pertille, C.T.; Vieira, F.S.; Corrêa, B.J.S. and Souza, C.F. de. 2018. Caracterização morfométrica da Bacia Hidrográfica do Rio Itajaí – Santa Catarina. Available online at: < http://periodicos.univille.br/index.php/ABC/article/view/446/526# >

The Limnic/Freshwater Mollusks of Sucre State, Northeast Continental Venezuela

A. Ignacio Agudo-Padrón, Project Avulsos Malacológicos - AM, P.O. Box 010, 88010-970 Centro, Florianópolis, Santa Catarina/ SC, Brazil – ignacioagudo@gmail.com ; http://noticias-malacologicas-am.webnode.pt/

Project AM has been studying the non-marine mollusks present in the northeast region of Venezuela, specifically in Sucre State (Salazar *et al.* 2018:122, 123) (Figure 1), for the last six years (formally at least since 2014), with the invaluable participation, assistance, and support from local researchers, naturalists, environmental photographers, and informal field collaborators (Bello-Pulido & Agudo-Padrón 2019; Agudo-Padrón 2020 a: 35; Agudo-Padrón 2020b). During this time, we have been developing some basic taxonomic and bioecological surveys including its limnic/ freshwater forms (see Table 1).

Table 1. Freshwater mollusk species present in the Sucre State territory, Northeast Venezuela, mainly in the Manzanares River Basin. Ref.: Archive/ Database Project AM

GASTROPODA
Ampullariidae
Marisa cornuarietis (Linnaeus, 1758)
Pomacea aurostoma (Lea, 1856)**
Pomacea diffusa Blume, 1957
Pomacea glauca (Linnaeus, 1758)
Thiaridae
Melanoides tuberculata (Müller, 1774)
Tarebia granifera (Lamarck, 1816)
Cochliopidae
Aroapyrgus vivens (Baker, 1930)
Pyrgophorus parvulus (Guilding, 1828)
Lymnaeidae
Galba cubensis (Pfeiffer, 1839)
Lymnaea viatrix (d'Orbigny, 1835)**
Pseudosuccinea (- *Lymnaea*) *columella* (Say, 1817)**
Physidae
Aplexa (- *Stenophysa*) *marmorata* (Guilding, 1828)
Physa acuta (- *cubensis*) Draparnaud, 1805
Planorbidae
Biomphalaria kuhniana (Clessin, 1883)
Biomphalaria prona (Martens, 1873)
Biomphalaria straminea (Dunker, 1848)**
Drepanotrema lucidum (Pfeiffer, 1839)**
Drepanotrema surinamensis (Clessin, 1884)
Helisoma duryi (Wetherby, 1879)
Planorbidae (- Ancylidae)
Gundlachia radiata (Guilding, 1828)
BIVALVIA
Mycetopodidae
Mycetopoda siliquosa (Spix, 1827)*
Hyriidae
Castalia ambigua Lamarck, 1819
Sphaeriidae
Eupera viridans (Prime, 1865)
~ namesake *E. bahiensis* (Spix, 1827)

* For a synonymy, see Agudo-Padrón (2020b)
** Species not cited for the State territory by Pontier (2015)

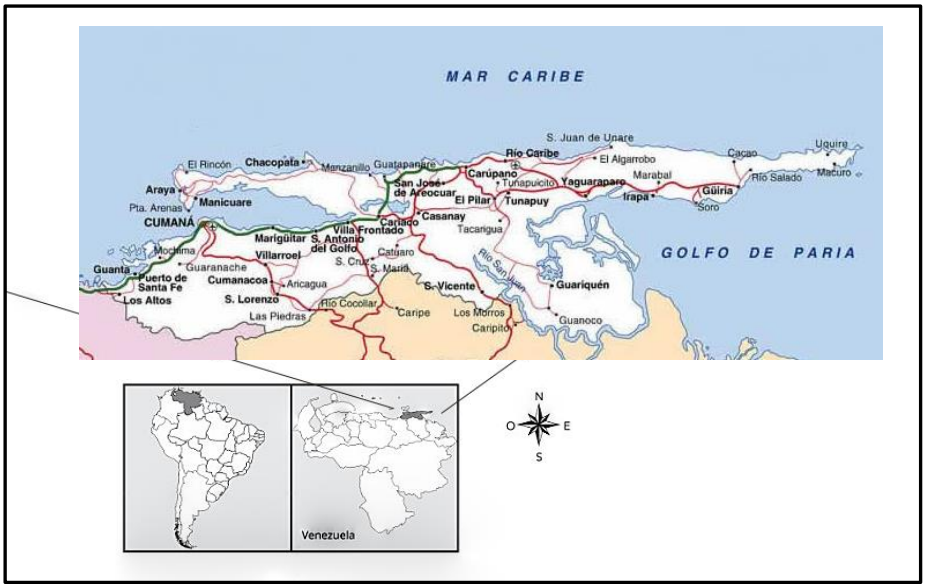


Figure 1. Location of Sucre State on the Northeast continental coast of Venezuela.

So far, we have confirmed a total of 23 limnic/ freshwater species for this State in Venezuela: twenty gastropod and three bivalve forms (Table 1), mainly found in the Manzanares River Basin system. As one of the most extensive hydrographic basins and with the highest flow that drains directly into the Caribbean Sea in Venezuela, the Manzanares River is the most important body of water in the eastern region of Sucre State, with several limnic environments present throughout its length (Salazar *et al.* 2018:122, 123).

Specific previous studies on the non-marine mollusk fauna occurring in Sucre State are scarce. Only in recent years have some researchers reported the presence of limnic/ freshwater mollusks from various places in this region of the country. These reports include:

-- Graf & Cummings (2013) reporting under the synonymy for the State the species of native mussel/ naiad *Mycetopoda siliquosa* (Spix, 1827), information reflected in Agudo-Padrón (2020b).

-- Pontier (2015) reports and records on maps the occurrence in the State of 18 species, including 15 gastropods (10 native, 5 introduced exotic) and 3 native bivalves.

-- Salazar *et al.* (2018) relate the occurrence in the Manzanares River Basin system of four limnic gastropod species: two native forms – *Marisa cornuarietis* (Linnaeus, 1758), *Pomacea glauca* (Linnaeus, 1758) – and two introduced exotic ones (*Melanoides tuberculata* (Müller, 1774), *Tarebia granifera* (Lamarck, 1816).

-- Bello-Pulido and Agudo-Padrón (2019) reported four recent and subfossil gastropod freshwater species for the Araya Peninsula region, including the native common forms *Marisa cornuarietis* (Linnaeus, 1758), *Pomacea glauca* (Linnaeus, 1758), the Planorbidae *Drepanotrema lucidum* (Pfeiffer, 1839), and the exotic introduced Lymnaeidae *Pseudosuccinea* (- *Lymnaea*) *columella* (Say, 1817), the last two forms not cited for the State in the previous regional literature (see Table 1).

-- Additionally, a regional list with the 18 freshwater species previously confirmed for the State by Pontier (2015), including 15 gastropods and three bivalves, is presented in Agudo-Padrón (2020b).

Here are the names and pictures if some of the freshwater gastropod species found in Sucre State that have been directly verified by the AM Project during the survey conducted with the participation of our regional collaborators in Venezuela, determined with help to the available malacological literature (mainly Simone 2006; Matinella 2014; and Pontier 2015).

Ampullariidae

Marisa cornuarietis (Linnaeus, 1758) (Figure 2)

Pomacea aurostoma (Lea, 1856) (Figure 3)

Pomacea glauca (Linnaeus, 1758) (Figure 4)

Pomacea diffusa Blume, 1957 (Figure 5)

Thiaridae

Tarebia granifera (Lamarck, 1816) (Figure 6)

Lymnaeidae

Pseudosuccinea (- *Lymnaea*) *columella* (Say, 1817) (Figure 7)

Planorbidae

Drepanotrema lucidum (Pfeiffer, 1839) (Figure 8)

Figure 2. Operculate neotropical snails Ampullariidae *Marisa cornuarietis* (Linnaeus, 1758) from Cumaná City, Sucre State, 31/07/2016. All shell photographs by Jesús Antonio Bello-Pulido.

Figure 3. Operculate native common apple snail Ampullaridae *Pomacea aurostoma* (Lea, 1856) from Guaranache stream, Middle basin of the Manzanares River, Cumaná City, Sucre State, 09/06/2018.

Figure 4. Operculate native common apple snail Ampullariidae *Pomacea glauca* (Linnaeus, 1758) from Cumaná City, Sucre State, 31/07/2018.

Figure 5. Operculate introduced (aquarium trade – see Pontier 2015:40) apple snail with singular "anomalous" shell) Ampullariidae *Pomacea* cf. *diffusa* Blume, 1957 from El Peñón Quarter, Cumaná City, Sucre State, 29/05/2018.

Figure 6. Operculate invasive snails Thiaridae *Tarebia granifera* (Lamarck, 1816) from El Tacal River, Mochima National Park, Sucre State, 08/03/2017.

Figure 7. Subfossil specimens of Invasive pulmonate snails Limnaeidae *Pseudosuccinea* (- *Lymnaea*) *columella* (Say, 1817) from El Guamache (Cubagua Geological Formation – see Bello-Pulido and Agudo-Padrón 2019), Araya Parish, Sucre State, 16/09/2016.

Figure 8. Native pulmonate snails Planorbidae *Drepanotrema* cf. *lucidum* (Pfeiffer, 1839) from temporal lagoon in Cerro Macho, Araya town (see Bello-Pulido and Agudo-Padrón 2019), Araya Parish, Sucre State, 24/10/2016.

Finally, five new gastropod species are added in the present contribution to the previously list presented by Agudo-Padrón (2020b): *Pomacea aurostoma* (Lea, 1856), *Lymnaea viatrix* (d'Orbigny, 1835), *Pseudosuccinea* (- *Lymnaea*) *columella* (Say, 1817), *Biomphalaria straminea* (Dunker, 1848), *Drepanotrema lucidum* (Pfeiffer, 1839) (see Table 1).

Additional information:

On June 3, 2020, local ecologist Jesús Antonio Bello Pulido (https://www.facebook.com/jesusantonio.bellopulido) indicated that, two years ago, he was informed about to the "supposed abundant presence" in the Carinicuao River watershed (tributary of the Buena Vista Lagoon), Sucre State in Saco de Cariaco region, of an undetermined freshwater clam, supposedly the exotic invasive Asian Cyrenidae *Corbicula fluminea* (Müller, 1774), a species present in several localities of the neighboring State of Monagas (Pontier 2015: 196, 198-199; Jiménez *et al.* 2017). So far that report has not been verified in field. It should be noted that the freshwater bivalve that occurs in the mentioned location by Bello-Pulido is the small Sphaeriidae *Eupera viridans* (Prime, 1865) (for a taxonomic description see Simone, 2006: 302 – *Eupera bahiensis* (Spix, 1827) and Pontier, 2015:197-Figure 115, 202-203, 205), a species which can be similar for the laity.

References:

Agudo-Padrón, A. I. 2020a. The limnic/ freshwater mollusks of Hispaniola Island, Greater Antilles, Caribbean. *Ellipsaria*, 22(1):35-39.

Agudo-Padrón, A. I. 2020b. New geographical record of the native freshwater mussel/ naiad *Mycetopoda siliquosa* (Spix, 1827) (Unionoida, Mycetopodidae) in Venezuela. *Ellipsaria*, 22(2):24-26

Bello-Pulido, J. A. and Agudo-Padrón, A. I. 2019. Aproximación al conocimiento de la malacofauna continental de la Península de Araya, Estado Sucre, Venezuela Nororiental. *Boletin del Instituto Oceanográfico de Venezuela – BIOV*, 58(1): 29-41.
Available online at: https://drive.google.com/file/d/13X-4CkOgURBtJH5jbBs-dIXfuvByywBR/view?fbclid=IwAR3WgZw-08Qt0qP89m59Cu1ZUwnmD1u07QJz549ut5MoUsmcBwOVglkd72U

Graf, D. L. and Cummings, K. S. 2013. *Mycetopoda pittieri*. In: The freshwater mussels (Unionoida) of the World (and other less consequential bivalves. MUSSEL Project Web Site. Available online at: < http://mussel-project.uwsp.edu/fmuotwaolcb/specimen_16931.html?fbclid=IwAR3SCJcxedD8dlYimKX_d4g0QfnMdURhmVULSBHsk6b_gh_oXnRZ9ZW9lhA >.

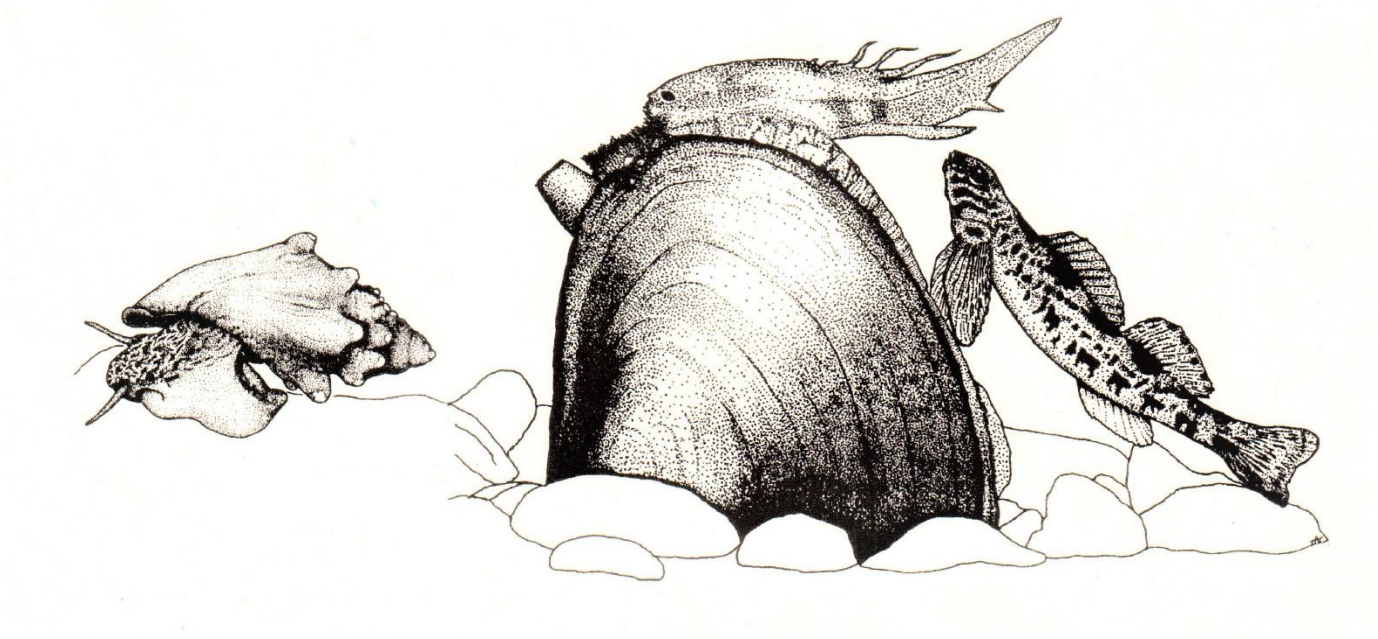
Jiménez, J. H. P.; Pulido, J. A. B.; Acosta, M. Á. G. and Mago, R. J. C. 2017. Nueva área de distribución de *Corbicula fluminea* (Bivalvia: Cyrenidae) em el Estado Monagas, Venezuela. *Boletin del Instituto Oceanográfico de Venezuela – BIOV*, Especial en honor al I Congreso Venezolano de Malacologia 2016:3-6. Available online at: https://www.researchgate.net/publication/335277734_NUEVA_AREA_DE_DISTRIBUCION_DE_Corbicula_fluminea_MULLER_1774_BIVALVIA_CYRENIDAE_EN_EL_ESTADO_MONAGAS_VENEZUELA?fbclid=IwAR3VgKSr5tqpDZXYgAJPdOH-xefFkG5jNtYkNYkl98tftEPn20OaXML8JBQ

Matinella, L. 2014. Moluscos gasterópodos dulceacuícolas de Venezuela: identificación e importancia en salud pública. Maracay/ Aragua, Venezuela: *Instituto Nacional de Investigaciones Agrícolas – INIA*, 87 p. Available online at: http://servidordesmtp.com/kennel/Moluscos-de-Venezuela-Liboria-Mantinella.pdf?fbclid=IwAR36M8a5opfo_R7fxZPFmwQ6MIUcoMwAfO3bRdS8LnquA5yiYyhtPVkJ3og

Pontier, J-P. 2015. *Freshwater molluscs of Venezuela and their medical and veterinary importance*. Harxheim, Germany: ConchBooks, 228 p.

Salazar, S. K.; Alfonsi, C. Y.; Gómez, B.; Bello, J. A.; Senior, W. and Troccoli, L. 2018. Rios en riesgo en el Oriente de Venezuela: caracterización y conservación del Rio Manzanares, pp. 121-138 (Fauna acuática – Moluscos, pp. 129-131). *In*: Olarte, D. R. (Ed.), Rios em Riesgo de Venezuela 2. Barquisimeto/ Lara, Venezuela: *Universidad Centroccidental Lisandro Alvarado – UCLA, Colección Recursos Hidrobiológicos de Venezuela*, 199 p. Available online at: https://www.researchgate.net/publication/325143476_Rios_en_Riesgo_de_Venezuela_Volumen_2?fbclid=IwAR1SSjI7qxK35KvH--Pvskl-AjRIMfc0oRlgxqTqEr8pSFJZld-G1AUZavE

Simone, L.R.L. 2006. *Land and freshwater molluscs of Brazil*. São Paulo, SP: FAPESP, 390 p.



Obituary

Richard Irwin Johnson, 1925 - 2020

Richard I. Johnson at the MCZ in 2004.

Richard Irwin Johnson passed away on July 1, 2020, at the age of 95. He died peacefully at home in Chestnut Hill, Massachusetts.

In 1939, when Richard was 14 and showed an interest in biology, his science teacher took him to meet William J. Clench, the Curator of Mollusks at the Museum of Comparative Zoology (MCZ) at Harvard University. With his typical remarkable and infectious enthusiasm, Clench encouraged Johnson to volunteer at the Museum and become interested in freshwater mollusks. Richard started out unpacking the extensive incoming collections of Unionidae, including those of the Grand Rapids, Michigan, Public Museum, and duplicates from the Bryant Walker collection at the University of Michigan Museum of Zoology. He published his first scientific paper in *The Nautilus* in 1941, at the age of 16.

Early on, Richard recognized the difference between the Museum director and other well-off people in authority as opposed to people like Clench who had to support a family on a modest curator's salary. He decided that financial success was important, even if he had then been aware that Robert Louis Stevenson said: "It is perhaps a more fortunate destiny to have a taste for collecting shells than to be born a millionaire."

In 1940 and 1941, Richard became acquainted with James R. Miller, a professional collector of biological specimens, and through him, Herbert D. Athearn, who also spent his life collecting and studying Unionoidea. As he helped Miller at the New England Museum of Natural History, Richard discovered an old catalogue which led him to reidentify many of the type specimens of mollusks described a century before by Joseph P. Couthouy. Johnson was drafted into the U.S. Army in June 1943, knowing only that he had an early acceptance to Harvard if he returned. He corrected the proofs of his Couthouy paper while on latrine duty at Camp Hood, Texas. When finally sent to Europe, he was occasionally able to sneak away to Paris where he found important works on mollusks so cheaply priced that he purchased virtually everything he saw. Later, as a Harvard undergraduate, he financed his summers in Europe with the books he bought and sold.

After graduating from Harvard in 1951, Richard attended what is now the American Graduate School of International Management in Arizona, then returned to Boston and the Museum, and became involved in life insurance and trading securities. In 1954, he married

Marjory W. Austin, with whom he had three children. In 1983, he married Marrian L. Gleason, who predeceased him.

Richard became a long-time Research Associate at MCZ. In 1952, he led the Harvard Expedition to peninsular Florida to collect Unionidae, accompanied by undergraduate student Samuel L. H. Fuller. After trips in 1964 and 1965 to Mississippi, Louisiana, Alabama, and central Ohio (where he collected shells with David Stansbery), he had an office constructed in the room which contained the Unionidae, retired from business, and started devoting most of his time to the Museum.

Clench (L) and Johnson "contemplating unios" on the steps of the MCZ in May 1963.

Richard developed an extensive publication record with an emphasis on molluscs, particularly the family Unionidae. He also authored a number of biographies and catalogues of numerous scholars who collected and studied molluscs. These included articles on Unionid specialists (Call, Frierson, Heude, Lea, Marshall, Simpson, Utterback, and the Wrights), as well as those whose molluscan studies included other taxa (*e.g.*, Bequaert, Brooks, Bush, Clench, Couthouy, Fuller, Gould, Mighels, Ortmann, Pease, Prime, Storer, Turner, Verrill, and Wetherby). Richard also prepared invaluable collations of a number of nineteenth-century publications that appeared in multiple parts over many years. He authored type catalogues of the Unionidae holdings of several museums, including the MCZ and the Natural History Museum of the United Kingdom, and wrote histories of several now defunct museums, including the Boston Society of Natural History, the Portland (Maine) Society of Natural History, and the Lyceum of Natural History of New York.

Richard was probably the oldest and longest-serving member of the American Malacological Society, having joined the predecessor entity, the American Malacological Union, in 1941. Over a period of nearly six decades, he also built what is perhaps the largest private library of books and journals on molluscs, including antiquarian titles seldom found in research libraries.

Richard Johnson's extensive knowledge of the literature on mollusks and his stimulating conversations will be missed but his contributions to that literature will serve his memory extremely well.

[The text of this obituary was compiled from two sources: the 1998 dedication to Volume 5 of the Occasional Papers on Mollusks of the Museum of Comparative Zoology written by Kenneth J. Boss; and the 2020 email announcement of Mr. Johnson's passing by Alan Kabat. The photograph of Johnson and Clench is from the Occasional Papers dedication, and the color photograph was provided by James D. Williams. Alan Kabat is preparing a more extensive biography, a complete bibliography of Richard Johnson's publications, and a list of new taxa that he described to be published in an appropriate professional journal. JJJ]

FMCS Officers

President
Jeremy Tiemann
Illinois Natural History Survey
1816 South Oak Street
Champaign, Illinois, USA 61820
jtiemann@illinois.edu

President Elect
Stephen McMurray
Missouri Department of Conservation
3500 East Gans Road
Columbia, Missouri, USA 65201-8992
stephen.mcmurray@mdc.mo.gov

Secretary
Janet Clayton
West Virginia Div. of Nat. Res. - Retired
3514 Mountaineer Road
Philippi, West Virginia, USA 26416
wvmusselmomma2020@yahoo.com

Treasurer
Alan Christian
Office of Planning and Analysis
Clarkson University
CU Box 5557
Potsdam, New York, USA 13699-5557
adchrist@clarkson.edu

Past President
Heidi L. Dunn
EcoAnalysts, Inc.
1417 Hoff Industrial Park
O'Fallon, Missouri, USA 63366
HDunn@ecoanalysts.com

Ellipsaria is posted on the FMCS web site quarterly: around the first of March, June, September, and December. This newsletter routinely includes Society news, meeting notices, pertinent announcements, and informal articles about ongoing research concerning freshwater mollusks and their habitats. Anyone may submit material for inclusion in *Ellipsaria* and all issues are accessible to anyone on the FMCS website (http://molluskconservation.org).

Information for possible inclusion in *Ellipsaria* should be submitted via e-mail to the editor, John Jenkinson, at jjjenkinson@hotmail.com. Contributions may be submitted at any time but are due by the 15th of the month before each issue is posted. MSWord is optimal for text, but the editor may be able to convert other formats. Graphics should be in a form that can be manipulated using PhotoShop. Please limit the length of informal articles to about one page of text. Note that submissions are not peer-reviewed but are checked for clarity and appropriateness for this freshwater mollusk newsletter. Feel free to contact the editor with questions about possible submissions or transmission concerns.

FMCS Committees and Their Chairs/Co-chairs

If you are interested in participating in committee activities, please contact one of the appropriate chairs.

Standing Committees

Awards
Emy Monroe - emy_monroe@fws.gov
Susan Oetker - susan_oetker@fws.gov
David Hayes - david.hayes@eku.edu
Curt Elderkin - elderkin@tcnj.edu

Environmental Quality & Affairs
Braven Beaty - bbeaty@tnc.org
Mickey Matthews - mickey.matthews@ahtd.ar.gov

Gastropod Status and Distribution
Nathan Whelan - Nathan_Whelan@fws.gov
Wesley Daniel - wdaniel@usgs.gov

Genetics
Dave Zanatta - zanat1d@cmich.edu
Kevin Roe - kjroe@iastate.edu

Guidelines and Techniques
Ryan Schwegman - RSchwegman@EnviroScienceInc.com
Lisie Kitchel - lisie.kitchel@wisconsin.gov

Information Exchange
Journal
W. Gregory Cope - greg_cope@ncsu.edu
Wendell R. Haag - whaag@fs.fed.us
Dave Berg - bergdj@miamioh.edu
Newsletter
John Jenkinson - jjjenkinson@hotmail.com

Mussel Status and Distribution
Gerry Dinkins - Gdinkins@utk.edu
Jason Wisniewski - jason.wisniewski@tn.gov

Nominations
[Vacant at Present]

Outreach
Jennifer Archambault - jmarcham@ncsu.edu
Amy Maynard - Amy.Maynard@dgif.virginia.gov

Propagation, Restoration, & Introduction
Rachael Hoch - rachael.hoch@ncwildlife.org
Tim Lane - tim.lane@dgif.virginia.gov
Maddie Pletta - madeline.pletta@state.mn.us

Symposium
Steve McMurray - stephen.mcmurray@mdc.mo.gov

Ad Hoc Committees

Chapters
Manuel Lopes-Lima - lopeslima.ciimar@gmail.com

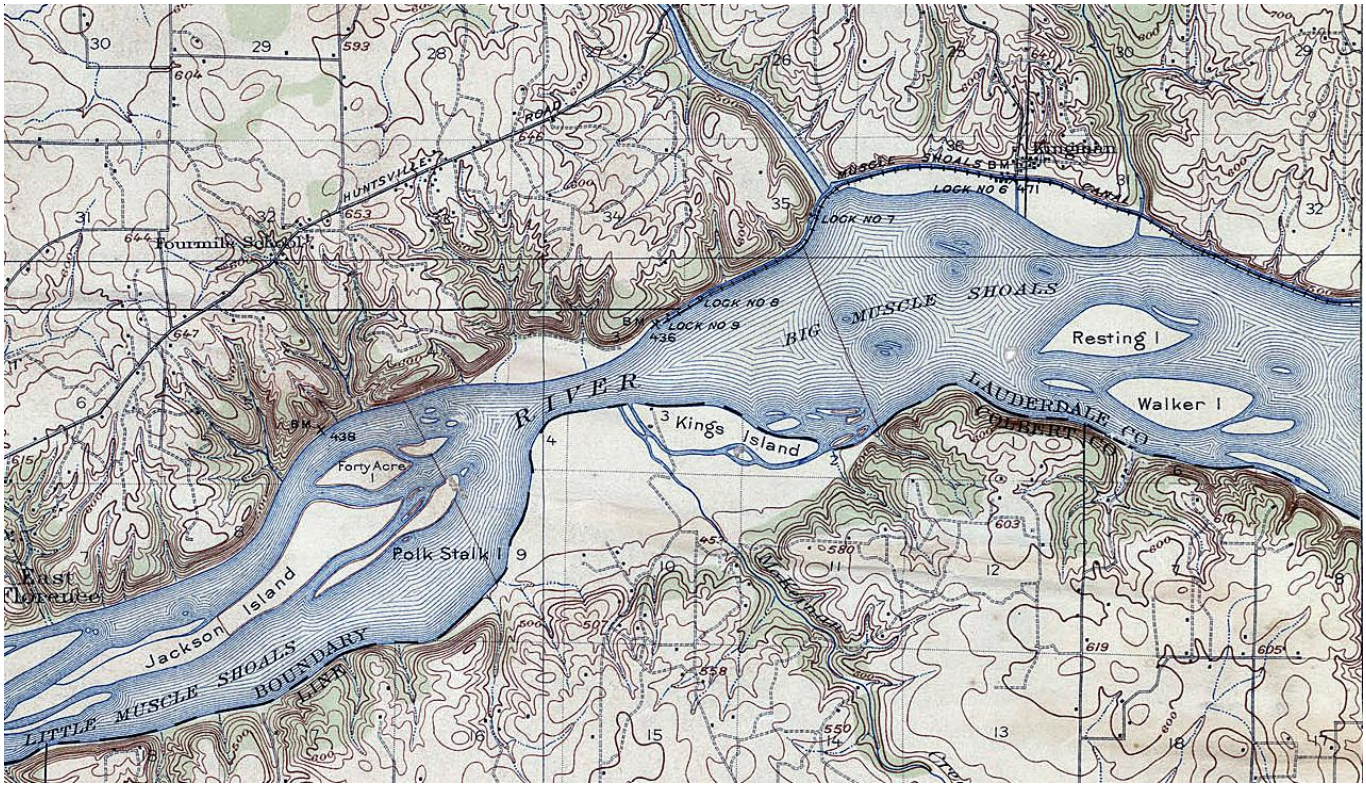
Diversity and Inclusiveness
Tamara Smith - tamara_smith@fws.gov

Ecosystem Services
Carla Atkinson - carlalatkinson@gmail.com

Monetary Values
Megan Bradley - megan_bradley@fws.gov

Professional Development
Rebecca Winterringer - beccawint6@gmail.com
Amanda Rosenberger - arosenberger@tntech.edu

Parting Shot



This Shot shows part of the Muscle Shoals reach of the Tennessee River, adjacent to Florence, Alabama, included on the 1916 edition of the U.S. Geological Survey Muscle Shoals Quadrangle 1:62,500 topographic map [color-corrected in Photoshop]. Make sure to zoom in to see all of the detail, including the barge canal and some of the locks that helped barges and other boats get around the Big Muscle Shoals. Wilson Dam was constructed across the river in the area of Kings Island, starting in 1918. This map is one of thousands of high resolution digitized historic, topographic, and other maps of the United States and many other countries that are available online from the University of Texas at Austin, University of Texas Libraries, at https://legacy.lib.utexas.edu/maps/.

If you would like to contribute a freshwater mollusk-related image for use as a **Parting Shot** in *Ellipsaria*, e-mail the picture, informative caption, and photo credit to jjjenkinson@hotmail.com.