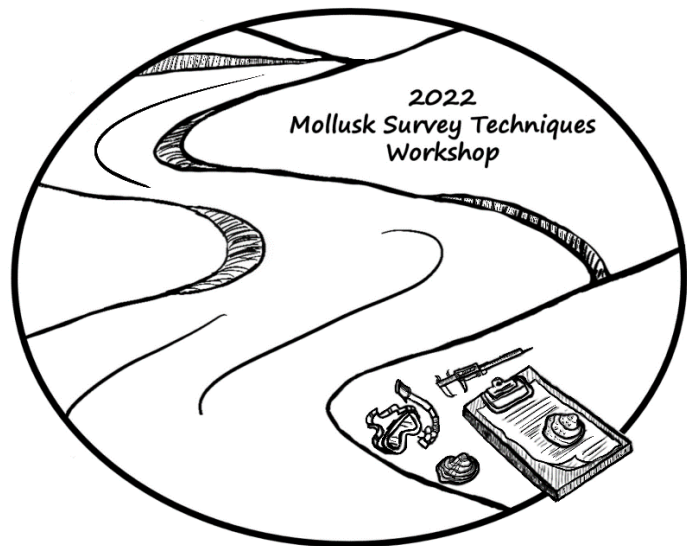




Newsletter of the Freshwater Mollusk Conservation Society
 Vol. 24 – No. 2 ISSN 2689-2936 June 2022

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**The Survey Guidelines and Techniques Workshop is Happening Soon:
 Have you Registered Yet?**

Specific plans for the 2022 FMCS Guidelines and Techniques Mollusk Sampling Workshop at Henry Horton State Park, in Chapel Hill, Tennessee, are now set, and the organizers can't wait to gather with you August 8 - 11, 2022, along the banks of the historic Duck River. Whether you are a beginning biologist or an experienced malacologist, we all need to collect mollusks, and interpret and apply the data we have collected. This Workshop has been designed to help everyone improve their sampling and data interpretation techniques.

Participants will be able to choose one of two paths during the Workshop: Survey Techniques, and Advanced Topics. Both paths will consist of four sessions of 3 - 3.5 hours each. There also will be an evening poster session and a town hall style discussion.

Survey Techniques Path participants will be assigned to groups of no more than 20 people who will rotate through the following four sessions:

1. **Field Sampling** – participants will conduct semi-quantitative, quantitative, and qualitative sampling.
2. **Classroom sampling exercise** (Mussel battleship) – participants will use semi-quantitative sampling in a classroom simulation to delineate a mussel bed, then quantitative sampling to assess standard metrics with confidence intervals.
3. **Finding and processing mussels** – participants will learn techniques for mussel handling, identification, measuring, aging, and marking.
4. **Habitat and survey design** – participants will learn techniques for evaluating mussel habitat, identifying where to sample, and for designing a mussel survey

The learning objective for the **Advanced Topics Path** is for participants to develop an awareness of advanced methods that are applicable to assess and study freshwater mussel populations and communities. Participants will remain together in a symposium-style setting as speakers provide introductory overviews, case studies and demonstrations on the following topics:

1. **Population and community assessment fundamentals** – This session will include an overview of core techniques and data types that are needed to conduct a baseline status of populations and communities, population health and resilience, and assessments. Species status assessments (SSA) as used in endangered species decisions will be presented as a special case.
2. **Estimation of change and trend** – The session will include an overview of statistical inference of change and trend of an event either a disturbance or reintroduction/augmentation and case studies on impact assessment and trend detection.
3. **Capture-recapture based methods** – The session will include background on why estimation of detectability is important, relationship between distribution and habitat at multiple scales, vital rates (survival, movement, recruitment, lambda, and relationship between vital rates and habitat, and case studies illustrating occupancy sampling, modeling and tag-based sampling.
4. **Emerging topics** – The session will include introductory presentations to discuss new methods that have promise to solve persistent or emerging information needs, case studies, and panel discussions. Possible topics include use of eDNA to sample for native and AIS, estimation of ecosystem services, formal protocols for expert elicitation, and forecasting. Coverage of topics will depend on availability of expertise. If time allows, discussions will be scheduled for participants to describe survey or analysis issues they are facing to get advice and suggestions from the instructors and other participants.

Schedule Overview:

Monday August 8 - Travel Day - Registration and Evening Mixer

Tuesday August 9 - Breakfast, Introduction with Dave Smith for all participants, groups split and begin rotations, lunch, rotations of groups, dinner, Poster Session and Mixer.

Wednesday August 10 - Breakfast, rotations of groups, lunch, rotations of groups, dinner, State and Federal Survey Protocols Town Hall

Thursday August 11 - Field Trip to the Duck River, and/or Travel Home.

Poster Session:

The poster session will take place on Tuesday evening, August 9. Poster presentations will not be limited in topic and can include a wide variety of information and research pertinent to freshwater mollusks. See the Call for Abstracts for details and instructions for submitting abstracts are on the FMCS Events web site: [FMCS Workshop 2022 \(molluskconservation.org\)](https://molluskconservation.org). Poster abstracts will be due no later than June 30.

Registration:

Register online at the FMCS Events web site: [FMCS Workshop 2022 \(molluskconservation.org\)](https://molluskconservation.org). As with all things in our post COVID world, prices have increased. Early registration ended on May 31. Present registration costs are:

Type	Late Registration June 1 – July 8 ❖
FMCS member	\$325
Non-Member	\$405
Student/Retiree FMCS member	\$225
Student/Retiree non-member	\$265

❖ Registration after July 8 will be **online only**, and only if the attendance cap has not been met. After July 8, please contact one of the organizers to confirm that a spot is still available. We will not be able to process registrations on-site.

Student Sponsorships:

We encourage student participation and will be soliciting for sponsorships. Students, please keep checking the event web site for more information on how to apply. That information should be posted soon.

Location and Lodging:

Henry Horton State Park is located in Chapel Hill, Tennessee, along the shores of the Duck River, one of the most diverse freshwater systems in the world. The Park has self-contained accommodations, meals will be catered by the Park’s Governor’s Table Restaurant, and the Tipped Canoe Lounge is on site. More information about Henry Horton State Park is available at: <https://tnstateparks.com/parks/henry-horton>

All of the available rooms in the Park Lodge have been reserved for our use, and eight cabins are also available. Room rates in the Lodge are as follows: Two Double Beds: \$86.40/ night plus taxes, King Room: \$90.90/ night plus taxes; Suite Room (pullout sofa and small kitchen): \$99.90/ night plus taxes. The cabins are fully equipped and have two or three bedrooms. Call for details on each cabin, phone (931) 364-2222, Please make every effort to book rooms with co-workers and friends as space is limited. Reservations must be made by July 10th <https://tnstateparks.com/parks/henry-horton>. **When booking, ask for the Freshwater Mollusk Conservation Society rate and provide our group number: 4549.**

Campsites for both RV’s and tents are available at the Park. Camping rates vary between \$11 and \$35/night, not including taxes and fees. Campsite reservations can be made by visiting <https://reserve.tnstateparks.com/henry-horton/campsites>.

What to bring:

This is a hands-on Workshop, come prepared to get wet and dirty. Bring a wetsuit if you have one, otherwise clothes and shoes you don't mind getting wet. Mask and snorkel are beneficial and other field gear you typically use in the water. Don't forget your sunscreen, water bottle, and camera. Dry clothes are required at all other times. Bring your laptop for materials and classroom use.

Transportation:

Henry Horton Park is located in Chapel Hill, Tennessee, about 50 miles south of Nashville. Nashville International Airport is the closest airport, but other airports are available.

Driving distance from Nashville -- approximately 50 miles (1 hour)

Driving distance from Chattanooga -- approximately 115 miles (2 hours)

Driving distance from Memphis -- approximately 220 miles (3.5 hours)

Field Trip:

On Thursday August 11, Workshop attendees will have the option of attending a mussel sampling field trip. Due to our proximity to such tremendous freshwater mussel resources, the field trip will focus on mussels of the Duck River. Space will be limited so make sure to register early. More information about this trip is included on the registration web page.

For further information about the Workshop please contact the Guidelines and Techniques Chair Lisie Kitchel, Lisie.Kitchel@wisconsin.gov. For more information about the venue, lodging, transportation, or sponsorships please contact Ryan Schwegman, Ryan@BioSurveyGroup.com

We look forward to seeing you in Tennessee!!

Society News



Joint Aquatic Science Meeting- Grand Rapids It Happened; it was HUGE; and FMCS was Represented

first impressions by **Daelyn Woolnough**, Central Michigan University

The second ever Joint Aquatic Sciences Meeting (JASM), sponsored by nine professional aquatic societies (including FMCS) took place on May 14 -20, 2022, in Grand Rapids, Michigan. Around 3,500 attendees from around the world (57 countries) came, there were over 2,600 talks

and posters, and FMCS was represented by at least 70 members, either in-person or virtually. The conference was HUGE, as you might imagine, including more than 30 concurrent sessions throughout the week. The DeVos Center building was open and bright and easy to navigate, but it was more of a maze to try to find the sessions in the adjacent Amway Grand building. Overall, the setting was very elaborate -- imagine presenting in golden rooms with huge chandeliers! There were large plenary sessions to attend (or stream) each day, with the speakers emphasizing how great science is performed in a collaborative and inclusive way.

Posters were up from Monday through Friday to allow for viewing any time, which was a nice way to take a break from the busy schedule of oral presentations. Monday and Wednesday were both attended poster session nights, so that every poster area was not too crowded.

The meeting included a large outdoor dinner on Thursday evening that was held on a bridge over the Grand River. An emergence of aquatic insects from the river was happening the week of JASM, which added some fun to casual conversations!

Masking due to COVID was a must. As you can imagine with >3,500 attendees, there were COVID positive cases popping up throughout the conference; which may have persuaded most people to comply with the masking mandate.

FMCS presentations were incorporated into a wide variety of sessions and that encouraged great questions, conversations, and feedback. FMCS had a booth in the vendors/society area and the FMCS Diversity, Equity, and Inclusion Committee had a poster in the Wednesday night poster session. The FMCS booth seemed to be the place to meet at such a large conference and I think all agreed it was really good to see everyone again after such a long COVID-hiatus from face-to-face meetings.

We had great interactions with other professional societies, with folks from the American Fisheries Society and the Society for Freshwater Science especially interested in FMCS talks. At the FMCS booth, three pages were filled with names requesting information about our society and memberships.



A more complete report about FMCS involvement in this JASM meeting will be posted in the September issue of *Ellipsaria*. That article also will include photographs of those attending in person and virtually; we tried to round up those available for a photo on the Thursday morning.

Overall, JASM was a huge success and lots of great science was shared in a collaborative atmosphere. The timing of a potential future JASM meeting will be decided by the Consortium of Aquatic Science Societies, but it is likely to be at least five years from now.

SAVE THE [Revised] DATES!
13th Biennial FMCS Symposium
Portland, Oregon, USA
Monday - Friday, April 10 - 14, 2023

Yes, you heard it here! The Planning Committee is really looking forward to welcoming everyone to the 13th Biennial FMCS Symposium on April 10 -14, 2023, and we are excited to announce it will be live and in person at the DoubleTree by Hilton Hotel in downtown Portland, Oregon, USA. Unlike in past years, this Symposium will be held **Monday through Friday** to accommodate the Easter holiday weekend.

So, mark your calendars now, start thinking about what you will want to present, and where you will want to visit next April in Portland. More details about the Symposium will be forthcoming in the September 2022 issue of *Ellipsaria* and on the FMCS Events website.

Need more information now? Contact Emilie Blevins (Emilie.Blevins@xerces.org) or Megan Bradley (megan_bradley@fws.gov).



Call for FMCS Officer Nominations for 2023

Every other year, our Society elects members to serve in three Executive Committee positions: President-elect (who, after two years, goes on to serve as President for two years, then Past-President for two years), Treasurer (for a 2-year term), and Secretary (also for a 2-year term). This is an invitation for nominees to fill all three positions. Any member may volunteer themselves or nominate another member, but the nominee must be a current FMCS member in good standing and agree to be nominated. Please consider yourself or another worthy member for these positions.

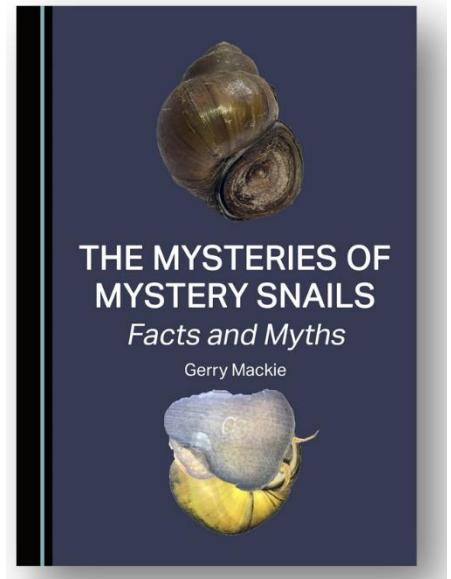
These positions will be filled during an election to be held later this year and the new officers will assume their duties during the 2023 FMCS Symposium in Portland, Oregon. If you want to nominate someone or have questions about this process, send an email to the Election Committee Chairman, Wesley Daniel, at wdaniel@usgs.gov.

Announcements

The Mysteries of Mystery Snails *Facts and Myths* *By Gerry Mackie*

This book offers a comprehensive review of the literature on Chinese and Japanese mystery snails around the globe, providing details of their distribution in 10 continents and more than 130 countries. It discusses several fascinating facts on dispersal mechanisms, biology, ecology, impacts, and control, revealed from more than 900 peer-reviewed articles. The Chinese Mystery Snail has been in North America now for more than 130 years and is the second oldest introduced freshwater mollusc species from Eurasia, the oldest being the Faucet Snail, *Bithynia tentaculata*, introduced in 1870. The scientific genus name for the Chinese and Japanese mystery snails, *Cipangopaludina*, may have its origin in the poem, "Les Conquérants", by De Heredia, who incorporated the name Cipango in his story of the search for gold on a mysterious island, Zipangu (Japan). The book will appeal to anyone interested in invasive molluscs.

Available from June 1st, 2022, from Cambridge Scholars Publishing at [The Mysteries of Mystery Snails: Facts and Myths - Cambridge Scholars Publishing](#) **Hardback Pages / Size:** 598 / A5 **ISBN-13:**978-1-5275-8265-1; **ISBN-10:**1-5275-8265-5 **Price:** £89.99



Freshwater Research News

Freshwater Research News (FRN) is a free newsletter covering all aspects of freshwater research. Compiled by Kev Warburton, School of Agricultural, Environmental and Veterinary Sciences, at Charles Sturt University in Australia, it highlights the broad significance and applicability of recent findings from around the world. FRN is produced for scientists, practitioners, educators, and conservationists. It's a convenient way for specialists to stay abreast of developments in freshwater areas outside, as well as within, their own fields, and its jargon-free style makes it ideal for community consumption.

FRN is issued in PDF form four times per year. To receive FRN automatically, just email Kev Warburton at KWarburton@csu.edu.au. You can view a sample issue of FRN at: <https://freshwaterresearch.Wordpress.com/sample-issue-pdf>

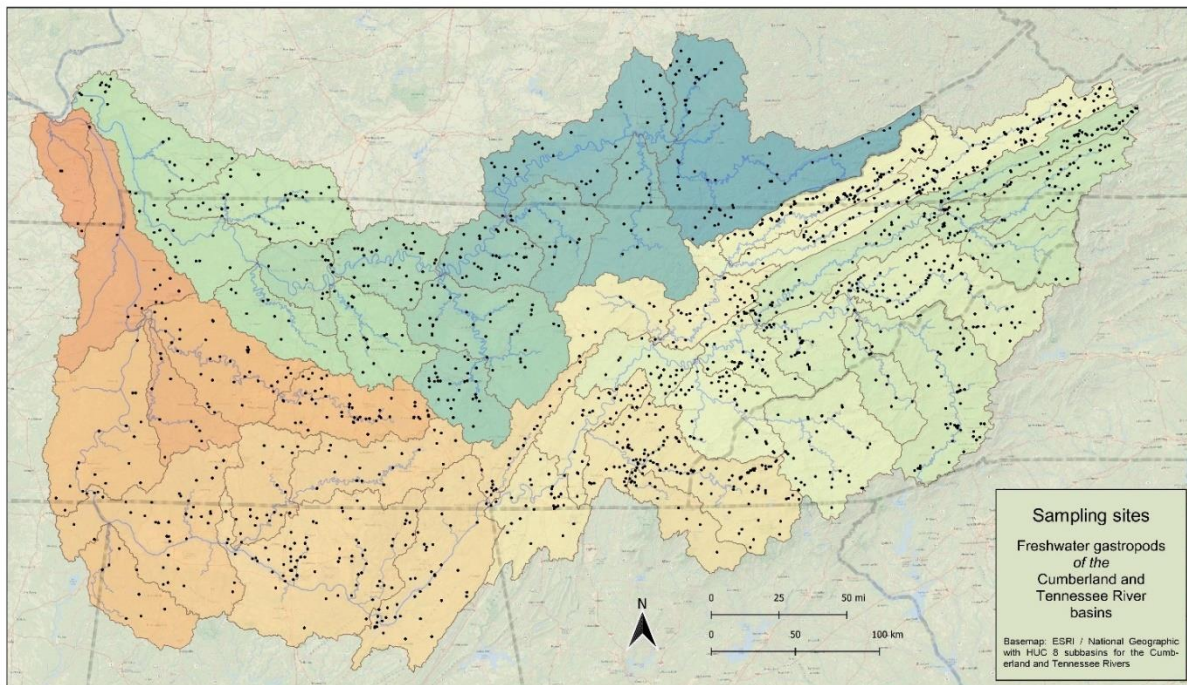
Expanded Coverage of the Freshwater Gastropods of Tennessee Web Resource

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

<https://www.fwgna.org/dillonr/>

We are pleased to announce the expansion of our Freshwater Gastropods of Tennessee (FWGTN) coverage from its East Tennessee origins though the **entirety of the Tennessee and Cumberland River drainage basins**, increasing our sampling area from approximately 22,000 square miles to over 58,000. We document 54 species of freshwater gastropods with 16 additional subspecies in this malacologically rich region, offering ecological and systematic notes for each, as well as detailed distribution maps, a dichotomous key, and a photo gallery. This expanded web resource, coauthored by R.T. Dillon, M. Kohl and R. Winters, is available at: <https://www.fwgna.org/FWGTN/>

The previous version of our FWGTN website, brought online in 2011 by Dillon & Kohl, covered only the Tennessee River drainage system from southwest Virginia and western North Carolina through East Tennessee to clip a bit of northwest Georgia and stop at the Alabama border. Our 2011 database included 1,674 records from approximately 767 discrete sites, documenting 39 species and 2 subspecies. The expanded database includes 4,003 records from approximately [1,700 discrete sites](#) (see Map), ranging though North Alabama and Middle Tennessee to clip the corner of northeast Mississippi, plus a big slice across southern Kentucky as well.

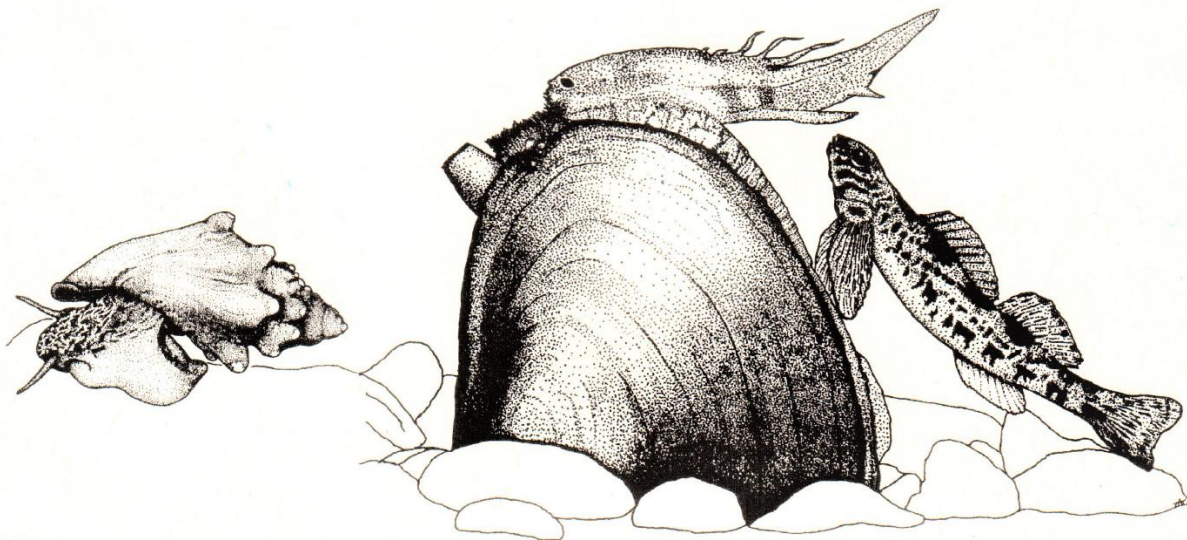


Among many interesting findings, we report that three pleurocerid species previously thought restricted to East Tennessee range significantly further west: *Pleurocera simplex* (with its subspecies *ebenum*), *Pleurocera troostiana* (with subspecies *perstriata*, *edgariana*, and *lyonii*) and *Pleurocera clavaeformis* (subspecies *unciale*). We have also discovered that *Pleurocera semicarinata*, previously unknown further south than Kentucky, ranges through Cumberland drainages well into Tennessee. The distributions of several hydrobioid species are also clarified and expanded – more about this in coming months.

Our complete FWGNA database, covering the drainages of the Ohio as well as Atlantic drainages from Georgia to the New York line, now contains 22,044 records, documenting 107 species of freshwater gastropods, with 21 subspecies. We have updated our overall website with a new continent-scale [biogeographic analysis](#), dividing records into North Atlantic, South Atlantic, Ohio, and Tennessee/Cumberland subsets. Our analysis suggests that natural selection has been more important in the evolution of freshwater pulmonates than gene flow restriction, but that gene flow restriction has been more important in the evolution of freshwater prosobranchs than natural selection.

Upcoming Meetings

- July 16 - 21, 2022** – Society for Conservation Biology North American Sectional Meeting, Reno, Nevada, USA Theme: *Restoring Connections and Building Resilience in a Changing World*, <https://scbnorthamerica.org/index.php/naccb-2022/>
- August 1 - 6, 2022** – American Malacological Society Annual Meeting will be held jointly with the World Congress of Malacology in Munich, Germany. Theme: *All aspects of diversity, function, ecology, evolution, and conservation of extant and fossil Mollusca* <https://www.wcm2022.bio.lmu.de/wcmslider3/index.html>
- August 8 - 11, 2022** – FMCS Field Sampling Workshop, Henry Horton State Park, Tennessee, USA [FMCS Workshop 2022 \(molluskconservation.org\)](https://www.fmcsworkshop2022.org/). [see article on Page 1]
- August 21 - 25, 2022** – American Fisheries Society 152nd Annual Meeting, Spokane, Washington, USA Theme: *What do fish mean to us? Perspectives above and below the water* <https://afsannualmeeting.fisheries.org/>
- October 23 - 26, 2022** – Southeastern Association of Fish and Wildlife Agencies 76th Annual Conference,. Charleston, West Virginia, USA. <http://www.seafwa.org/conference/overview/>
- March 26 - 30, 2023** – National Shellfisheries Association 115th Annual Meeting, Baltimore Marriott Inner Harbor at Camden Yards, Baltimore, Maryland, USA [Annual Meeting \(shellfish.org\)](https://www.shellfish.org/annual-meeting/)
- April 10 - 14, 2023** – FMCS Biennial Symposium, Double Tree Hotel, Portland Oregon, USA. Theme: *Mountains to Sea and Mollusks Between*. [other details yet to be determined]
- June 3 - 7, 2023** – Society for Freshwater Science Annual Meeting, Brisbane, Australia [Theme and other details not yet posted]
- May (?) 2025** – FMCS Biennial Symposium, somewhere in Michigan, USA. [dates, location, theme, and other details yet to be 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 little editing. The opinions expressed are those of the authors.

A COVID-19 Lockdown High School Science Experiment: Lower pH Effects on Development Success in Freshwater Snails

Bruce J. Stephen, Distance Education Adjunct Faculty, Unity College;
Marine Science Instructor, The Acadia Institute of Oceanography
bstephen@mac.com; <http://bstephen.weebly.com/>

[Not Peer-reviewed]

The COVID-19 pandemic forced many adjustments to daily living, science research, and teaching techniques. The following are the setup and test results of an experiment that I used to direct similar experiments by high school students during COVID-19 lockdowns. The data presented here are from the run I performed to provide students with an idea of what they might expect. The small number of citations is by design to encourage students to search for additional resources to cite.

One of the major gases involved in climate warming is carbon dioxide, which also causes acidification of aquatic systems. As more carbon dioxide dissolves in water, a shift in the carbonate/bicarbonate pathway causes a decrease in carbonate ions and an increase in hydrogen ions, thus lowering the pH (NRC, 2010). Changes in pH influence invertebrate species; of particular concern is the influence on development (Bell 1971; NRC 2010). Acidification of aquatic systems also has been shown to influence development in freshwater snails (Shaw and Mackie 1989).

At the start of this experiment, paired adult Marsh Pond Snails (*Stagnicola elodes*) were placed in mini aquaria (500 ml clear plastic cups), each with an air stone (Dillon and Wethington, 1992), and were fed boiled Romaine lettuce or commercial fish food containing algae every other day. The aquaria were monitored for egg deposition and, when this occurred, the adult snails were removed. After adult removal, different pH levels were produced by replacing small amounts of aquarium water two times a day with previously prepared water adjusted to the desired pH (7.0, 6.8, or 6.5) using a commercial product (API brand pH buffer and pH down). One set of aquaria was kept at the original collection site pH of 7.4. Snail eggs were viewed, and development monitored, through the walls of the clear plastic cups. The percentage of eggs that hatched from the gel masses and the number of days to 50% hatch in each egg mass were recorded and compared using ANOVA.

As indicated in Figure 1, the percentage of eggs that hatched was similar among the treatments except under the lowest pH (pH 6.5), where only a few eggs hatched. The ANOVA test indicated the effect was significant ($F(3, 24) = 36.5, P < 0.001$); however, the power of this test is low due to the small sample size in each treatment group (5 to 8 individual egg masses).

The ANOVA test on the 50% hatch data indicated that hatching time increased significantly ($F(3, 24) = 22.9, P < 0.001$) in the lower pH treatments (Figure 2); however, the lowest pH treatment yielded only two hatchlings and thus did not reach 50% hatching. Those data are included on Figure 2 only for visualization purposes.

Overall, the results of this experiment indicated that hatching of *Stagnicola elodes* eggs proceeded with few differences except under the lowest pH treatment (pH 6.5). At pH 6.5, hatching success was near zero. At the next lowest pH level tested (pH 6.8), development did take longer than at higher pH levels, and the success rate of individual eggs masses varied more, suggesting that pH 6.8 also may hamper development. Viability after hatchling was not tested as a part of this experiment.

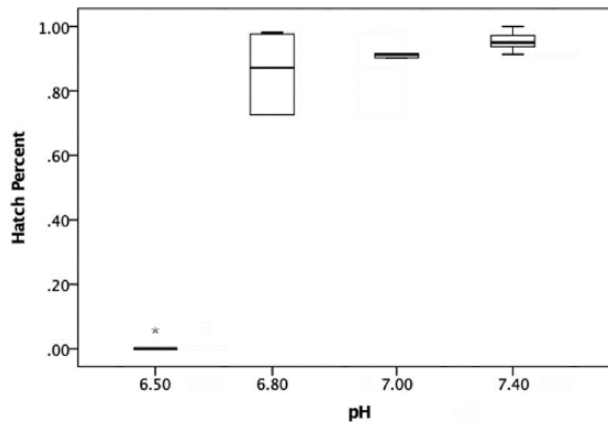


Figure 1. The percentage of eggs that hatched in egg masses of the Marsh Pond Snail, *Stagnicola elodes*, under different pH conditions. * Very few eggs hatched in the pH 6.5 treatment.

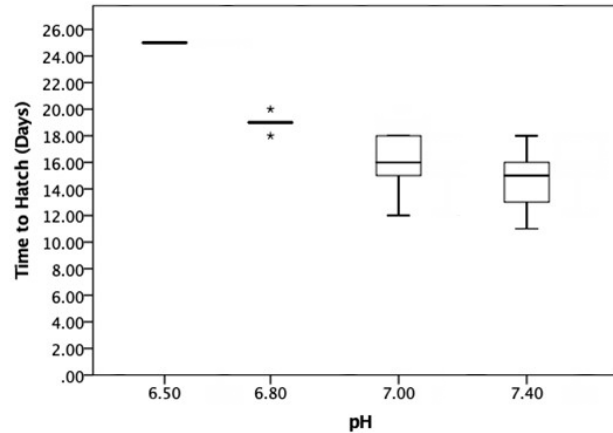


Figure 2. The number of days for 50% of the eggs in each Marsh Pond Snail, *Stagnicola elodes*, egg mass to hatch under different pH conditions. At pH 6.5 fewer than 50% of the eggs hatched; the entry for those eggs that did hatch is included for illustrative purposes only.

This example demonstrates the ease of setting up an experiment on the effect of lower pH on the viability of developing snails similar to what could occur in nature due to increasing carbon dioxide levels. Freshwater snails are abundant and easily obtained in most areas of the United States, this experiment requires few materials, and the data are easily analyzed.

Levels of complexity could be added to this experimental setup; for example, by placing adults under different pH conditions and recording the number of eggs laid or other effects on the adult snails. Extending the experimental period beyond hatching and measuring growth rates and/or shell thickness could also be performed without adding too much complexity.

One of the weaknesses of this experiment -- a trade-off for the ease of use by students -- may be the alteration of pH using commercial products that include chemicals which could affect development on their own, in addition to changing the pH. The pH reducing ingredient in the commercial product that has been used before (Bell 1971) usually is sulfuric acid. Using a compressed-CO₂ tank to provide periodic infusions of carbon dioxide was tried but only maintained pH values for two hours, at most. Other methods of controlling pH, such as placing the aquaria in a carbon dioxide air bath, are more complex than could be used by high school students, especially at home.

There was mixed success from individual students or student pairs; however, each experiment resulted in a written report that required them to delve into the effects of climate change. Some students also presented their data in informal or formal science fair situations. I believe that all of the students who performed this experiment developed a solid appreciation for the challenge, and frustrations, of biological research.

References:

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- Dillon, R.T. and A.R. Wethington. 1992. The inheritance of Albinism in a freshwater snail, *Physa heterostropha*. *Journal of Heredity* 83:208–210.
- National Research Council. 2010. *Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/12904>.
- Shaw, M.A. and Mackie, G.L. 1989. Reproductive success of *Amnicola limosa* (Gastropoda) in low alkalinity lakes in south-central Ontario. *Canadian Journal of Fisheries and Aquatic Sciences* 46:863–869.

Unionids of Rice Creek, an Urban Central Minnesota Stream

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[Not Peer-reviewed]

The Rice Creek watershed drains approximately 520 km² in Anoka, Hennepin, Ramsey, and Washington counties, Minnesota; a large portion of which is the northeast part of the Twin Cities metro area. Our project objectives were to study mussel species distributions in the Rice Creek watershed and to combine our observations with historical records from the basin.

We gathered Rice Creek watershed unionid distribution information from a variety of sources. Using standard qualitative mussel collection methods, we snorkeled the stream and walked the shoreline to collect all live mussels or shell fragments and record the number of each species observed. Living mussels and most shells were returned to where they were collected. We also gathered mussel records from the State of Minnesota (Minnesota Department of Natural Resources, Center for Aquatic Mollusk Programs, pers. comm.), and from the following online databases: James Ford Bell Museum Minnesota Biodiversity Atlas (JFBM 2021); Illinois Natural History Survey (INHS 2021); Ohio State University Division of Molluscs Bivalve Collection (OSU 2021); National Museum of Natural History, Smithsonian Institution (NMNH 2021); Milwaukee Public Museum (2021); Canadian Museum of Nature (2021); and iNaturalist (2021). We visually confirmed the mussel identifications of available specimens at James Ford Bell Museum, and photos on iNaturalist. Mussel nomenclature follows Williams et al. (2017).

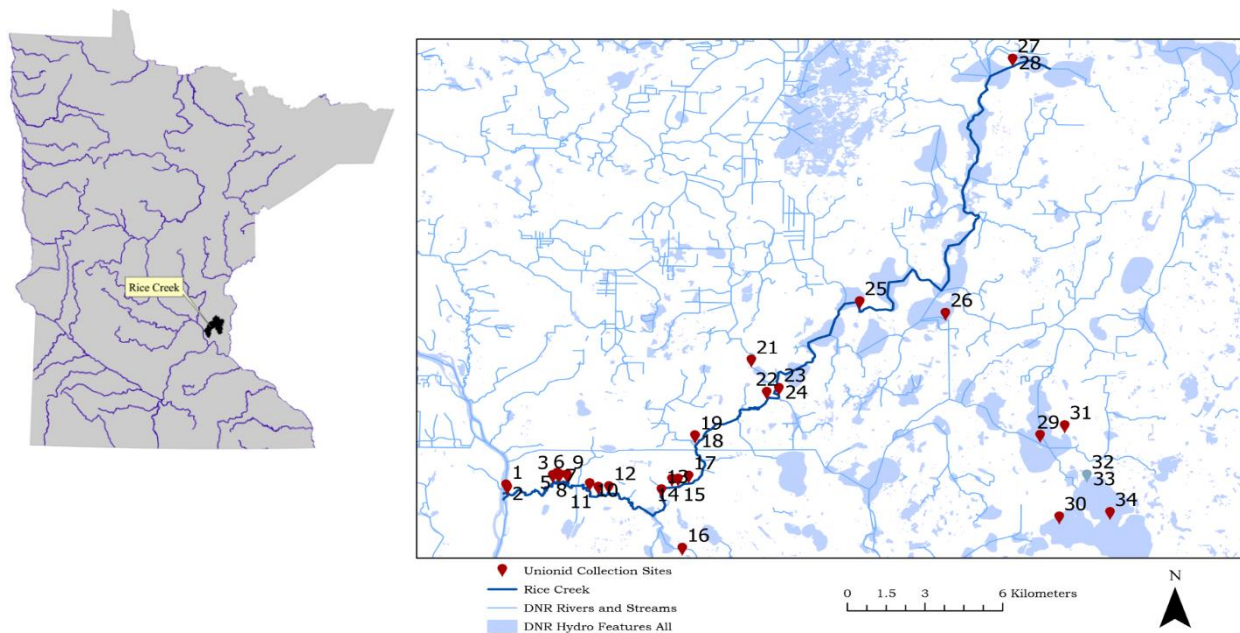


Figure 1. Unionid collection sites from the Rice Creek watershed, Hennepin, Anoka, and Ramsey counties, Minnesota (1940-2021). These numbered locations are identified in Table 1. Rice Creek watershed study site map was generated using Environmental Systems Research Institute (ESRI) software and data from the Minnesota Dept. of Natural Resources Hydrography Dataset, <https://gisdata.mn.gov/dataset/water-dnr-hydrography>. The locator map in Minnesota was created with ArcMap from ESRI.

Table 1. Collection site numbers, Universal Transverse Mercator (UTM) coordinates, collection dates, and data sources for mussel collection sites in the Rice Creek watershed, Hennepin, Anoka, and Ramsey Counties, Minnesota (1940-2021).

Site No.	Coordinates	Date	Data Source
1	15T 478094 4993074	2021 10 02	This study
2	15T 478146 4992972	2021 10 02	iNaturalist (2021) Observation number 97096166
3	15T 479903 4993489	2021 05 25	This study
4	15T 479903 4993500	2021 05 21	This study
5	15T 480073 4993597	2021 05 16	This study
6	15T 480140 4993530 (Approximate location)	1999 08 31	JFBM Catalog #10826-10829
7	15T 480142 4993549	2020 08 17	This study
8	15T 480175 4993531	2020 08 17	This study
9	15T 480445 4993519	2021 06 13	This study
10	15T 481330 4993132	1998	JFBM Catalog #13794
11	15T 481660 4992974	2021 10 23	This study
12	15T 482070 4993000	2020 08 15	This study
13	15T 484100 4992864	1990 11 17	This study
14	15T 484508 4993330	2003 09 06	This study
15	15T 484746 4993341	2005 12 12	This study
16	15T 484906 4990249	1999 09 25	JFBM Catalog #11458, and Personal Communication with collector
17	15T 485152 4993471	2003 09 06	JFBM Catalog #21825-21828
18	15T 485394 4995272	2020 05 09	This study
19	15T 485403 4995258	2020 05 09	iNaturalist (2021) Observation number 45597532
20	15T 486296 4988250	1995 08 03	JFBM Catalog #7628
21	15T 487575 4998654	2021 05 22	iNaturalist (2021) Observation number 80934638
22	15T 488170 4997209	2021 11 26	iNaturalist (2021) Observation number 101960388
23	15T 488640 4997388	2018 08 07	iNaturalist (2021) Observation number 15712981
24	15T 488641 4997388	2018 08 07	iNaturalist (2021) Observation number 15712981
25	15T 491762 5001289	2021 08 25	iNaturalist (2021) Observation number 93009676
26	15T 495075 5000772	2014 06 10	INHS Mollusk Collection, Catalog #79633-79635

Table 1. (continued)

Site No.	Coordinates	Date	Data Source
27	15T 497670 5012142	2021 08 24	iNaturalist (2021) Observation number 92476943
28	15T 497671 5012142	2021 08 24	iNaturalist (2021) Observation number 92476943
29	15T 498734 4995291	1940 07 07	JFBM Catalog #2621
30	15T 499473 4991649	No date	INHS Mollusk Collection, Catalog #38017, 39581
31	15T 499685 4995722	2021 09 04	iNaturalist (2021) Observation numbers 93605874 and 94058154
32	15T 500540 4993522	2013 07 10	INHS Mollusk Collection, Catalog #49570, 49571, 49573
33	15T 500541 4993521	2013 09 27	Minnesota Department of Natural Resources, Center for Aquatic Mollusk Programs, Unpublished Data
34	15T 501435 4991844	No date	JFBM Catalog #2719

Mussel occurrences have been reported from the Rice Creek watershed since 1930; however, that oldest record -- of an *Utterbackia imbecillis* -- has been excluded from this report because of its imprecise location data ("lower Rice Creek"). We collected mussels from 13 locations and found 21 historical records for a combined total of 92 species occurrences at 34 mussel collection sites (Table 1, Figure 1). Of the 10 species observed in the watershed, six were found alive during the past 20 years, distributed across 18 sites (Table 2). The majority of species (both alive and dead) were observed at or near site nine. The most frequently observed species, *Pyganodon grandis* and *Lampsilis siliquoidea*, were found at 29 and 19 sites in the watershed, respectively. We found only one geo-referenceable record of *U. imbecillis* from this watershed. Empty shells of *Anodontooides ferussacianus* and *Ligumia recta* were reported twice. *Dreissena polymorpha* has been observed in some lakes within the Rice Creek watershed (Bald Eagle Lake, Lake Johanna, Long Lake, White Bear Lake) but, as of yet, has not been reported from Rice Creek itself (MNDNR 2022).

Mussel species diversity appears to be declining in the Rice Creek watershed. Four of the ten species (*A. ferussacianus*, *Lampsilis cardium*, *Ligumia recta*, and *U. imbecillis*) were reported only as empty adult shells, and three of these species (all but *U. imbecillis*) only as weathered empty shells.

The possible decline, loss, or absence of recent live individuals of these species may be due to several reasons. Some species appear to be rare. When collected, the previously mentioned four species (*A. ferussacianus*, *Lampsilis cardium*, *Ligumia recta*, and *U. imbecillis*) were represented by few shells among the many specimens of *P. grandis* or *L. siliquoidea*. Next, shells degrade at different rates; thick shells break down slower in the stream and are therefore more likely to remain observable longer (Newell et al. 2007, Strayer and Malcom 2007). Finally, the dam that impounds Rice Creek near its mouth, which is believed to be a barrier to upstream fish movement from the Mississippi River, may also affect the watershed mussel assemblage. *Lampsilis cardium*, *Ligumia recta*, and *U. imbecillis* have been observed living nearby in the Mississippi River at the following distances from Rice Creek, 5 km, 20 km, and 20 km, respectively (Kelner and Davis 2002, iNaturalist 2021). Live *A. ferussacianus* have not been reported near Rice Creek. Removal of fish movement barriers has been shown to enable upstream fish movement (Catalano and Bozek 2007, Burroughs et al. 2010), which may improve unionid dispersal (Smith 1985, Nedeau et al. 2000).

Table 2. Distribution of Rice Creek watershed unionids. Site locations are described in Table 1.

Species (number of site records)	Observed alive during last 20 years	Observed dead during last 20 years	Observed alive more than 20 years ago (or no date provided)	Observed dead more than 20 years ago (or no date provided)
<i>Anodontoides ferussacianus</i> (2)		3, 4		
<i>Lampsilis cardium</i> (6)		3, 4, 8, 9, 14, 17		
<i>Lampsilis siliquoidea</i> (19)	3, 5, 7, 8, 9, 11, 12, 14, 33	4, 8, 9, 14, 17, 26, 32	13	6, 30
<i>Lasmigona complanata</i> (14)	8, 9, 11, 12, 14	3, 4, 5, 8, 9, 14, 17		6, 10
<i>Leptodea fragilis</i> (7)	9, 11, 12	3, 4, 8, 9		
<i>Ligumia recta</i> (2)		4, 9		
<i>Pyganodon grandis</i> (29)	1, 2, 3, 5, 7, 8, 9, 11, 12, 14, 21, 23, 24, 33	4, 8, 9, 14, 15, 17, 22, 25, 26, 27, 28, 32		6, 16, 20
<i>Pyganodon lacustris</i> (5)	33	32		29, 30, 34
<i>Toxolasma parvum</i> (7)	18, 19	3, 4, 26, 31		6
<i>Utterbackia imbecillis</i> (1)		31		

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First Confirmed Record of the Exotic Invasive (Macrofouling) Asian Golden Mussel, Mytilidae, *Limnoperna fortunei* (Dunker, 1857) in the Upper Chapecó River Basin, Western Santa Catarina State, Central Southern Brazil

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As expected from previous verbal field reports (Agudo-Padrón 2021:14), we finally have specimens to document the presence of the Asian Golden Mussel, Mytilidae, *Limnoperna fortunei* (Dunker, 1857) in the hydrographic domain of the Upper Chapecó River Basin, Western Region, Number 3 of Santa Catarina State/ SC, Central Southern Brazil (Agudo-Padrón 2018a). This is a significant region of the State malacologically but it has been very poorly studied so far, with only some scarce and incidental records of malacofauna (see Agudo-Padrón 2012, Agudo-Padrón 2017, and Agudo-Padrón and Lisboa 2013).

On March 18, 2022, professional Military Firefighter Saida Lina Agudo-Blondell, an AM Project field collaborator, was conducting a technical inspection in the Barragem da Usina Hidrelétrica/ PCH Santa Luzia (Santa Luzia Small Hydroelectric Power Plant Dam ~ 26°37'01.00"S & 52°32'19.00"W) (Figure 1).

Severe drought conditions in the region had lowered water levels at the site and he found some singular little bivalve shells on the banks of the reservoir that he photographed (Figure 2) and forwarding to us for identification and taxonomic determination. After examination and analysis, the specimens were confirmed to be the exotic invasive (macrofouling) Asian golden mussel *Mytilidae Limnoperna fortunei* (Dunker, 1857). This is the first confirmed field record of this species from this location and region of the Upper Chapecó River Basin but it confirms the inevitable upstream advance of this troublesome invader predicted a few years ago (Agudo-Padrón 2018b).

Other malacofauna observed in the region include the exotic invasive freshwater Asian basket clams *Corbicula largillierti* (Philippi, 1844), a common and abundant species in the region, and *Corbicula fluminalis* (Müller, 1774) (Figure 3). This is the second confirmed record of this species in the region (see Agudo-Padrón 2017); that sighting, also made by Saida Lina Agudo-Blondell, in the Pequena Central Hidrelétrica/ PCH Ludesa - Barragem Cascata (Ludesa Small Hydroelectric Power Plant - Cascade/ Waterfall Dam installed on the Chapecó River ~ 26°34'42.2"S & 52°29'53.1"W), Comunidade Linha Cascata (Waterfall Line Community).

It should be noted that in the São Domingos region (city and Municipal District) includes a total of three hydroelectric plants, the UHE Quebra Queixo, the little PCH Ludesa, and the little PCH Santa Luzia, all built on the Upper Chapecó River Basin and, probably, all of them already "contaminated" by the disastrous presence of the Asian golden mussel.



Figure 1. Location of the São Domingos Municipal District (Map – red color) and the Santa Luzia Small Hydroelectric Power Plant Dam in the Western region of Santa Catarina State, Central Southern Brazil, and two views of the dam area. All photographs by Saida Lina Agudo-Blondell.



Figure 2. Two photographs of the two shells of the exotic invasive golden mussel Mytilide *Limnoperna fortunei* (Dunker, 1857) found at the Santa Luzia Small Hydroelectric Power Plant Dam in the Upper Chapecó River Basin, Western region of Santa Catarina State/ SC, Central Southern Brazil.

Figure 3. A random sample of the exotic invasive Asian clams Cyrenidae *Corbicula fluminalis* (Müller, 1774) (the larger shells) and *Corbicula largillierti* (Philippi, 1844) (the smaller shells in the center) found in the cascade/ waterfall dam area of the Ludesa Small Hydroelectric Power Plant, Upper Chapecó River Basin in São Domingos Municipal District, Western region of Santa Catarina State/ SC, Central Southern Brazil.



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Extinction Risk Assessment of Continental/ Freshwater Gastropod Mollusks of Brazil: Reassessment Process of the Conservation Status

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As described previously (Agudo-Padrón 2022:27; Santos and Miyahira 2022a:29), the reassessment process (Phase 2) of the conservation status (extinction risk assessment) of Brazilian mollusks is underway starting with mainland/ freshwater bivalve species and, now, including land/ terrestrial and limnic/ freshwater gastropod species. This project is being coordinated by the Chico Mendes Institute for Biodiversity Conservation - ICMBio, the federal agency responsible for promoting the conservation of Brazilian biodiversity (Agudo-Padrón 2022:27).

In this review, each gastropod species to be evaluated is described in an individual online form, available during the period in the official SALVE System < <https://salve.icmbio.gov.br/salve-consulta/>. The form contains information compiled from previous evaluations, as well as recent data added based on the literature. As in the case of the previous bivalve analysis, the final results of the evaluation now in progress will become part of the contents of the next edition of the Red Book of Brazilian Fauna Threatened with Extinction.

Worldwide, limnic/ freshwater gastropods are recognized today as the mollusks most threatened with extinction next to the freshwater bivalves (Agudo-Padrón 2022: 27) basically because they are highly vulnerable to the various anthropic actions and changes that act directly or indirectly on their restricted/ limited habitats.

A total of seventy-five continental gastropod species are being evaluated (Santos and Miyahira 2022b:23-25), including 60 land/ terrestrial forms in 14 families and 32 genera, around nineteen of which occur in the State of Santa Catarina/ SC). The list also includes 15 limnic/ freshwater representatives in nine families and twelve genera (Table 1). Six of these forms, including one endemic (Agudo-Padrón 2018 b:36), occur in the southcentral region of Santa Catarina State/ SC, geographical Atlantic slope portion of the Southern Cone, where systematic inventory of their malacological species in general has been carried out since 1996 (Agudo-Padrón 2018a). Two of the freshwater species contemplated in the evaluation were included in the last available edition of the Red Book of the Brazilian Fauna Threatened with Extinction (Agudo-Padrón 2019:33): Ampullariidae *Pomacea sordida* (Swainson, 1823) and the Physidae *Stenophysa* (- *Physa*) *marmorata* (Guilding, 1828); however, both are highly polemic and controversial gastropods regarding their actual conservation status in Brazil (Agudo-Padrón 2015a, 2015b:174, 2016, 2018b).

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Table 1. Brazilian freshwater gastropod mollusk species being considered in the National Reassessment Process of their conservation status.

Ampullariidae
<i>Pomacea sordida</i> (Swainson, 1823) ▲
Bulinidae
<i>Plesiophysa dolichomastix</i> Paraense, 2002
Cochliopidae
<i>Heleobia brucutu</i> Simone & G.V. Oliveira, 2021
Hemisinidae
<i>Aylacostoma tenuilabris</i> (Reeve, 1860)
Lymnaeidae
<i>Galba</i> (- <i>Lymnaea</i>) <i>rupestris</i> Paraense, 1982 ▲★
Physidae
<i>Stenophysa</i> (- <i>Physa</i>) <i>marmorata</i> Guilding, 1828 ▲
Planorbidae
<i>Acrorbis petricola</i> Odhner, 1937 ▲
<i>Biomphalaria kuhniana</i> (Clessin, 1883)
<i>Biomphalaria occidentalis</i> Paraense, 1981 ▲
<i>Biomphalaria schrammi</i> (Crosse, 1864) ▲
<i>Drepanotrema pileatum</i> Paraense, 1971
<i>Gundlachia bakeri</i> Pilsbry, 1913
<i>Gundlachia ticaga</i> (Marcus & Marcus, 1962)
Pomatiopsidae
<i>Spiripockia umbraticola</i> Simone & Salvador, 2020
Tateidae
<i>Potamolithus karsticus</i> Simone & Moracchioli, 1994

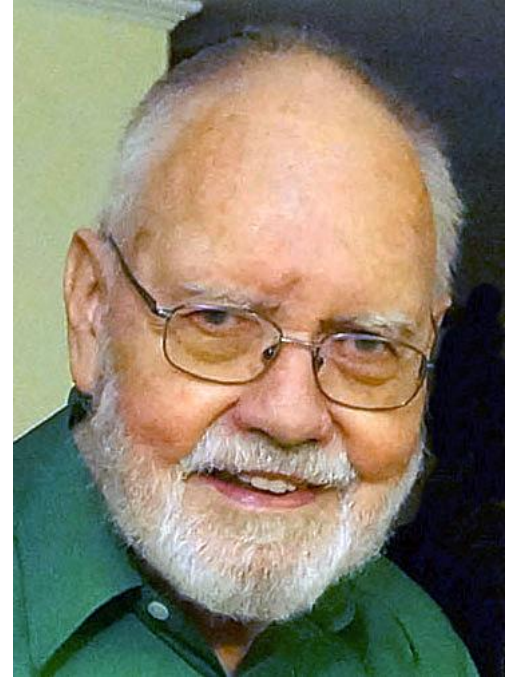
- ▲ – Species occurring in the geographical territory of Santa Catarina State/ SC, Central Southern Brazil region, Atlantic slope portion of the Southern Cone.
- ★ – Species endemic to Santa Catarina State/ SC, Western region domain of the Uruguay River Basin Valley (Agudo-Padrón 2018 b:36).

Obituary

William Herman (Bill) Heard -- 1936 - 2022 **Virginia A. Vail and Dan C. Marelli**

William Herman Heard -- Bill to everyone in his professional life-- passed peacefully on Tuesday February 1, 2022. He was 86. Bill had a long and varied as well as illustrious career that revolved around research on the Phylum Mollusca, particularly freshwater bivalves. His main interest was in the systematics and reproductive biology of sphaeroidean and unionoidean bivalves, but his interests spanned many areas, and he had an encyclopedic knowledge of many aspects of biology.

Bill received his Ph.D. in 1963 from the University of Michigan Department of Zoology. His dissertation was titled "*Some comparative life histories of pill clams (Sphaeriidae: Pisidium).*" Bill was hired in 1962 as a faculty member by the Florida State University Department of Biological Science and spent his entire professional career at FSU. Over the next 38 years, until his retirement in 2000, Bill conducted research on the systematics and reproduction of sphaeroidean and unionoidean bivalves based on the character and character states of valves and reproductive anatomy since the field of molecular biology as it relates to systematics had not yet been developed. His particular interest was focused on invertebrate reproduction, but his research emphasized the reproduction of freshwater mollusks. He maintained an interest in bivalve reproduction but also began to explore aging in metazoans up until the time that his health made further work impossible.



His Ph.D. research and subsequent research while at Florida State resulted in 45 peer-reviewed articles as well as a number of reports (see bibliography below). One of his reports, written in 1979 for the Florida Department of Environmental Regulation, was a taxonomic guide to the freshwater bivalves of Florida. This guide was the definitive work for identifying freshwater bivalves in Florida for many years. He also served as a referee for more than a dozen peer-reviewed scientific journals, served on the editorial board of *Malacological Review* and on committees of professional scientific societies.

Bill was active in the southeastern United States in terms of his research and participation at societal meetings and internationally with the meetings of *Unitas Malacologia* and the *International Society for Medical and Applied Malacology*. In addition to his local research interests, he was involved in field work at Eniwetok Atoll in 1960, Southeast Asia for a year from 1970-1971 on a Smithsonian project involving waterborne diseases of the Mekong delta, and he also spent two months in Africa in 1972 collecting unionoidean bivalves. During his time in Thailand, he discovered two new species of mayfly naiads living within unionid mussels, one of which was named in his honor.

In addition to his teaching and administrative duties at FSU, Bill supervised 19 successful Masters' and 15 PhD students at Florida State. Unlike contemporary faculty "labs," Bill did not assign students to conduct a piece of his research and insist on being an author on his student's published literature. In fact, Bill was quite clear about not caring what his PhD students worked on as long as it was related to mollusks. He was also insistent that his name did not belong on the publication of one of his students. He encouraged his students to think independently but he worked diligently to ensure that they had the proper environment and support in which to succeed.

In 2001, the *Freshwater Mollusk Conservation Society* awarded Bill a Lifetime Achievement Award for "exemplary contributions to the fields of freshwater bivalve reproductive biology and unionoidean and sphaeriacean anatomical systematics." Bill remained active in national and international molluscan research circles until the last few years.

Everyone who knew Bill recognized his sharp wit and easy smile. As our major professor and friend, we knew Bill like most did not. He was a wise mentor who worked to develop students into good scientists. Often contemplative, it was sometime difficult to know what Bill was thinking but nothing escaped his ability to observe and provide salient advice. He was old school in his research methods and his approach to his students, insisting in developing young scientists that were able to think through problems and make new discoveries. After retiring from FSU, where he remained an emeritus professor for 22 years, we had the distinct pleasure of enjoying his company both socially and professionally. He continued to be a source of knowledge on freshwater bivalves, but he also devoted much time to his extended family and the students in his adopted home of Tallahassee.

Scientist, mentor, friend, there was only one Bill Heard and he will be missed. Those wishing remember Bill in a way that helps current and future malacologists should consider contributing to the John B. Burch Malacology Fund. "Jack" Burch, a longtime researcher and educator at the University of Michigan Museum Of Zoology, was a colleague and collaborator of Bill's and made important contributions to the field of malacology. He also trained many students who continue his legacy in malacology. Bill was a supporter of the John B. Burch Malacological Fund and contributions in his memory will help train malacologists of the future.

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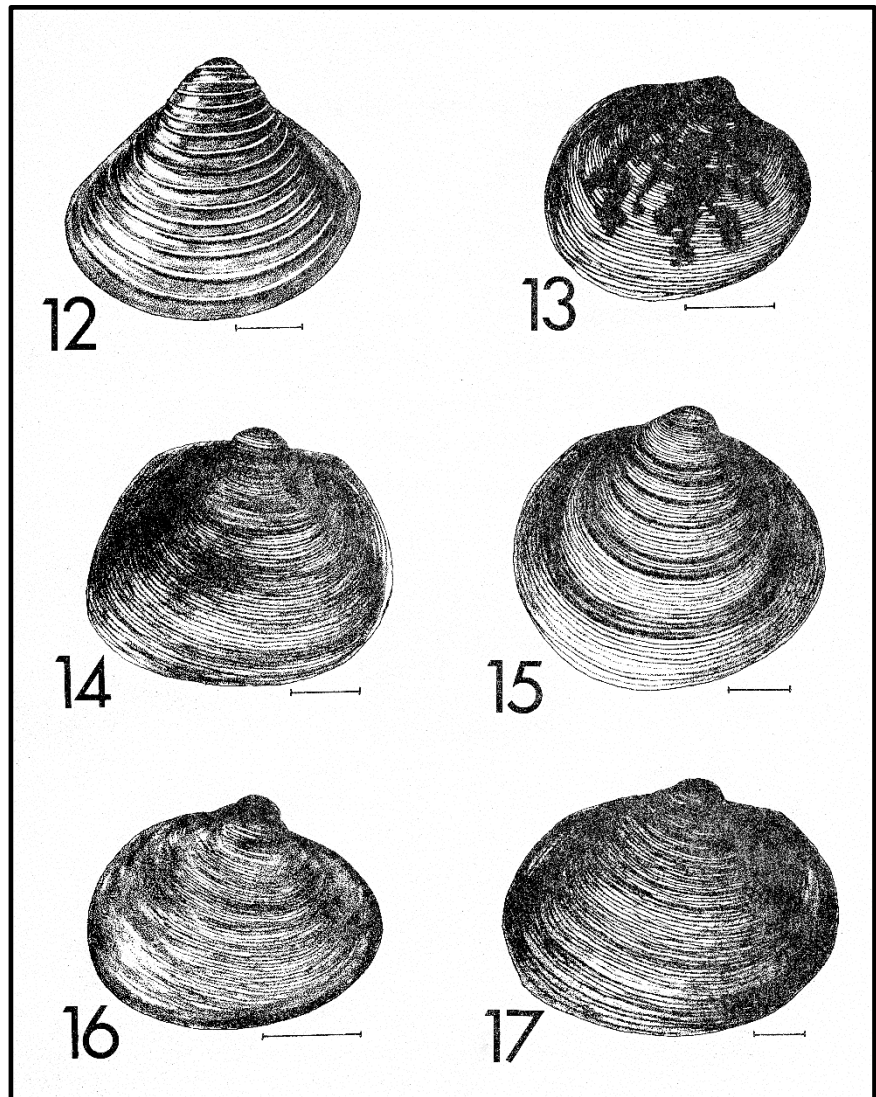
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Figures 12 - 17 from Bill Heard's *Identification manual of the freshwater clams of Florida*.

- 12. *Corbicula manilensis*
- 13. *Byssanodonta cubensis*
- 14. *Musculium lacustre*
- 15. *Musculium partumeium*
- 16. *Musculium securis*
- 17. *Musculium transversum*



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Ellipsaria is posted on the FMCS web site quarterly: around the first of March, June, September, and December of each year. The 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>).

Articles contributed to *Ellipsaria* should be preliminary or initial observations of note (e.g., natural history observations, meaningful new distribution records, interesting finds, etc.) concerning freshwater mollusks, their habitats, and/or their conservation. Articles that include quantitative analyses, draw conclusions based on analyses, or propose taxonomic revisions should not be submitted to *Ellipsaria* and, instead, should be submitted to a peer-reviewed journal such as *FMBC*. Please limit the length of contributed articles to about one page of text (i.e., excluding pertinent tables, figures, and references).

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. Note that submissions are not peer-reviewed but are edited for clarity and checked for appropriateness for posting in this freshwater mollusk newsletter. Feel free to contact the editor with questions about possible submissions or transmission concerns.

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

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Parting Shot



In case you were wondering if the zebra/quagga mussel invasion of North America has spread as much as it is likely to, the answer is no, not yet. As one example, this photograph was taken in late March 2022, at an upstream site on Melton Hill Reservoir, an impoundment on the Clinch River near Knoxville, Tennessee. The relatively few, small (~ 10-15mm) dreisseniids found along the Melton Hill shoreline apparently are developing from veligers released further upstream in Norris Reservoir, one of the large Tennessee Valley Authority impoundments on the headwaters of the Tennessee River. Local news reports indicate that “zebra mussels” were first observed in Norris and nearby Cherokee reservoirs in 2014. While some dreisseniids have been found in all nine mainstem Tennessee River reservoirs since the early 1990s, their numbers have remained low through, at least, the late 2000s [see *Ellipsaria* 20(1):29], perhaps because there were no significant upstream sources of veligers. Now, with population levels building in the upstream reservoirs, it will be interesting to see if dense populations develop further downstream and, if so, what effects they will have on local ecosystems and human uses of this major river system. Photograph by John Jenkinson.

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.

