



Newsletter of the Freshwater Mollusk Conservation Society

Volume 18 – Number 1 March 2016

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2016 FMCS Genetics Workshop Draws Participants from Afar

The FMCS Genetics Workshop was held February 16-19, 2016, at the US Fish and Wildlife Service National Conservation Training Center (NCTC) in Shepherdstown, West Virginia. Despite some travelers encountering a bit of snow and ice on their way in, all participants arrived safely and had clear weather for the remainder of the week.

This Workshop attracted 75 registrants, hailing from 23 US states, Germany, and Finland. The workshop featured sessions covering general conservation genetics concepts, genetic drift and diversity in populations,

phylogeny, and new directions in genetics. Those talks were followed by hands-on laboratory exercises exploring population genetic structure, genetic drift, and phylogeny analyses. The plenary speaker was Dr. Gordon Luikart of the University of Montana, who described applications of new techniques in genomics that allow us to answer questions that could not be addressed with past genetics approaches. We also had nine poster presentations describing ongoing mollusk and genetics projects conducted by Society members. From all the positive feedback we received, the workshop was enjoyable and educational for those experienced in genetics, as well as for those new to the subject. NCTC provided a picturesque background for the workshop, and many participants commented on both the beauty of the campus and the convenience of having all necessary amenities on-site.



This workshop would not have been possible without support from six sponsors and the dedicated efforts of the Workshop Committee. We received sponsorships from the US Geological Survey, Virginia Department of Game and Inland Fisheries, Alan Buchanan, AllStar Ecology, MICRA, and Three Oaks Engineering. Their support is greatly appreciated!

Workshop organizers Curt Elderkin, Dave Berg, and Sarah Veselka, along with many other volunteers, did a great job and kept everything running smoothly. Thanks to all of the presenters (Dave Berg, Kentaro Inoue, Curt Elderkin, Emy Monroe, Kevin Roe, and David Hayes) for taking the time to put together relevant and informative talks, and for answering all of those questions. Thanks, also, to Janet Clayton for taking the pictures included in this article.

Society News

Minutes of Fall 2015 FMCS Board Meeting Teleconference Thursday, December 3, 2015

Call to Order – President Teresa Newton

Attendees – Teresa Newton, Emily Grossman, Janet Clayton, Heidi Dunn, Mary McCann, Becca Winterringer, Greg Cope, Emy Monroe, Art Bogan, John Harris, Curt Elderkin, Art Bogan, Jeremy Tiemann, Jennifer Archambault, John Jenkinson, Ryan Schwegman, Dave Berg, Steve McMurray, Rachael Hoch, Megan Bradley, and Greg Zimmerman.

Minutes of the July 20, 2015 Board Meeting (published in the September 2015 *Ellipsaria*) were approved following a motion by Heidi Dunn and a second by Curt Elderkin.

Treasurers Report – Emily Grossman
for the period 7/1/15 – 11/22/15

Income

Memberships:	\$1,560.00
Workshop:	
Registration:	\$1,120.00
Sponsorships (so far):	\$500.00
Interest:	<u>\$44.04</u>
Total:	\$3,224.04

Expenses

Allen Press/FMBC costs:	\$120.00
Annual corporate registration:	\$31.75
Credit card machine fees:	\$245.93
PayPal fees:	\$36.38
Square (new credit card system) fees:	<u>\$11.50</u>
Total:	\$445.56

Current bank balance

Checking:	\$7,363.64
Savings:	<u>\$124,832.01</u>
Total:	\$132,195.65

Update on credit cards

Emily has set up an account with Square and used it to process a couple of credit card payments for members. So far, so good! She plans to purchase their chip card reader (\$49) before the Workshop so that option will be available for people paying in person. It was suggested that if payment by USGS and FWS is successful through Square, then we should consider cancelling the other credit card machine.

Secretary's Report – Janet Clayton

We currently have 521 on the FMCS mailing list. This includes 126 lapsed members (from 2015, as earlier ones were previously archived) and 378 active members. Active members include 296 regular members, 64 students, 10 lifetime members, and 8 contributing members. There are also a few pending memberships due to the registration process for the upcoming genetics workshop.

Old Business**Long term investment and funding strategies for the Society – Heidi Dunn**

An announcement was placed in last two *Ellipsaria* issues to solicit committee members but there has been no response. Greg Cope earlier expressed interest. There are still hopes some interest will come forward over winter and spring. If not, we may have to target help. Leroy Koch was contacted as his wife has experience, he noted she would be available to answer questions and provide advice but he did not want to be on the committee.

Formation of the ad hoc International Committee, effective October 23, 2015 – Teresa Newton

This new ad-hoc committee now consists of Art Bogan(US), Kevin Cummings (US), Lyubov Burlakova (US), Jüergen Geist, (Germany) Alexander Karatayev (US) and Manuel Lopes-Lima (Portugal). A chairman has yet to be selected. Three tasks were given to the committee and a plan for it is to be provided at the Cleveland Symposium. Art noted that there had been some discussion at the Buffalo meeting; he had talked to Manuel Lopes-Lima who had been talking to several international colleges. Teresa emphasized the need to select a chair and determine how to move forward.

New Business**AFS Monetary Values of Fish and Freshwater Mussels update – Heidi Dunn, Mary McCann, Ryan Schwegman**

AFS and Southwick Associates, Inc. are in the process of updating the 2003 AFS Special Publication 30 on Monetary Values of Fish and Freshwater Mussels. There have been numerous advancements in mussel propagation over the past decade and this update is long overdue. The FMCS Guidelines and Techniques Committee has been tasked with advising Southwick Associates, Inc. to update this publication. We will be forming a discussion group within FMCS to provide insight and guidance of how different states and regions handle freshwater mussel kills and pollution events, and what methodologies they have utilized to successfully evaluate these events. The revised publication, unlike the one published in 2003, may include values for gastropods. Additional information was included in the December issue of *Ellipsaria*.

Southwick is seeking about \$40,000 of which, pending a board vote, FMCS would provide half. In order to seek the other \$20,000, Mary put together a letter which was sent out, with little response. Heidi is now following up with phone calls. Support has tentatively been indicated from UMRCC, Paul Johnson's organization, and Jess Jones. Discussion ensued about applying for a Great Lakes Fish and Wildlife Restoration Act grant, though the deadline is December 14. Another potential grant is through the FMS. Becca noted she had experience in

filling out the grant application and would help if needed. Heidi and Mary are to continue working on what needs to be done.

Mary is trying to get together a group of FMCS members to be advisors to Southwick. In addition to seeking folks with experience in kill assessments as described above, many of these will be from the propagation facilities as they will need to work on the propagation costs. The committee is to have a call to discuss how to solicit additional help within the society. That call should include Teresa, Heidi, Ryan, Dan Hua, Rachael Hoch, and Patty Morrison.

Committee Reports

1. Awards – Greg Cope, Emy Monroe

This is an off year and thus mostly maintaining activity on regional meeting assistance awards; however, they have not had a lot of requests. Some have included: Matt Ashton, Chesapeake Bay; Pete Hazelton, New England; Brian Watson, Virginia - Atlantic slope; and Jeremy Tiemann, IL Consortium.

2. Gastropod Status & Distribution – Nathan Whelan, Jeremy Tiemann

Active work on the Gastropod Scientific and Common Names subcommittee continues. (The full committee report is presented on Page 7.)

3. Guidelines & Techniques – Mary McCann, Ryan Schwegman

(The full report from this committee is presented on Page 8.) In addition to working on the AFS Monetary Values revision, Mary McCann has compiled a list of available state and federal survey and relocation protocols. She is now reformatting that list into a table for uploading to the Committee's webpage.

Ryan Schwegman is gathering information on establishing photo guidelines for photo vouchering field specimens.

Becca Winterringer is exploring recommendations for mussel surveyor qualifications, with the understanding that FMCS does not want to be in the place of issuing any 'certifications'. Teresa suggested the committee come up with a qualifications list and, later, could possibly address certification. It was suggested the committee provide an outline of the proposed recommendations for the Board to consider. Discussion ensued as to what direction to take; there appear to be two major directions, one education, the other more identification and skills-based. Teresa emphasized needing an outline that addressed the need, certification process, and how to best implement. This outline should be supplied to the Board by early March so that it can be discussed at the next meeting (in mid-April).

4. Mussel Status & Distribution – Art Bogan, John Harris

- Recent feedback on Mussel App has been helpful.
 - As indicated for Gastropods, the Mussel Names subcommittee is actively working.
- (Full report presented on Page 9.)

5. Outreach – Megan Bradley, Jennifer Archambault

(Full report presented on Page 9.)

Continuing to work on website and Facebook pages. Megan said she has not had a lot of feedback on the change in website organization. Several of the Board members noted they liked the changes.

Greg Cope noted the pdf file for the new issue of the journal is almost ready to send to Megan for posting on the website. Since any information that is to be posted on the website should go through Megan, John Jenkinson requested clarification as to whether he should continue to

work directly with Sophie on posting issues of *Ellipsaria*. Megan indicated that it is working so no need to change.

6. Symposium – Heidi Dunn and others

2016 Genetics Workshop at NCTC. -- Dave Berg, Curt Elderkin.

The agenda for the workshop has been set and will be posted on the website soon. A few things are still in the works such as ensuring Wi-Fi, how to pay for main speaker and travel. All sessions have been assigned a moderator. There are currently only two sponsors but others have expressed interest.

Early registration ends December 31 and only 11 have registered to date. Dave Berg had sent the announcement to benthos and ecology list serves. It was agreed that Janet should resend announcement to FMCS membership, with weekly reminders. A short version of the announcement was developed to be sent to non-mussel folks as the workshop is on basic genetics, not necessarily mussel genetics. Dave questioned changing the title to drop the “Freshwater Mussel Conservation”.

Due to the low registration thus far, there was concern over what the breakeven number was and what would happen if not met. Heidi noted she would like to see 100 to 125. Teresa said that if anyone had upcoming meetings, the information could be made into a flier. Discussion ensued on the room rate at NCTC and there was a need for better clarification. Little student help has stepped forward. Incentive to help has been changed from reduced registration to payment of an hourly rate. Only one poster abstract has been submitted thus far.

2017 Symposium in Cleveland Ohio. -- Becca Winterringer, Greg Zimmerman

A text document was recently sent to Heidi and the contract has been finalized with hotel. Committee is still working on development of a theme and are exploring keynote speakers. They hope to have this set by January. Topics being discussed include: toxic algae issues and zebra mussels; the Clean Water Act and a burning river; climate change; among others. Teresa noted that the USGS, NOAA, Great Lakes Fisheries Commission and Great Lakes Commission are working on an invasive mollusk collaborative.

The date for the Cleveland Meeting (March 26-30, 2017) was published in the December *Ellipsaria*. A quick budget crunch is estimating about \$93,000 in registrations and another \$25,000 in extras. Becca wants to explore the symposium being acceptable to international membership – how to go about that, considering a web-based attendance. Maybe just limit web-based registration to international folks. Questions arose about how this can be restricted. Teresa said to discuss it with the International Committee.

Heidi noted that a 2018 Workshop is still lacking. She suggested holding another Propagation workshop; however, it was dismissed since there is currently a class at NCTC. Another topic was a get-together to discuss the National Strategy and how to possibly reorganize committees. Southwick and Associates had discussed possibly providing a training session on the new monetary values document. The Board lent a lot of support for another snail workshop. Greg Cope rallied support especially with the Johnson *et al.* paper. Snails are also likely to be included in the AFS monetary values publication. Several workshops are already being conducted and could provide material to carry this forward as an FMCS workshop. Art is giving two workshops on introduction to snails to AFS divisions. Suggestion was to maybe have a half-day snail propagation session in 2018.

Ad hoc committees

Ecosystem Services – Dan Spooner, Danielle Krieger

Dan reported that the committee has developed a couple of action items. They plan to address UNIO list serve members to see if others want to join. Danielle has developed a rough

draft of a paper describing ecosystem services. Caryn Vaughn has also drafted a paper on biofiltration and Dave Strayer is coming out with a book on biofiltration.

Dan wants to work with the Guidelines Committee to develop monetary values as Caryn is working on dollar valuation of services. Teresa encouraged committee to get a core group and setup goals and outline a couple of action items to tackle first. She hopes that in about a year (next Board meeting they are set to report at) they will have something to report.

Greg Zimmerman suggested this as possible topic for the 2017 symposium. Dan thought that would be a great idea. There was much discussion on what was actually meant by the term ecosystem services. The terminology is being used in several different ways in academics, management, and government. John Jenkinson also suggested exploring an alternative title for the committee. Dan said they would come up with a definition.

Other committee reports or issues requiring Board action?

Steve McMurray said the Environmental Quality and Affairs committee has been contacted about drafting a letter to the USFWS supporting Black Warrior River Keepers challenge of the US Army Corps of Engineers recent decision to permit fill in a small tributary to the Locust Fork in Jefferson County, Alabama, which supports the only remaining population of plicate rocksnails (*Leptoxis plicata*) as well as numerous other federally listed aquatic species. This was requested by Mike Gangloff. Art suggested contacting Paul Johnson as he has worked with the species of interest. The committee is also working on issue papers addressing gas drilling, hydrologic issues and may possibly develop one for coal mining.

Greg Cope stated on behalf of the information exchange, the journal co-editors would like to inform everyone that the first issue of FMBC is out and a nice group of submissions are coming in. The transition to Allen Press has been a good experience and cost effective. A few things still need customized. Wendell said they were seeing more back and forth on the production side and, if submissions continue to increase, they may ask for funds for part-time editorial assistant. They have been dealing a lot with proof sets, table of contents, and covers. Not at this point yet but wanted to let the Board know they may need assistance in the future.

The National Strategy is done and Teresa wants to proof one more time. It will then go back out to co-authors one more time. The plan is to have it back to the journal editors by Christmas.

Motion to Adjourn was made by Heidi Dunn and seconded by Greg Cope.

Meeting adjourned until April 2016.

Respectfully submitted by Janet L. Clayton, Secretary.

Committee Reports Submitted to Support the December 3, 2015, Board Meeting

Gastropod Status & Distribution -- Nathan Whelan and, Jeremy Tiemann

Gastropod scientific and common names subcommittee: We are still working with the Mussel Scientific and Common Names subcommittee on establishing organizational criteria for the subcommittees (e.g., number of members, length of term, frequency of meetings), as well as maintaining a consensus checklist of names on the FMCS website, periodically printing checklists in *Freshwater Mollusk Biology and Conservation*, and establishing a process for reviewing proposed name changes. We expect to provide the final guidelines to the FMCS soon.

FMCS Snail pages: We are working with Sophie updating the snail pages as issues arise.

Prioritizing the Center for Biological Diversity's snail listing package: Tierra Curry of the Center for Biological Diversity (CBD) attended the committee meeting in St. Charles. The committee is working with her to help CBD prioritize their list of candidate species for listing under the Endangered Species Act, and to come up with a list of high-priority species. As of 10 November 2015, Tierra did not have much news to report yet. They are looking at the information that USFWS has made available on their upcoming work plan and reconciling that information with the information they received from scientists. She hopes to have more solid information to share with us by next spring. [See update on Page 10.] She informed us that over the past four years, they have negotiated dates for 12-month findings for several freshwater mollusks:

- Suwannee Moccasinshell (*Medionidus walker*), which is now proposed for listing
- Ichetucknee Siltsnail (*Floridobia mica*) by June 2016
- Yellow Lance (*Elliptio lanceolata*) by March 2017
- Four springsnails threatened by the proposed Las Vegas water pipeline, (FMCS signed on to this petition): Flag Springsnail (*Pyrgulopsis breviloba*), Hardy Springsnail (*Pyrgulopsis marcida*), Bifid Duct Springsnail (*Pyrgulopsis peculiaris*), and Lake Valley Springsnail (*Pyrgulopsis sublata*) by September 2017
- Atlantic Pigtoe (*Fusconaia masoni*) by 2018

She will follow up with us with any new developments.

Guidelines & Techniques -- Mary McCann and Ryan Schwegman

Assist American Fisheries Society (AFS) with Mussel Kill Valuation Update: AFS and Southwick Associates, Inc. are in the process of updating the 2003 addition of this publication. There have been numerous advancements in mussel propagation over the past decade and this update is long overdue. The FMCS Guidelines and Techniques Committee has been tasked with advising Southwick Associates, Inc. to update AFS SP30. We will be forming a discussion group within FMCS to provide insight and guidance of how different states and regions handle freshwater mussel kills and pollution events and what methodologies they have been utilized to successfully evaluate these events. The revised publication, unlike the one published in 2003, may include values for gastropods. Additional information was included in the December issue of *Ellipsaria*.

Compile State and Federal Survey and Relocation Protocols. Mary McCann has compiled a list of available protocols but am now reformatting into a table for uploading to the Committee's webpage. The table will include internet links where available and pdfs of the protocols. The hope is that this will be an active table that will be updated as new protocols are developed (NY is currently in development) or updated (MA are being updated). Currently I have protocols from Massachusetts, Virginia, West Virginia, Ohio, Illinois, Indiana, Minnesota, Wisconsin, Tennessee, Pacific Northwest, USFWS (Georgia and Florida), USFWS (Pennsylvania Allegheny River), and Ontario.

Professional Certification. During the committee meeting in St. Charles last spring, it was suggested that recommendations for mussel surveyor qualifications should be developed, with the understanding that FMCS does not want to be in the place of issuing any 'certifications'. In the July Board Meeting, the topic was re-visited and John Jenkinson questioned if we came up with a set of guidelines, would agencies be interested in that list? Teresa suggested the committee come up with a qualifications list and, later, could possibly address certification. It was suggested the committee provide an outline of the proposed recommendations for the board to consider. Becca Winterringer has compiled a summary of requirements for similar certification programs (e.g. AFS, The Wildlife Society (TWS), Ecological Society of America (ESA),

Society of Wetland Scientists). She has AFS and TWS entered into a working draft excel file at the moment, and is reviewing the other societies when time allows. We would like to ask the Board to consider an ad-hoc committee to continue vetting the possibility and efficacy of FMCS developing a certification or similar program. Establishing an ad-hoc committee would: 1) be a mechanism to keep the topic moving forward towards a resolution, and 2) provide the details and information needed for leadership to take the issue to the next phase. If the Board is supportive of establishing an ad-hoc committee, Becca Winterringer said she would prepare brief outline describing the purpose, need, objective, and applicability to the National Strategy (e.g. Issue 9.7 in the Draft Revised version) for the Board.

Mussel Status & Distribution -- Arthur E. Bogan and John L. Harris

J. D. Williams *et al.* Conservation assessment of freshwater mussels of US, Canada and Mexico. This revision of Williams *et al.* (1993) was submitted to Freshwater Mollusk Biology and Conservation in August 2015. The Editor has returned comments from reviewers to the authors for consideration.

Development of Mussel ID App We took the opportunity to test the app at Texas mussel identification workshops hosted by Charles Randklev in August and October 2015. Workshop participants (ca. 50 total) were mostly inexperienced in mussel identification. The app did not perform to our expectations or satisfaction, and we are undertaking an extensive QA/QC and revision to the characters database. Feedback from workshop participants and observation by two of the primary app developers (Oetker, Randklev) revealed the app too narrowly restricted identification characters to the "classic" form of each species and did not capture variation inherent to shell morphology. Revisions to the app character matrix are approximately 40% complete, and we now anticipate release to an initial group of FMCS beta testers for comments in early 2016. We also continue to improve and augment the photo archive for the app, and the team continues to search for high quality photos to complete the North American set.

Atlas of Freshwater Mussels of North America. Currently, 161 of the approximately 365 taxa addressed in the Atlas have volunteer authors for species accounts. We have received 21 first draft accounts as of November 23, 2015. External review and subsequent revisions are complete for 1 species, and the account should be posted to the website shortly. We are proceeding with preliminary and external reviews of the remaining draft species accounts and hope to have those posted live to the website by Spring 2016.

Mussel Scientific and Common Names Subcommittee. John Harris and Paul Johnson drafted guidelines for the mussel and gastropod names subcommittees and distributed this working paper to subcommittee members in February 2015. A joint meeting of the subcommittees was held on March 22, 2015 to discuss and finalize guidelines. With Nathan Whelan and Jeremy Tiemann, we have revised the guidelines based on comments received during the meeting, and these will be distributed to subcommittee members for final review and comment.

Outreach -- Jennifer Archambault and Megan Bradley

FMCS Website: In 2015, the FMCS website has undergone significant revision. Menus have been consolidated, links updated and old material archived. With the introduction of our new journal, *Freshwater Mollusk Biology and Conservation*, histories of our publications have been added and free access increased. There have been 2921 hits on our page, many likely my own, but I hope that, as we improve our non-members pages, we will see increases in use of the resources found here. Following the propagation workshop this spring, we worked to create an all-digital but limited access resource of pdf documents for those who paid and attended the

workshop. This decreased workshop costs and created a digital archive of the total material of the presentations. On the home page, you will also notice a link to a calendar of freshwater mollusk meetings and symposia.

FMCS Facebook Page: We have been very active with social media outreach since the 2015 symposium, sharing relevant news stories and interesting mussel or aquatic-related links and photos. There has been much more interaction with fans of our page, and we've gained lots of new followers this year - as of 11/20/15, we have 498 Likes, up from 310 at the beginning of the year. We gain new fans every week!

We also published an update about the Facebook page in the September issue of *Ellipsaria*. It told members how our social media outreach is doing, and how they can use it as a resource, and even access and share content if they are not on Facebook. We also highlighted that our social media presence is international, and we have reached people in 45 countries through our more active Facebook presence!

Workshop Topics Still Needed for 2018!

We are still looking for ideas to be addressed during the FMCS Workshop in calendar year 2018. We also will need volunteers to organize and help conduct that workshop. If you have a topic you would like to see addressed in a Workshop and/or would like to help with the 2018 Workshop, please contact Heidi Dunn at HDunn@ecologicalspecialists.com. Now is the time to speak up about what you would love to see covered in one of our workshops !

Financial Advice Still Needed, Too!

FMCS is forming a Finance Committee to consider how to best invest funds not being used for day-to-day operations. Some members also have expressed an interest in donating or bequeathing funds to the society. We are looking for expertise on potential tax issues and investments. Anyone interested in serving on this committee, please contact President-elect Heidi Dunn at HDunn@ecologicalspecialists.com

FMCS Helps with Withdrawal of Ten Mollusk Species from Petition for Endangered Species Act Protection

Jeremy S. Tiemann and Nathan V. Whelan

On April 20, 2010, the Center for Biological Diversity (CBD) and their allies petitioned for Federal Endangered Species Act protection for 404 aquatic, riparian, and wetland species from

the southeastern United States. In response, the US Fish and Wildlife Service (USFWS) issued a positive 90-day finding for 374 of the species in the petition on September 27, 2011 (76 FR:59836).

During the FMCS 2015 Meeting in St. Charles, Missouri, Tierra R. Curry of the CBD sought the advice from our Mussel and Gastropod Distribution and Status Committees on the present knowledge about the freshwater mollusks included on their petition list. Based on the information we were able to provide, CBD has withdrawn the following ten mollusk species from their petition:

<u>Common Name</u>	<u>Latin Name</u>
Altamaha Arcmussel	<i>Alasmidonta arcula</i>
Ample Elimia	<i>Elimia ampla</i>
Caper Elimia	<i>Elimia olivula</i>
Cobble Elimia	<i>Elimia vanuxemiana</i>
Compact Elimia	<i>Elimia showalteri</i>
Helmet Rocksnail	<i>Lithasia duttoniana</i>
Inflated Floater	<i>Pyganodon gibbosa</i>
Mud Elimia	<i>Elimia alabamensis</i>
Shortspire Hornsnail	<i>Pleurocera curta</i>
Smooth Mudalia	<i>Leptoxis virgata</i>

The CBD will continue to examine the information that USFWS has made available on their upcoming work plan and reconcile that information with the data we have accumulated from scientists. By this spring, the CBD hopes to have more solid information to share with FMCS.

Announcements

Herbert D. Athearn Correspondence

In 2007, The North Carolina Museum of Natural Sciences received a large collection of mollusks from the Museum of Fluvial Mollusks, Cleveland, Tennessee. This donation, from Herbert D. Athearn, consisted of approximately 23,000 cataloged lots of freshwater mollusk specimens, a large topographic map collection, his unprocessed field collections from the 1970's, his reprint collection, and his correspondence files. The freshwater gastropods and sphaeriids have been rehoused and the cataloged Unionid collection has been moved into cabinets and arranged alphabetically by genus and species, according to his identifications. Currently, adding his unionid records to our database is our top priority.

Herb corresponded with a great number of people around the world for about 60 years. We are interested in creating an archive of his correspondence. Copies of letters Herb received and carbon copies of some of his outgoing letters were donated with his collection, but we would like to archive copies of as much of his correspondence as possible to complement the shell collection. We are requesting contributions of original or scanned pdf copies of any correspondence from Herb or letters you might have sent to him. All contributions will be greatly appreciated. These items will be added to his existing archive. Please send email and regular mail to Jamie Smith at the addresses listed below.

Arthur E. Bogan, Jamie M. Smith, and Cynthia M. Bogan, Mollusk Collection, NC Museum of Natural Sciences, MSC 1626, Research Laboratory, Raleigh, NC 27699-1626 arthur.bogan@naturalsciences.org; Jamie.smith@naturalsciences.org; cindy.bogan@naturalsciences.org

Freshwater Mussel Identification Workshop 2016
Museum of Biological Diversity, The Ohio State University
25-28 April 2016

This four-day workshop is geared towards the identification of upper Ohio River and Great Lakes species, survey methods, and conservation. The course would be applicable for most of the upper Mississippi River drainage as well. Identification topics include discerning look alike taxa from one another, identifying rarely seen species, those pesky "Fuscobemas," and general key characteristics. Guest speakers will cover survey methods and permitting. The entire Ohio State University Museum of Biological Diversity bivalve collection is available for study but only these geographic areas will be covered.

The workshop will include a field trip to the Columbus Zoo and Aquarium Freshwater Mussel Conservation and Research Facility, with a bonus trip behind the scenes at the Aquarium and/or Manatee exhibits led by a Zoo curator. Weather permitting, an additional field trip will be to Big Darby Creek to see the Northern Riffleshell introduction sites and the use of PIT tags in monitoring.

Further information about the workshop, including registration information can be found here: <http://www.biosci.ohio-state.edu/~molluscs/OSUM2>

**A Symposium Brings Method and Modeling Madness
for Midwest Malacologists**

Kristen Bouska and Amanda Rosenberger from the Missouri Fish and Wildlife Cooperative Research Unit organized a symposium for the 76th Midwest Fish and Wildlife Conference, held in Grand Rapids, Michigan, January 24-27, 2016, entitled "Understanding mussel distribution and habitat associations in the Midwest: is there a method to our madness"? This symposium brought together scientists to discuss approaches and techniques to understand mussels and their habitat. Presenters ranged from M.S. students to senior research scientists, and all offered their perspectives on strategies to enhance freshwater mussel ecology and conservation.

Here is the list of presentations made during this symposium:

Development of sampling protocols for freshwater mussel density estimates in the Meramec River Basin, Missouri. Matthew Schrum, Amanda Rosenberger, Missouri Fish and Wildlife Cooperative Research Unit and Steve McMurray, Missouri Department of Conservation

Turning data acquired into information desired using freshwater mussel projects in Illinois. Alison Stodola, Sarah Douglass, Jeremy Tiemann, and Kirk Stodola, Illinois Natural History Survey

Predicting habitat suitability for Michigan's imperiled mussels. Wesley Daniel, Arthur Cooper, Pete Badra, and Dana Infante, Michigan State University

Using ecological niche modelling to predict the presence of unionid refuges after 25 years of Dreissena invasion in the Laurentian Great Lakes. Jonathan Bossenbroek, University of Toledo; Lyubov Burlakova, SUNY Buffalo State; Todd Crail, University of Toledo; Alexander Karatayev, SUNY Buffalo State; Robert Krebs, Cleveland State University; and David Zanatta, Central Michigan University

Longitudinal patterns of freshwater mussel assemblage structure in rivers of central Michigan, U.S.A. Amanda Chambers and Daelyn Woolnough, Central Michigan University

Associations between stream hydrogeomorphology and codependent mussel-fish assemblages: evidence from an Ohio, USA river system. Clarissa Lawlis and S. Mažeika P. Sullivan, The Ohio State University

Maxent modeling for Missouri Ozark unionids with macroscale hydro-geomorphic variables. Garth Lindner, Kristen Bouska, Kayla Key, and Amanda Rosenberger, Missouri Cooperative Fish and Wildlife Research Unit, The University of Missouri

Habitat of Native Freshwater Mussels in a Large Floodplain River: Hydrophysical Models to Guide Restoration. Teresa Newton and Steve Zigler, U.S. Geological Survey, Upper Midwest Environmental Sciences Center

Freshwater mussel habitat construction/creation in the Mississippi River. Heidi Dunn, Ecological Specialists, Inc.; Brian Johnson, St. Louis District Army Corps of Engineers; and Teresa Allen, St. Louis District Army Corps of Engineers

Mussel madness in Michigan: Understanding a rare species distribution and ecological preferences by prioritizing research goals. Daelyn Woolnough and Mandi Caldwell, Central Michigan University

Central Michigan University MS Student Wins Top Student Award at Midwest Fish and Wildlife Conference

At the January 2016 Midwest Fish and Wildlife Conference in Grand Rapids Michigan, Central Michigan University Masters of Science (Conservation Biology) student Amanda Chambers was awarded the Janice Lee Fenske Memorial Award, a plaque, and a check for \$500 that goes along with the award. This award is a competitive award among students from across the Midwest that had 24 finalists. It is awarded to students, “for their achievements in the field of fisheries or wildlife management”. More information about the Janice Lee Fenske Memorial Award and its past recipients is available at: www.fisheriessociety.org/miafs/jfenske_award.html.

Amanda gave an oral presentation at the conference entitled “Longitudinal patterns of freshwater mussel assemblage structure in rivers of central Michigan, USA”. She is in her last semester of a MS program in Dr. Daelyn Woolnough’s lab and is looking at the upstream/downstream variation of native freshwater mussel assemblages in the Chippewa and Pine Rivers in Michigan. Amanda’s undergraduate degree was from Lake Superior State University. She has presented at multiple conferences and has been involved with conservation of mollusks for many years.

Central Michigan University was well represented at the 2016 Midwest Fish and Wildlife Conference, with many CMU presentations and CMU alumnae presenting on both fisheries and wildlife topics.

Submitted by Daelyn Woolnough, Biology Department and Institute for Great Lakes Research, Central Michigan University, Mt. Pleasant, Michigan.



Left to Right: Selection Committee members Jessica Mistak (Michigan DNR), Dan O’Keefe (Michigan Sea Grant), and Award recipient Amanda Chambers.



Amanda Chambers with *Lasmigona costata* (Flutedshell) in the Chippewa River, Michigan.

Regional Meetings

FMCS Regional Mollusk Meeting Assistance Award Program

As described in the December 2012 issue of *Ellipsaria*, the FMCS has established a Regional Mollusk Meeting Assistance Award Program to facilitate regional mollusk meetings that address local and regional concerns with freshwater mollusk conservation and management. Our interest in assisting with these meetings is to bring people together who work with freshwater mollusks to exchange information on how to conserve and protect this faunal group. These meetings are often attended by a variety of individuals, including agency personnel, academia, private citizens, scientists, and others, some of whom may not be FMCS members. Therefore, a secondary goal of this program is to increase the awareness of, and membership in, FMCS among individuals in these groups. Support is provided via a cash award of \$100 to the regional group to help defray the costs (e.g., meeting room rental, speaker travel, break refreshments, etc.) associated with holding their meeting. It is anticipated that about 15-20 awards will be made in a given calendar year.

The complete program description and application form may be obtained from the Awards Committee website at http://www.molluskconservation.org/Mservices_awards.html. One copy of the completed application must be received by the Chair of the Awards Committee at least two months prior to the Regional Mollusk Meeting to allow for application and payment processing.

Chesapeake Bay Freshwater Mussel Workgroup Meeting

The annual Chesapeake Bay Freshwater Mussel Workgroup convened in Annapolis, MD on January 13th, 2016. The meeting was attended -- in person by 25 people and via web conferencing by 17 people -- representing state and federal resource agencies, river basin commissions, consulting firms, non-profit organizations and academia. Presentation topics included:

- Freshwater mussel training at the National Conservation Training Center.
- Range-wide assessment of Brook floater.
- Species status assessments for yellow lance and Atlantic Pigtoe.
- Dwarf wedgemussel updates from North Carolina.
- Chesapeake Bay Program efforts to incorporate mussels into the Habitat Goal Implementation strategy of the propagation at Harrison Lake National Hatchery.
- Mussel relocation, environmental DNA, and tidal-freshwater surveys in Maryland.
- Eastern pearlshell surveys in Pennsylvania.
- American eel and Eastern elliptio restoration in the upper Susquehanna River.
- Delaware River basin mussel restoration program update.
- Variation in growth and survival of Dwarf wedgemussel in the Northeast.
- Chronic effects of chloride exposure to mussels.
- Eastern elliptio contaminant bioaccumulation study in the Anacostia River.
- James spiny mussel mark-recapture study.

A brief update from most north Atlantic states regarding Dwarf wedgemussel status and conservation efforts took place on the morning of January 14th. Financial assistance for this regional meeting was graciously provided by FMCS through the Awards Committee and supported refreshments and a working lunch for attendees. Presentations, with permission of the author, are shared on a password protected share-point web site. For more information on the meeting contact Julie Devers julie_devers@fws.gov or Matt Ashton at matthew.ashton@marylnd.gov.

Upcoming Meetings

May 21 – 26, 2016 – Society for Freshwater Science Annual Meeting, Sacramento Convention Center, Sacramento, California Theme: “*Running on Empty.*” <http://sfsannualmeeting.org/SFS2016.cfm>

June 12 – 16, 2016 – American Malacological Society 82nd Annual Meeting and 49th Annual Meeting of the Western Society of Malacologists, Universidad Autónoma de Baja California, Ensenada, Mexico. http://www.cpp.edu/~aavalde/wsm_ams/index.htm

July 17 – 20, 2016 – Society for Conservation Biology North American Sectional Meeting, Madison Wisconsin Theme: *Communicating Science for Conservation Action* <http://scbnorthamerica.org/naccb2016/>

February 2017 – National Shellfisheries Association 109th Annual Meeting, <http://www.shellfish.org/annual-meeting> .

March 26 – 30, 2017 – FMCS 10th Biennial Symposium, Cleveland, Ohio theme yet to be determined

Spring (?) 2018 – FMCS Workshop, Topic and location yet to be determined.

Job Announcements

Permanent and Temporary Malacologists Positions, Ecological Specialists, Inc., O’Fallon, Missouri

Ecological Specialists, Inc. (ESI) currently has openings for **one freshwater mussel biologist** (permanent position) and **four seasonal freshwater mussel biologists** (approximately May to October, but flexible) to assist with mussel sampling and data analysis in the Ohio River and Mississippi River basins. All of these positions will include fieldwork throughout the Midwest. The permanent position also will include proposal preparation, project management, supervision of field crews, equipment maintenance, data analysis, and report preparation.

Please send resume to: Heidi L. Dunn, Ecological Specialists, Inc., 1417 Hoff Industrial Drive, O’Fallon, Missouri 63366-1959. Fax: 636-281-0973 E-mail: HDunn@EcologicalSpecialists.com

ESI is an Equal Opportunity Employer. All applicants for employment shall be given fair and equal consideration, regardless of race, religion, color, gender, age, sexual orientation, disability, veteran status or national origin, except that minimum age limits imposed by law are observed. More information about ESI is available on their website: www.ecologicalspecialists.com.

Job Announcements has been an infrequent heading for postings in *Ellipsaria* over the years; however, because job announcements are often released with short response times that rarely coordinate well with the quarterly schedule of the newsletter, they will no longer be included here. From now on, we will post job announcements on the FMCS website, a site capable of quickly posting such up-to-the-minute items. The opening page of our website now includes an **Opportunities** tab that, starting in January 2016, lists current job announcements (including the ones presented above) and, potentially, other openings of interest to freshwater malacologists. The editors of both *Ellipsaria* (ijjenkinson@hotmail.com) and the website (Megan.Bradley@dgif.virginia.gov) would welcome comments on what we believe is an improvement in our service to Society members.

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.

Mollusks Afloat

Mark Hove*, **Leslie MacKichan**, **Meara Hove**, and **Leif Hove**

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“... some old clammers on the Mississippi up here [in Minnesota] thought that mussels migrated in the spring by floating themselves up and riding the current to greener filtration grounds – I doubt they ever smelled them first. Before the dams were built, many backwater lakes became disconnected from the river at low flow; winter took a toll on the lake- and pond-dwelling critters, including mussels (*Pyganodon grandis*, mainly); and, with the spring rise, the river spilled into the lakes and exported all sorts of stuff back down the river channel, including floating “migrating” mussels.” Mike Davis, 2015

A floating mollusk is an uncommon sight for most people, but many who spend time on fresh waters, have witnessed this phenomenon. Floating mussels apparently occurred frequently enough that early malacologists named several thin-shelled species “floaters” (e.g., giant floater, strange floater, etc.).

We observed a live floating fatmucket, *Lampsilis siliquioidea*, during July 2012 while canoeing down the Pomme de Terre River near Morris, Minnesota. The river was near bankfull, around twice normal flow for that time of year. The mussel, which we watched for several minutes before picking it up, was floating at the surface, although most of its body was underwater (Figure 1). The animal appeared to be in good health; holding its valves tightly closed against thumbnails trying to pry it open, and the animal inside looked and smelled normal.



Figure 1. *Lampsilis siliquioidea* found floating downstream in the Pomme de Terre River near Morris, Minnesota.

A quick review of naiad literature yielded some records of floating unionids, but all were reports of dead animals. Floating mussels have been reported after diminished water quality caused dead animals to become buoyant as gases collected in their decomposing tissues (several references in Neves 1987, Cvancara 2000).

We also queried members of the Unio server, an international electronic ‘bulletin board’ for the discussion of various topics about unionoids. Many respondents shared experiences with dead floating mollusks; most of which were of thin-shelled Anodontines (Table 1). Floating mollusks were often associated with a decline in water quality due to toxicants, anoxia, or a toxin (e.g., intense blue-green

algae bloom). At other times, wave action appeared to have dislodged some mussels, and, sometimes, it was simply unclear why dead mussels or snails were floating.

Table 1. Unio-offered observations of dead floating mollusks.

Species (#)	Location	Date	Conditions	Observer
Unionids				
<i>Anodonta implecata</i> , <i>Pyganodon</i> <i>cataracta</i> , <i>Ligumia</i> <i>nasuta</i> (1)	Massachusetts		Fresh dead of the 2 Anodontine mussel species in low densities	Peter Hazelton
<i>Anodonta</i> <i>suborbiculata</i> (several)	Anderson Creek branch of Kentucky Reservoir, Calloway Co., Kentucky	1990's	Mussels were moribund. Based on the mussel odor, gas accumulation in meat caused floatation. Shells remained closed until forced open.	Jim Sickel
<i>Pyganodon grandis</i> (several)	channel of Kentucky Reservoir near Aurora, Kentucky			
<i>Pyganodon cataracta</i> (3, >120 mm)	Potomac River tidal embayment near Piscataway Creek, off Mockley Point, Maryland (38.702128, - 77.041450)	Aug. 24, 2012	A strong ENE wind blew water into the embayment, which may have dislodged mussels. Several fresh dead <i>Pyganodon</i> lay on the shore.	Matt Ashton
<i>Pyganodon grandis</i> (≥3, ≈6 in)	Shallow bays of Big Wood Lake, near Grantsburg, Wisconsin	June- July 2012	Early ice out, rapid spring warming surface water temp. to mid-80s	Matt Berg
<i>Pyganodon grandis</i> (1, ≈6 in)	Long Lake, near Centuria, Polk County, Wisconsin	March 22, 2012	Blue-green algae bloom, and curly-leaf pondweed die-back in 2-3 ft. water, 2 ft. down temp 87 °F, probably low dissolved oxygen	Matt Berg
<i>Pyganodon grandis</i> (50-100)	Ohio and Tennessee rivers	Summer – fall 1985-87		Teresa Newton
<i>Pyganodon grandis</i> , <i>Leptodea fragilis</i>	Dunkard Creek, Pennsylvania/West Virginia		Associated with fish kill; appeared that dead, heavier- shelled mussels accumulated gas and moved up in substrate	Nevin Welte
<i>Pyganodon grandis</i> (<5), <i>Utterbackia</i> <i>imbecillis</i> (<10)	Grand River downstream of Lyons Dam, Michigan	Sept. 2015	Observed mussels dead, or near death, while working at wadeable depths in strong current over coarse substrate	Daelyn Woolnough
<i>Pyganodon grandis</i>	Back bays of Lake Erie & Ohio River			Greg Zimmerman
Anodontines (100s)	Mississippi River back sloughs, Wisconsin		Late summer “dog days” (August, maybe September)	Lisie Kitchel
Dead Anodontines appear to be floating among dead fishes near end of video	Pearl River downstream of Bogalusa, Louisiana	2011	Temple-Inland Inc. paper mill discharged effluent resulting in a large die-off (https://youtu.be/VXj-ujpxkqY)	Matthew Rowe

Species (#)	Location	Date	Conditions	Observer
Gastropods*				
<i>Campeloma</i> (1)	Wolf Lake, Sangamon River, Illinois (40.07635 -90.15615)	5 July 2007	Fresh dead, clean shell, no meat	Jeremy Tiemann
Chinese mystery snail (scores)	Wetlands and backwaters in northern Illinois, & southern Wisconsin; reservoirs in Nebraska, Kansas, and on military bases in Kentucky		Found floating empty	Jeremy Tiemann

* The reason for these floating empty snail shells is unclear. Shell air pockets could form from tissue decomposition, buoying the shell to the surface, or, air-filled shells along a dry shore could enter the water. (J. Tiemann)

Observations of live floating mollusks were rare among the Unio responses. Jason Wisniewski observed a live *Pyganodon gibbosa* floating in a slough along Horse Creek Wildlife Management Area boat landing on the Ocmulgee River (Telfair County, Georgia) during July 2006. When he looked inside; the animal looked and smelled healthy, and quickly closed its valves afterwards. Jason said the water level was pretty low but conditions appeared normal; there were no signs of a mussel die-off in the area.

On September 9, 2010, Celeste Mazzacano observed live members of the *Anodonta nuttalliana/californiensis* clade (length 73-122 mm), living within mats of floating aquatic vegetation in Oregon. Local water conditions seemed normal and the bivalves appeared perfectly healthy.

Some people noted that live mussels held out of water for a time, and then returned to the water, would sometimes float, or sink more slowly, due to air trapped between closed valves. This occurred more frequently among thin-shelled species (e.g., *Alasmodonta arcuata*, *A. varicosa*, *Anodonta implicata*, *Pyganodon cataracta*, *P. grandis*, or *Strophitus undulatus*) (pers. comm. Jacob Culp, Peter Hazelton, and Jason Wisniewski).

On July 16, 2001, Al Smith visited the Columbia River approximately 20 mi east of Portland, Oregon, where there was a drought. He collected a mix of *Anodonta californiensis* and *A. oregonensis* from an exposed mudflat comprised of moist, drying, fine sand and mud. He tested seven live and two dead mussels, all of which were closed and intact. When he placed each mussel in a bucket of water, each live mussel sank, and both dead mussels floated.

Paul Hartfield reported that late summer mussel die offs in Mississippi are generally discovered by the quantity of floating mussel meats. He believed most meats were *Corbicula* bodies, as they seem disproportionately affected by low dissolved oxygen and high water temperature. Paul has also seen an occasional floating *P. grandis*. On November 1, 1990, one week after a report of dead mussels covering the surface of the lower Pearl River near Walkiah Bluff, Pearl River County, Mississippi, he and Bob Jones visited the site. The dissolved oxygen was extremely low, water level was very low, little flow, water temperature was hot, there were some mussel meats floating on the water surface, and mussels dying in pools. The bottom of the stream bed was littered with fresh dead unionids and thousands of dead *Corbicula*. They excavated several ¼ m² quadrats. Near surface excavations yielded hundreds of fresh dead *Corbicula* and a few fresh dead unionids. As they dug further down, they began to encounter more ground water and the water temperature dropped. Approximately 10+ inches below the surface, they found hundreds of live *Corbicula*, as well as a number of live unionids. Apparently those animals were surviving in the interstitial flow.

We thank everyone for sharing their observations. Floating dead mussels were often associated with degraded water quality. Floating live mussels seem to be uncommon. We remain interested in hearing more about live floating mollusks (e.g., frequency, environmental conditions, distance mollusks travel, etc.).

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Determining Host Fish for the Creek Heelsplitter (*Lasmigona compressa*)

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Mark Hove and Erin Haws, University of Minnesota, St. Paul, Minnesota

Matt Berg, Anders Ames, Laura Drohman, Kelsey Fiedler, Jordan Knutson, Violet Ohnstad, Christopher Parker, Emily Riewestahl, Anna Scheunemann, Nathan Swenson, and Alyssa Taylor, Grantsburg High School, Grantsburg, Wisconsin

The creek heelsplitter (*Lasmigona compressa*) (Lea 1829) can be found in small streams across the Upper Mississippi and northern Ohio River basins (Cummings and Mayer 1992, Haag 2012), and is a species of special concern in Minnesota. Previous host studies on *L. compressa* identified 21 species in nine families as suitable laboratory hosts (Tomba 1979, Hove et al. 1995, McGill et al. 2002). To build on this work, the goals of this study were to: 1) identify suitable hosts for the creek heelsplitter using laboratory trials, 2) identify natural hosts from wild-caught fishes, and 3) describe how the glochidia are released.

We used established methods to conduct this study (Allen et al. 2007, Hove et al. 2016). Gravid mussels were collected from Turtle Creek (Cannon River drainage) and the Willow River (St. Croix River drainage) in the fall of 2014. Initially, we obtained glochidia by flushing gills with water filled syringe; however, glochidia clung tightly to the gill tissue, requiring vigorous flushing to remove them, which damaged the gills. Subsequently, we collected glochidia released into holding aquaria. We inoculated 52 fish species (14 families) and the mudpuppy (*Necturus maculosus*) with *L. compressa* glochidia, and held the possible hosts for up to 34 days at 20 – 21°C to monitor juvenile transformation.

We also collected nine species of fish from Turtle Creek in May 2015 to recover naturally-infested *L. compressa*. We identified unknown juveniles recovered from naturally-infested fish using glochidial shell morphometrics. Scanning electron microscopy was used to measure shell dimensions of glochidia from unknown juveniles and glochidia from anodontine species known to occur in Turtle Creek. These dimensions were compared using discriminant function analysis (JMP v.12).

Lasmigona compressa released small conglutinate masses containing glochidia and structural programmed eggs that were orange in color (Figure 1), confirming previous observations in Watters (2008). Like other conglutinate producing species (e.g. *Fusconaia* and *Pleurobema*), these probably function as a host infection mechanism by eliciting feeding responses from fishes.

Similar to other Anodontines, our results indicate that *L. compressa* is a host generalist. Glochidia metamorphosed on 35 fish species in 11 families, and on the mudpuppy (Table 1). Among the fish species that yielded juveniles, transformation was broadly successful and highest on minnows. Hornyhead chub (*Nocomis biguttatus*), common shiner (*Luxilus cornutus*), creek chub (*Semotilus atromaculatus*), spotfin shiner (*Cyprinella spiloptera*), spottail shiner (*Notropis hudsonius*), western blacknose dace (*Rhinichthys obtusus*), and southern redbelly dace (*Chrosomus erythrogaster*) were particularly strong hosts. We also recovered juvenile *L. compressa* from naturally-infested creek chub (1 juvenile from 4 fish), Iowa darter (5 juv. from 3 fish), and Johnny darter (10 juv. from 181 fish). Similar to *L. compressa*, most of these fish species frequently occur in small streams.

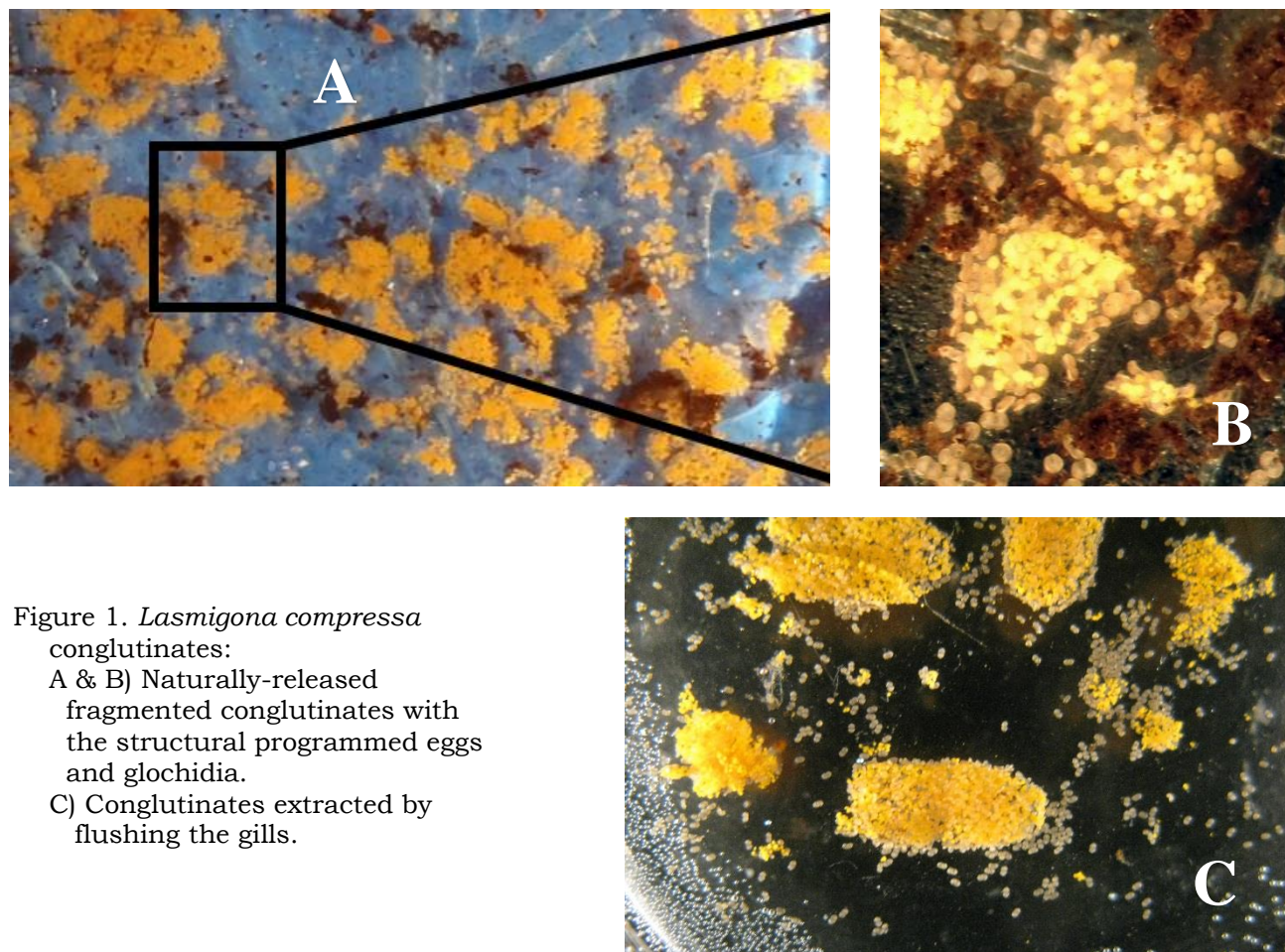


Figure 1. *Lasmigona compressa*

conglomerates:

A & B) Naturally-released
fragmented conglomerates with
the structural programmed eggs
and glochidia.

C) Conglomerates extracted by
flushing the gills.

Table 1. Results of laboratory host trials for creek heelsplitter (*Lasmigona compressa*). Trials were conducted at Minnesota Department of Natural Resources, University of Minnesota, and Grantsburg High School.

Common Name (Scientific name)	No. of Trials	No. Inoculated	No. Survivors	Recovery Period (d)	Juveniles Recovered
mudpuppy (<i>Necturus maculosus</i>)	1	1	1	17-23	81
spotfin shiner (<i>Cyprinella spiloptera</i>)	1	5	4	17-45	329
common shiner (<i>Luxilus cornutus</i>)	2	7	7	13-27	599
hornyhead chub (<i>Nocomis biguttatus</i>)	1	4	2	13-37	901
emerald shiner (<i>Notropis atherinoides</i>)	1	1	0	20-26	49
bigmouth shiner (<i>Notropis dorsalis</i>)	1	3	3	20	1
spottail shiner (<i>Notropis hudsonius</i>)	1	4	0	20-31	213
southern redbelly dace (<i>Chrosomus erythrogaster</i>)	1	3	2	13-26	130
bluntnose minnow (<i>Pimephales notatus</i>)	1	3	0	17-22	42
fathead minnow (<i>Pimephales promelas</i>)	1	7	0	14-21	13
western blacknose dace (<i>Rhinichthys obtusus</i>)	2	13	13	11-34	244

western blacknose dace (<i>Rhinichthys obtusus</i>)	1	11	11	NR	0
creek chub (<i>Semotilus atromaculatus</i>)	3	64	18	13-33	525
white sucker (<i>Catostomus commersonii</i>)	5	26	24	12-21	12
creek chub sucker (<i>Erimyzon oblongus</i>)	1	2	1	18	1
bigmouth buffalo (<i>Ictiobus cyprinellus</i>)	1	1	0	17-20	67
western mosquitofish (<i>Gambusia affinis</i>) *	1	1	1	24-33	10
banded killifish (<i>Fundulus diaphanus</i>)	1	1	1	20-34	10
brook stickleback (<i>Culaea inconstans</i>)	3	15	6	9-34	81
brook stickleback (<i>Culaea inconstans</i>)	1	15	15	NR	0
mottled sculpin (<i>Cottus bairdii</i>)	1	4	4	13-20	26
mottled sculpin (<i>Cottus bairdii</i>)	1	2	2	NR	0
slimy sculpin (<i>Cottus cognatus</i>)	1	1	1	17-23	5
rock bass (<i>Ambloplites rupestris</i>)	1	1	1	10	1
rock bass (<i>Ambloplites rupestris</i>)	1	1	1	10	0
green sunfish (<i>Lepomis cyanellus</i>)	2	5	5	12-27	85
pumpkinseed (<i>Lepomis gibbosus</i>)	2	6	5	13-27	57
bluegill (<i>Lepomis macrochirus</i>)	2	12	11	14-31	11
smallmouth bass (<i>Micropterus dolomieu</i>)	1	1	1	11-15	11
largemouth bass (<i>Micropterus salmoides</i>)	2	4	4	14-20	18
largemouth bass (<i>Micropterus salmoides</i>)	1	10	10	12	0
black crappie (<i>Pomoxis nigromaculatus</i>)	1	5	5	12-17	11
Johnny darter (<i>Etheostoma nigrum</i>)	1	5	5	13-20	9
Johnny darter (<i>Etheostoma nigrum</i>)	1	17	17	NR	0
slenderhead darter (<i>Percina phoxocephala</i>)	1	3	3	13-26	3
yellow perch (<i>Perca flavescens</i>)	1	9	9	12-19	62
yellow perch (<i>Perca flavescens</i>)	1	2	1	24	0
trout perch (<i>Percopsis omiscomaycus</i>)	1	2	1	9	4
bowfin (<i>Amia calva</i>)	1	5	5	13	1
bowfin (<i>Amia calva</i>)	1	2	2	13	0
channel catfish (<i>Ictalurus punctatus</i>)	1	4	2	13-23	8
channel catfish (<i>Ictalurus punctatus</i>)	1	8	8	3	0
northern pike (<i>Esox lucius</i>)	1	3	2	12-14	4
northern pike (<i>Esox lucius</i>)	1	1	1	11	0
central mudminnow (<i>Umbra limi</i>)	1	1	1	15	3
central mudminnow (<i>Umbra limi</i>)	1	5	5	NR	0
Totals		379	291		3627

* These fish were collected in southeastern Missouri.

NR = not recorded.

Fish species that did not facilitate glochidia metamorphosis (number of trials, number of inoculated fish/number of surviving fish, range of days to rejection): longnose gar (*Lepisosteus osseus*) (2, 5/5, 3-12), American eel (*Anguilla rostrata*) (2, 6/5, 7-13), black bullhead (*Ameiurus melas*) (2, 11/11, 10), yellow bullhead (*Ameiurus natalis*) (1, 8/8, 8), tadpole madtom (*Noturus gyrinus*) (1, 3/3, 4), burbot (*Lota lota*) (1, 4/4, 9), common carp (*Cyprinus carpio*) (1, 1/1, 10), brassy minnow (*Hybognathus hankinsoni*) (1, 1/1, NR), northern redbelly dace (*Chrosomus eos*) (1, 12/12, NR), northern hogsucker (*Hypentilium nigricans*) (1, 2/2, 8), shorthead redhorse (*Moxostoma macrolepidotum*) (1, 5/5, 8), longear sunfish (*Lepomis megalotis*)* (1, 1/1, 24), logperch (*Percina caprodes*) (1, 10/8, 17), blackside darter (*Percina maculata*) (1, 4/4, 30), walleye (*Sander vitreus*) (2, 4/4, 8/13).

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The Hazards of DNA Barcoding, as Illustrated by the Pleurocerid Gastropods of East Tennessee

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Unusually high levels of intraspecific mtDNA sequence heterogeneity are not uncommonly reported in populations of pleurocerid gastropods sampled throughout the southeastern United States (Dillon & Frankis 2004, Dillon & Robinson 2009, Whelan & Strong 2016). The several hypotheses offered to account for this phenomenon (not mutually exclusive) include: great antiquity, mitochondrial introgression, pseudogenes, and cryptic speciation. Here we report a fresh example of striking mtDNA sequence heterogeneity in conspecific pleurocerid populations, controlled by a larger survey of allozyme variation at ten enzyme loci published by Dillon (2011).

Dillon (2011) sampled 30 to 50 individuals from each of 15 pleurocerid populations inhabiting East Tennessee and North Georgia: 9 populations of *Pleurocera clavaeformis*, 4 populations of *P. simplex*, and one population each of *P. carinifera* and *P. vestita*. To simulate a typical DNA barcoding approach, in the spring of 2011 we sampled single individuals from each of these 15 populations, cracking the shell and preserving the animal in absolute ethanol. Genomic DNA was isolated from an anterior portion of the foot muscle using a CTAB protocol. Then, an approximately 700 base-pair fragment of the mitochondrial COI gene was amplified via PCR using universal primers (Folmer et al. 1994) in a final volume of 25 µL. Reaction solutions and cycling protocols were slightly modified from those of Dillon & Robinson (2009) by

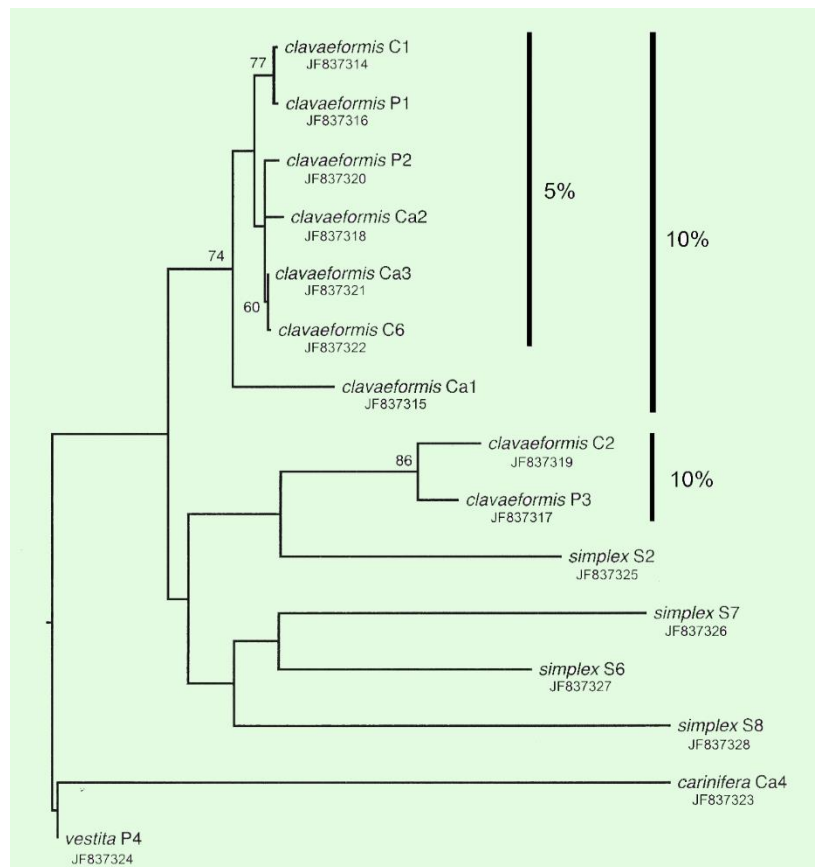
increasing $MgCl_2$ concentrations to 3 mM. PCR products were electrophoresed on 1% w/v agarose gels using GelRed, cleaned up with EXO/SAP, and cycle-sequenced in half-reactions of ABI Big Dye Terminator at the Georgia Genomics Facility on an ABI 3730 sequencer. Sequences were obtained in both directions multiple times, resulting in a total of four to five reads per individual.

Sequence alignments were performed using CodonCode Aligner. After trimming low-quality regions from the ends of the sequences, our alignment contained a total of 591 bp, with individual sequences ranging in length from 488 to 591 bp. Individual base pairs with sequence quality scores less than 20 were recoded as ambiguities before analysis. A matrix of raw pairwise percent sequence differences was calculated in R using the 'ape' package. We compared a total of 88 different models of molecular evolution using jModelTest ver. 0.1.1. We then used the best model from this analysis (HKY +I +G), with maximum likelihood parameter estimates and constructed a bootstrapped maximum-likelihood phylogeny (2000 replicates) in PAUP ver. 4.0b.

Figure 1 shows that only four of the 14 nodes in the maximum-likelihood phylogeny were supported by bootstrap values of 60% or greater. Setting a maximum sequence divergence within nominal species at 5%, only one (six-population) cluster of *P. clavaeformis* would appear conspecific, and setting the maximum divergence at 10% only added a seventh *clavaeformis* population to the cluster, leaving two additional *clavaeformis* populations united as a spurious second species. And even at 10% sequence divergence, none of our four control populations of *P. simplex* was depicted as conspecific with any other, their pairwise interpopulation divergences ranging from 16% (S6/S7) to 23% (S2/S8). Indeed, *simplex* sample S2 demonstrated greater sequence similarity with several *clavaeformis* samples (e.g. 85% with C6) than with any conspecific.

The use of DNA barcoding data to define species boundaries represents a return to the quality of 19th-century typological thinking long discredited by the modern synthesis. The striking contrast in resolving power between the single-character, single-individual results depicted in Figure 1 and the 10-gene, 450-individual analysis of Dillon (2011) should serve as a warning to those who imagine otherwise.

Figure 1. Maximum-likelihood phylogeny of mitochondrial COI genes sampled from the 15 pleurocerid populations of Dillon (2011), with GenBank accession numbers. Bootstrap support values are shown on nodes if at least 60% of the replicates supported the grouping.



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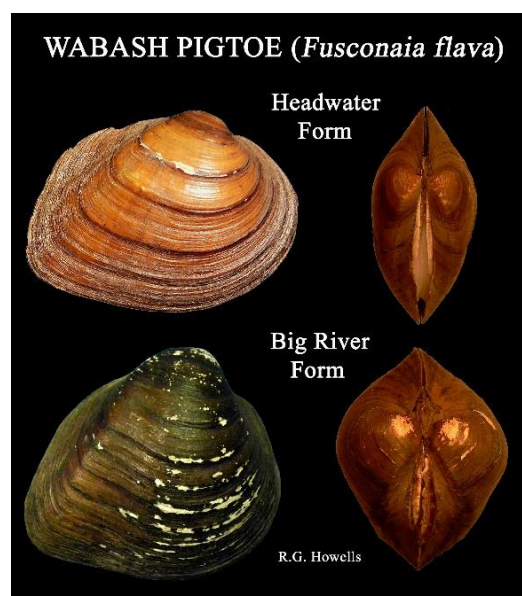
Ecophenotypes: When and Where They Do and Do Not Occur

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It is generally recognized among those of us working with unionids that some species develop distinctive ecophenotypes in different environments. One classic example occurs in Wabash Pigtoe (*Fusconaia flava*) that produces larger, heavier-shelled, inflated forms in larger rivers, but has smaller, thinner, more-compressed morphs in headwater streams (Figure 1). In other cases, sculpturing may be far more pronounced in large, flowing waterbodies and sometimes less so in small streams. Similarly, populations in natural lakes may be morphologically distinct from corresponding individuals in big-river environments. W.R. Haag (2012. North American Freshwater Mussels. Cambridge University Press, New York.) gave an excellent summary and discussion of these situations.

However, not all unionids produce distinctive ecophenotypes even in seemingly different environments. Queries recently crossed my desk from folks seeking images of specific Texas unionid forms from reservoirs, rivers, and small streams. But in point of fact, few such ecophenotypic differences between water-body types actually occur in Texas.

Figure 1. Wabash Pigtoe (*Fusconaia flava*) is an example of a unionid that has distinctive ecophenotypes from smaller headwater streams and larger rivers throughout much of its range. Although this species does occur in Texas, no major ecophenotypic distinctions have been recognized across the state.



Definite morphological differences are known in other states where mussel species occur both in natural lakes and larger rivers. But in Texas, there is only one natural lake, Caddo Lake, and it may only have begun to develop in the 1800s with human modification around 1900. All other larger fresh water-bodies called “lakes” are actually reservoirs (man-made impoundments). Most Texas reservoirs were constructed in the 1950s and 60s. Perhaps 50-75 years is not long enough for major ecophenotypic differences to develop. Similarly, differences among Texas mussel populations in rivers differ little from those in smaller streams. In part, this reflects the fact that Texas rivers are not as large as big rivers like the Mississippi or Ohio rivers. Texas rivers and associated streams that are large and stable enough to support unionids may not be as significantly distinct. Selection pressures that impact shell morphology may be more similar in many Texas waters than some other areas.

Threeridge (*Amblema plicata*) and Southern Mapleleaf (*Quadrula apiculata*) have numerous distinctive ecophenotypes in Texas waters. However, neither species shows major morphological differences between reservoir, river, or stream populations. Significant physical differences (in size, sculpture, inflation, thickness) do occur among these species between drainage basins, but with few such distinctions between waters within drainage basins (Figures 2 and 3). Only a few exceptions appear to occur in Texas. For example, Western Pimpleback (*Q. morton*) from the San Jacinto River are usually smaller, less sculptured, and more rectangular than those in Lake Houston, where they are larger, more heavily sculptured, and more rounded (Figure 4).

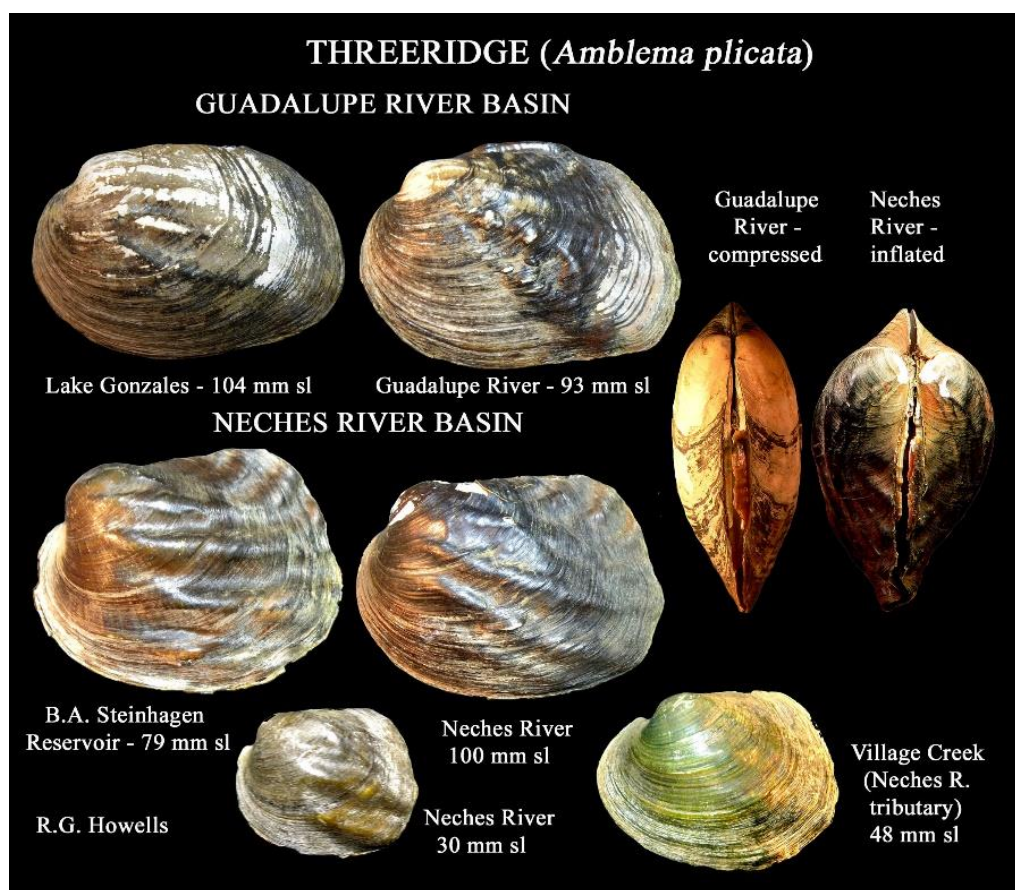


Figure 2. Threeridge (*Amblema plicata*) produces very distinctive ecophenotypes in many Texas drainage basins; however, forms in Lake Gonzales (impounded ca 1931) in the Guadalupe River drainage and B.A. Steinhagen Reservoir (impounded in 1951) in the Neches River basin differ little from corresponding river populations. Some small specimens from Village Creek (Neches River drainage) may have reduced sculpturing; however, most tributaries do not support Threeridge populations.

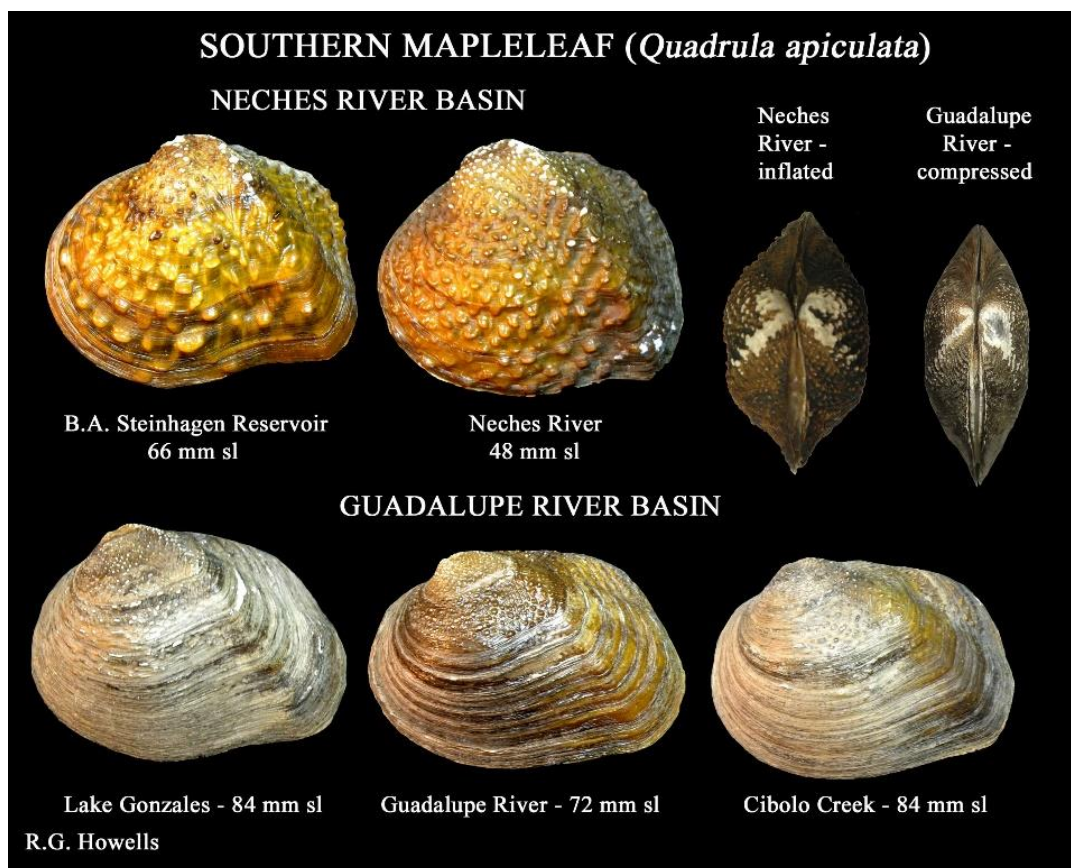


Figure 3. Southern Mapleleaf (*Quadrula apiculata*) produces very distinctive ecophenotypes in many Texas drainage basins. Forms in Lake Gonzales (impounded ca 1931) and Cibolo Creek in the Guadalupe River drainage and B.A. Steinhagen Reservoir (impounded in 1951) in the Neches River, however, differ little from corresponding river populations.

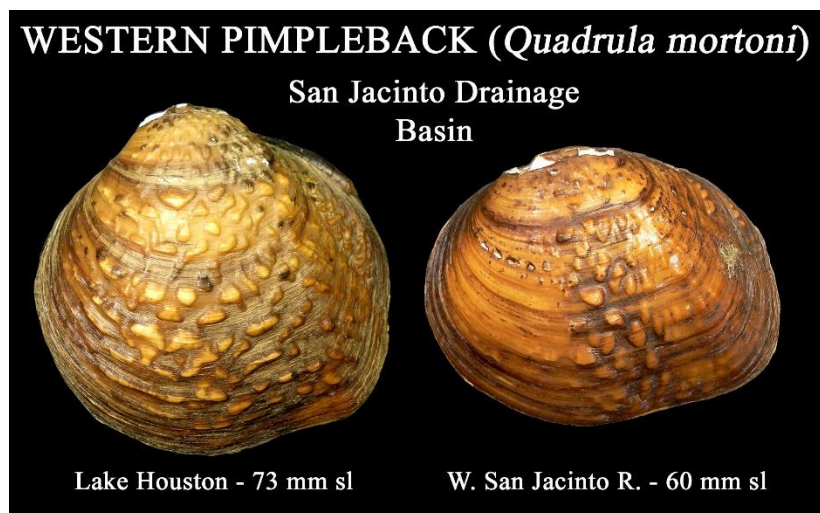


Figure 4. Western Pimpleback (*Quadrula mortoni*) is one of the few Texas unionids that sometimes does produce different ecophenotypes in the San Jacinto River and associated waters of Lake Houston. Elsewhere, most river and reservoir populations in Texas may show few morphological differences.

In 2011 and 2013, Dr. Charles Randklev (Texas A&M University), Dr. Neil Ford (University of Texas at Tyler), and I conducted mussel identification tests among subjects working in the field to examine identification accuracy and sources of misidentifications. Sources of mistaken identifications were often

found among mussel biologists with prior experience in other parts of the United States but limited experience in Texas, individuals that were new to the field and primarily familiar with non-Texas literature, or had Texas mussel background only in very limited geographic areas. Morphological variation between drainage basins appeared to be far more problematic for these biologists than limited variation associated with waterbodies within a given drainage.

In summary, distinctive ecophenotypes may occur among some unionid species in small streams and large rivers or in geologically-old natural lakes or very old reservoirs and associated rivers. Such distinctions, however, may not be evident when stream and river size do not differ significantly, or in newer reservoirs.

Historic Mussel-Host Work: Questions About Interpretation

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In the early 1990s, commercial harvest of freshwater mussels to supply the pearl-implant nuclei trade escalated dramatically. Concurrently, biologists were rapidly becoming aware of both the impact of this harvest and the rapidly declining conservation status of our unionid fauna. Many state, federal, private, and academic interests initiated mussel studies in response. Part of this increased interest was the creation of several newsletters (e.g., Triannual Unionid Report, Info-Mussel Newsletter, and others) to help speed dissemination of information. Recently, I was approached about making digital copies of the Info-Mussel Newsletter (which I produced for Texas Parks and Wildlife Department, TPWD, from 1992 to 1997) available for additional distribution. I declined to do so and cautioned that our understanding of unionids had advanced dramatically beyond what we thought two decades ago. Some things written long ago would need to be corrected, updated, or qualified to avoid potential misunderstandings; spreading dated and inaccurate or misleading information could be more harmful than helpful. Ironically, a recent publication (late 2015) actually did misrepresent some of the early mussel-host relationship material in the Info-Mussel Newsletter. With this misinterpreted archaic information now in circulation in the formal scientific literature, some are likely to accept it as valid when indeed it is not.

For example, when bleufer (*Potamilius purpuratus*) was discovered in the Rio Grande drainage (Howells 1995a, 1997a), glochidia were obtained from one specimen and presented to several host fishes. This was reported as “Glochidia successfully attached to redear sunfish, redbreast sunfish, warmouth, and golden shiner gills but not on blacktail shiner or on any species’ fins” (Howells 1995a). These initial infections, however, failed and all of the glochidia died. Subsequent publications that addressed mussel hosts (Howells 1997b, 2014; Howells et al. 1996) therefore, correctly, did not list any of these species as confirmed hosts for bleufer. Assuming in 2015 that those infections from two decades ago successfully identified the fish hosts is incorrect.

Indeed, TPWD host studies examined many fishes as potential mussel hosts without obtaining transformation to the juvenile stage and producing a confirmed host. For example, similar failures were reported in work with Tampico pearlymussel (*Cyrtoneurina tampicoensis*). In that case, Howells (1995b) stated “...have now attempted to infect several sunfishes and flathead catfish. Glochidia were found on gills of all fishes exposed the following day.” However, this was later amended in Howells (1995c) as “In two prior attempts and a third in July and August, Tampico pearlymussel glochidia attached to a variety of fish species, remained on those fishes for about 10 days, then disappeared.” Similarly, work with sandbank pocketbook (*Lampsilis satura*) found glochidia transformed on bluegill, encysted on warmouth but did not transform, and did not appear to encyst on channel catfish (Howells 1996b). Such failures were therefore not reported in discussions of confirmed hosts (Howells 1996a, 1997b). In some instances, the failures were not reported at all.

In an effort to locate hosts for Texas pimpleback (*Quadrula petrina*) (Howells 1997c), Howells (1997d) reported good infections on flathead catfish, moderate infections on yellow bullhead, and only a single glochidium on bluegill. None transformed to juveniles; dead and non-transformed glochidia were recovered from the study tanks for up to 54 days, and infected fish gills were free from encysted glochidia thereafter. Although unacceptable host fishes usually rejected glochidia within a few days, this and other

TPWD trials revealed glochidia attached to gills for days or weeks before dying and failing to produce transformed juveniles.

In summary, despite a recent claim, my work never confirmed any sunfishes or minnows as acceptable hosts for bleufer. Further, our early work strongly indicated that glochidia may attach to non-host fishes and remain attached for extended periods before finally dying. Both earlier and recent studies that claim to have identified host fishes based on identified glochidia removed from gills or fins of field-collected fishes should be viewed with caution. I would suggest that verified transformation to the juvenile stage should be necessary to confirm acceptable unionid hosts. Confirmed attachment without transformation to the juvenile stage represents only a potential “maybe” and little more than an educated guess.

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Illegal Sale of Exotic Freshwater Molluscs in Aquarium Shops in Israel

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Exotic freshwater molluscs like *Clithon*, *Neritodryas*, *Vittina*, *Marisa*, *Pomacea*, *Tarebia*, *Mieniplotia*, *Tylomelania*, *Clea* (*Anentome*), *Pseudosuccinea* and *Planorbella* are on sale in most aquarium shops in Israel (Milstein *et al.*, 2012:51-53). Most of these animals were imported from countries in S.E.-Asia, although some of them have American roots. They are offered as a means of biological control of unwanted algae and aquatic plants in aquariums. Some species like *Tarebia granifera* (Lamarck, 1822), *Mieniplotia scabra* (Müller, 1774), *Pseudosuccinea columella* (Say, 1817) and *Planorbella duryi* (Wetherby, 1879) are reproducing so profusely in aquariums that they rapidly become a nuisance.

Since most aquarium-keepers consider themselves nature lovers, they don't destroy the excess specimens but, instead, release them in a nearby stream, pond or lake. In this way, all four species managed to establish viable populations in Israel. *Mieniplotia scabra* is now considered one of the worst invasive freshwater snails in Israel. It has upset the mollusc biodiversity of the Sea of Galilee (Israel's

major freshwater source) and endangers some species, among them *Falsipyrghula barroisi* (Dautzenberg, 1894), which are confined in their natural distribution to that lake. Other species, like *Pomacea maculata* Perry, 1810, are more and more encountered in public ponds, and it is only a matter of time until we will come across them in natural habitats.

Any of the four exotic Apple snail species belonging to the genus *Pomacea* recorded so far from Israel, may have not only an unwanted negative effect on the local mollusc fauna, but also may cause problems in exporting products of the Israel agriculture and horticulture. EPPO, the European and Mediterranean Plant Protection Organization, and EFSA, European Food Safety Authority, have outlawed *Pomacea maculata* (= *insularum*), based on the "Pest risk analysis on the introduction of *Pomacea insularum* (d'Orbigny, 1835) into the EU" carried out in Spain (Anonymous, 2011 & EFSA Panel on Plant Health, 2012). In Spain, *Pomacea maculata* managed to establish viable populations in the Ebro watershed and is causing considerable damage in local rice-fields.

The European Union has accepted the *Pomacea* decision (Anonymous, 2012). This means that not only any member belonging to the genus *Pomacea* shall not be introduced into or spread within the EU, but also aquatic plants like Water lilies *Nymphaea* species, Yellow pond-lilies *Nuphar lutea* and Indian lotus *Nelumbo nucifera*, and legumes like lettuce grown by means of the hydroponic method, exported to the Union from countries where *Pomacea* species are known to occur, should be accompanied by a statement of the local Plant Protection agencies that the merchandise has been grown without the presence of *Pomacea* species. This applies to Israel for which the EU countries form an important market for such export items. In the long run, the presence of so many exotic freshwater snails in aquarium shops may endanger not only native species but may have also a negative effect on the export potential of Israeli agricultural and horticultural products.

How did we arrive in such a complicated situation? In Israel, the import of live fish, including such items as corals, molluscs, and crabs, is regulated by the Department of Fisheries of the Ministry of Agriculture. The most up-to-date list of aquatic animals which are allowed to be imported in Israel was published in 2012. It contains the scientific names of hundreds of fish species but among the invertebrates are only 11 molluscs (7 bivalves and 4 gastropods), which are all marine species. Not a single freshwater snail or mussel is mentioned on the list. The introduction to the list ends with the statement that species not included in this list are not allowed to be imported (Anonymous, n.d.). The perpetrator of illegal imports is prone to be brought to court. In other words, all the exotic freshwater molluscs currently up for sale in aquarium shops in Israel were imported illegally.

It is becoming time that the Plant Protection and Inspection Services and the Department of Fisheries both of the Ministry of Agriculture, and the Israel Nature and National Parks Authority of the Ministry of Environmental Protection, draw up a plan not only to curb the further import of illegal freshwater molluscs but also to seize the existing stocks present in aquarium shops. Whether it is already too late to eradicate established populations of exotic freshwater molluscs in Israel will remain an open question, for a while.

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Some of the exotic freshwater mollusc species on sale in aquarium shops in Israel:

1. *Tylomelania zeamais*,
2. *Mieniplotia scabra*,
3. *Marisa cornuarietis*,
4. *Pomacea maculate*,
5. *Clithon corona* (spineless form),
6. *Vittina variegata*.

Photographs by Oz Rittner

**Additional Information Concerning the Conquest of Europe by the
Invasive Chinese Pond Mussel *Sinanodonta woodiana*, 41.
News from Belgium, Croatia, Montenegro, the Netherlands, and Ukraine**

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The invasive Chinese Pond mussel *Sinanodonta woodiana* remains in the news throughout Europe. Here is some new information from Belgium, Croatia, Montenegro, the Netherlands, and Ukraine.

Belgium

On the website 'waarnemingen.be' [observations.be(lgium)], Achille Schretter placed a photograph of a freshwater mussel found in a dry area of a lake in Oud-Heverlee North (Flemish Brabant) on 8 February 2016. With some doubt, he identified the specimen as a Swan mussel *Anodonta cygnea*; however according to Tom van den Neucker, the figured specimen belongs to *Sinanodonta woodiana*. I share his opinion that we are dealing here with the Chinese Pond mussel.

Croatia

Bielen *et al.* (2016) carried out laboratory trials on the native Pond mussel *Anodonta anatina* and the exotic Chinese Pond mussel *Sinanodonta woodiana* in order to verify the tolerance to anthropogenic stress (thermal stress and trace metal zinc pollution stress). *Sinanodonta* showed a higher stress tolerance.

Montenegro

Tomović *et al.* (2013) dealt with the find of a specimen of the Chinese pond mussel in Lake Šasko. It represents the first record of *Sinanodonta woodiana* from Montenegro. Most likely, the species was introduced to the lake by means of exotic carp species which are known as intermediate hosts for the glochidia of the species.

The Netherlands

A brand new field guide dealing with the inland snails and mussels occurring in the Netherlands has recently been published by Bert Jansen (2015). Photographs of *Sinanodonta woodiana* and a map showing the two localities for this species so far known in the Netherlands appear on page 229.

Why this invasive species seems to be far less commonly encountered in the Netherlands than in Belgium remains a riddle. One possibility is the fact that carps, which serve as intermediate hosts for the glochidia of *Sinanodonta woodiana*, are more intensively cultivated in fishponds and marketed in Belgium than in the Netherlands.

Ukraine

During the period 2000-2012, *Anodonta*-like mussels were collected in the major rivers throughout Ukraine and the female specimens were checked for their state of propagation (Yanovych, 2015). Only the invasive Chinese Pond mussel showed multiple ovipositions during the whole year and its hemibranchs were completely filled with reproductive products.

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Brief Report: Experimental Production of Freshwater Cultured Pearls in Santa Catarina State/ SC, Central Southern Brazil Region

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Today, only one species of native limnic bivalve naiad, the giant Unionoid Mycetopodidae *Anodontites trapesialis* (Lamarck, 1819) (Figure 1), is directly involved in experimental activities of aquaculture, technically known as “Naiadiculture” (Agudo 2006) in the State of Santa Catarina/ SC, little central portion of the Southern Brazil region (Figure 1). These activities are being conducted in university laboratory focused on development of “marine farms”, because of its great potential to produce cultured pearls (Agudo-Padrón 2015b:378-Table 1, 379). For additional information, see Agudo-Padrón (2015a:6).



Figure 1.- “X-ray monitor” visualization of “bead nucleus” (left, at arrow) in a live giant native naiad *Anodontites trapesialis* (Lamarck, 1819) specimen (middle), conducted in the “Itajaí Valley” region, Santa Catarina’s State (red color on map).

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The Limnic/ Freshwater Mollusk Fauna in the State of Santa Catarina, Central Southern Brazil Region: Knowledge Achieved after Twenty Full Years of Research

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Today, after twenty years of modest autonomous research in field and cabinet (1996 - 2016), we can comment in security that the State of Santa Catarina/ SC, the geographic central portion of the southern Brazil region, basic domain of the “Atlantic Forest Biome” (Figure 1), consists of a total of 72 limnic/ freshwater mollusk species (42 Gastropoda and 30 Bivalvia). That total includes two amphibious representatives of the genera *Omalyonx* d’Orbigny, 1837 (semi-slug Succineidae) and *Assimineia* Fleming, 1828 (operculated snail Assimineidae) (Agudo-Padrón 2008, 2014a, 2014b, 2015:28).

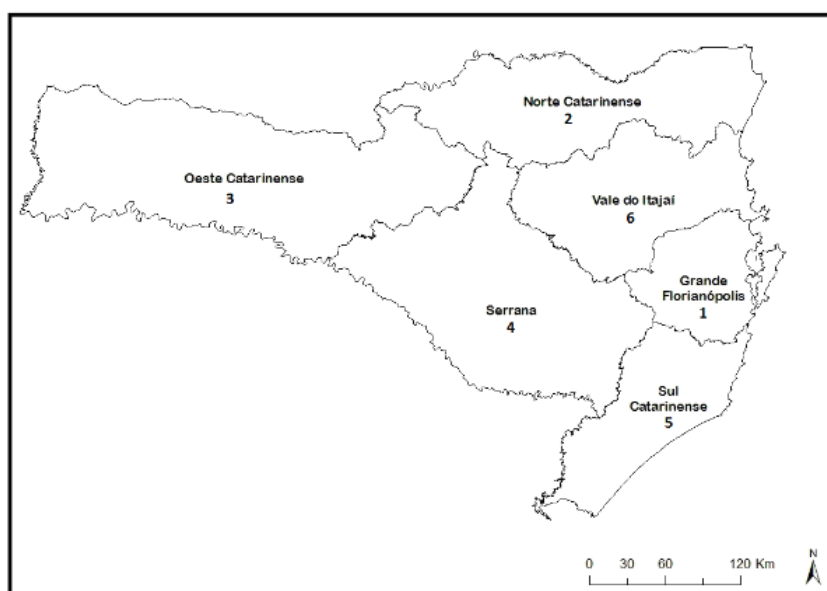
Eight of the listed species are alien forms: five Gastropoda [*Pomacea paludosa* (Say, 1829), *Assimineia* sp, *Melanoides tuberculatus* (Müller, 1774), *Physa acuta* Draparnaud, 1805, *Lymnaea columella* Say, 1817] and three Bivalvia [*Corbicula fluminea* (Müller, 1774), *Corbicula largillierti* (Philippi, 1844), and *Limnoperna fortunei* (Dunker, 1857)]. The native naiad species *Mycetopoda siliquosa* Spix, 1827, needs to be confirmed in the field; it has only been reported in the literature for the territory of the State.

The 72 species are spatially distributed in the six great malacological regions established by us in the geographical territory of the State (Agudo-Padrón 2014a:20, 2014b:9) (Figure 2); however, this knowledge should be viewed as "preliminary." The numbers certainly should increase in the future, to the extent that the geographical coverage of malacological research in the State is realized and completed.

Figure 1.- Morphotype *Pomacea sordida* (Swainson, 1823), a typical and representative limnic/ freshwater mollusk (native apple snail) of the sand banks ("Restingas") and adjacent river environments domain of the regional “Atlantic Forest Biome”.



Figure 2.- The six great malacological regions of Santa Catarina State/ SC. For region descriptions, see Agudo-Padrón 2014a:20, 2014b:9.



**Check List and Spatial/ Geographical Distribution well known Limnic/ Freshwater Mollusks
Found in the State of Santa Catarina/ SC in twenty full years of research (1996 - 2016)**
(numbers indicate the regions where each species has been found)

Class GASTROPODA Cuvier, 1787

Family AMPULLARIIDAE Gray, 1824

- Asolene (Pomella) megastoma* (Sowerby, 1823) – 3
- Felipponea iheringi* (Pilsbry, 1933) – 3
- Pomacea bridgesii* (Reeve, 1856) (“Mystery Apple Snail”) – 1, 2, 5, 6
- Pomacea canaliculata* (Lamarck, 1819) – 1, 5, 6
- Pomacea lineata* (Spix, 1827) – 4, 5, 6
- Pomacea paludosa* (Say, 1829) – 6
- Pomacea sordida* (Swainson, 1822) (Fig. 1) – 1, 2, 5, 6

Family HYDROBIIDAE Stimpson, 1865

- Littoridina australis* (d’Orbigny, 1835) – 1
- Littoridina piscium* (d’Orbigny, 1835) – 1, 5, 6
- Littoridina charruana* (d’Orbigny, 1840) – 1, 3, 4
- Littoridina davisii* Silva & Thomé, 1985 – 5
- Potamolithus catharinae* Pilsbry, 1911 – 2, 3, 4, 6
- Potamolithus kusteri* (Ihering, 1893) – 3, 4
- Potamolithus lapidum* (d’Orbigny, 1835) – 3
- Potamolithus philippianus* Pilsbry, 1911 – 2, 3, 6

Family ASSIMINEIDAE H. Adams & A. Adams, 1856

- Assiminea* sp (In “taxonomic determination”) – 1, 2, 6

Family THIARIDAE Gill, 1871 (1823)

- Aylacostoma* sp (In “taxonomic determination”) – 6
- Melanoides tuberculatus* (Müller, 1774) – 1, 2, 6

Family SUCCINEIDAE Beck, 1837

- Omalyonx convexus* (Heynemann, 1868) – 1, 5, 6
- Succinea meridionalis* d’Orbigny, 1846 – 1, 2, 4, 5, 6

Family ANCYLIDAE (Menke, 1830)

- Burnupia ingae* Lanzer, 1991 – 5
- Hebetancylus moricandi* (d’Orbigny, 1837) – 1, 4, 5, 6
- Ferrissia gentilis* Lanzer, 1991 – 5
- Uncancylus concentricus* (d’Orbigny, 1835) – 3

Family CHILINIDAE Dall, 1870

- Chilina fluminea* (Maton, 1809) – 3, 4
- Chilina globosa* Frauenfeld, 1881 – 4, 6
- Chilina parva* Martens, 1868 – 3, 5

Family PHYSIDAE Fitzinger, 1833

- Physa acuta* Draparnaud, 1805 – 1, 5, 6
- Aplexa marmorata* Guilding, 1828 – 1, 3, 5

Family LYMNAEIDAE Rafinesque, 1815

- Lymnaea columella* Say, 1817 – 1, 3, 4, 5, 6
- Lymnaea rupestris* Paraense, 1982 – 3
- Lymnaea viatrix* d’Orbigny, 1835 – 1, 6

Family PLANORBIDAE Rafinesque, 1815

- Biomphalaria glabrata* (Say, 1818) – 1, 5, 6
- Biomphalaria occidentalis* Paraense, 1981 – 1, 2
- Biomphalaria oligoza* Paraense, 1981 – 1
- Biomphalaria peregrina* (d’Orbigny, 1835) – 3, 6
- Biomphalaria schrammi* (Crosse, 1864) – ?
- Biomphalaria straminea* (Dunker, 1848) – 1, 3, 4
- Biomphalaria tenagophila* (d’Orbigny, 1835) – 1, 2, 3, 5, 6
- Acorbis petricola* Odhner, 1937 – 3

- Drepanotrema cimex* (Moricand, 1838) – 1, 5
Drepanotrema heloicum (d'Orbigny, 1835) – 6
Drepanotrema pfeifferi (Strobel, 1874) – 3, 6

CLASSE BIVALVIA Linnaeus, 1758**UNIONOIDA** Stoliczka, 1871**Family MYCETOPODIDAE** Gray, 1840

- Mycetopoda legumen* (Martens, 1888) – 3
Mycetopoda siliquosa Spix, 1827 – ?
Anodontites elongatus (Swainson, 1823) – 3, 6
Anodontites tenebricosus (Lea, 1834) – 1, 3, 5
Anodontites ferrarisii (d'Orbigny, 1835) – 3
Anodontites moricandi (Lea, 1860) – 3
Anodontites patagonicus (Lamarck, 1819) – 3, 6
Anodontites obtusus (Spix, 1927) – 3
Anodontites trapesialis (Lamarck, 1819) – 2, 3, 5, 6
Leila blainvilleana (Lea, 1834) – 1
Monocondylaea minuana d'Orbigny, 1835 – 3

Family HYRIIDAE Swainson, 1840

- Rhipidodonta charruana* (d'Orbigny, 1835) – 1, 3, 4, 5, 6
Rhipidodonta rhombea (Wagner, 1827) – 3
Diplodon ellipticus (Wagner in Spix, 1827) – 2, 3, 4, 5
Diplodon expansus (Küster, 1856) – 1, 4, 5, 6
Diplodon (Rhipidodonta) koseritzi (Clessin, 1888) – 3
Diplodon multistriatus (Lea, 1834) – 3
Diplodon delodontus (Lamarck, 1819) – 3, 6
Diplodon parallelipipedon (Lea, 1834) – 4
Diplodon rhuacoicus (d'Orbigny, 1835) – 3, 4, 5

VENEROIDA Gray, 1854**Family CORBICULIDAE** Gray, 1847

- Corbicula fluminea* (Müller, 1774) – 3, 5, 6
Corbicula largillierti (Philippi, 1844) – 1, 2, 3, 5, 6
Cyanocyclas (= *Neocorbicula*) *limosa* (Maton, 1809) – 3

Family SPHAERIIDAE Deshayes, 1855

- Eupera klappenbachii* Mansur & Veitenheimer-Mendes, 1975 – 1
Eupera platensis Doello-Jurado, 1921 – 3
Pisidium globulus Clessin, 1888 – 1, 3
Pisidium observationis (Pilsbry, 1911) – 4
Pisidium pipoense Ituarte, 2000 – 3
Pisidium taraguyense Ituarte, 2000 – 3

Family MYTILIDAE Rafinesque, 1815

- Limnoperna fortunei* (Dunker, 1857) – 2, 3

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Ellipsaria is posted on the FMCS web site quarterly: around the first of March, June, September, and December. This newsletter routinely includes Society news, abstracts, meeting notices, pertinent announcements, informal articles about ongoing research, and comments on current issues affecting freshwater mollusks. 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. Those 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 documents 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.

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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



The Ample Elimia, *Elimia ampla* (Anthony, 1854), is endemic to the Cahaba River in central Alabama. It also is one of the species previously included in the Center for Biological Diversity (CBD) Southeastern Megapetition to add ~750 Southeastern freshwater species to the US Endangered Species Act. The CBD has recently withdrawn this and nine other freshwater mollusk species from the petition because of new status, distribution, or systematics data provided by FMCS members (See article on Page 10.). Photograph by Thomas Tarpley, Alabama Department of Conservation and Natural Resources.



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.