



Newsletter of the Freshwater Mollusk Conservation Society
Volume 20 – Number 1 **March 2018**

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Clinch River Mussel Die-off

Jordan Richard, Southwestern Virginia Field Office,
 U.S. Fish and Wildlife Service, Abingdon, Virginia

This winter, a massive mussel die-off is occurring in the Tennessee reach of the Clinch River, one of the most diverse surviving mussel habitats on the North American continent. This die-off is affecting an increasing number of native mussel species, but it is not affecting resident Asiatic Clams (*Corbicula fluminea*), freshwater snails (like the Spiny Riversnail *Io fluviialis*), aquatic insects, or fishes. The extent of the die-off is being documented and studied; however, its cause or causes have not yet been identified.

The Clinch River is an eastern tributary of the Tennessee River that flows from southwestern Virginia into northeastern Tennessee. Historically, it supported populations of as many as 55 native mussel species. Even in recent years, this river has maintained reproducing stocks of at least 46 native mussels, including representatives of 20 federal endangered species. The Clinch River is considered one of the most important remaining refuges for protected native mussels in the United States. It also has been a major source of brood stock for mussel propagation and reintroduction activities.

Unexplained die-offs of freshwater mussels have been reported in recent years from multiple sites in the Virginia portion of the upper Tennessee River basin and have been documented in the Powell River (in 1983) and Middle Fork Holston River (in 1999). Monitoring data indicate limited or no recovery at these sites following the die-offs. The upstream part of the Clinch River in Virginia has been heavily impacted by toxic spills and other anthropogenic pressures, leaving all mussel populations from the headwaters downstream to near the Tennessee border either extirpated or significantly reduced.

Starting in June 2016, biologists began to notice an increase in the number of fresh-dead mussel shells in the Clinch River at Kyles Ford (see Figure 1 for site locations). By September 2016, there were thousands of fresh-dead mussels at Horton Ford, and from there downstream to Swan Island, a reach of approximately 28 river miles. At that time, most of the dead mussels were Pheasantshell (*Actinonaias pectorosa*) (Figure 2); however, other species also were represented, including members of eleven federally-listed species. At the same time, some mussel species appeared to be healthy and active, and healthy populations of fish, snails, and other benthic macroinvertebrates were observed at the die-off sites

Figure 1. Map of the Clinch River at the Virginia-Tennessee State Line showing the relative locations of sites mentioned in the text.

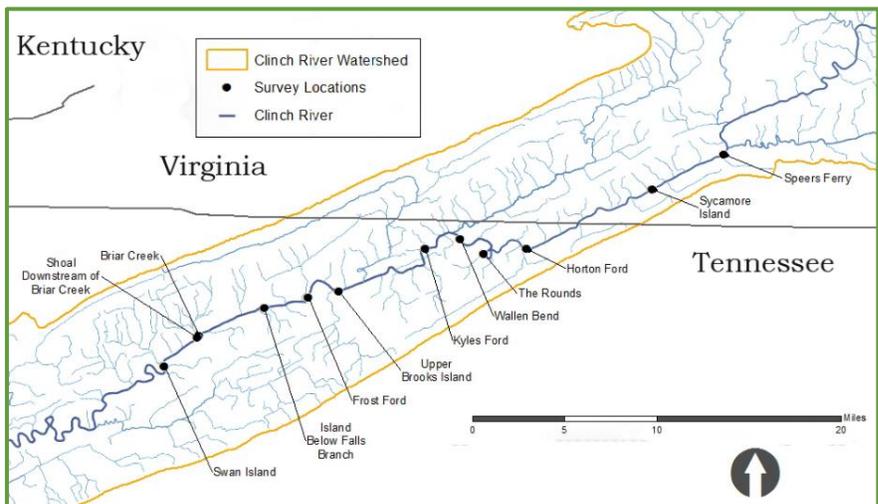


Figure 2. Dead Pheasantshell (*Actinonaias pectorosa*) in the Clinch River.

During the summer of 2017, quantitative surveys were conducted at Kyles Ford, Frost Ford, Wallen Bend, and Swan Island in Tennessee, and at Sycamore Island and Speers Ferry in Virginia (the closest mussel shoals upstream of the die-off area). There was no evidence of changes in mussel abundance at the Virginia (upstream) sites; however, 50-80% declines in Pheasantshell populations were documented at all sites in Tennessee. Field observations suggested that numerous other mussel species also were involved

in the die-off, but those observations were not supported in the quantitative data. As an example, dozens of fresh-dead shells of the seldom-seen, endangered Cracking Pearlymussel (*Hemistena lata*) were found at the Tennessee sites.

By October 2017, the scope of attempts to identify what was causing this ongoing die-off was expanded. Hemolymph samples collected from healthy and dying mussels of several species at both die-off and unaffected sites were sent to the University of Wisconsin–Madison and the FWS Fish Health Center in LaCrosse, Wisconsin. The analysis of those samples is ongoing.

Site visits conducted in November 2017 indicated no active new mortalities at upstream Tennessee sites (Wallen Bend, Kyle’s Ford, and Frost Ford), but limited surveys at Falls Branch and Swan Island (further downstream in Tennessee) yielded dozens of recently-dead (fully-intact) Pheasantshell and thousands of fresh-dead shells of other species.

Early in January 2018, several hundred fresh-dead listed endangered Fluted Kidneyshell (*Ptychobranthus subtentus*) were found at Kyles Ford, but Frost Ford and Wallen Bend appeared to be unaffected. Near the end of that month (January 26), the situation at Kyles Ford seemed to have deteriorated significantly. Mussel mortality was widespread, with hundreds (likely thousands) of mussels dead, representing numerous species (Figure 3). On the same day, mussel populations at Sycamore Island, Frost Ford, and Swan Island appeared to be unaffected. By February 1, 2018, active mortality at Kyles Ford seemed to have largely curtailed since the previous visit. The crew was unable to locate live, moribund specimens needed for evaluation in a case-control design. Samples were collected at Kyles Ford and from Sycamore Island (where no die-off has been detected).



Figure 3. Fresh-dead mussels found at Kyles Ford on January 26, 2018.

More information about this ongoing Clinch River die-off will be presented at the FMCS Freshwater Mollusk Health and Disease Assessment Workshop to be held on March 13-15, 2018, in La Crosse, Wisconsin. The various samples from dead and dying mussels collected so far have not been fully analyzed, but preliminary results indicate that novel pathogenic viruses are likely playing at least some role in this event.

Funding is currently being sought to further the scope of the investigation. Hemolymph samples from newly-afflicted species will be collected as field conditions allow. Regular monitoring of affected populations will continue, along with the collection of shell material to catalog the spatial and temporal extent of the die-off. Quantitative surveys to be conducted in 2018 will enable the evaluation of population trends related to the die-off.

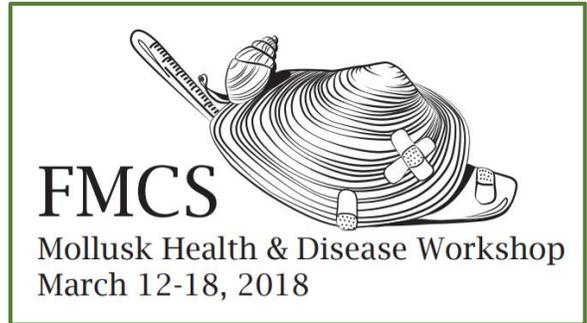
As a preventative measure, FWS personnel and our partners will try to limit the spread of potential etiological agents through the decontamination of gear used at these Clinch River sites and halting the translocation of mussels from the affected shoals.

Staff from numerous conservation partners have been, and will continue to be, instrumental in efforts to document and identify the causes of this die-off. These partners include: Virginia Tech. Conservation Management Institute, US Geological Survey (Upper Midwest Environmental Sciences Center, National Wildlife Health Center, Leetown Science Center), University of Wisconsin–Madison, FWS (Field Offices in Abingdon, Blacksburg, and Gloucester, Virginia; Asheville, North Carolina; Cookeville, Tennessee; Midwest Fisheries Center), Tennessee Wildlife Resources Agency, Virginia Department of Game and Inland Fisheries, The Nature Conservancy, and others.

Society News

Freshwater Mollusk Health and Disease Workshop

Many FMCS members and others really seem interested in attending our Freshwater Mollusk Health and Disease Workshop on March 13-15, 2018, in La Crosse, Wisconsin, USA. As of February 9, over 100 people have registered for the Workshop, and the field trip roster is full. If you hope to attend and have not registered by March 3, 2018 (the late registration deadline), you **must** contact Megan Bradley (megan_bradley@fws.gov) or Diane Waller (dwall@usgs.gov) rather than trying to register online or think you can register on-site.



The schedule for the Workshop is outlined below. Tuesday will be spent learning about the state of knowledge of mollusk disease and health. On Wednesday and Thursday, each person will move with their group of around 40 people among sessions focused on Risk Assessment, Mollusk Die-offs, and Laboratory Techniques. The laboratory section will cover anatomy, parasites, disease organisms, and sampling techniques for diagnostics. We look forward to seeing you soon.

Freshwater Mollusk Health and Disease Workshop Schedule

Monday, March 12

4:00-9:00 pm Registration Open

Tuesday, March 13

7:30-8:00 Breakfast

8:00-8:10 Welcome

8:10-8:40 The Uncertain State of Molluscan Health. Greg Cope

8:45-9:30 Back to the Drawing Board: Assessing Causes of Freshwater Mussel Declines. Wendell Haag

9:30-10:00 Viruses of freshwater mussels (and other species): expanding the invertebrate “virosphere” in the pursuit of mussel health and conservation. Tony Goldberg

10:15-10:45 An Overview of the Bacteriological Examination of Freshwater Mussels. Eric Leis

10:45-11:15 Are Parasites and Diseases Contributing to the Decline of Freshwater Mussels (Bivalvia, Unionida)? Andrew McElwain

11:15-12:00 Perspective from the Marine Realm: Contemporary Challenges and Approaches to Bivalve Mollusc Health Management. Ryan Carnegie

12:00-1:30 Lunch

1:30-1:45 Overview of Health Assessment Tools in Native Freshwater Mollusks. Greg Cope and Diane Waller

1:50-2:05 Omics. Ieva Roznere

2:10-2:25 Use of Condition Indexes for Mussel Health Assessment. Serena Ciparis

2:30-2:45 Hemolymph chemistry profiles and fatty acid analysis as tools for evaluating freshwater mussel health. Andrea Fritts

2:50-3:10 Influence of water and sediment on the digestive gland microbiome in the Alabama rainbow (*Villosa nebulosa*). Cova Arias

3:25-3:45	Disease Risk Analysis – Applications for the Management of Fresh Water Mussels. Tiffany Wolf
3:50-4:05	Do the Infectious Diseases of Dreissenids Represent a Threat to North American Unionid Populations? Daniel Molloy
4:10-4:25	Invasive snails and their potential to serve as hosts for parasites in the Midwest. Greg Sandland
4:30-4:45	Factors Related to Growth Inhibition in Juvenile Mussels Exposed to Ambient Stream Conditions. Wendell Haag
4:50-5:05	1999 Ohio River Mollusk Kill Assessment: The Gastropod Study. Janet Clayton
5:10-5:30	Freshwater mussel die-offs: insights from a compilation of known cases. Jordan Richard
7:00-9:00	Poster Session and Social

Wednesday, March 14

8:00-11:30 am	Small Group Session 1
11:30-1:00	Lunch
1:00-4:30 pm	Small Group Session 2
5:00-7:00 pm	FMCS Board Meeting
7:00-9:00 pm	Social and Jam Session

Thursday, March 15

8:00-11:30 am	Small Group Session 3
11:30-1:00	Lunch
1:00-5:00 pm	Optional Field Trip to tour Genoa National Fish Hatchery

By the way. Don't forget to bring your instrument for the jam session (old time, bluegrass, Irish, Scottish, Scandinavian, etc.) on Wednesday night during the Social.

Minutes of the Winter 2017 FMCS Board Meeting Teleconference Tuesday, December 19, 2017

Call to order was made by President Heidi Dunn. In attendance were Heidi Dunn, Emily Grossman, Janet Clayton, Greg Cope, Rachael Hoch, Tim Lane, Jeremy Tiemann, John Jenkinson, John Harris, Jennifer Archambault, Celeste Mazzacano, Megan Bradley, Diane Waller, Art Bogan, Braven Beatty, Carla Atkinson, Dave Zanatta, Tamara Smith, Ryan Schwegman, Teresa Newton, Nathan Whelan, Emy Monroe, Becca Winterringer, Lisie Kitchel, Steve McMurray, Nathan Eckert, Nicoletta Riccardi, and Dave Berg. A quorum was established. Meeting called to order at 10:05 EST.

Carla Atkinson made a motion to approve the August 2017 Board Meeting Minutes (published in the September 2017 *Ellipsaria*), with a second by Art Bogan. All approved.

Treasurer's Report – Emily Grossman2018 Workshop Update

Registration for the 2018 Mollusk Disease Workshop opened November 17th. As of December 19, 10 people had registered.

Workshop income to date

- Registration: \$855.00
- Sponsorships: \$3,250.00
(MICRA, Dairyland Power Cooperative, Exelon, Virginia Department of Game and Inland Fisheries)
- Field trip: \$100.00
- T-shirts: \$40.00
- Total workshop income to date: \$2,745.00

Other income and expenses, 8/1/17 – 12/13/17

Income

- Memberships: \$1,280.00
- Past years t-shirts, hats, etc.: 30.00
- Interest: 33.14
- Total non-symposium income: \$1,343.14

Expenses

- FMCS contribution to fish/mussel values book: \$17,500.00
- Allen Press/FMBC costs: 4,807.04
- Regional meetings: 200.00
- CASS booth at SACNAS meeting: 311.00
- Vests: 149.80
- Biennial corporate registration: 20.50
- Webpage: (security certificate) 15.00
- PayPal/Square fees & misc: 72.88
- Total expenses: \$23,076.22

Bank balances:

- Checking: \$25,814.61
- Savings: 110,073.32
- PayPal: 3,002.05
- Total: \$138,889.98

Motion to approve the treasurer’s report was made by Braven Beaty with a second by Steve McMurray. All approved.

Secretary’s Report – Janet Clayton

There are currently 578 on the mailing list. Several of these are still having bounce-back emails which may be reduced once spring cleaning is conducted on the list. The 578 include 308 regular members, 79 student members, 18 lifetime members, 7 contributing members, and 5 which are authors and non-members. The remaining balance have lapsed memberships. One lifetime member, Dick Neves, has not created a profile and thus is not on the list. As I have a current email address for him, a profile will be created so folks can contact him if they wish and so that he will receive our notices. He is doing missionary work abroad and most likely not currently involved with mollusks. One of our current lifetime members recently passed, Dr. Stansbery; his profile will be archived.

Old Business**Update on AFS Monetary values of fish and freshwater mussels** – Heidi Dunn

The book is now published and available from the American Fisheries Society (AFS) bookstore to Non-AFS members for \$79.00. The AFS member price is \$55.30. AFS offered FMCS the member price if we made a bulk purchase (30% off list price) and then these could be made available to members. Contact was made with AFS and they cannot provide FMCS members the reduced rate if purchased through an FMCS link, they must be AFS members. It was decided that we would take orders from Workshop attendees and have the order shipped to the meeting. This can be done by adding a check box to the registration form if they want to place an order. The website will be updated, and an email will be sent to those that have already registered to provide them the opportunity to order the book at the reduced rate.

Update on CASS – Jeremy Tiemann

FMCS along with AFS and the Society Freshwater Science (SFS) contributed to a Consortium of Aquatic Science Societies (CASS) booth at the Coastal and Estuarine Research Federation Society meeting. FMCS was recently one of the signatories on the Wetlands of the United States letter. All letters that FMCS has collaborated on are posted on the website. These are also shared with social media. CASS holds monthly calls and the next one is on the December 20. CASS participates in a lot of joint society meetings with the next one scheduled for 2022. They are expecting 3000 to 3500 participants. They are still exploring options and nothing has been finalized yet. We may want to consider joining our 2022 Workshop into this meeting. If anyone has any ideas they can contact Jeremy. Dave Berg noted that he had participated in the first Aquatic Sciences meeting and noted it was very good and we may want to consider substituting it for our next Workshop.

AFS liaison – Jeremy Tiemann

Liaison efforts started about six years ago. This keeps the line of communications open between AFS and FMCS with regards to Society activities. There has not been a lot going on recently except for the recently published monetary values book and CASS activities.

Lifetime dues – Heidi Dunn and Jeremy Tiemann

Heidi made a motion to add retirees to the student category for dues and add a lifetime membership of \$800.00. The change in dues would take effect prior to the 2019 Symposium. Two-year membership fees would then be Student/Retirees \$40.00, Regular member \$80.00, and Contributing member \$250. A Lifetime membership would be \$800. The motion was seconded by Janet Clayton. It was further decided that a definition for Retiree must be developed before implementation. Suggestions included: age requirement, retirement from career position, or possibly retirement from career position and not working more than 20hrs/week. The final definition and membership fee scale should be published in *Ellipsaria* following the March Workshop. All approved.

Code of Conduct – Heidi Dunn

Heidi proposed adding a Code of Conduct statement to the Symposium registration. It would be on the registration site and the person registering would need to check a box indicating they agree to abide by the code. It would also be listed in the program. As previously mentioned, this could be modified from the SFS code. Lisie thought we could just substitute FMCS in place of SFS. Heidi said this should be ready for the 2019 Symposium registration, no objections were heard. This should be printed in the September issue of *Ellipsaria* with the corrected name changes. Steve also advised that it should be included in the Society By-laws and Heidi agreed, noting that the By-laws are in need of several changes.

By-laws update – Heidi Dunn

Tabled until next meeting.

New Business**Chapters revisited** – Heidi Dunn, Celeste Mazzacano

Recently, the Pacific Northwest Mussel Group approached FMCS to again consider Regional Chapters. Their request and justification were as follows:

**Creation of regional chapters under the umbrella of the FMCS:
Perspective of the Pacific Northwest (PNW) Native Freshwater Mussel Workgroup
Celeste Searles Mazzacano, Chair**

The Pacific Northwest Native Freshwater Mussel Workgroup was founded in 2003. It came about as the result of a workshop held in Vancouver, Washington, attended by 91 participants to initiate discussion on the regional population status of freshwater mussels. The Workgroup subsequently established a charter (<https://pnwmussels.org/workgroup-charter/>) and a mission statement. The purpose of the Workgroup is "to ensure that freshwater mussel research, management, and educational activities are coordinated, prioritized, and are consistent with identified information needs".

The Workgroup has grown since 2003 and now has about 120 members (i.e., list serve members). The geographic focus of the group is the United States and Canada west of the Rocky Mountains, and the geographic range of our current membership includes California, Idaho, Arizona, Montana, Oregon, Washington, and British Columbia. Member affiliations include federal, state, and regional government agencies; private consultants; tribes; and non-profit organizations. The Workgroup is led by a Chair, whose term of service is not codified but generally runs 2-3 years. There are no Standing Committees, nor is it membership-based (i.e., no dues are collected). The Workgroup holds quarterly meetings via conference call, and hosts occasional regional Workshops as funding allows, the most recent of which (Sept. 2017) was sponsored and organized by EcoAnalysts.

While the Workgroup has done a great deal to advance knowledge and awareness of western freshwater mussels, the vast majority of our members do not work on mussels as part of their daily jobs. In addition, although the West is home to a much smaller number of freshwater mussel species than the East, several of which are in serious decline, none of our species receives protection at the Federal level, and state protections are limited and often difficult to enforce. In the past few years, however, our membership has grown to 120, more regional organizations are turning to the Workgroup for information and advice, and we created a new web site (pmwmussels.org), Facebook page (<https://www.facebook.com/MusselsPNW/>), and iNaturalist project (<https://www.inaturalist.org/projects/freshwater-mussels-of-the-western-u-s>). This year, it was decided that the Workgroup has reached the point where it makes sense for us to become a nonprofit organization, both from a financial and effectiveness standpoint. This discussion occurred in the same year that FMCS leadership broached the suggestion that the PNW Workgroup host the 2021 annual meeting of FMCS, to increase communication and coordination among our two groups. At this time, the possibility of FMCS creating regional chapters also arose. The PNW Mussel Workgroup is strongly in favor of this idea; we feel that it will benefit both of our organizations, for the reasons outlined below:

Benefits to FMCS

- increased participation from different geographic regions
- increased membership and dues
- input on mollusk-related issues from a region with different species that are facing different challenges than the Midwest and East
- expanded ability to address mollusk-related conservation, research, and outreach in the PNW
- additional vehicle for carrying out FMCS programs and sharing news and information
- new base for development of leaders, officers, committee members, and/or board members
- improved inter-organizational communication
- standardized, unified, amplified messaging

Benefits to PNW Mussel Workgroup

- increased membership due to formal affiliation with national-level nonprofit organization
- access to existing non-profit status
- increased ability to host Workshops or conferences under the aegis of FMCS
- access to wider range of resources, expertise, and information
- greater effectiveness in mussel research and conservation
- increased visibility and effectiveness
- improved inter-organizational communication
- access to well-defined operating systems
- standardized, unified, amplified messaging

The Board discussion started by noting that about ten years ago the Interior Highlands Mussel Group approached the FMCS Board with the idea of forming chapters. At that time, the Board decided to support mussel groups, but did not want to have formal chapters. The Board decided to award \$100 to local groups for promoting FMCS at their meetings and for providing a summary of their meetings in *Ellipsaria*.

Greg Cope noted that the time has come to address this. The Society is more stable now and there are good models out there for regional chapters or other boundaries -- such as watershed groups -- that could be used to assess how well they function. All agreed that the subject warranted the formation of an Ad Hoc committee and Celeste Mazzacano, Art Bogan, and Greg Cope were appointed to serve on that committee. There are several societies (such as AFS and SETAC) that can be looked at as to how their chapters are implemented. Each chapter has own set of by-laws, etc. that must be approved by the parent society. Many pros and cons were discussed (listed below).

- Afraid that it will dilute the direction of the National Strategy.
- By-laws need updated.
- Could lead to someone at the local level deciding to speak for FMCS as a whole.
- Would it work better at the international level to be chapters or committees?
- Could detract from Symposium attendance.
- Some of the issues could be worked out in Policy and Procedures.
- Pacific Northwest group feels they could do a more effective job if they had the backing, infrastructure, etc. of the national/international organization.
- Braven wondered if we had the size to carry this forward but saw the merits of regional structure.

The ad-hoc Committee is to report back at the next Board meeting.

Malacological Data Net – Art Bogan

All issues if Arthur Clarke's grey literature journal *Malacological Data Net* have been scanned and we plan to make it available on the FMCS website. Complete sets are scarce and many species descriptions are found here. *Sterkiana*, mostly produced by Aurele La Rocque, may also be a good candidate for scanning and posting on our website. Volumes 71 and 72 of that journal are not generally available, although we are not sure who owns the copyright. This will be checked into. When posted, please supply an announcement for publishing in *Ellipsaria*.

Mollusk names – Art Bogan

The current list is posted within the committee's pages. Previous discussions were about making these active lists on the website. Paul Johnson and Jim Williams are currently meeting to discuss how often to conduct revisions. The Williams' paper is already out of date. Nathan Whelan noted that document guidelines were previously drafted with the process already fleshed

out. Due to the delay in the Williams' paper, this effort got sidetracked. The names group plans to meet at the 2019 Symposium.

List-serve – Jeremy Tiemann

There are currently two unio list-serves, one based in Florida which no longer works, and one that Matt Patterson recently opened with a "fws" suffix. Once the "fws" list-serve is ready, an email will be sent to the membership encouraging all interested to use it. Most likely this will be after the first of the year. [See article on this subject starting on Page 15.]

Committee Reports

2018 Mollusk Health and Disease Workshop - Diane Waller

Registration is open. We've reached out to American Zoos and Aquaria, AFS and, Unio list serves, and the FMCS membership to promote the Workshop. Abstracts for poster presentations are now being accepted. All speakers have been confirmed for the opening session. Subcommittees have been formed for each of the small group sessions. Abstracts and supplementary materials have been requested from the speakers, with the intent to develop a resource handbook, including a bibliography, for participants to take home. Sponsorships are coming in and Emily is tracking the total. Local arrangements for lodging, meals, and transportation are complete. We will be working on the program and handbook in January. [More detail about this Workshop is presented in the article starting on Page 4.]

2018 1st FMCS Meeting in Europe, Verbania, Italy, 16-20 Sep 2018 - Nicoletta Riccardi

Registration will open on January 7. The first announcement and a reminder have reached the FMCS membership to promote this meeting. We are working to create and manage the website for conference logistics, enrollment, and payment; a link to the conference website will be made on the FMCS events webpage. We are completing the text to put on the FMCS website (scope, call for abstracts, scientific and organizing committees, and invited speakers). Tentative budget and program were provided for Board evaluation. The Local Committee is in need of a \$1000 payment to Federica who is organizing the symposium website and taking care of the logistics information. The committee asked for approval of the program and budget and no objections were heard. Heidi noted that if in the United States, the budget would most likely be a lot more, so she deferred to Nicoletta's judgement. The theater which will host the meeting is at no charge but since September is a high tourist month, folks should look for lodging early. Nicoletta was requested to supply lodging options and she will supply a list of hotels, apartments, camping, etc. The Local Committee is interested in inviting an International Union for the Conservation of Nature speaker on gastropods, but his primary interest is terrestrial. The Board agreed that this would be satisfactory so long as he at least addressed aquatic gastropods.

FMCS has been asked to participate in this Meeting and Heidi will do so. She plans to present the history of the Society and introduce the National Strategy. Some funding for travel will be provided by the Meeting. Art Bogan and Manuel Lopes-Lima are on the scientific committee for the meeting and also plan to attend. Wendell Haag is one of the invited speakers. [See also the Meeting announcement on Page 17.]

2019 Symposium – Jeremy Tiemann

The contract has been signed and the 2019 Symposium will take place on April 14-18, 2019 at the Hyatt Regency, San Antonio, Texas. The second 2019 Conference Planning Committee conference call will be December 18, 2017, to discuss progress with the various committees. [Save-the-Date flier is on Page 25.]

Awards Committee Report – Teresa Newton, Greg Cope, Emy Monroe

As this is a non-Symposium year, the Awards Committee has nothing to report on professional awards or student travel awards. For the Regional Meeting Assistance Award Program in 2017, we provided monetary support for five meetings: Northeast, Canadian, Chesapeake, Ohio River, and Virginia Atlantic Slope.

Nominations – Leroy Koch

Nothing to report.

Outreach – Megan Bradley, Jennifer ArchambaultProjects and Progress

Since our last report in March, the Outreach Committee initiated progress on some of the agenda items developed at our meeting during the 2017 Symposium in Cleveland, Ohio. In May, Co-Chair Jennifer Archambault created a signup in [GoogleSheets](#) for members to work on proposed projects of their interest. Proposed outreach projects included posters, fact sheets, brochures, and videos; for a full list, refer to the GoogleSheets link or the Outreach summary published in the June 2017 issue of *Ellipsaria*. The sheet includes the proposed projects, interested members' names, and their contact information to facilitate work in small groups rather than all communications routed through Chairs. As progress is made, members will share drafts with Chairs and other committee members. At the same time, we distributed the signup, we also created a poll to schedule a committee conference call and keep progress moving. To help facilitate projects and in lieu of an FMCS storage account, Jennifer created a folder on her university Google Drive account (university accounts have unlimited storage) and shared access with Outreach members, with the premise that members can add content (photos, videos, etc.) that could be used for creating outreach materials (e.g., posters, brochures, etc.), and mutually access draft projects for help and feedback.

A conference call was held on June 26 and attended by seven members. The purpose of the call was to touch base on progress or ideas related to developing outreach materials. Members shared to the Drive folder an early stage draft poster (Freshwater Mollusks of North America), several presentations that have been used in the past and can be mined for slides, and several short videos. Thanks especially to Sarah Douglass for sharing materials from the Illinois Natural History Survey. The Committee discussed ways we could incorporate such materials into producing outreach content. Other highlights from the conference call include: discussion of using the Piktochart website for future infographics if FMCS is willing to pay an access fee during content development (\$15/month); interest in creating a high quality outreach short film, creating a calendar potentially as dual outreach and fundraiser, updating the operations manual to appropriately reflect all the duties of the Outreach Committee (it currently only reflects the website), results from the member survey about the student/mentor mixer held in Cleveland. Minutes from the conference call are attached as an appendix to this report. Committee members Dan Symonds and Amy Maynard reported the student/mentor mixer survey results to all FMCS members in the September 2017 issue of *Ellipsaria*.

Since our conference call, one infographic was created using Pictochart, and members are planning to make a series of them for the National Strategy. Amy Maynard registered on Pictochart last month and estimates a subscription of about four months would be sufficient time to complete additional infographics. Jennifer requested FMCS to fund six months, Heidi approved with no objections.

During and since the conference call, one major hurdle has been understanding the intentions of the National Strategy authors regarding the development of a communication plan (Issue 7.1. "Develop a formal communication plan to guide the conservation of mollusks into the

future.”). Outreach members are willing to work on developing the plan, and are seeking input, guidance, and assistance from the Board, National Strategy authors, and related committees regarding content and drafting the formal plan.

Social Media

In August, Jeremy Tiemann expanded FMCS social media footprint by creating a Twitter account. The FMCS Twitter handle is @FMCS_Mollusk and the page name is simply Freshwater Mollusk Conservation Society for easy search ability. He also created a Hootsuite account that allows simultaneous posting to multiple social media platforms at once. Jeremy and Jennifer have continued to share content on social media, including Society announcements, job postings, and relevant news stories. The Outreach Committee thanks Jeremy for his major efforts to keep our social media presence active over the last several months. Other FMCS members occasionally post directly to the Facebook page. *We would like to remind members that the FMCS Facebook page is public and they can post interesting news, job announcements, etc., directly to the page anytime they like. Members can also easily mention FMCS with the Twitter handle for quick sharing/retweets.*

Megan continues to work with our webmaster to update the website content, including committee pages, job announcements, new publications and event-related content. Letters from the Consortium of Aquatic Science Societies have been the most significant new addition to the website.

Changing of the Guard

The Chairs of the Outreach Committee have recently changed. Due to constraints related to working for a federal agency, Megan Bradley has stepped down from the Outreach Co-Chair position. She still plans to remain active on the committee, especially regarding her work on the FMCS website. We thank Megan for her dedicated service as Co-Chair and look forward to her continued contributions to the committee and the website! We are grateful to Kimberly Horndeski, who has volunteered to Co-Chair the committee with Jennifer, and welcome her energy, service, and leadership! Please include Kimberly on future Outreach and Board related communications at: kimberly.horndeski@cpa.texas.gov.

Final Notes

- If there is priority need for specific materials, please let Outreach know so that we can focus efforts appropriately.
- Kimberly was just in communication with the newly formed Inclusion and Diversity Committee discussing ways their mission could be incorporated into a communication plan and any visible materials, including the Society website.
- **Request to the membership:** The Outreach Committee requests media – photos, videos, or other materials – that people are willing to allow FMCS to use, with proper credit, to facilitate creating effective outreach materials. Members can send media to Jennifer (jmarcham@ncsu.edu) or Kimberly (please use her personal account for media (kahorndeski@gmail.com), as videos cannot be received at her work address). Alternately, if members have Flickr or other media accounts with available materials, please let Outreach know that too.

Gastropod Status/Distribution - Nathan Whelan

Paul Johnson and others will be talking about issues concerning the names committee. According to the last FMCS procedures manual, the common and scientific names committee is

supposed to be a subcommittee of the Gastropod Distribution and Status Committee. Nathan is not opposed to this changing, but that's what the procedures manual states.

It has been five years since the last conservation status review has been published for freshwater gastropods of the U.S. and Canada (Johnson *et al.* 2013). The procedures manual states reviews should be "periodic". Nathan likes this flexibility because he doesn't think short times frames like every two years are realistic. Status reviews are incredibly time-consuming and require extensive buy-in from a group of scientists willing to dedicate large amounts of time to one publication. It is certainly something more than one committee chair can take on. Over 2018, Nathan will start building a team that would be willing to help with a new status review. Ideally, a team would be in place by the 2019 Symposium and a publication out by the 2021 Symposium. He realizes this is a long timeline, but a faster timeline is unrealistic. Nathan is open to feedback and it would be nice to get more members involved.

Guidelines/Techniques - Ryan Schwegman and Lisie Kitchel

Our goal is to develop consistent best practices for freshwater mollusks. There is a lack of standard practices for surveying, handling, and vouchering species among different organizations, agencies, and individuals. The goal of the committee is to review and disseminate information regarding guidelines and techniques that minimize harm to freshwater mollusks. The committee created and continues to maintain a list of mussel survey guidelines and protocols organized by state or government agency on the FMCS website. Additionally, the committee plans to add guidelines concerning photographs for publications to FMCS website. Any new information that is available about survey or photograph guidelines is welcome and should be forwarded to the committee chairs.

The committee would like to host a Workshop during the 2019 Symposium covering survey techniques and possibly include a state by state guideline overview. One of our goals in 2018 is to establish a small team to spearhead this Workshop effort. Several members expressed interest in helping with this effort during the 2017 Symposium. Discussions during the Board meeting encouraged the committee to host a full Workshop in 2020 on survey techniques and kill assessments rather than a workshop during the Symposium.

Ad hoc Committees

International – Art Bogan, Manuel Lopes-Lima

We have been having discussions with the European Malacological Society in Poland and how they would be able to fit into FMCS. We were thinking of committee status but now, with the possibility of chapters, plans may change. Europe has a large number of folks. We also are looking at a similar situation in Asia. Then, there is the question as to whether Asia would include Australia and New Zealand. Another group in South America is growing and expanding. Africa has very few folks interested. Goal now is to work on collaboration.

Professional Development - Becca Winterringer, Amanda Rosenberg

The Committee has surveyed FMCS members and the greater mollusk conservation community to gauge interest in an education-based Professional Certification Program administered by the FMCS. As of December 14, 2018, the survey had received 30 responses (26 current FMCS members, one past FMCS member, and three non-members). The survey will close on January 1, 2019. The Committee will compile all responses and provide a summary for the next Board Meeting as well as the next issue of *Ellipsaria*. [See Results article starting on Page 17.] A summary of the responses received to this point are provided below.

While a description of the goals of a FMCS Professional Certification Program were provided with the survey link, it is clear from the survey responses that the Committee did not clearly communicate that this is not a taxonomic certification. Action items for the committee are:

- Send out a reminder for FMCS members to participate in the survey and reiterate that this is not a taxonomic certification,
- Upon conclusion of the survey, prepare a summary of the results to present to the Board, and
- Determine efficacy of moving forward with program development.

Monetary Values of Mollusks – Megan Bradley

- The AFS kill book has been published to resounding cheers from those involved!
- We are in the process of scheduling a meeting of this committee around the spring FMCS Workshop (hopefully on Thursday afternoon at Genoa National Fish Hatchery.)
- The spring meeting is intended to generate an outline and timeline of the process, a list of holes that we need to fill (can we expand it to all freshwater mollusks?) in order to improve the process and create momentum.
- The mollusk die-off section of the Workshop will generate improved material for Chapter 5.

Ecosystem Services – Carla Atkinson

The goals of this committee are:

- 1) Engage Society members and help them to connect their work to an ecosystem services/ecosystem framework. Further, we would like to extend the ecosystem service frameworks across systems that have diverse or dense mussel or snail communities as an important conservation tool.
- 2) Engage with scientists and other professionals (e.g. social scientists, economists) outside the Society on how best to determine the ecosystem services provided by mussels. This may include inviting an outside speaker to come in for a plenary session or to lead a Workshop.
- 3) Enhance the public's knowledge about freshwater mollusks by working closely with the Outreach Committee on developing materials to engage citizens on the uniqueness of these organisms and their ecosystem functions. Furthermore, perhaps work with professional illustrators/film makers to help us capture the imagination of the public.
- 4) We aim to strive (over time) to develop a list of research information gaps relevant to mollusk conservation and ecosystem services. Little work on gastropods has been done.

Carla Atkinson is working a lot with water utilities and working with a professional illustrator to bring mollusks to the forefront. They are trying to bring in professionals from other disciplines into the group. They are looking into a Workshop topic for 2022. They are currently looking at a large water quality study in Alabama.

Members: Carla L. Atkinson, Caryn Vaughn, Traci Popejoy (PhD student), Brian van Ee (PhD student), Jennifer Archambault, Danielle Kreeger

Inclusiveness/Diversity – Tamara Smith

The Diversity and Inclusiveness Ad Hoc Committee held their first meeting on December 13, 2017, with the purpose to explore the issues of diversity, inclusiveness, and equity within FMCS. Participants included: Tamara Smith, Jeremy Tiemann, Brooke Penaluna, Kimberly Horndeski, and Neil Ford. After hearing about what AFS and other organizations have done to address the topics of diversity and inclusion, the group talked about some tangible things that FMCS could do. The group came up with numerous ideas to entrench diversity and inclusion as core values of the Society, enhance recruitment, and to provide a welcoming environment. Some ideas included improvements to the website, diversity sessions at FMCS meetings, diversity training for leadership, and including statements addressing diversity into the By-laws and FMCS

mission statement on the web. The Committee would work with other committees to accomplish certain tasks (e.g., website, Outreach Committee). The Committee would like to develop goals and a plan to move forward. The Committee plans to meet via conference calls and to work on a draft plan together over Google Drive.

The Committee would like to compile demographic data (age, disability, national origin, gender, generation, language, race, religion & beliefs, sexual orientation, etc.) to help us identify needs or areas of concern and to provide baseline data to help measure our success. The Committee would like to use the membership renewal forms to ask for voluntary demographic data. Can we collect these data on our membership renewal forms? The committee was encouraged to discuss this topic with Sophie Bender, our webmaster, to determine what can be done on the website while keeping information anonymous. This should be followed up with a good discussion in *Ellipsaria* as to why it is there.

The committee asked if we can we add something about diversity and inclusion to the FMCS vision/mission statements, By-laws, and on the web? Heidi suggested talking to other societies on how they are dealing with this and develop language they think should be added.

Final Comments

Heidi requested information from the Ecosystem Services and Diversity Ad Hoc committees for development of their webpages.

Megan Bradley is looking for people to sit on a Risk Assessment Group. What risk (disease, parasite, and invasive species) is there for moving mussels around? Paul Johnson was suggested as a resource. Others suggested members of the Propagation Committee. Rachael said she would revisit her notes from their last meeting. Trying to build level of interest.

Janet Clayton was directed to send an email blast announcement every two weeks leading up to the March Workshop to promote registration -- at least two before mid-January and early registration and then some after that.

Heidi made a motion to adjourn. That motion was seconded by John Jenkinson. All approved.

Respectively Submitted,
Janet L. Clayton, Secretary

FMCS Communication Platforms

Jeremy Tiemann, President-Elect

Communication is key to a thriving society and, in this digital age with the availability of instant access, there are many ways for our Society and our members to communicate with each other. As we reactivate one platform – the unio list-serve – on our list of possible tools, it seems a good time to describe all of the various communication platforms now being used by the FMCS.

Our **website** (<https://molluskconservation.org>) is the backbone of our Society. Not only is it the internet gateway for informing the public about freshwater mollusks and our role in their conservation, it is the depository of information for and about our members. Among other things, our website contains information about the diversity of freshwater mussels and snails, upcoming Society events, our member directory, materials from our various committees, and

our involvement with CASS, the Consortium of Aquatic Science Societies. Our website also houses our journal (*Freshwater Mollusk Biology and Conservation* and its predecessor *Walkerana*) and our newsletter (*Ellipsaria* and its predecessor *Triannual Unionid Report*). All issues of these past and active publications – including the current issues – are available to anyone whether they are FMCS members or not.

Freshwater Mollusk Biology and Conservation (FMBC) is a formal, peer-reviewed scientific journal that allows us to play a role in expanding our knowledge about the biology, ecology, and ecological services provided by freshwater mollusks and strengthen our ability to conserve these animals. It continues the long history of publishing research on freshwater mollusks started in *Walkerana*.

Ellipsaria is the electronic newsletter of the FMCS, now posted on the website quarterly. *Ellipsaria* is a relatively formal – and permanent – periodic record of the things our Society thinks are important and interesting. It is our method of providing all members the minutes of our Board Meetings, committee reports, details about upcoming FMCS activities, and sharing informal research reports. Also included on a yearly basis is the list of new additions to the Freshwater Mollusk Bibliography database.

When you become a FMCS member (and as long as you continue to be in good standing with the Society), you are added to our Member Directory on the website and to our email list. Occasionally, our Secretary sends out **emails** to all members concerning FMCS business activities, such as pending due dates for Symposia and Workshops, dues renewal reminders, when input is due for the next issue of *Ellipsaria*, and when it or a new issue of FMBC has been posted.

FMCS also has two social media pages: one on **Facebook** (@FreshwaterMolluskConservationSociety) and one on **Twitter** (@FMCS_Mollusk). You do not have to be an FMCS member to subscribe to either of these pages. We often post FMCS announcements, share “Mussels in the News” articles that appear in various news outlets, or forward items from other societies on these pages. Social media platforms offer the opportunity to reach and interact with an extremely wide and diverse audience. FMCS members can post directly to our Facebook page (e.g., job postings, regional meeting announcements, etc.) and tag us directly with the Twitter handle to bring posts to our attention for retweets to expand their distribution.

Our most recent addition (in some ways) is the resurrection of the **unio list-serve**. During the past several years, a previous version of a unio list-serve (with an “fit.edu” extension) was not actively managed and new participants could not sign up or post to it. We helped create a new list-serve site (with an “fws” extension) to allow these types of discussions to continue. Anyone can join, post freshwater mollusk-related information or questions on it, and actively engage in the discussions. Like the social media pages, a list-serve is an easy and immediate way to reach a large number of people with a particular question or to informally pass on information about a specific topic, in this case freshwater mollusks. If you are interested in participating on the unio list-serve and have not already joined the new site, you can sign up for this service by sending a blank email to unio-join@fws.gov and follow the instructions you receive in a response.

We know that the future of our Society and our interest in conserving freshwater mollusks both depend on our ability to inform our members and the general public about the importance of these unique animals. That’s why we are using a wide variety of ways to get our messages out there. We also know that our members have diverse communications preferences and, because we are trying to reach as many people as we can, at times there will be some redundancy across platforms. While some may see this as an inconvenience, we hope that will be a small price to pay to make sure our members and others interested in what we do are kept as informed as possible.

First FMCS International Meeting in Europe



As announced in the September 2017 issue of *Ellipsaria*, the first FMCS International Freshwater Mollusk Meeting will be held on 16--20 September 2018, in the Teatro Maggiore in Verbania, Italy. The theme for this meeting is: **“Bridging the gap between freshwater mollusk research and conservation in the Old and New Worlds.”** The Local Committee is well along in the planning for four days of presentations on a variety of topics that cover all aspects of freshwater Malacology, targeting the latest research advances in both theoretical and applied issues. Several internationally-recognized keynote speakers will present the state of current research on these topics and, we expect, will spark debate and interest on research needs concerning the many ways mollusks affect society and ecosystems.

Increasingly detailed information about this International Meeting and its sessions continues to be added to the FMCS Events Page (https://molluskconservation.org/EVENTS/2018-INTNL/2018_FMCS-INTNLMeet.html). That page also includes links to the registration site and information about travel and lodging in the area. Please be aware that two important deadlines for this meeting are rapidly approaching. Both **abstract submission** and **early registration** for this meeting **close on 30 April 2018**. Late registration will close on 31 July 2018.

The Results are In!

The Professional Development Ad-hoc Committee has compiled the 100 responses we received from the FMCS Poll regarding interest in an education-based certification (*not a taxonomic certification!*). Thank you to all who participated in the poll.

- 86% of the respondents are current FMCS members, 7% are past FMCS members, and 7% are non-FMCS members.
- 60% of non-member responses indicated that a certification would encourage membership in the Society.
- 72% “Strongly Agreed” or “Somewhat Agreed” that they personally would benefit from and see value in having a Mollusk Professional certification. We received several comments on this poll question, and we appreciate that feedback. Thanks to all who took the time to provide comments – both in favor and opposed. All opinions are important and will contribute to strengthening the Society.

- Nearly 75% “Strongly Agreed” or “Somewhat Agreed” that a Certified Mollusk Professional program would increase interest in FMCS.
- 75% of respondents are members of other organizations but do not hold any formal certification, 12% indicated they are members of other organizations and do hold a formal certification, and the remaining 13% are not members of any other organization.

All of the responses and feedback we received during this poll are being reviewed by the Committee. We will be engaging the FMCS Board and identifying our strategy moving forward in the upcoming months. Just a reminder, the intent of a Certified Mollusk Professional program is to have an education-based certification that will support the mission of FMCS and the Society’s education strategy.

If you have any questions about the poll results or the work of this ad-hoc committee, feel free to contact the co-chairs: Rebecca Winterringer at rwinterringer@trcsolutions.com, or Amanda Rosenberger at rosenbergera@missouri.edu.

Announcements

International Seminar: Monitoring and Restoration of Freshwater (mussel) Habitats

Tuesday 27th November – Thursday 29th November 2018
Clervaux, Luxembourg

In Luxembourg, more than 80% of the wetlands and their related habitats have disappeared within the last 50 years. This is, however, not only a national problem as in most highly developed countries a similar decline of wetlands was observed. The loss of aquatic habitats often goes together with a loss of aquatic species. One of the most imperiled aquatic groups worldwide are freshwater mollusks. Freshwater mollusks are, however, vital for ecosystem functions and are a bioindicator for healthy freshwater systems. The only sustainable way to ensure the survival of these flagship species is to protect or to restore their natural habitats.

Organized within the LIFE Nature Project *Restoration of Unio crassus rivers in the Luxemburgish Ardennes LIFE11 NAT/LU/857*, the aim of the seminar is to present the latest monitoring and habitat restoration methods, as they were carried out in different countries throughout the last years. The presentations may or may not be related to freshwater mussel conservation. This seminar will hopefully bring together researchers from different fields and give rise to discussion of synergistic basin-wide strategies for the recovery of freshwater-species and -habitats.

The local organization team would be glad to welcome all of you in late autumn 2018 in the north of Luxembourg. Much more information about this Seminar is available at the event website: <http://www.unio.lu/aktuelles/news/international-seminar-monitoring-and-restoration-o/>

Maryland Mussel Survey Protocol Being Developed

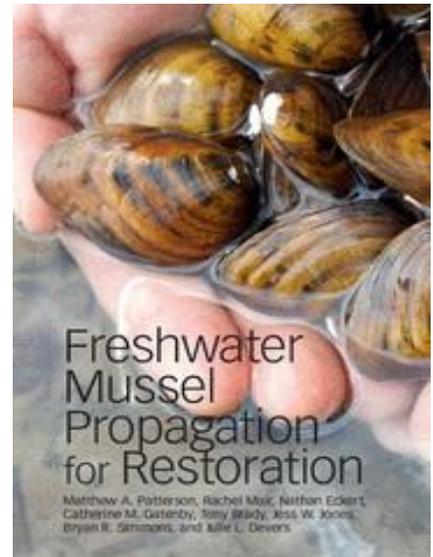
The US Fish and Wildlife Service Chesapeake Bay Field Office, Maryland Fish and Wildlife Conservation Office, and the Maryland Department of Natural Resources are currently developing a mussel survey protocol for the State of Maryland. This protocol will provide guidance for conducting freshwater mussel surveys and relocations in Maryland. For more information about this protocol development please contact Trevor Clark at trevor_clark@fws.gov.

New Book Available**Freshwater Mussel Propagation for Restoration**

Matthew A. Patterson, Rachel Mair, Nathan Eckert,
Catherine M. Gatenby, Tony Brady, Jess W. Jones,
Bryan R. Simmons, and Julie L. Devers

February 2018

Cambridge University Press
Paperback 978-1-108-44531-3
228 x 152 mm c.340pp 229 b/w illus. 8 tables



Freshwater mussels are declining rapidly worldwide. Propagation has the potential to restore numbers of these remarkable organisms, preventing extinction of rare species and maintaining the many benefits that they bring to aquatic ecosystems. Written by practitioners with firsthand experience of propagation programs, this practical book is a thorough guide to the subject, taking readers through the process from start to finish. The latest propagation and culture techniques are explored as readers follow freshwater mussels through their amazing and complex life cycle. Topics covered include the basics of building a culture facility, collecting and maintaining brood stock, collecting host species, infesting host species with larval mussels, collecting and culturing juvenile mussels, releasing juveniles to the wild, and post-release monitoring. This will be valuable reading for any biologist interested in the conservation of freshwater mussel populations.

20% Discount on this title -- Expires 4 January 2019

Original price	Discount price
£39.99	£31.99
\$49.99	\$39.99

For more information, and to order, visit: www.cambridge.org/9781108445313 and enter the code **PATTERSON2018** at the checkout.

**Publication of *Conserving the Gems of Our Waters*
Guidelines for Freshwater Mussel Protection and Conservation
in the Western United States**

Emilie Blevins, The Xerces Society for Invertebrate Conservation,
628 NE Broadway Suite 200, Portland, Oregon, USA 97232 xerces.org

Although the western United States is home to only a few species of freshwater mussels (belonging to the genera *Anodonta*, *Margaritifera*, and *Gonidea*), they occur in a wide variety of aquatic habitats in urban, rural, and wild landscapes. These same habitats support important western fisheries, including salmon, trout, and other native fish. These fishes are often the focus of large-scale or long-term projects to restore degraded habitat or improve aquatic connectivity. The scope of these projects and the investment in this work has incredible potential to improve long-term conditions for many aquatic species; however, in practice, many of the activities associated with restoration projects (especially dewatering and construction activities in river beds and along banks) have resulted in the destruction of freshwater mussel beds. These losses are especially concerning given that western mussel species have declined in their historic ranges.

As restoration practitioners have become more aware of freshwater mussels, there has been a growing interest to incorporate freshwater mussels into projects. However, it has been challenging for restoration

experts and fisheries biologists to incorporate freshwater mussels into more fish-focused or infrastructure-based projects because they often do not know that much about freshwater mussel distributions or requirements. A lack of specific guidance and concrete approaches to incorporate freshwater mussels has also limited both the adoption and success of mussel conservation into western aquatic restoration work.

To address these issues, the Xerces Society has developed and published *Conserving the Gems of Our Waters* as a guide to best management practices (BMPs) to address many of the questions or concerns related to this work. With input from many experts in restoration and mussel conservation, including review by a number of members of the Pacific Northwest Native Freshwater Mussel Workgroup (pnwmussels.org), this BMP guide covers:

- basic information about freshwater mussels and western species,
- a discussion of potential restoration impacts to freshwater mussels,
- straightforward approaches to determining if mussels could be impacted by a specific project,
- and solutions to addressing these impacts, including an in-depth discussion of salvage and relocation efforts.

While this guide was developed with a western United States focus, the BMPs provide a framework with potential to be adapted or modeled elsewhere for use by individuals conducting project planning or implementation that has potential to impact freshwater mussels.

Conserving the Gems of Our Waters is available free of charge for download at <https://xerces.org/conserving-the-gems-of-our-waters/>. Please contact mussels@xerces.org to obtain a printed version. As a follow-up to the guide, the Xerces Society is also condensing the recommendations into a field-handly companion -- due in spring 2018 -- which will provide a summary of the BMPs and basic information for use by staff involved in on-the-ground work.

The Xerces Society for Invertebrate Conservation is an international nonprofit organization that protects wildlife through the conservation of invertebrates and their habitats. Since 1971, we have worked on habitat conservation and restoration, species conservation, protecting pollinators, contributing to watershed health, and reducing harm to invertebrates from pesticide use. Our website address is <https://xerces.org/>



2018 Freshwater Mussel Training Courses at NCTC

During 2018, the U.S. Fish and Wildlife Service (FWS) will be offering three training courses concerning freshwater mussels at the National Conservation Training Center (NCTC) in Shepherdstown, West Virginia, USA. Each of these courses is 4.5 days in length and worth two semester hours of college credit. Here are descriptions of each of these three courses:

Conservation Biology of Freshwater Mussels CSP 1101

This is an introductory course on the biology and ecology of freshwater mussels and the conservation issues facing this highly endangered group of animals. Topics to be covered include anatomy, physiology, life history, health, ecosystem services, mussels as biomonitors, conservation status, population impacts, conservation measures (relocation, propagation, conservation genetics), legal issues (permits and the ESA, Section 7 consultations, critical habitat) and field techniques (survey techniques, sampling techniques,

habitat assessment). This course will address key characters for identification of freshwater mussels and will provide opportunities in the laboratory to practice with dichotomous keys, however due to time constraints and the regional nature of mussel assemblages; this is NOT a mussel identification course.

Objectives

Upon completion of this course, you will be able to identify:

- ✓ why mussels matter to FWS
- ✓ why so many mussel species are endangered
- ✓ the skills and tools available for mussel conservation
- ✓ the legal issues related to mussel conservation
- ✓ the genetic concerns associated with mussel conservation

Dates: August 6 – August 10, 2018

Instructors: Dr. Chris Barnhart and Heidi Dunn

Who Should Attend: Anyone who works with freshwater mussels (biologists, environmental educators, etc.) but has little formal knowledge of their biology.

Freshwater Mussel Propagation for Restoration CSP 1102

Freshwater Mussel Propagation for Restoration is an introductory course designed to explore all culture activities associated with freshwater mussels. Participants will explore the latest culture techniques as they follow freshwater mussels through their entire life cycle in a culture facility, from the collection of gravid females to stocking cultured juvenile freshwater mussels. Following a basic introduction on mussel biology and the goals of mussel propagation, the course will cover the basics of building a culture facility, collecting and maintaining brood stock, collecting host species, infesting host species with larval mussels, collecting and culturing juvenile mussels, and releasing juveniles to the wild.

Objectives

Upon completion of this course, you will be able to:

- ✓ describe the internal and external anatomy of a freshwater mussel
- ✓ collect and maintain freshwater mussel brood stock in captivity
- ✓ collect and maintain host species in captivity
- ✓ harvest freshwater mussel larvae and infest host species
- ✓ collect newly metamorphosed juvenile mussels and culture them for release
- ✓ describe the advantages and disadvantages of the various techniques, equipment, and culture units used in freshwater mussel propagation throughout the United States.
- ✓ release and monitor cultured juvenile freshwater mussels
- ✓ maintain accurate records and publish results

Dates: September 24 – September 28, 2018

Who Should Attend: Biologists interested in freshwater mussel biology and freshwater mussel culture techniques.

Freshwater Mussel Identification CSP 1103

The purpose of this course is to develop the participant's freshwater mussel identification skills and knowledge of regional freshwater mussel species. Participants will learn an overall system for identifying mussels and characteristics of major taxonomic groups within the families Unionidae and Margaritiferidae and will provide the basis to approach species-level identification. Although emphasis will be placed on the Ohio River fauna (including the Tennessee River) and the northern Atlantic Slope, specimens will be available from across the country. This course is "hands on" and laboratory and field exercises will provide shells and fresh specimens for identification.

Objectives:

Upon completion of this course, participants will be able to:

- ✓ identify unknown freshwater mussels
- ✓ use proper freshwater mussel collection-labeling and preservation techniques
- ✓ use distributional maps as an aid to freshwater mussel identification
- ✓ use dichotomous keys,
- ✓ discuss identification tricks-of-the-trade

Dates: June 25 - 29, 2018

Who Should Attend: Anyone who works with freshwater mussels (biologists, environmental educators, etc.) and would like to be able to identify shells and live specimens in the field.

Registration: To register for any or all of these courses:

Department of Interior (DOI) employees: Log in to DOI Learn, enter the course title in the search box, click scheduled classes, click submit request.

Non-DOI employees: If you do not have a DOI Learn account, please contact Matthew Patterson (304/876-7473 matthew_patterson@fws.gov) for instructions on how to create an account and register.

Tuition: The cost of each course is prepaid for FWS, NPS, and BLM employees and is \$1,195.00 for participants from other agencies and organizations.

Lodging: NCTC has lodging and meal plans for course participants at the standard government per diem rate for Shepherdstown, West Virginia, USA. Other lodging and eating facilities also are available in the area. Please contact Matthew Patterson (304/876-7473 matthew_patterson@fws.gov) with any questions about these courses or the venue.

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 each 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, Maryland on January 16, 2018. In person attendance increased slightly to over 30 people, and at least 20 people participated via web and teleconferencing. Two posters were also displayed in the meeting room. Meeting participants represented state and federal resource agencies, river basin commissions, non-profit organizations, consultants, and academia. Financial assistance for this regional meeting was graciously provided by FMCS through the Awards Committee and supported refreshments and a working lunch for attendees.

The topics discussed included:

- Brook Floater Species Status Assessment and Work Group updates
- Propagation at Harrison Lake National Hatchery
- Mussel relocation, 2018 survey plans, and propagation summaries by Maryland
- Brook floater surveys by Pennsylvania in the Susquehanna River watershed
- Potomac River impact surveys by MDNR and Normandeau Inc.,
- Atlantic Slope species status assessment and status review timelines by USFWS
- eDNA applications in Potomac basin streams by West Virginia
- Eastern elliptio contaminant bioaccumulation studies in the Anacostia River
- Phylogeography of Atlantic Slope *Elliptio* spp.
- Modeling approach to implement Ammonia criteria in Maryland

With permission of the authors, the presentations are archived in a secure web repository. Access to the repository can be obtained from Julie Devers or Matt Ashton at matthew.ashton@marylnd.gov .

Finally, before adjourning the meeting, it was proposed that our future meetings be held every other year to fall on years with no FMCS Symposium.

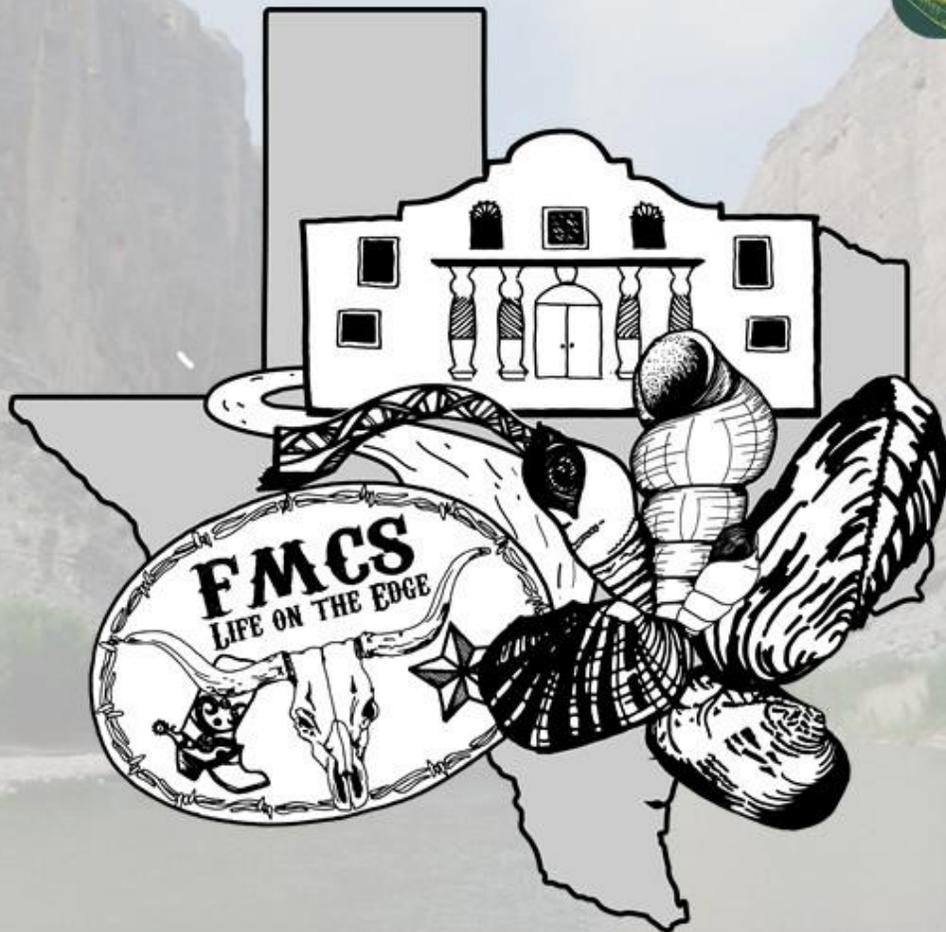


Upcoming Meetings

- March 12 – 15, 2018** – FMCS Mollusk Health and Disease Workshop, Radisson Conference Center, La Crosse, Wisconsin, USA.
<http://molluskconservation.org/EVENTS/2018Workshop/2018Workshop.html>
- March 18 – 22, 2018** – National Shellfisheries Association 110th Annual Meeting, Renaissance Hotel, Seattle, Washington, USA Theme: [not posted] <https://shellfish.memberclicks.net/annual-meeting>
- May 20 – 24, 2018** – Society for Freshwater Science Annual Meeting, Detroit, Michigan, USA Theme: *Navigating Boundaries in Freshwater Science* <http://sfsannualmeeting.org/>
- June 19 – 22, 2018** – American Malacological Society 84th Annual Meeting, Honolulu, Hawaii, USA Precise Location, and Theme not yet posted] <http://www.malacological.org>
- July 21 – 26, 2018** – Society for Conservation Biology North American Sectional Meeting, Westin Harbour Castle Conference Centre, Toronto, Ontario, Canada. Theme *Conservation Science, Policy, and Practice: Connecting the Urban to the Wild* <http://conbio.org/groups/sections/north-america/meetings/>
- August 19 – 23, 2018** – American Fisheries Society 148th Annual Meeting, Atlantic City, New Jersey, USA Theme: *Communicating the Science of Fisheries Conservation to Diverse Audiences* <http://fisheries.org/events-page/future-afs-meetings/>
- September 2 – 6, 2018** – 8th International Symposium on Aquatic Animal Health, Charlottetown, Prince Edward Island, Canada Theme: *Biotechnology in the Advancement of Aquatic Animal Health* <https://isaah2018.com/>
- September 16 – 20, 2018** – First FMCS International Freshwater Mollusk Meeting, Theater Maggiore Verbania, Italy, Theme: *Bridging the gap between freshwater mollusk research and conservation in the Old and New Worlds* <http://molluskconservation.org/Events.html>
- October 21 – 24, 2018** – Southeastern Association of Fish and Wildlife Agencies 72nd Annual Conference, Renaissance Riverview Plaza Hotel, Mobile, Alabama, USA. Theme: [not yet posted] <http://www.seafwa.org/conference/overview/>
- November 27 – 29, 2018** – International Seminar: Monitoring and Restoration of Freshwater (mussel) Habitats, Clervaux, Luxembourg. <http://www.unio.lu/aktuelles/news/international-seminar-monitoring-and-restoration-o/>
- April 14 – 18, 2019** – FMCS 11th Biennial Symposium, Hyatt Regency, San Antonio, Texas, USA. Theme: *Life on the Edge: Reconciling River Management*. Other details not yet announced.

11TH BIENNIAL SYMPOSIUM OF THE
FRESHWATER MOLLUSK CONSERVATION SOCIETY

Save the Date!
San Antonio, Texas



April 14th – 18th, 2019
Hyatt Regency San Antonio Riverwalk
123 Losoya St, San Antonio, TX 78205

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.

A Newly-recognized Anatomical Structure for the Margaritiferidae

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During research on the comparative anatomy of species assigned to the Margaritiferidae, we observed an unreported anatomical structure on the external mantle of some margaritiferid species (Lopes-Lima et al. submitted). We found papillae on the outside of the mantle adjacent to the incurrent and excurrent apertures in eight species of margaritiferids.

During July 2015, specimens of *Margaritifera falcata* (Gould, 1850) from Vancouver Island, British Columbia, Canada, were first photographed possessing papillae on the external mantle adjacent to the excurrent, as well as incurrent apertures (Figure 1). Live specimens of *M. falcata* from British Columbia exhibited short, simple, secondary papillae or bumps in the area between the incurrent and excurrent apertures, extending along the excurrent aperture and incurrent apertures (labeled as Type I papillae on Figure 1, blue arrows). The same specimens also have a series of slender, simple papillae on the external side of the mantle adjacent to the incurrent aperture, lateral to the arborescent papillae and seemingly part of them (labeled as Type II papillae on Figure 1, red arrows). Other *Margaritifera falcata* specimens from Alaska also were photographed in 2016 and were found to possess Type I secondary papillae on the external mantle adjacent to the excurrent aperture and a few adjacent to the incurrent aperture (Figure 2, blue arrows). A live specimen of *Margaritifera hembeli* (Conrad, 1838) from Louisiana, exhibited a long line of the Type I papillae along the excurrent aperture, but no Type II papillae were obvious on this specimen (Figure 3). Interestingly, specimens of *Margaritifera margaritifera* (Linnaeus, 1758) that have been examined and photographed so far from rivers in eastern Canada and preserved specimens from the United States do not appear to have either set of secondary papillae.



Figure 1. In addition to the primary arborescent papillae typical of margaritiferids, *Margaritifera falcata* in British Columbia exhibit two different types of secondary papillae: Type I (blue arrows), which are short papillae or bumps adjacent to the excurrent aperture and numerous adjacent of the incurrent aperture; and Type II (red arrows), long and slender, simple papillae adjacent to the incurrent aperture that appear to be a possible component of the primary arborescent papillae of the incurrent aperture. Left photograph by Andre Martel from the Sarita River; right photograph by Greg Wilson, from the Cowichan River, both in British Columbia, Canada.



Figure 2. *Margaritifera falcata* in Moose Creek, part of the Upper Deshka River Basin, Alaska, have a row of simple, short (Type I) papillae adjacent to excurrent aperture (blue arrow) and a few adjacent to the incurrent aperture. Photograph by Ilya Vikhrev.

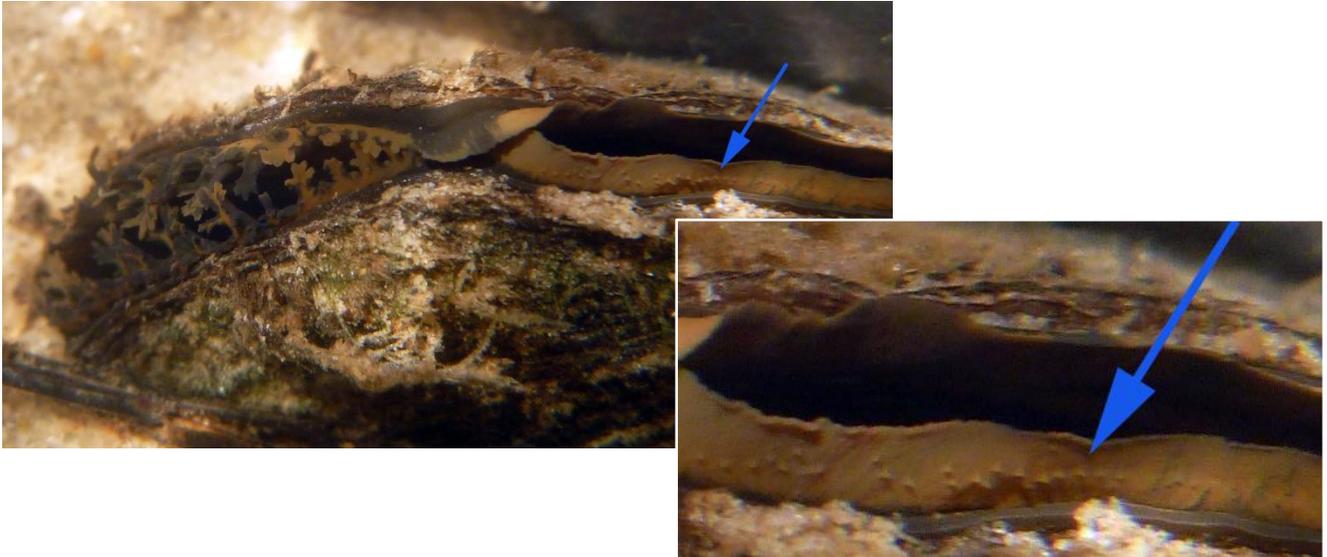


Figure 3. A live specimen of *Margaritifera hembeli* in Brown Creek, Rapides Parish, Louisiana, showing the arborescent papillae on the incurrent aperture and the row of short Type I secondary papillae along the outer mantle adjacent to the excurrent aperture. The secondary papillae are most obvious on the enlarged insert. Photograph by Paul Johnson.

Many alcohol-preserved margaritiferid specimens housed in the North Carolina Museum of Natural Sciences, as well as those in the mollusk collections at the Canadian Museum of Nature, and Royal British Columbia Museum also were found to have these papillae; however, they may be obscured in museum specimens depending on the preservative and the state of relaxation when they were preserved.

We also have examined preserved specimens and live-animal pictures of a number of species of unionids and representatives from the other four Unionida families. None of them exhibited either type of these secondary papillae. As an example, *Cyclonaias pustulosa* (Lea, 1831) has arborescent papillae on the edge of the incurrent aperture (Figure 4) but lacks either type of secondary papillae we have observed in the margaritiferids.



Figure 4. A live specimen of the unionid *Cyclonaias pustulosa* in the St. Croix River, Minnesota, showing the typical arborescent papillae on the incurrent aperture and the smooth excurrent aperture. Unionids do not show any evidence of the external rows of secondary papillae adjacent to the two apertures that have been found in *Margaritifera falcata*. Photograph by Bernard Sietman.

Initial questions raised by the discovery of these secondary papillae include:

- What is the function of these secondary papillae?
- Is the distribution of secondary papillae species-specific or are our observed differences in *M. falcata* related to the sex of the animals?
- Is the presence of secondary papillae seasonal or are they permanent?

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Alabama Zebra Mussel Update

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Zebra Mussels (*Dreissena polymorpha*) have been present in the northern Alabama reach of the Tennessee River since at least the early 1990s; however, densities have remained low relative to what they are in many other areas of the eastern United States. For example, in 2006, a spike in Zebra Mussel density was noted in the Wilson Dam tailwater during a unionid die-off investigation when quantitative sampling revealed a density of 13 per m² in a localized area. By the end of that summer, however, Zebra Mussels had themselves experienced a die-off.

Since 2008, Zebra Mussels have been quantitatively sampled annually in conjunction with native mussel sampling in the secondary channel of Sevenmile Island in the Wilson Dam tailwater [Tennessee River Mile (TRM) 247 to TRM 253]. Observed Zebra Mussel densities remained below 1 per m² from 2008 through 2015 (for example, the density in 2015 was 0.3 per m²). In 2016, however, Zebra Mussel density in the same reach was much higher -- 6.3 per m². In 2017, Zebra Mussel density in the Wilson Dam tailwater exploded. On 20 July 2017, densities at three sites approximately five miles upstream of the 2015-16 samples were 21,893 per m² at TRM 257.0; 20,552 per m² at TRM 257.9; and 10,025 per m² at TRM 258.0.

In an apparently related matter, underwater visibility in the Wilson tailwater is much greater now than it has been in the past, presumably due to the volume of water filtered by the Zebra Mussels. The bottom is now clearly visible in five feet of water, which is an approximate two-fold increase in visibility over past years.

There have been periodic reports of possible Zebra Mussel sightings in the Mobile River Basin (south of the Tennessee River Basin), but, until now, all of those animals have proven to be the Dark False Mussel (*Mytilopsis leucophaeata*). During summer 2017, however, we found Zebra Mussels at two sites in the Black Warrior River (BWR). On 13 and 14 June 2017, 7 individuals were collected at BWR Mile 318.0, and 3 were collected at BWR Mile 283.9. While underwater visibility was near zero at both sites when they were sampled, it was obvious that Zebra Mussel densities were not very high at either site.

A New Record of the Rio Grande Monkeyface, *Quadrula couchiana* (Lea 1860) from the Rio Salado, Mexico

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The Rio Grande Monkeyface was described by Lea (1860) as *Unio couchianus* based on material from the Rio Salado, Nuevo Leon, Mexico (Figure 1). Crosse and Fischer (1894) erected *Amphinaias* for this species. Later, Simpson (1900), Strecker (1931), and others placed it in *Quadrula*. Graf and Cummings (2007) also used *Amphinaias couchiana* and transferred other pimpleback-type quadrulids into this genus as well. Williams et al. (2017), however, retained it in *Quadrula* based on shell morphology that more closely resembles the mapleleaf-type quadrulids than the pimpleback-types (now in *Cyclonaias*), and on the absence of biochemical genetic support for *Amphinaias*.

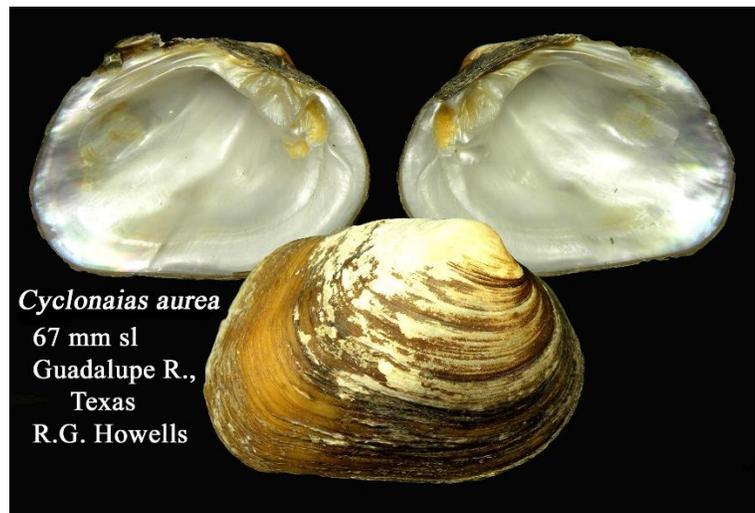


Figure 1. Top left is the presumptive Rio Grande Monkeyface (*Quadrula couchiana*) valve collected in the Rio Salado, Coahuila, Mexico, in September 2017. Top right is a Southern Mapleleaf (*Q. apiculata*) introduced into the lower Rio Grande drainage in the past century. Bottom left is the lectotype specimen of *Q. couchiana* from the Rio Salado, Nuevo Leon, Mexico, at the U.S. National Museum. Bottom right is a Rio Grande Monkeyface shell from Las Moras Creek, Kinney County, Texas.

Despite being recognized over 155 years ago, this unionid remains enigmatic and poorly known. Possibly fewer than 30 specimens can be confirmed, and most specimens are individual valves. Most records are based on fossil or subfossil material. A few historical examples appear to have been fresh (recently-dead) when collected, but it is questionable if any have ever been observed alive.

In addition to the limited amount of reference material in formal collections or published descriptions, confusion with other related species has been problematic. Although *Quadrula couchiana* was endemic to the Rio Grande drainage of Texas, New Mexico, and Mexico, specimens of the Golden Orb (*Cyclonaias aurea*) from the Guadalupe-San Antonio and Nueces-Frio systems to the north have mistakenly been reported to be *Q. couchiana*. Elongate, gravel-bar morphs of *C. aurea* have likely contributed to this confusion (Figure 2). While the type description of *Q. couchiana* was based on unsculptured shells, other *Q. couchiana* specimens from Las Moras Creek, Texas, have shell sculpturing more-closely resembling Mapleleaf (*Q. quadrula*) (Figure 1). Further, the general shell shape of *Q. couchiana* more is more like *Quadrula* than *Cyclonaias*. Although Strecker (1931) noted that specimens taken north of the Rio Grande were inconsistent with the description of *Q. couchiana*, some formal collections persist in listing some *C. aurea* specimens as *Q. couchiana*.

Figure 2. Golden Orb [*Cyclonaias* (previously *Quadrula*) *aurea*] is endemic only to the Guadalupe-San Antonio, and Nueces-Frio systems north of the Rio Grande. Though typically oval in shape, elongate gravel-bar morphs of this species have been confused with the Rio Grande Monkeyface (*Q. couchiana*), only found in waters of the Rio Grande drainage.



While extensive surveys of the Rio Grande drainage have been conducted in the past 30 years (e.g., Howells 2001, 2006; Randklev et al. 2017; and others), none of them have produced additional specimens of *Quadrula couchiana*. Most collection efforts, however, have been restricted to border and United States waters, with little work done in Mexican streams. D.W. Taylor is reported to have seen living specimens in the Rio Conchos, Chihuahua, Mexico (Neck 1984), but subsequent collections in the Rio Conchos by Texas Parks and Wildlife Department personnel in the 1990s failed to find any evidence of it there (Howells 2001). No new specimens of *Q. couchiana* have been reported in several decades and some sources have presumed it to be extinct (Howells 2013).

In September 2017, N. Strenth and M. Jones obtained a collection of unionid shells, valves, and fragments from the Rio Salado, Coahuila, Mexico. No living or recently dead specimens were taken or observed. This assemblage included a single long-dead valve of *Q. couchiana* (Figure 1). Other species found included Tampico Pearlymussel (*Cyrtonaias tampicoensis*), Yellow Sandshell (*Lampsilis teres*), Texas Hornshell (*Popenaias popeii*), Texas Lilliput (*Toxolasma texasiense*), Pondhorn (*Unio merus* spp?), and Paper Pondshell (*Utterbackia imbecillis*) as well as Asian Clam (*Corbicula fluminea*). All were long-dead weathered shells. Except for introduced Southern Mapleleaf (*Q. apiculata*), other unionids in this drainage are not morphologically similar to *Q. couchiana* and misidentification of the shell seems unlikely. ASU staff returned to the area in December 2017 but failed to locate any additional *Q. couchiana* specimens. Future survey efforts are planned.

This new valve adds to the number of known specimens, but, so far, does not confirm the existence of a surviving *Q. couchiana* population. Nonetheless, in the absence of even long-dead remains in recent years in Texas, New Mexico, or the Rio Grande mainstem, it suggests this species may have persisted in the Rio Salado longer than it did at more-northern locations.

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Gulf Mapleleaf (*Quadrula nobilis*): Comments on Morphological Variation

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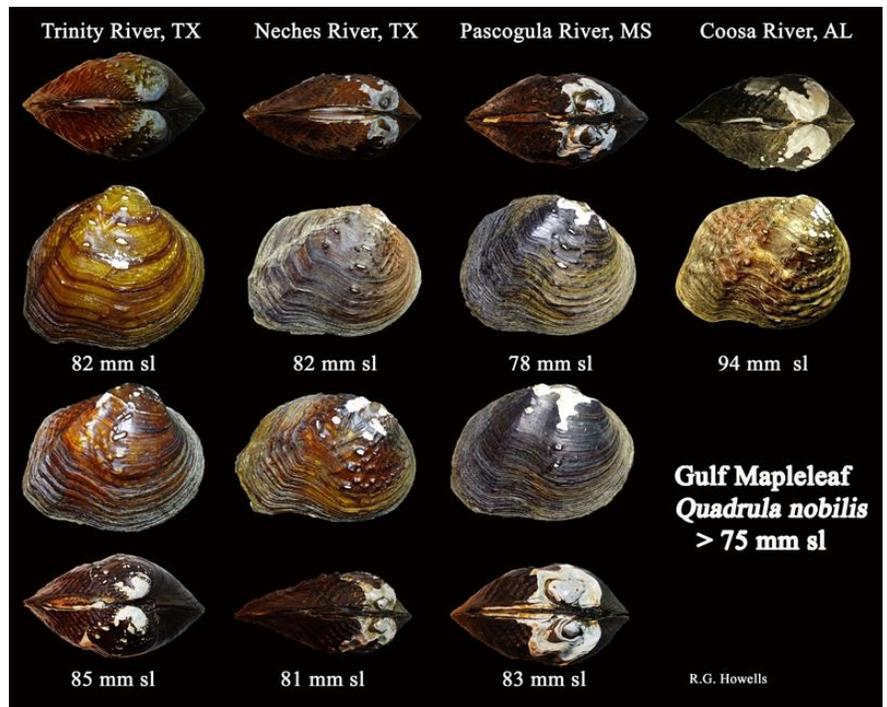
In the early 1990s when Ray Neck, Harold Murray, and I began writing *Freshwater Mussels of Texas* (Howells et al. 1996), we assumed the small, unusual Mapleleaves from eastern Texas were simply atypical “common” Mapleleaf (*Quadrula quadrula*) specimens. Days before that book went to press in late 1994, electrophoretic work done at Heart of the Hills Fisheries Science Center demonstrated that these were neither Mapleleaf or Southern Mapleleaf (*Q. apiculata*), but clearly were a distinct species (Howells 1994, 1995; Howells et al. 1996). A unionid fitting this description had been described by Conrad (1854) as *Unio nobilis* from Bayou Teche, Louisiana, but, shortly thereafter, others had dismissed it as only a form of *Q. quadrula*. Later, Simpson (1900) described this same species as a form of Pistolgrip he called *Tritogonia verrucosa obesa* from the Neches River, Texas, the same location where our initial specimens were collected.

With a greater number of specimens than either Conrad or Simpson had available, our electrophoretic work, and later DNA analysis (Serb et al. 2003 and others), indicated that Conrad had been correct all along. In the 1990s, most of my specimens originated in the Neches-Angelina drainage of eastern Texas, with a small number of individuals from other Gulf states. Because the range appeared to be largely restricted to waters feeding the Gulf of Mexico, I called Conrad’s quadrulid “Gulf Mapleleaf”. I also based most of my descriptions on specimens from the Neches River, Texas. There, smaller specimens were usually rather quadrate (Figure 1) but, as they became larger, many shells became more rectangular or trapezoidal (projecting posterior-ventrally) and were not as massive or as large (Figure 2) as some “common” Mapleleaf or Southern Mapleleaf specimens. Since then, I have repeated this description in other publications (Howells 2010, 2013) and in training classes and lectures.

Figure 1. Smaller Gulf Mapleleaf (*Quadrula nobilis*) specimens [< 60 mm shell length (sl)] are typically quadrate or subquadrate in shape. They typically have flattened, often shelf-like pustules, in dorsal-to-ventral rows both anterior and posterior to the sulcus. These large pustules are not, however, drop-shaped or tear-like as in many Mapleleaf (*Q. quadrula*). The sulcus may be apustulose or have small pimples or diagonal ridges but is not as heavily pimpled as Southern Mapleleaf (*Q. apiculata*).



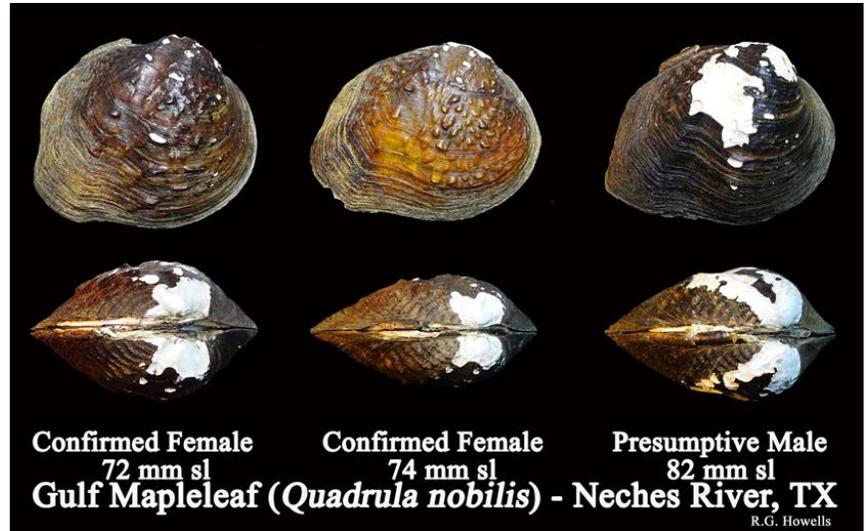
Figure 2. Despite general similarities among smaller Gulf Mapleleaf (*Quadrula nobilis*) specimens, larger individuals can vary in morphology both among and within populations. Some larger animals from the Neches River (Texas), Sabine River (Texas and Louisiana), and Bayou Teche (Louisiana), can have elongate to rectangular or trapezoidal outlines and become compressed posteriorly resembling male Pistolgrip (*Tritogonia verrucosa*). In other cases, larger specimens may retain the subquadrate form and may or may not become produced postero-ventrally.



We now know that not all specimens in Gulf Mapleleaf populations follow this shift from small-quadrate to large-rectangular morphology, and some may become relatively robust at larger sizes. Recently, staff of the Trinity River Authority, Texas, found larger specimens from the Trinity River that, generally, retained a more-quadrate shape with relatively thick valves. Earlier, we had found examples from the Pascagoula River, Mississippi, that were quadrate when small, but larger specimens became more rectangular, lost most of their typical shell sculpture, and were substantially more inflated posteriorly than specimens in the Neches River.

With regard to sexual dimorphism, a good link between shape and sex (as seen in Pistolgrip, *T. verrucosa*) has not been well demonstrated in the Gulf Mapleleaf (Figure 3). Some Neches River females (glochidia present) are slightly produced posterior-ventrally, but some presumptive males (no gametes found) may show this trait as well.

Figure 3. Although the related Pistolgrip (*Tritogonia verrucosa*) is sexually dimorphic, no similar condition has been demonstrated thus far in the Gulf Mapleleaf (*Quadrula nobilis*). Several confirmed female Gulf Mapleleaf specimens (oocytes or glochidia found) from the Neches River, Texas, were slightly produced posterior-ventrally, but so were some presumptive males (lacking gametes). Too few sex/shell morphology comparisons have been studied date to draw conclusions.



In addition to the realization that not all Gulf Mapleleaf populations are morphologically identical, some specimens regularly look like intermediates between Gulf Mapleleaf and Mapleleaf, Southern Mapleleaf, and Ridged Mapleleaf (*Q. rumphiana*). To the best of my knowledge, biochemical genetic work has never confirmed any hybrids between these taxa. Regardless of their morphological appearance, the questionable specimens that have been tested biochemically have all proven to be members of one recognized species or another.

Finally, biochemical evidence now indicates that the range of the Gulf Mapleleaf extends much farther inland than I originally recognized (Serb et al. 2003 and others). However, the identity of very large and very heavy-shelled quadrulids found in the central and upper Mississippi drainage basin remains problematic. These specimens often resemble Mapleleaf (*Q. quadrula*) that are produced posterior-ventrally. I had initially assumed these to be atypical Mapleleaf specimens, Frierson (1927) considered them a subspecies of *Q. quadrula*, and Couch (1997) listed them as a form of *Q. quadrula*. Others have suggested they be considered very robust Gulf Mapleleaves, and some have wondered if they might represent an undescribed cryptic species. Until living specimens are genetically examined, the disposition of these shells remains unresolved.

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A Follow-up Report Dealing with the Presence of the Invasive Freshwater Snail *Pyrgophorus cf. coronatus* in Israel (Mollusca, Gastropoda, Cochliopidae)

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Freshwater snails belonging to the genus *Pyrgophorus* Ancey, 1888, are restricted in their natural distribution to the circum-Caribbean area (Hershler & Thompson, 1992). In the past decade, however, *Pyrgophorus* specimens have been reported in the Levant from Israel (Mienis, Rittner & Vaisman, 2011; Mienis, 2011 & Mienis & Rittner 2013) and Jordan (Nasarat, Amr & Neubert, 2014) and in southeast Asia from Singapore (Ng, Liew, Song & Yeo, 2016).

Due to their variable shell morphology, we don't know how many valid species of *Pyrgophorus* are recognizable at the moment. The specimens found in Israel were reported as *Pyrgophorus* species, those from Jordan as *Pyrgophorus cf. coronatus*, while the specimens found in Singapore were identified as belonging to *Pyrgophorus platyrachis*. Because the late Dr. Fred Thompson, a specialist of *Pyrgophorus*, had a look at the Jordanian material, which is without doubt identical with that of Israel, we now prefer to call all the latter material *Pyrgophorus cf. coronatus*.

Since our last review of the presence of *Pyrgophorus* in Israel (Mienis, 2011) we have received additional material from most of the main rivers. That new information based on material permanently lodged in local scientific collections is presented here in this report. At most localities, *Pyrgophorus cf. coronatus* was found in extremely large numbers.

Abbreviations:

HUJ MOL – Mollusc Collection Hebrew University of Jerusalem
 INAEC – the Israel National Aquatic Ecology Centre at the SMNH
 SMNH MO – Mollusc Collection, the Steinhardt Museum of Natural History

Coastal Rivers of Israel:

Na'aman River, leg. F. Ben-Ami, 6 February 2012 (SMNH MO 75569).
 Zippori River, near Ras Ali, leg. Y. Hershkovitz, 16 May 2011 (SMNH MO 73207); idem, leg. Y. Hershkovitz, 9 October 2011 (SMNH MO 80483 & INAEC coll.).
 Qishon River near Jelahmah bridge, leg. Y. Hershkovitz, 27 September 2016 (SMNH MO 81847 & INAEC coll.); idem, near Kfar Hasidim, leg. E. Elron, February 2014 (SMNH MO 80242); idem, leg. Y. Hershkovitz, 26 September 2016 (SMNH MO 81843 & INAEC coll.).
 Tanninim River, Stat. 4, leg. F. Ben-Ami, 23 December 2010 (SMNH MO 72586); idem, Stat. 5, leg. F. Ben-Ami, 23 December 2010 (SMNH MO 72093); idem, Nature Reserve, leg. F. Ben-Ami, 23 December 2010 (SMNH MO 72094); idem, lower part, south bank, leg. H.K. Mienis & O. Rittner, 4 December 2012 (SMNH MO 77269 & HUJ MOL 55099); idem, leg. Y. Hershkovitz, 5 April 2016 (INAEC coll.).

Timsah Springs, leg. D. Kentish, 1 November 2010 (SMNH MO 72195); idem, leg. F. Ben-Ami, leg. 29 November 2010 (SMNH MO 72092 & 72587).

Yarqon River, Mekorot Canal towards the Nuphar Pond, leg. U. Suleimani, 13 January 2011 (SMNH MO 73212)

Rivers and Streams in the Jordan Valley Shared by Israel and Jordan:

Sede Eliyyahu, canal along the road, leg. H.K. Mienis, 5 April 2011 (SMNH MO 72854 & HJ MOL 55098).

This canal receives water from quite a number of commercial fish hatcheries and ponds in the Bet She'an Valley and drains into the lower part of the Jordan River.

Jordan River, downstream of Damiya bridge (= Adam bridge), leg. Y. Hershkovitz, 20 June 2017 (INAEC coll.). Its presence downstream of the Damiya (=Adam) bridge over the Lower Jordan River represents a new locality for this invasive species in Jordan.

In almost every population, specimens are present with and without spines on the periphery of the shell (Figure 1). These spines are rather similar to those often seen in another invasive species *Potamopyrgus antipodarum*, however, in *Pyrgophorus* the spines are calcified and form an integral part of the shell while in *Potamopyrgus* the "spines" are formed by the organic periostracum. In addition, most specimens of *Pyrgophorus* show incised spiral lines while these are absent in *Potamopyrgus*. All these morphological shell characters are very important because *Potamopyrgus antipodarum* also has recently been recorded from Israel (Mienis *et al.*, 2016; Mienis & Rittner, 2017).

Acknowledgement

We like thank Dr. F. Ben-Ami, Dr. E. Elron, Dr. Y. Hershkovitz, D. Kentish, and Mr. U. Suleimani for lodging part of their collected material in the Mollusc Collection of the Steinhardt Museum of Natural History.

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Figure 1. *Pyrgophorus* cf. *coronatus*.
Photograph by Oz Rittner.

***Myxas glutinosa*, a Critically Endangered Lymneid Species in the Netherlands, Discovered in the "Famberhorst," a Private Nature Reserve in Joure, Friesland**

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During a 11-12 October 2017 survey of the freshwater mollusc fauna of the "Famberhorst", a private Nature Reserve in Joure, Friesland, the Netherlands, several specimens of the Glutinous Snail, *Myxas glutinosa* (Müller, 1774), Family Lymnaeidae, were encountered. These animals were found in one of the low laying, wet areas on the Reserve. Since this species is considered a critically endangered species, not only in the Netherlands (de Bruyne *et al.*, 2003) but also elsewhere in Europe, only a single shell was preserved for further study in the Steinhardt Museum of Natural History (SMNH MO 82504).

The snail is characterized by its rather blunt top and the extremely thin shell (Figure 1). While alive, the outside of the snail shell is completely covered by the mantle flaps which are rather sticky hence the specific name *glutinosa*. Empty shells are vitreous and extremely fragile.

The Glutinous Snail inhabits clear standing water with rich aquatic vegetation. Such a habitat fits the situation in the "Famberhorst," where several low laying areas receive water either by means of rainfall or by seepage from the Jonkersloot, which runs at a somewhat higher level along the north-side of the Nature Reserve. Because the percolating water is being filtered in a natural way by a thick layer of earth, the water in these wet areas is of a rather good quality.

The material from the Famberhorst was compared with several samples in the National Mollusc Collection of the Hebrew University of Jerusalem (HUJ MOL):

IRELAND: Kerry, Killarney, Cromaglawn, ex-coll. W.J. Wintle in A. Blok coll. (HUJ MOL 55105 & 55106).

WALES: Pembrokeshire, St. Nicholas, ex-coll. W.J. Wintle in A. Blok coll. (HUJ MOL 55104).

ENGLAND: Lincolnshire, East Lindsey, Tetney, ex-coll. W.J. Wintle in A. Blok coll. (HUJ MOL 55101); Kent, Sandwich, 1874, ex-coll. W.J. Wintle in A. Blok coll. (HUJ MOL 55102); East Kent, St. Nicholas marches, ex-coll. W.J. Wintle in A. Blok coll. (HUJ MOL 55103);

FRANCE: Brittany, Rennes, ex-coll. Monterosato in G.S. Coen coll. HUJ MOL 55107).

BELGIUM, Brussels, ex-coll. Monterosato in G.S. Coen coll. HUJ MOL 55108).

SWEDEN, Dalarna, Säter, leg. A. d'Ailly, ex-coll. N.H. Odhner in G.S. Coen coll. (HUJ MOL 55109).

In most European countries, *Myxas glutinosa* is suffering from a deterioration of its habitat caused by increasing pollution. The discovery of a previously unknown population of this critically endangered species in the "Famberhorst" shows the important role private nature reserves can play in the conservation of endangered animals.



Figure 1. An Irish specimen of *Myxas glutinosa* with the mantle covering its shell. Photograph by Dr. Roy Anderson.

Acknowledgement

I like to thank Mr. D.J. Bergsma (Joure) for allowing me to carry out a preliminary survey of the mollusc fauna of the "Famberhorst," and Dr. Roy Anderson, National Museums Northern Ireland, for the use of his photograph.

Reference:

De Bruyne, R.H., Wallbrink, H. & Gmelig Meyling, W. 2003. *Bedreigde en verdwenen land- en zoetwater-mollusken in Nederland (Mollusca) – Basisrapport met voorstel voor de Rode lijst*. 88 pp. Stichting European Invertebrate Survey – Nederland, Leiden & Stichting Anemoon, Heemstede.

New Geographical Record of the Operculate Amphibious Snails Assimineidae for Santa Catarina State/ SC, Central Southern Brazil

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This brief report adds a new geographical record of an exotic amphibious gastropod mollusk in the family Assimineidae, H. and A. Adams, 1856, genus *Assimineea* Fleming, 1828, to the territory of Santa Catarina's State/ SC. These are minute snails with an operculum that live in brackish water, freshwater, or on the land (Agudo-Padrón and Luz 2015).

On December 25, 2017, two little -- approximately 5mm long -- robust live animals (Figure 1) were found by the second author in the Aguas Claras neighborhood of Brusque (city and Municipal District – 27°05'52"S; 48°55'04"W) (Figure 2). These animals were found in an area used as for the disposal of garden and yard-cleaning waste in a natural drainage microbasin of a nearby hill. The microbasin included a little partially-channelized spring and some flooded points (Figure 3). This location is in the Itajaí River basin, part of Malacological Region No. 6 of Santa Catarina State/ SC, Central Southern Brazil (Agudo-Padrón 2014).

Additionally, malacofauna found at this site included two other exotic forms: the micro-snail Subulinidae *Lamellaxis clavulinus* (Potiez & Michaud, 1838) and the Asian slug Philomycidae *Meghimatium pictum* (Stoliczka, 1873).

This is a new geographical record for this species in the Itajaí River basin. The species now has been found in Malacological Regions 1, 2, and 6 of Santa Catarina State/ SC (Agudo-Padrón 2014).



Figure 1. The specimens of *Assimineea* sp. found in the Aguas Claras neighborhood of Brusque, Santa Catarina State/ SC, Central Southern Brazil.

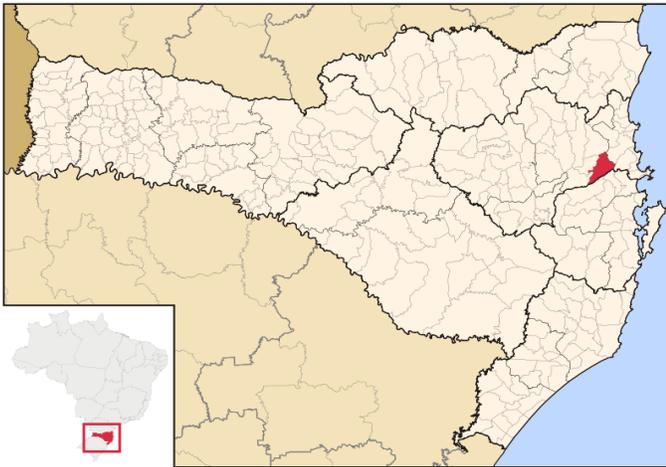


Figure 2. Location (red color) of the Brusque Municipal District in the Itajaí River basin, Santa Catarina State/ SC, Central Southern Brazil.



Figure 3. The collection site where the *Assiminea* sp. specimens were found.

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The Freshwater Bivalve Mollusks of Santa Catarina State/ SC, Central Southern Brazil: Current State of our Knowledge After 22 Years of Research

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After 22 years of systematic field research, examination of specimens deposited in museum collections, and parallel reference studies, the limnic/freshwater bivalve mollusk fauna occurring in Santa Catarina State/ SC, Central Southern Brazil, is finally consolidated. This fauna consists of a verified/confirmed total of 34 species, including 20 native Unionida (11 Mycetopodidae, 9 Hyriidae), 13 Veneroidea (four Cyrenidae/clams – one native, three non-native/exotic – and nine native Sphaeriidae/pea clams), and one Mytilida (non-native/exotic Mytilidae/Asiatic golden mussel) (Table 1).

The first comprehensive report of this group for the State corresponds to start of the years 2000 (Agudo 2002, 2004, 2005, 2007). Already, the first occurrence reporting confirmed in the field for the state of a pea clam Sphaeriidae corresponds to the native species *Eupera klappenbachi* Mansur & Veitenheimer 1975 (Agudo-Padrón 2011a).

While this fauna is distributed in the six malacological regions of the State first identified by us in 2014 (Agudo-Padrón 2014) (Figure 1), the majority of the species (30 of the total) occur in the fluvial environments of the great watershed of the Upper Uruguay River, Western Malacological Region 3 (Figures 1 and 3). It is the principal environmental domain par excellence of the freshwater bivalves in the State (Agudo-Padrón 2011b, 2014).

Table 1. Systematic relationships of the 34 freshwater bivalve mollusk species known to occur in the State of Santa Catarina/ SC, Central Southern Brazil, and the Malacological Regions in which each has been found. See Figure 1 for the names and locations of the Regions.

Orders, Families, and Species	Malacological Regions					
	1	2	3	4	5	6
Order Unionoida						
Family Mycetopodidae Gray, 1840						
<i>Mycetopoda legumen</i> (Martens, 1888)			X		X	
<i>Mycetopoda siliquosa</i> (Spix, 1827) ?						
<i>Anodontites elongatus</i> (Swainson, 1823)			X			X
<i>Anodontites tenebricosus</i> (Lea, 1834)	X		X		X	
<i>Anodontites ferrarisi</i> (d'Orbigny, 1835)			X			
<i>Anodontites moricandi</i> (Lea, 1860)			X			
<i>Anodontites patagonicus</i> (Lamarck, 1819)			X			X
<i>Anodontites obtusus</i> (Spix, 1927)			X			
<i>Anodontites trapesialis</i> (Lamarck, 1819)		X	X		X	X
<i>Leila blainvilleana</i> (Lea, 1834)	X					
<i>Monocondylaea minuana</i> (d'Orbigny, 1835)			X			
Family Hyriidae Swainson, 1840						
<i>Diplodon aethiops</i> (d'Orbigny, 1835) (Figure 2)	X		X	X	X	X
<i>Diplodon ellipticus</i> (Wagner in Spix, 1827)		X	X	X	X	
<i>Diplodon expansus</i> (Küster, 1856) (Figure 2)	X	X	X	X	X	X
<i>Diplodon (Rhipidodonta) koseritzi</i> (Clessin, 1888)			X			
<i>Diplodon multistriatus</i> (Lea, 1834)			X			
<i>Diplodon delodontus</i> (Lamarck, 1819)			X			X
<i>Diplodon parallelipipedon</i> (Lea, 1834)				X		
<i>Diplodon rhuacoicus</i> (d'Orbigny, 1835)			X	X	X	
<i>Rhipidodonta rhombea</i> (Wagner, 1827)			X			
Order Veneroida						
Family Cyrenidae Gray, 1847						
<i>Corbicula fluminalis</i> (Müller, 1774)			X			
<i>Corbicula fluminea</i> (Müller, 1774)		X	X		X	X
<i>Corbicula largillierti</i> (Philippi, 1844)	X	X	X		X	X
<i>Cyanocyclus limosa</i> (Maton, 1809)			X			
Order Veneroida						
Family Sphaeriidae Deshayes, 1855						
<i>Eupera klappenbachi</i> Mansur & Veitenheimer-Mendes, 1975	X					
<i>Eupera platensis</i> (Doello-Jurado, 1921)			X			
<i>Pisidium aff. dorbignyi</i> (Clessin, 1879)			X			
<i>Pisidium globulus</i> (Clessin, 1888)	X		X			
<i>Pisidium observationis</i> (Pilsbry, 1911)			X	X		
<i>Pisidium pipoense</i> (Ituarte, 2000)			X			
<i>Pisidium taraguayense</i> (Ituarte, 2000)			X			
<i>Pisidium aff. vile</i> (Pilsbry, 1897)			X			
<i>Sphaerium cambaraense</i> (Mansur, Meier-Brook & Ituarte, 2008)			X			
Order Mytilida						
Family Mytilidae Rafinesque, 1815						
<i>Limnoperna fortunei</i> (Dunker, 1857)		X	X			

Only one native species, the mussel/naiad Hyriidae *Diplodon expansus* (Küster, 1856) (Figure 2), followed closely by the species *Diplodon aethiops* (Lea, 1860) (Figure 2), both under syn. *Rhipidodonta charruana* (d'Orbigny, 1835), occurs in each and every one of the six malacological regions established for the State (Table 1).

Figure 1. Malacological Regions of the Santa Catarina State/ SC geographic territory Central Southern Brazil.: (1) Greater Florianópolis, coastal and mountain region; (2) Northern Region; (3) Western Region; (4) Highlands Region; (5) Southern Region; (6) Itajaí River Valley region.

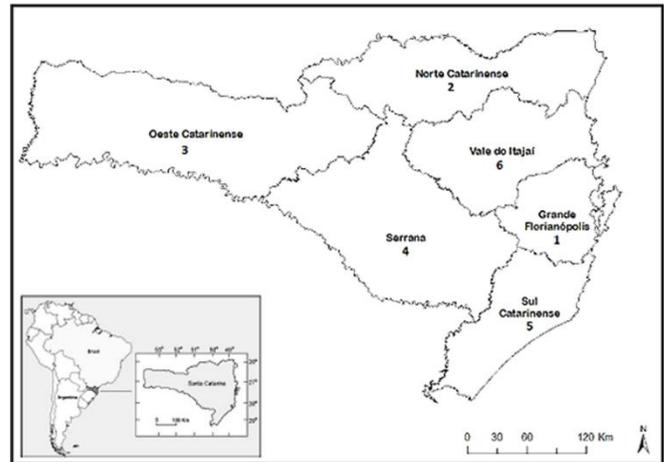


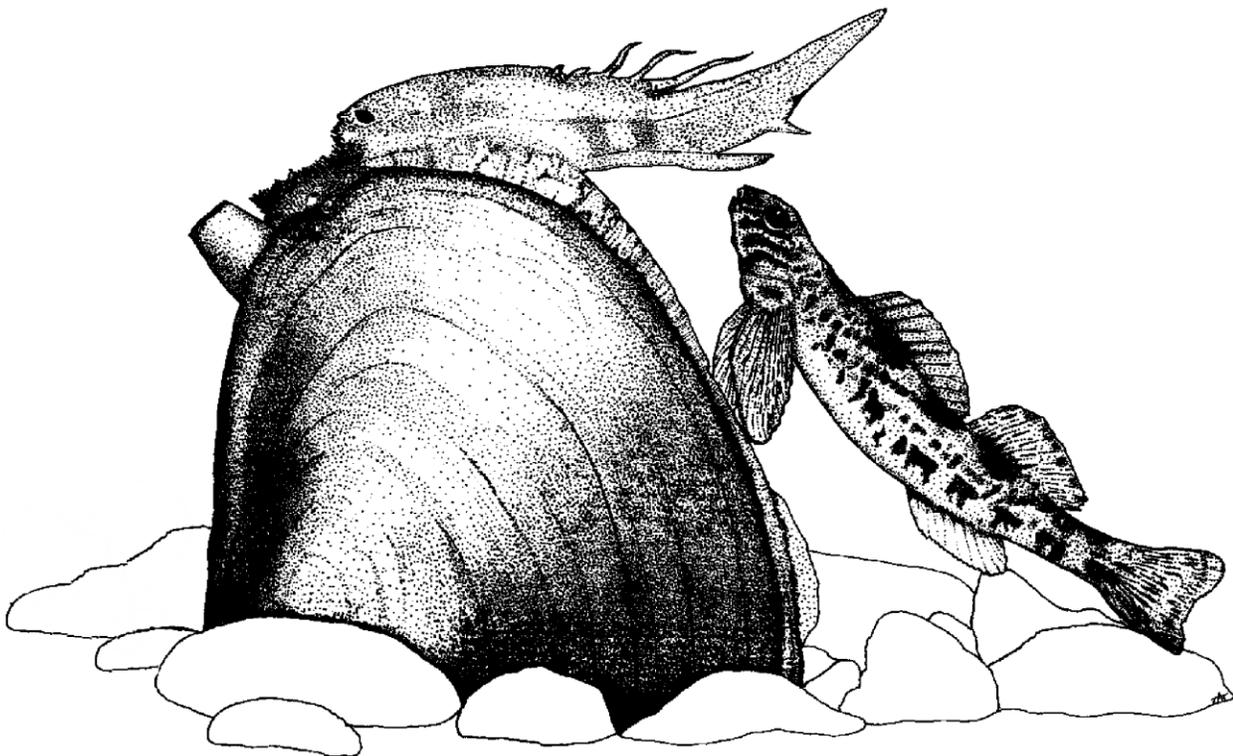
Figure 2. Typical native stream mussel/naiaids Hyriidae *Diplodon expansus* (Küster, 1856) (left) and *Diplodon aethiops* (Lea, 1860) (right), syn. *Rhipidodonta charruana* (d'Orbigny, 1835), from Santa Catarina State/ SC, Central Southern Brazil.

Figure 3. General aspect of the subtropical fluvial environment of the Upper Uruguay River Valley, Western Malacological Region 3, Santa Catarina State, Central Southern Brazil.



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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. 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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Parting Shot



Western Pearlshells, *Margaritifera falcata*, filter-feeding in the Cowichan River, Vancouver Island, British Columbia, Canada. The summer of 2015 was abnormally hot and dry on Vancouver Island and low flow from tributaries resulted in underwater visibility in the Cowichan River of over 30 feet. The Western Pearlshell appears stable in the upper sections of this river, with high density patches sometimes exceeding 300 mussels/m². The salmonid species and Western Pearlshells in the Cowichan River benefit from various conservation initiatives, including surveillance and monitoring of salmon stocks and spawning beds, locals and river users valuing habitat integrity and water quality, the presence of a provincial park, and official status within the Canadian Heritage Rivers System. The box outlines the small part of this photograph that was used to show the secondary papillae in Figure 1 on page 27. Photograph by Greg Wilson, British Columbia Ministry of Environment and Climate Change Strategy.

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.

