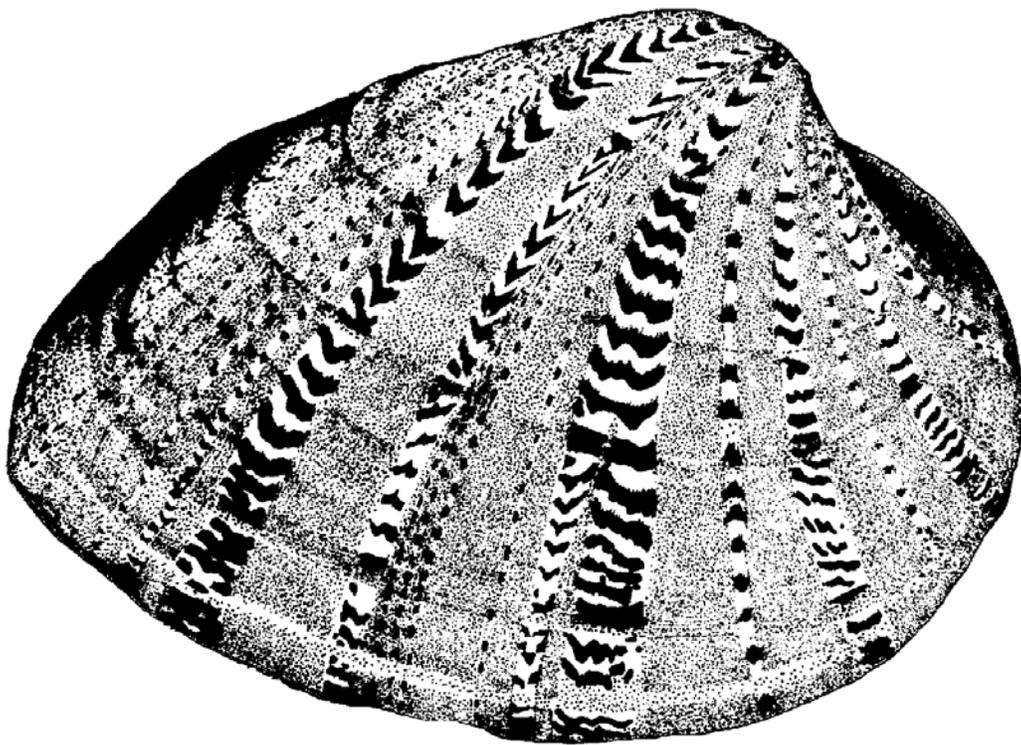


Ellipsaria

The Newsletter of the Freshwater Mollusk Conservation Society

Volume 10 - Number 1

April 2008



In this issue:
July Workshop Information

Freshwater Mollusk Conservation Society Officers

President

Steve A. Ahlstedt
PO Box 460
Norris, TN 37828
USGS: 865-545-4140 x 204
Cell: 865-776-9510
Home: 865-494-7389
ahlstedt@usgs.gov

President Elect

W. Gregory Cope
North Carolina State University
Dept. of Environ. & Molecular Tox.
Box 7633
Raleigh, NC 27695-7633
919-515-5296; Fax 7169
greg_cope@ncsu.edu

Secretary

Greg Zimmerman
EnviroScience, Inc.
6751 A-1 Taylor Road
Blacklick, OH 43004
614-866-8540
gzimmerman@enviroscienceinc.com

Treasurer

Heidi L. Dunn
Ecological Specialists Inc.
1417 Hoff Industrial Park
O'Fallon, MO 63366
636-281-1982; Fax: 0973
Hdunn@ecologicalspecialists.com

Past President

Robert M. Anderson
U.S. Fish and Wildlife Service
312 South Allen Street, Suite 322
State College, PA 16801
814-234-4090
Robert_M_Anderson@fws.gov

Ellipsaria Editor

Christine Mayer
Illinois Natural History Survey
1816 S Oak Street, Champaign, IL 61820
camayer@inhs.uiuc.edu

Submissions for the August 2008 issue of *Ellipsaria* may be sent to the editor at any time but are requested by **August 5, 2008**. Anyone may submit an article but you must be a member of FMCS to receive *Ellipsaria*. Please limit submissions to about one page. Categories for contributions include news, new publications, meeting announcements, current issues affecting mollusks, job postings, contributed articles (including ongoing research projects), abstracts, and society committee reports. Electronic submissions are preferred; contact the editor with any questions. Note that submissions are not peer reviewed, but are checked for content and general editing.

Thanks to Jeremy Tiemann for help assembling and mailing this newsletter.

Please send change of address information to the Secretary.

Ellipsaria

NEWSLETTER OF THE FRESHWATER MOLLUSK CONSERVATION SOCIETY

Volume 10, No. 1

<http://ellipse.inhs.uiuc.edu/FMCS/>

April 2008

FMCS News	1
Announcements.....	4
Publications.....	6
Contributed Articles	7



President's Message

The FMCS board meeting was held in Dry Ridge, Kentucky March 24-25, 2008. The meeting was hosted by Monte McGregor from the Kentucky Department of Fish and Wildlife Resources. New business included the SCB/FMCS joint symposium and workshop this July 13-15 in Chattanooga; a bargain at \$125 (thanks Rachel Muir).

Catherine Gatenby, FMCS symposium chair 2009, sent drafts of the symposium announcement, potential program topics, and a letter requesting sponsorship monies. The board is in the process of reviewing each to provide input back to Catherine. A major issue for our society is sponsorship monies, which allow us to keep our costs as low as possible for members. I urgently request each member representing their respective agency to budget some funding for sponsoring the 2009 symposium. If everyone in our society was able to garner \$500 or more that would be super. A letter will go out to all FMCS members requesting sponsorship monies. We also need to compile a list of other groups/agencies to send letters to.

Steve McMurray was nominated as co-chair of the Environmental Quality and Affairs Committee and Andy Roberts was nominated co-chair of the Outreach Committee. I welcome both to our standing committees. Heidi Dunn was re-elected Treasurer...was their any doubt! As a founding member, Heidi is the glue that holds FMCS together and we are so grateful for her dedication

A request was made for FMCS board representation at the Ohio River Basin Habitat Partnership meeting in Frankfort, Kentucky April 16-18. Greg Zimmerman, Tom Jones, Ryan Evans, and Leroy Koch will be attending.

Tom Jones and Andy Roberts are diligently working on updating the FMCS webpage and hopefully by fall we should have made great progress on this.

A considerable amount of time was spent looking over the National Strategy following the board meeting and determining what had or had not been accomplished and what needed to be added to update it. Rachel Muir is heading up revising or updating the Strategy and comments were compiled and emailed to her.

The transfer of Walkerana to FMCS is finally drawing to a close. A few items need to be taken care of and Heidi Dunn's lawyer will be mailing papers to Jack Burch to sign.

Steve Ahlstedt, FMCS President

FMCS 2008 WORKSHOP: JULY 13 - 15, 2008

The 2008 Freshwater Mollusk Conservation Society Workshop will be held at the Chattanooga Convention Center on Tuesday, July 15, 2008, in conjunction with the Annual Meeting of the Society for Conservation Biology (SCB). FMCS also will conduct a half-day Symposium for SCB on Monday afternoon, July 14, 2008, and will co-sponsor a day-long field trip to the Duck River on Sunday, July 13, 2008. Registration for all three events is available through the SCB website: <http://www.conbio.org/2008>. Go to "Registration" and follow the instructions. The special FMCS registration fee (\$125) will allow attendees to participate in the Workshop on Tuesday and any non-ticketed activities at the SCB Meeting on Sunday and Monday (including the FMCS Symposium). The field trip on Sunday has a separate charge (\$30).

Aquatic Field Trip – Sunday, July 13, 2008

A Day in a Freshwater Biodiversity Rainforest: The Duck River of Central Tennessee

(Co-sponsored by FMCS and the SCB Freshwater Working Group)

The Duck River supports over 140 species of fish and 75 species of freshwater mollusks, along with equally diverse communities of other aquatic groups. Participants on this all-day trip will be able to snorkeling and seining to observe many of the species at the site. Local experts in the identification and natural history of these species will coordinate the sampling and provide an overview of the current threats and opportunities for conserving this extraordinary freshwater ecosystem.

FMCS Symposium – Monday, July 14, 2008

Beneath the Surface: The Freshwater Mollusks of the Southeastern United States

Tentative Agenda

- The [Former] Diversity and Zoogeography of Southeastern Freshwater Mussels. John Jenkinson, Retired from the TVA
 - Wonders Down Under: Adaptations to Larval Parasitism in Freshwater Mussels. Chris Barnhart, Missouri State University
 - A Biodiversity Assessment of North American Freshwater Gastropods. Paul D. Johnson, AL Aquatic Biodiversity Center
 - The Functional Role of Freshwater Mussels in Ecosystems. Caryn Vaughn, University of Oklahoma
 - Propagation and Culture of Endangered Freshwater Mussels. Richard Neves, Virginia Polytechnic Institute and University
 - Chemical Impacts to Freshwater Mussels: A Comparison of Life Stage Exposure and Sensitivity. W. Greg Cope, N.C. State University, Teresa J. Newton, USGS, and Christopher G. Ingersoll, USGS
 - Freshwater Mussel Assemblage Change in Response to Habitat Alteration. Wendell Haag, US Forest Service, Center for Bottomland Hardwoods Research
 - Tennessee's Duck River: A Rare Gem of Aquatic Diversity. Leslie Colley, The Nature Conservancy
-
-

FMCS 2008 Workshop – Tuesday, July 15, 2008

The Road to Recovery: Science to Secure Freshwater Mollusk Diversity

Tentative Agenda

Recovery Science and Policy Overview

- Recovery under the Endangered Species Act. Debby Crouse, USFWS
- The Science of Recovery. Michael J. Scott, University of Idaho
- Metrics and Decision-making for Recovery of Endangered Species. Michael Runge, USFWS

Genetics

- Examples of Genetic Variation in Freshwater Mussels at Different Spatial Scales and the Implications for Species Conservation. Kevin Rowe, Iowa State
- Applied Conservation Genetics and Freshwater Mollusks. Tim King, USGS

Propagation

- Minimizing Genetic Risks Associated with Hatchery Propagation and Augmentation of Freshwater Mussel Species. Greg Moyer, USFWS
- Progress in Freshwater Mussel Cultivation and Recovery at Virginia's Aquatic Wildlife Conservation Center. Nathan Eckhart, Virginia Game & Inland Fisheries

Genetics and Propagation Panel Discussion

Life History and Habitats

- Effects of Small Impoundments on Freshwater Mussels. Michael Gangloff, Appalachian State University
- Hydrophysical Factors Affecting Native Mussel Distributions in Large Rivers. Steve Zigler, USGS
- Freshwater Mussels: Challenging Conservation Efforts in a Race Against Time. Tom Watters, Ohio State University
- The Role of Freshwater Mussels in Food Webs and their Nutritional Requirements in Ecosystems. Jeri Nichols and Teresa Newton, USGS
- The Effects of Contaminants and Other Water Quality Factors on the Recovery of Freshwater Mollusks. Tom Augspurger, USFWS

Monitoring and Recovery

- Monitoring Needs to Recover and Sustain Freshwater Mollusks. Alan Christian and John Harris
- Global Diversity and Conservation of Freshwater Mollusks: Causes, Consequences and Challenges for the Future. Arthur Bogan and Ellen Strong

Ecosystems

- Context-dependent Effects of Freshwater Mussel Communities on Stream Ecosystem Function. Caryn Vaughn, University of Oklahoma
- Vision for a Watershed Approach to Rebuilding Native Bivalve Resources from the Headwaters to Coast for Both Biodiversity and Population Biomass. Danielle Kreeger, Delaware Estuary Partnership

FMCS Board Meeting **Curtis Lloyd Wildlife Management Area,** **Crittenden, Kentucky** **March 24-25, 2008**

Attendees:

Steve Ahlstedt (President)
Heidi Dunn (Treasurer)
Greg Zimmerman (Secretary)
Paul Johnson (Gastropod Status and Distribution)
Ryan Evans (Environmental Quality and Affairs)
Tom Watters (Information Exchange)
Tom Jones (Outreach)
Monte McGregor (KY Dept. of Fish and Wildlife)
Leroy Koch (USFWS - KY)
Craig Walker (Office of Surface Mining)

Old Business

Committee Reports

Tom Jones - Outreach: Web Site - IT Students are looking for senior projects at Marshall University. They would like to host the FMCS web-page. There is a possibility of establishing a Pay-Pal account (5% fee + Credit Card Fee) for use of the service. The details include variable rate by credit card and PayPal (on-line sales and donations - tax deductible receipts). Database storage of membership and photos would be possible on unlimited storage space. Series of modules would be set-up for each Committee independently.

Marshall could host the main site and connect to web-pages that contain committee activities hosted on other servers. There was an offer from Marshall University to host the web site but it will need to be updated. Cost for paying someone to complete maintenance once-a-month would be \$1,000.00 per annum for maintaining the site.

Tom will provide a list of information in 2 weeks to the FMCS board. Need to review the list to decide the contents of the website (specific information to membership information).

Funding committee activities through a small fee was proposed. These monies would be used to assist committees with operational expenses. Many of the Committee Chairs have expressed the need to improve the web information for their committees and this would fill that need.

FMCS 2008 WORKSHOP & MORE - JULY 13 - 15, 2008

The 2008 FMCS Workshop, held in conjunction with the Society for Conservation Biology (SCB) is coming together

as a tremendous opportunity for FMCS members to have access to the SCB meeting as well as a great venue to introduce other scientists to freshwater mollusks. The workshop will feature a top-notch list of speakers on FW mollusk topics ranging from Zoogeography, Biodiversity, Functional Ecology, Life History, and much, much more! A field trip to the Duck River is also planned. The organizers have worked extra-hard to make this event both substantive AND affordable - particularly for our student members. Please see the FMCS website for more details.

FMCS 2009 SYMPOSIUM - Baltimore MD

The board discussed the upcoming symposium in 2009. A key topic was the need to keep the meeting affordable not only for students but the general membership. The best way to keep costs down for all is to find sponsors.

So, an IMPORTANT reminder:

Many of our FMCS members work for or work with a number of potential 2009 symposium sponsors. Potential sponsors contacts could include: heads of DNRs, Heads of DOTs, Tribes, the Energy Industry, Oil and Gas, Rail, U.S. Army Corps, NPOs, etc. Catherine Gatenby has drafted a request letter for potential sponsors outlining the symposium and sponsorship benefits. Please contact Catherine as soon as possible at catherine_gatenby@fws.gov if you have any potential leads.

Treasurer's Report

At the end of 2007, FMCS had \$53,513.67 in the bank.

Total income 2007 = \$91,708.37

Expenses 2007 = \$94,329.25

Loss = \$2620.88

Major income and expenses:

The 2007 workshop and symposium income was donations \$4,225 plus registration \$72,734.12. Symposium costs were \$78,000.07. Auction income was \$5,744 and award expenses were \$5,963.13. So we were slightly over budget on both, but not by much.

Membership income was \$8,320.00, interest income \$440.25, hats, t-shirts, Walkerana income \$220.

Expenses included newsletters, \$3,373.62, bank charges, credit card fees, \$1,082.69, Malcolm Pearce memorial fund \$500, Mining workshop \$750, AFS meeting in Madison, WI \$1500, purchase of hats for sale at meetings \$1080, shipping of Texas mussel books to the symposium \$264.01, purchase of some of the Walkerana back issues \$1815.73.

No other committees had anything to report.

New Business

Mollusk augmentation and reintroduction plan for both the Tennessee/Cumberland and the Mobile River Basin fauna

Paul Johnson reported that several state agencies and the FWS were working to produce a mollusk augmentation and reintroduction plan for both the Tennessee/Cumberland and the Mobile River Basin fauna. The documents have been in development for several years and are nearing completion. The document is broken into a general policy section and a species accounts section that details priority recovery action by species. Several appendices follow including key contacts, state requirements, example site plan, genetics considerations, and reporting form. The documents are standardized between basins and could be a template for similar recovery documents produced for other basins around the country.

USEPA Ammonia Criteria Response

Steve received a letter from the USEPA regarding the FMCS's position on ammonia limits being un-protective of juvenile freshwater mussels. The letter stated that the EPA understood the concerns but were still looking at "data gaps", and that they were conducting their own internal research before they would consider starting the process of revising the current ammonia criteria.

FMCS Sends Request to Reinitiate Formal Consultation on Southeastern U.S. Coal Mining

Steve Ahlstedt sent a letter from FMCS to the USFWS and Office of Surface Mining Reclamation and Enforcement regarding the September 1996 Biological Opinion and Incidental Take statement. The FMCS position is that the 1996 BiOp is not presently protective of freshwater mollusks. Watersheds particularly affected are the Clinch and Powell Rivers of the Tennessee River basin and the Big South Fork of the Cumberland River Basin. The Board will work to get such documents posted on the website. A copy of the document as well as the USEPA letter can be obtained by contacting Greg Zimmerman.

The Ohio River Basin Habitat Partnership (ORBHP) asked that a non-federal member of the FMCS board attend the kickoff meeting in Frankfort, KY. The group is seeking sponsorship under the National Fish Habitat Action Plan. Greg Zimmerman attended as well as numerous other FMCS members. Details on the ORBHP can be obtained from Rob Simmons at rob_simmonds@fws.gov.

Motion to adjourn by Steve, second by Heidi D., all in favor.
Submitted by Greg Zimmerman, FMCS Secretary

FMCS Symposium at Midwest Fish & Wildlife Conference Wrap-up

The FMCS sponsored a half-day symposium at the 2007 Midwest Fish and Wildlife Conference on 11 December 2007 in Madison, WI. The symposium's lineup:

Tom Watters - Freshwater mollusks: from living rocks to mean mothers

Steve McMurray - The intertwined interests of native mussels and fishes

Matthew Patterson - Ecosystem services provided by freshwater mussels

Robert Szafoni - Making Mussel Metrics

Tony Brady - Recovering the Higgins' eye Pearlymussel

Teresa Newton - An overview of the sensitivity of mussels to aquatic contaminants

Jeremy Tiemann - Effects of lowhead dams on stream ecosystems

Tim Stewart - Freshwater gastropods of the Midwest

Jeremy Tiemann (filling in for Kevin Cummings) - Resources for Freshwater Malacology

The symposium was well received and had as many as 85 people in attendance from various agencies across the U.S. and Canada.

The FMCS also set up a booth at the trade show. The above speakers, in addition to FMCS brethren Kurt Welke and Lisle Kitchel, entertained all who would listen. They answered questions about freshwater mollusks and the FMCS, showed-off some amazing mollusk footage, gave away posters, and sold T-shirts and hats. Thanks goes out to the speakers and the booth attendees, and a special thanks goes out to Matthew and his wife for setting up the booth. Check out the FMCS website for pictures of the meeting.

Submitted by Jeremy Tiemann

Announcements

University of Georgia MS Graduate Research Assistantship

MS Graduate Research Assistantship — Early life history of freshwater mussels, Warnell School of Forestry & Natural Resources, University of Georgia, Athens, Georgia.

RESPONSIBILITIES: The successful applicant will conduct a two-year research project to evaluate the early life history of mussels endemic to the Altamaha River basin. The project is a cooperative effort with the Georgia Department of Natural Resources and will involve field and laboratory work to determine host fishes, periods of gravidity, host fish attraction/infection strategy, etc.

QUALIFICATIONS: The successful applicant should have interests in freshwater mussel conservation and propagation, be highly motivated, have strong organizational skills, and should be able to work independently in the field and lab. Minimum academic qualifications include a B.S. in fisheries, biology, environmental chemistry, or closely related field, 1100+ on the GRE's combined verbal and quantitative, and a 3.0 GPA (on a 4.0 system). Additional graduate program information can be found at:

<http://www.forestry.uga.edu/h/admissions/h/admissions/graduate/>

Salary: \$17,000 per year plus benefits and tuition waiver.

Closing Date: Until filled.

Contact: send a cover letter, resume, copies of transcripts, GRE scores, and the name, phone number, and email address of three references to:

Dr. Robert B. Bringolf
Warnell School of Forestry & Natural Resources
University of Georgia
Athens, GA 30602
PH: (706) 542-1477 or rbringolf@warnell.uga.edu

Illinois Natural History Survey Mussel Field Biologists

Appointment: Two positions as a Mussel Field Biologist at the level of Assistant Technical Scientist III, and one position as Mussel Field Biologist Coordinator at the level of Assistant Research Scientist III, Illinois Natural History Survey, Division of Biodiversity and Economic Entomology. These are grant-supported fulltime positions.

Location: Illinois Natural History Survey, Champaign or Springfield, Illinois.

Project description: Collect baseline mussel data in conjunction with existing basin surveys for fishes on wadeable streams and other high priority locations in Illinois to fill knowledge gaps in Illinois' Wildlife Action Plan, support revisions of current mussel community indices, assist water quality initiatives, guide restoration initiatives.

Job description: The principal duty is to conduct field surveys for mussels at selected drainage basins throughout Illinois. Field surveys will include hand sampling for mussels and measuring stream habitat. The Mussel Field Biologists will assist in report writing for the funding agency and will participate in curation and collections management as needed. If time permits, outreach activities and independent research will be encouraged.

Qualifications: MA/MS in Biology or related field required by 1 June 2008. Expertise with field collection, processing, identification, and vouchering of mussels is required. Preference will be given to candidates with expertise and experience with Midwestern fauna. Candidates must have strong interpersonal skills and be able to express thoughts coherently, both verbally and in writing, to coworkers, the granting agency, the scientific and lay communities, and landowners associated with research sites. Experience with ArcGIS, multi-metric indices, database management, statistics and analytical methods is desirable for the coordinator position. Experience with museum collections, database management, and analysis of data is also desirable. Specific questions regarding the position should be referred to Kevin Cummings, Search Chair, 217-333-1623, ksc@inhs.uiuc.edu; <http://www.inhs.uiuc.edu/opportunities/>

University of Illinois MS Graduate Research Assistantship

MS Graduate Research Assistantship — spatial variability of stream mussel assemblages and sampling sufficiency, Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign.

Responsibilities: The successful applicant will conduct a 2-3 year research project to evaluate the reach-scaled variability of mussel assemblages and sampling sufficiency in Illinois wadeable streams. The project is a cooperative effort with the IL Department of Natural Resources and will involve field and laboratory work to collect samples, identify mussel species, and analyzing the data.

Qualifications: The successful applicant should have interests in freshwater mussel ecology, be highly motivated & self-organized, and should be able to work independently in the field and lab. Experiences in mussel identifications and biostatistics will be assets. Minimum academic qualifications include a B.S. in fisheries, ecology, zoology, or closely related field, 1100+ on the GRE's combined verbal and quantitative, 4.5 on the analytical writing, and a 3.0 GPA (on a 4.0 system). Additional graduate program information can be found at: www.nres.uiuc.edu.

Salary: \$1,500 per month for 11-months plus tuition waiver and benefits.

Review of applications will begin May 20, 2008. Preferred starting date is August 2008. Send a cover letter, resume, copies of transcripts, GRE scores, and the names, phone numbers, and email address of three references to: Dr. Yong Cao, Illinois Natural History Survey, (217) 244-6847, yongcao@uiuc.edu.

July 20 - 26, 2008: Freshwater Mussels of the Northeast: Taxonomy, Life History, and Conservation with Jay Cordeiro

Seminar description: <http://www.eaglehill.us/mssemdes.html>
Information on lodging options, meals, and costs:

<http://www.eaglehill.us/mapinfo.html>

Printable and online application form:

<http://www.eaglehill.us/mapweb.html>

<http://www.eaglehill.us/mapprn.html>

For more information, please contact:

Humboldt Institute,

PO Box 9

Steuben, ME 04680-0009.

207-546-2821. Fax 207-546-3042

office@eaglehill.us

General information: <http://www.eaglehill.us>

NATURAL HISTORY SEMINARS

In support of field biologists, modern field naturalists, and students of the natural history sciences, Eagle Hill offers specialty seminars and workshops for those who are interested in understanding, addressing, and solving complex ecological questions. Seminars topics range from watershed level subjects, and classical ecology, to highly specialized seminars in advanced biology, taxonomy, and ecological restoration. Eagle Hill has long been recognized as offering hard-to-find seminars and workshops which provide important opportunities for training and meeting others who are likewise dedicated to the natural history sciences.

Eagle Hill field seminars are of special interest because they focus on the natural history of one of North America's most

spectacular and pristine natural areas, the coast of eastern Maine from Acadia National Park to Petit Manan National Wildlife Refuge and beyond. Most seminars combine field studies with follow-up lab studies and a review of the literature. Additional information is provided in lectures, slide presentations, and discussions. Seminars are primarily taught for people who already have a reasonable background in a seminar program or in related subjects, or who are keenly interested in learning about a new subject. Prior discussions of personal study objectives are welcome.

Anne Favolise - Stanton, Administrative Assistant
Humboldt Field Research Institute
PO Box 9, 59 Eagle Hill Road
Steuben, ME 04680-0009 USA
Phone: 207-546-2821, FAX: 207-546-3042
office@eaglehill.us, <http://www.eaglehill.us>

Publisher of two regional natural history science journals.
Northeastern Naturalist:
<http://www.eaglehill.us/jngeninf.html>
Southeastern Naturalist:
<http://www.eaglehill.us/jsgeninf.html>

Publications

- Nedeau, E.J.** 2008. Freshwater Mussels and the Connecticut River Watershed. Connecticut River Watershed Council, Greenfield, Massachusetts. xviii+132 pages.
order: http://www.biodrawversity.com/freshwater_mussels.htm
- Serb, J.M., & M.C. Barnhart.** 2008. "Congruence and conflict between molecular and reproductive characters when assessing biological diversity in the western fanshell *Cyprogenia aberti* (Bivalvia, Unionidae)." *Annals of the Missouri Botanical Garden* 95(2).
- Watters, G.T.** 2008. The morphology of conglomerates and conglutinate-like structures in North American freshwater mussels: a scanning-electron microscopy study. *Novapex* 9: 1-20.
- Zanatta, D.T., Ngo, A. & Lindell, J.** 2007. Reassessment of the phylogenetic relationships among *Anodonta*, *Pyganodon*, and *Utterbackia* (Bivalvia: Unionoida) using mutation coding of allozyme data. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 156, 211-216.
- Zanatta, D.T. & R.W. Murphy.** 2007. Range-wide population genetic analysis of the endangered northern riffleshell mussel, *Epioblasma torulosa rangiana* (Bivalvia: Unionoida). *Conservation Genetics*, 8, 1393-1404.
- Zanatta, D.T., S.J. Fraley & R.W. Murphy.** 2007. Population structure and mantle display polymorphisms in the wavy-rayed lampmussel, *Lampsilis fasciola* (Bivalvia: Unionidae). *Canadian Journal of Zoology*, 85, 1169-1181.

- Zanatta, D.T. & R.W. Murphy.** 2008. The phylogeographic and management implications of genetic population structure in the imperiled snuffbox mussel, *Epioblasma triquetra* (Bivalvia: Unionidae). *Biological Journal of the Linnean Society*, 93, 371-384.

Environmental Toxicology and Chemistry

Volume 26, Issue 10 (October 2007)

Article abstracts are available to everyone.

Contaminant Sensitivity of Freshwater Mussels
Editorial

ADVANCES AND OPPORTUNITIES IN ASSESSING CONTAMINANT SENSITIVITY OF FRESHWATER MUSSEL (UNIONIDAE) EARLY LIFE STAGES

Tom Augspurger, F. James Dwyer, Christopher G. Ingersoll, and Cynthia M. Kane

INTRA- AND INTERLABORATORY VARIABILITY IN ACUTE TOXICITY TESTS WITH GLOCHIDIA AND JUVENILES OF FRESHWATER MUSSELS (UNIONIDAE)

Ning Wang, Tom Augspurger, M. Chris Barnhart, Joseph R. Bidwell, W. Gregory Cope, F. James Dwyer, Steve Geis, I. Eugene Greer, Chris G. Ingersoll, Cynthia M. Kane, Thomas W. May, Richard J. Neves, Teresa J. Newton, Andy D. Roberts, and David W. Whites

ACUTE TOXICITY OF COPPER, AMMONIA, AND CHLORINE TO GLOCHIDIA AND JUVENILES OF FRESHWATER MUSSELS (UNIONIDAE)

Ning Wang, Christopher G. Ingersoll, Douglas K. Hardesty, Christopher D. Ivey, James L. Kunz, Thomas W. May, F. James Dwyer, Andy D. Roberts, Tom Augspurger, Cynthia M. Kane, Richard J. Neves, and M. Chris Barnhart

CHRONIC TOXICITY OF COPPER AND AMMONIA TO JUVENILE FRESHWATER MUSSELS (UNIONIDAE)

Ning Wang, Christopher G. Ingersoll, I. Eugene Greer, Douglas K. Hardesty, Christopher D. Ivey, James L. Kunz, William G. Brumbaugh, F. James Dwyer, Andy D. Roberts, Tom Augspurger, Cynthia M. Kane, Richard J. Neves, and M. Chris Barnhart

LETHAL AND SUBLETHAL EFFECTS OF AMMONIA TO JUVENILE *LAMPSILIS* MUSSELS (UNIONIDAE) IN SEDIMENT AND WATER-ONLY EXPOSURES

Teresa J. Newton and Michelle R. Bartsch

AN EVALUATION OF FRESHWATER MUSSEL TOXICITY DATA IN THE DERIVATION OF WATER QUALITY GUIDANCE AND STANDARDS FOR COPPER

Ferrella A. March, F. James Dwyer, Tom Augspurger, Christopher G. Ingersoll, Ning Wang, and Christopher A. Mebane

RISK ASSESSMENT OF WATER QUALITY IN THREE NORTH CAROLINA, USA, STREAMS SUPPORTING FEDERALLY ENDANGERED FRESHWATER MUSSELS (UNIONIDAE)

Sara Ward, Tom Augspurger, F. James Dwyer, Cindy Kane, and Christopher G. Ingersoll

ACUTE AND CHRONIC TOXICITY OF TECHNICAL-
GRADE PESTICIDES TO GLOCHIDIA AND
JUVENILES OF FRESHWATER MUSSELS
(UNIONIDAE)

Robert B. Bringolf, W. Gregory Cope, Chris B. Eads, Peter
R. Lazaro, M. Christopher Barnhart, and Damian Shea

ACUTE AND CHRONIC TOXICITY OF GLYPHOSATE
COMPOUNDS TO GLOCHIDIA AND JUVENILES OF
LAMPILIS SILIQUOIDEA (UNIONIDAE)

Robert B. Bringolf, W. Gregory Cope, Shad Mosher, M.
Chris Barnhart, and Damian Shea

ACUTE AND CHRONIC TOXICITY OF PESTICIDE
FORMULATIONS (ATRAZINE, CHLORPYRIFOS, AND
PERMETHRIN) TO GLOCHIDIA AND JUVENILES OF
LAMPILIS SILIQUOIDEA

Robert B. Bringolf, W. Gregory Cope, M. Chris Barnhart,
Shad Mosher, Peter R. Lazaro, and Damian Shea

Contributed Articles

*The following articles were contributed by FMCS members and
others in the malacological community. The contributions are
incorporated into the newsletter with minimal editing and the
opinions expressed therein are those of the authors.*

On the Incidence of Monozygotic Twins and Triplets in a Laboratory Population of *Physa gyrina*¹ (Say 1821) from Idaho

Steven J. Lysne

Department of Biology, Boise State University
1910 University Avenue
Boise, Idaho 83725

I collected approximately 50 individuals from a population of *Physa gyrina* (Say 1821) during June and July of 2007 and reared them under laboratory conditions between July and September, 2007. The purpose of the collection was to establish a culture of snails for experimental purposes and to develop husbandry techniques that I may apply to more recalcitrant taxa. Spawning commenced almost immediately and my interest turned to the amazing reproductive output of these snails relative to my experience with other taxa. I began to make observations of egg masses, individual eggs within masses, and then the embryos within individual eggs. While a great deal of work has been conducted on the reproductive biology (DeWitt 1954), life history (McMahon 1975), and ecology (Duncan 1959) of species in the family Physidae (see Dillon 2000) for a review), I failed to find reference to the success of embryonic development or incidence of monozygotic twins or triplets in this cosmopolitan genus. I inspected 1727 *Physa gyrina* eggs from 61 egg masses under a compound microscope. I recorded the number of empty eggs (those eggs with no developing embryo inside), undeveloped eggs (those eggs

with an un/underdeveloped embryo inside), monozygotic twins (those eggs with two embryos inside a single egg), and monozygotic triplets (those eggs with three embryos inside a single egg). Results from this very simple study revealed 31 (1.8%) empty eggs, 25 (1.45%) eggs in some form of arrested development, 14 (0.81%) eggs containing monozygotic twins, and 2 (0.12%) eggs containing monozygotic triplets. While the incidence of twins and triplets is interesting, perhaps more important to the biology of the species is the approximately 3.3% of eggs that fail to develop. Future researchers might wish to incorporate such information on the developmental biology of *Physa gyrina* into studies pertaining to ontological mortality factors.

DeWitt, R.M. 1954. Reproduction, Embryonic Development, and Growth in the Pond Snail, *Physa gyrina* (Say) Transactions of the American Microscopical Society 73: 124-137.

Duncan, C.J. 1959. The Life Cycle and Ecology of the Freshwater Snail *Physa fontinalis* (L.) The Journal of Animal Ecology 28: 97-117.

Dillon, R.T. 2000. The Ecology of Freshwater Molluscs. Cambridge University Press, Cambridge, U.K.

McMahon, R.F. 1975. Effects of Artificially Elevated Water Temperatures on the Growth, Reproduction and Life Cycle of a Natural Population of *Physa Virgata* (Gould) Ecology 56: 1167-1175.

¹Following the classification of Wethington, A.R. and C. Lydeard. 2007. A molecular phylogeny of Physidae (Gastropoda: Basommatophora) based on mitochondrial DNA sequences. Journal of Molluscan Studies 73: 241-257.

Recent Observation of Metamorphosis Without Parasitism in *Utterbackia imbecillis*

Benjamin D. Dickinson and Bernard E. Sietman

Minnesota Department of Natural Resources
500 Lafayette Rd., St. Paul, Minnesota 55155
bddickinson@gmail.com, bernard.sietman@dnr.state.mn.us

Glochidial metamorphosis in the absence of parasitism (transformation within the marsupium) was reported for *Utterbackia imbecillis* dating back nearly a century (Howard 1914, Allen 1924). Documented cases of this reproductive strategy, however, are uncommon, and in the absence of recent observations this phenomenon has been called into question (Heard 1975, Watters and O'Dee 1998).

On 1 October 2007, we collected three gravid *U. imbecillis* from the St. Croix River near Hudson, Wisconsin. These specimens had colonized cages used to propagate rare unionids. All three individuals were in their 2nd year of growth. They were held in an aquarium with other unionids for two weeks prior to examining gill contents. On 13 October we flushed the contents from the marsupia and found each adult contained fully formed juveniles. Based on subsamples, we estimated there were about 7,700 (\pm 2,700)

juveniles per individual. Juveniles were actively moving around immediately after extraction, and many appeared to exhibit slight growth beyond the glochidial shell. Adults and juveniles were deposited in the University of Minnesota James Ford Bell Museum of Natural History invertebrate collection.

Howard (1914) found fully developed juveniles in gravid individuals on 7 November in Moline, Illinois. Later, Howard and Anson (1922) stated that *U. imbecillis* “has lost its parasitism,” referring to metamorphosis within the marsupium, which suggests they thought this was the standard mode of reproduction. Laboratory host suitability studies, however, indicate that *U. imbecillis* is a host generalist, transforming on a number of native fish species in multiple families (Trdan and Hoeh 1982, Howells et al. 1996) as well as over 30 species of non-native fish and four amphibian species (Watters and O’Dee, 1998).

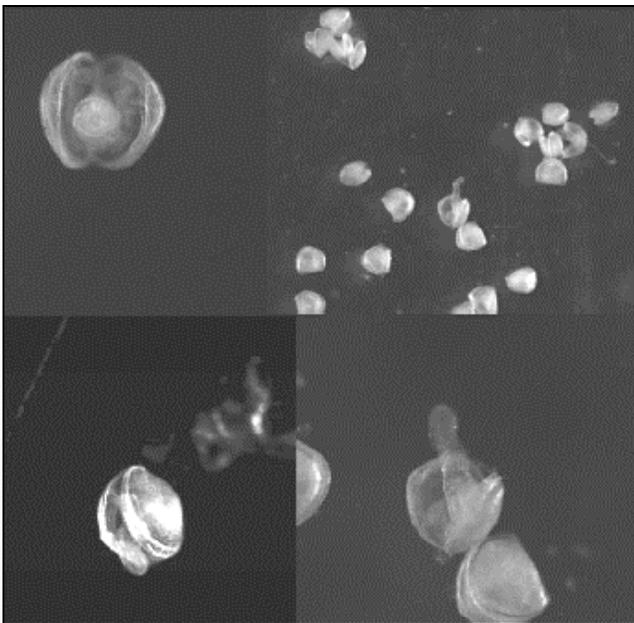


Figure 1. Fully formed juvenile *Utterbackia imbecillis* retrieved from the marsupia of three adults, St. Croix River, Minnesota.

Utterbackia imbecillis is considered to be bradyctytic (Heard 1975, Watters and O’Dee 1998), and a simultaneous hermaphrodite (Hoeh et al. 1995). Coker et al. (1919) found gravid individuals every month of the year except April, and Van der Schalie (1941) found them gravid throughout the year, except mid-June to early-July, consistent with the classification of a long-term brooder. However, Allen (1924) observed multiple individuals of *U. imbecillis* complete the entire breeding/brooding cycle in 22 to 27 days, and proposed that *U. imbecillis* has a continuous short-term breeding cycle. To the contrary, Heard (1975) found no direct evidence of short reproductive cycles, but suggested that populations in more northern latitudes might do so. There is also conflicting data on the age at which individuals become reproductive (Heard 1975). These inconsistencies exemplify Watters and O’Dee’s (2000) assertion that the two system brooding model of bradycty and tachycty is not

adequate.

When viewed as a whole, this body of evidence paints a mosaic picture of *U. imbecillis* reproduction. These differences in reproductive strategy might be habitat related, e.g. small streams versus lakes and larger rivers (Tucker 1928), regional or latitudinal (Heard 1975), seasonal, or combination of these or other variables. The underlying mechanisms or conditions under which these various reproductive strategies are employed warrant further study.

Literature Cited

- Allen, E. 1924. The existence of a short reproductive cycle in *Anodonta imbecillis*. *Biological Bulletin* 46:88-94.
- Coker, R.E., A.F. Shira, H.W. Clark, and A.D. Howard. 1919. Natural History and Propagation of Fresh Water Mussels. *Bulletin of the Bureau of Fisheries* Doc. 893.
- Heard, W.H. 1975. Sexuality and other aspects of reproduction in *Anodonta* (Pelecypoda: Unionidae). *Malacologia* 15: 81-103.
- Hoeh, W.R., K.S. Frazer, E. Naranjo-Garcia, and R.J. Trdan. 1995. A phylogenetic perspective on the evolution of simultaneous hermaphroditism in a freshwater mussel clade (Bivalvia: Unionidae: *Utterbackia*). *Malacological Review* 28:25-42.
- Howard, A.D. 1914. A second case of metamorphosis without parasitism in the Unionidae. *Science* 40:353-355.
- Howard, A.D. and B.J. Anson. 1922. Phases in the parasitism of the Unionidae. *Journal of Parasitology*. 9:68-82.
- Trdan, R.J., and W.R. Hoeh. 1982. Eurytopic host use by two congeneric species of freshwater mussel (Pelecypoda: Unionidae: *Anodonta*). *American Midland Naturalist* 108:381-388.
- Tucker, M.E. 1928. Studies on the life cycles of two species of fresh-water mussels belonging to the genus *Anodonta*. *Biological Bulletin* 54:117-127.
- Van der Schalie, H. and F. Locke. 1941. Hermaphroditism in *Anodonta grandis*, a fresh-water mussel. *Occasional Papers of the Museum of Zoology*. University of Michigan Press, Ann Arbor, Michigan. No. 432.
- Watters, G.T. and S.H. O’Dee. 1998. Metamorphosis of freshwater mussel glochidia (Bivalvia: Unionidae) on amphibians and exotic fishes. *American Midland Naturalist* 139:49-57.

Southeastern Atlantic Slope Mollusk Meeting in Raleigh, NC

Sarah McRae
 North Carolina Natural Heritage Program
 DENR, Office of Natural Resource Planning & Conservation, MSC 1601
 Raleigh, NC 27699-1601

On January 8-9, 2008, over 70 people from Virginia, North Carolina, South Carolina, Georgia, and Florida gathered for a Southeastern Atlantic Slope Mollusk Meeting in Raleigh, NC. An overview of topics addressed follows:

Taxonomy, distribution, status and threats for select SE Atlantic Slope Unionids:

How does the US Fish and Wildlife Service create a listing package?

Do we have enough information to create a listing package for *Fusconaia masoni* and *Toxolasma pullus*?

Status review, survey and life history needs for *Lasmigona subviridis*, *Elliptio lanceolata*, and *Alasmidonta varicosa*.

Genetics issues related to the SE Atlantic Slope:

Introduction on how to interpret genetics data.

Alasmidonta taxonomy in Atlantic Coast drainages.

Lampsilis radiata complex in Atlantic Coast drainages.

Southeastern *Elliptio* taxonomy: current status and future direction.

What specimens are needed? From where? What about a regional repository?

Where is the money for genetics research?

Water Quality research needs:

Advances in understanding the pollutant sensitivity of freshwater mussels.

Effects of temperature on early life stages of freshwater mussels.

Drought and Mussels:

Hot topic in the press (especially GA and FL).

Highlighting the importance of 7Q10 data.

NC/SC drought meeting update.

Data Sharing:

What is the database situation in each state?

Do we need a regional database? How to manage this?

E-library of grey literature?

Collaborative Conservation Management:

Part I – Habitat Conservation

Innovative conservation activities in the SE Atlantic Slope.

Southeastern Aquatic Resources Partnership (SARP).

Part II – Captive Breeding/Propagation

New efforts in NC.

What to do with mussels during drought?

The group decided that having a SE Atlantic Slope Mollusk Meeting every other year is needed. Next meeting will be January 2010 in South Carolina. For more detailed information on this meeting, contact Sarah McRae at sarah.mcrae@ncmail.net or 919-715-1751.

A record of a freshwater clam in Singapore (Unionidae - *Ensidens ingallsianus* *ingallsianus* (Lea, 1852))

CHAN Sow-Yan

Vbox 888313, Singapore 919191, SINGAPORE.

chansowyan@gmail.com

In July 2006 I found a new record of a freshwater clam, *Ensidens ingallsianus ingallsianus* (Lea, 1852), residing happily in an aquaculture farm west of the island. In March 2008, I paid another visit to the same farm to confirm its

existence and collected another 6 (both empty and living) specimens by hand and got it identified and catalogued in my collection (available for loan and studies; Catalogue #: CSY-501.073ensi001.00).

The live clams were found openly exposed in the drainages and ponds around the farm in coarse marine sand with running water. This water seemed to drain into a nearby reservoir and I am uncertain if the waste or excess water is filtered before emptying into that reservoir. This clam is a likely candidate for introduction into the reservoir where another introduced East Asian unionid, *Anodonta woodiana* was also found.



According to Brandt, the natural range of *Ensidens ingallsianus ingallsianus* is Thailand, Laos, Cambodia, Vietnam, and the Malay Peninsula. Singapore falls well within the range but there were no records of such a species on papers or from earlier collections. Moreover, the clam was found in an aquaculture farm where there are many types of feeder fishes imported from Malaysia.

References:

Brandt, Rolf A.M. 1974. The Non-marine Aquatic Mollusca of Thailand. Arch. Moll., 105 (1/4):1 - 423, pls. 1 - 30.

Chou, L.M. & Lam, T.J. 1989. Introduction of exotic aquatic species in Singapore. IN: Exotic aquatic organisms in Asia (154 pages). Proceedings of the workshop on introduction of exotic aquatic organisms in Asia. Editor: S. S. de Silva. Asian Fish. Soc. Spec. Publ., 3:91 - 97.

Clements, R., Lian P.K., Tien M.L., R. Meier & D. LI 2006. Importance of Reservoirs for the conservation of freshwater molluscs in a tropical urban landscape. Biological Conservation, 128 (2006):136 - 146.

Haas, F. 1952. Some non-marine mollusks from Northwest and Southwest Siam. Bull. Siam Soc. Nat. Hist. 15(1):21-25.

Lim, C.F. 1970. A checklist of the molluscs of Singapore. 46 pages. Department of Zoology, University of Singapore (unpublished).

Mekong River Commission (MRC) 2006. Freshwater Mollusca. Chapter 10. Pages 41 - 74 (34 pages). IN: Identification of freshwater invertebrates of the Mekong River and its tributaries. 276 pages.

Ng, Peter K.L., Chou, L.M. & Lam, T.J. 1993. The status and impact of introduced freshwater animals in Singapore. *Biological Conservation*, 64:19 - 24.

Woodward, F.R. 1969. The morphology of *Ensidens ingallsianus* (Lea, 1852) and *Scabies crispata* (Gould, 1843). *Vidensk Meddr dansk naturh. Foren*, 132: 49-62.

Some aquaria-limited clams from Singapore (Unionidae - *Hyriopsis bialatus* Simpson, 1900)

CHAN Sow-Yan
 Vbox 888313, Singapore 919191, SINGAPORE.
 chansowyan@gmail.com

What a surprise! This was the first time I saw a large and elegant freshwater clam available for sale in a large aquarium store in Singapore and it is a 2-winged unionid, *Hyriopsis bialatus*, a widespread species occurring naturally in mostly Indochina. Another surprise was 2 live purplish *Batissa similis* Prime, 1859 with its heavy periostracum neatly ripped off! The clams are speculated to originate from Thailand (*Corbicula siamensis* and *Unionetta fabagina* were also found in the same tank) and are potentials for introduction.

Note: The above mentioned clams (empty) are available for loan and studies.



References:

Brandt, Rolf A.M. 1974. The Non-marine Aquatic Mollusca of Thailand. *Arch. Moll.*, 105 (1/4):1 - 423, pls. 1 - 30.

Chou, L.M. & Lam, T.J. 1989. Introduction of exotic aquatic species in Singapore. IN: Exotic aquatic organisms in Asia

(154 pages). Proceedings of the workshop on introduction of exotic aquatic organisms in Asia. Editor: S. de Silva. *Asian Fish. Soc. Spec. Publ.*, 3:91 - 97.

Clements, R., Lian P.K., Tien M.L., R. Meier & D. LI 2006. Importance of Reservoirs for the conservation of freshwater molluscs in a tropical urban landscape. *Biological Conservation*, 128 (2006):136 - 146.

Haas, F. 1952. Some non-marine mollusks from Northwest and Southwest Siam. *Bull. Siam Soc. Nat. Hist.* 15(1):21-25.

Huang, Y.Y., H.Z. Liu, X.P. Wu & S. Ouyang. 2002. Testing the relationships of Chinese freshwater Unionidae based on analysis of partial mitochondrial 16s rRNA sequences. *Journal of Molluscan Studies*, 68 (4):359 -363.

Lim, C.F. 1970. A checklist of the molluscs of Singapore. 46 pages. Department of Zoology, University of Singapore (unpublished).

Liu, Y.Y. 1979. Freshwater Mollusks. Economic Fauna of China. Science Press, Beijing, Peoples Republic of China.

Mekong River Commission (MRC) 2006. Freshwater Mollusca. Chapter 10. Pages 41 - 74 (34 pages). IN: Identification of freshwater invertebrates of the Mekong River and its tributaries. 276 pages.

Ng, Peter K.L., Chou, L.M. & Lam, T.J. 1993. The status and impact of introduced freshwater animals in Singapore. *Biological Conservation*, 64:19 - 24.

Additional Information Concerning the Conquest of Europe by the Invasive Chinese Pond Mussel *Sinanodonta woodiana*. 17. News from Hungary, Italy, Poland and Serbia

Henk K. Mienis
 Mollusc Collection, National Collections of Natural History, Dept. Zool., Tel Aviv University, IL-69978 Tel Aviv, Israel and
 Mollusc Collection, National Natural History Collections, Berman Bldg., Hebrew University, IL-91904 Jerusalem Israel
 mienis@netzer.org.il

The presence of the Chinese Pond Mussel *Sinanodonta woodiana* (Lea, 1834) in Europe remains a hot topic. Recently published articles have become available from Hungary, Italy, Poland, and Serbia. The paper describing the presence of this invasive mussel species in the Eastern Odra River in Poland is especially interesting since it means that the Chinese Pond Mussel is not only encroaching upon Germany from the south via the Danube, but also from the east by means of the Oder, which forms the border between Poland and Germany. Although a short paper by Jacques Mouthon concerning a new locality of *S. woodiana* in the south of France has become available on the internet (www.journal-malaco.fr/page-35.html), it will be reported in the next installment of this series, because volume 5 of MalaCo has not yet been published.

Hungary

The Chinese Pond Mussel was one of the 52 molluscs recorded in a review of the fauna and flora of the Ráckeve-

Soroksár Danube (Vadadi-Fülöp et al., 2007), a 58 km long arm of the Danube running from the Kvassay sluice in Budapest southwards to the Tassi sluice north of Dunaújváros. Among the fish species mentioned in the report are some of the major host species of the glochidia of this large mussel.

Italy

In another review this time dealing with the presence of exotic species in Italy (Gherardi et al., 2008), *Sinanodonta woodiana* (as *Anodonta*) is recorded as having been unintentionally introduced by stocking [ponds with various species of Carps].

Poland

An inventory carried out in 2004-2005 revealed the presence of *Sinanodonta woodiana* at five different localities in channels near the Eastern Odra River (Regalica), Western Pomerania Region, Poland (Domagała et al., 2007). All the localities are downstream of the Dolna Odra Power Plant. Although the channels are partly frozen during the winter, glochidia were present in the outer demibranch marsupia of the females, an indication that this mussel species has adapted well to conditions in temperate zones.

The presence of the Chinese Pond Mussel in the Eastern Odra River is also of faunistic importance for Germany since the Western Odra River (or Oder, in German), which is connected by means of an intensive network of channels with the Eastern Odra River, forms the border between Poland and Germany.

Soroka (2008) published a second paper on the double uniparental inheritance of mitochondrial DNA in the Chinese Pond Mussel, an event still under recorded among freshwater mussels.

Serbia

The Chinese Pond Mussel is being used more and more for biochemical research within its range of distribution in Central Europe. In Serbia two papers have been published recently on the activities of superoxide dismutase and catalase in the foot of *Sinanodonta* and two species of *Unio* from the river Sava (Perendija et al., 2007a) and glutathione dependent enzyme activities in the foot of these three mussel species (Perendija et al., 2007b).

References

Domagała, J., Łabęcka, A.M., Migdalska, B. & Pilecka-Rapacz, M. 2007. Colonisation of the Channels of Międzyodrze (North-Western Poland) by *Sinanodonta woodiana* (Lea, 1834) (Bivalvia:Unionidae). Polish Journal of Natural Sciences, 22 (4): 679-690.

Gherardi, F., Bertolino, S., Bodon, M., Casellato, S., Cianfanelli, S., Ferraguti, M., Lori, E., Mura, G., Nocita, A., Riccardi, N., Rossetti, G., Rota, E., Scalera, R., Zerunian, S. & Tricarico, E. 2008. Animal xenodiversity in Italian inland waters: distribution, modes of arrival, and pathways. Biological Invasions, 10: 435-454.

Perendija, B.R., Borković, S.S., Kovačević, T.B., Pavlović, S.Z., Stojanović, B.D., Paunović, M.M., Cakić, P.D., Pajović, S.B. & Saičić, Z.S. 2007a. Activities of superoxide

dismutase and catalase in the foot of three freshwater mussel species. Archives of Biological Sciences, Belgrade, 59 (2): 17P-18P.

Perendija, B.R., Borković, S.S., Kovačević, T.B., Pavlović, S.Z., Stojanović, B.D., Paunović, M.M., Cakić, P.D., Radojičić, R.M., Pajović, S.B. & Saičić, Z.S. 2007b. Glutathione dependant enzyme activities in the foot of three freshwater mussel species in the Sava River, Serbia. Archives of Biological Sciences, Belgrade, 59 (3):169-175.

Soroka, M. 2008. Doubly uniparental inheritance of mitochondrial DNA in the freshwater bivalve *Anodonta woodiana* (Bivalvia: Unionidae). Folia Biologica (Kraków), 56 (1-2): 91-95.

Vadadi-Fülöp, Cs., Mészáros, G., Jablonszky, Gy. & Hufnagel, L. 2007. Ecology of the Ráckeve-Soroksár Danube – a review. Applied Ecology and Environmental Research, 5 (1): 133-163.

Additional News about the Presence of Quagga Mussels in the Netherlands

Henk K. Mienis

National Collections of Natural History, Department of Zoology, Tel Aviv University, IL-69978 Tel Aviv, Israel
and

National Natural History Collections, Berman Building, Hebrew University of Jerusalem, IL-91904 Jerusalem, Israel
mienis@netzer.org.il

The first record of the Quagga mussel *Dreissena bugensis* (Andrusov, 1897) from the Netherlands goes back to Bij de Vaate (2006), who found the species on 19 April 2006 near Willemstad in the Hollands Diep, part of the Rhine delta. A more in depth coverage on that find was given by Molloy et al., 2007.

In the meantime this species has been reported from other localities in the Netherlands, although most of these records have never been published properly. Soes (2007) found this species near Wageningen in the Neder-Rijn ("Lower-Rhine") on 27 September 2007. About 40% of all the *Dreissena* specimens collected by him turned out to belong to *bugensis*, all others to *polymorpha*.

On the website "waarneming.nl", devoted to observations concerning the flora and fauna of the Netherlands, the Quagga mussel has also been reported from the Diem and the Kinselmeer, lakes situated respectively in the south-eastern part and just north-east of Amsterdam. Both localities are situated at a stone-throw from the IJsselmeer.

Unpublished records are still known from the IJssel (a branch of the Rhine), the Ketelmeer (at the mouth of the IJssel), Markermeer and IJmeer. The last three localities are all parts of the IJsselmeer. If these localities turn out to be correct then the whole delta of the Rhine in the Netherlands i.e. from the entrance of that river near Millingen at the German-Dutch border up to its outlet in either the North Sea or the IJsselmeer seems to be infected by this invasive species.

References

- Bij de Vaate 2006. De Quaggamosse, *Dreissena rostriformis bugensis* (Andrusov, 1897), een nieuwe zoetwater mosselsoort voor Nederland. *Spirula*, 353:143-144.
- Molloy, D.P., bij de Vaate, A., Wilke, T. & Giamberini, L. 2007. Discovery of *Dreissena rostriformis bugensis* (Andrusov 1897) in Western Europe. *Biological Invasions*, 9: 871-874.
- Soes, D.M. 2007. Quagga-mossels bij Wageningen. *Macrofaunanieuwsbrief*, 75: 2 pp. <http://macrofauna.web-log.nl/macrofauna/> (7 December 2007)

Predation on Five Species of Unionidae near Polder the Berkmeer, North-Holland, the Netherlands, by Invasive Muskrats, Followed by a List of References for Predation on Freshwater Mussels by *Ondatra zibethicus* in Europe

Henk K. Mienis

Mollusc Collection, National Collections of Natural History, Dept. Zool., Tel Aviv University, IL-69978 Tel Aviv, Israel and
National Mollusc Collection, Dept. Evol., Systematics & Ecol., Hebrew University of Jerusalem, IL-91904 Jerusalem, Israel
mienis@netzer.org.il

Years ago I published a short note dealing with the unexpected find of a large population of *Ceriuella aginnica* (Locard 1882), Fam. Hygromiidae, an exotic land snail in Polder the Berkmeer, North-Holland, the Netherlands (Mienis, 1993).

In the introduction I mentioned the find of five different species of large freshwater molluscs in canal the "Korte Lagererei" where it enters another canal running around Polder the Berkmeer: *Unio pictorum* (Linnaeus 1758), *Unio tumidus depressus* (Donovan, 1802), *Anodonta anatina* (Linnaeus, 1758), *Anodonta cygnea cellensis* (Schröter, 1779), and *Pseudanodonta complanata elongata* (Holandre, 1836), all Unionidae. It was the first place where I found these five species together in the province North-Holland north of the North-Sea-channel. What I did not mention was the fact that all the specimens were found in a so-called shell midden of the Muskrat *Ondatra zibethicus*.

That a muskrat midden may form an excellent starting point for assessing the mussel diversity of a stream or lake has been pointed out over and over again elsewhere. Although it may not contain all the species living in a certain aquatic biotope, often rare to very rare species are also present in such mussel heaps. *Pseudanodonta* is considered in the Netherlands an endangered species (de Bruyne et al., 2003); at localities where it still occurs, population density is usually very low. I doubt very much whether I would have noticed the presence of that particular mussel species near the Berkmeer without the help of the Muskrats.

Additional references to literature mentioning predation on large freshwater mussels by the Muskrat in Europe are given

at the end. It forms a supplement to a similar list published in a previous issue of "Ellipsaria" (Mienis, 2007).

References

- Bruyne, R.H., Wallbrink, H & Gmelig Meyling, 2003. Bedreigde en verdwenen land- en zoetwaterweekdieren in Nederland (Mollusca). Basisrapport met voorstel voor de Rode Lijst. 88 p. Stichting European Invertebrate Survey – Nederland, Leiden & Stichting Anemoon, Heemstede.
- Mienis, H.K., 1993. De Franse duinslak: *Ceriuella aginnica* (Locard, 1882) nabij de Opdammermolen, Polder de Berkmeer, Noord-Holland. *Correspondentieblad van de Nederlandse Malacologische Vereniging*, 271: 30-32.
- Mienis, H.K., 2007. Some literature dealing with predation on bivalves by the Muskrat *Ondatra zibethicus* In North America and Europe. *Ellipsaria*, 9 (1): 8-9.

Additional References dealing with predation on freshwater mussels by *Ondatra zibethicus* in Europe

- Ehrenberg, K. 1951. Beobachtungen über Lebensspuren und Nahrungsweise der Bisamratte (*Fiber zibethicus* L.). Sitzungsberichten österr. Akademie für Wissenschaften (math.-naturw. Kl. Abt. I), 160 (5): 355-376.
- Hochwald, S. 1990. Bestandsgefährdung seltener Muschelarten durch den Bisam (*Ondatra zibethica*). Schriftenreihe Bayerischen Landesamt für Umweltschutz, 97: 113-114.
- Mildner, P., & Taurer, M. 2003. Beitrag zur Unionidenfauna Kärntens (Mollusca: Bivalvia: Unionidae). *Rudolfinum, Jahrbuch des Landesmuseums Kärnten* 2002: 417-446.
- Nesemann, H., & Holler, C. 1998. Zur Wassermolluskenfauna (Mollusca: Gastropoda, Bivalvia) des burgenländisch-ungarischen Stremtales (Bezirk Güssing, Komitat Vas). *Nachrichtenblatt der Ersten Vorarlberger Malakologischen Gesellschaft*, 6: 15-22.
- Reischütz, A., & Reischütz, P.L. 2001. Zur möglichen Gefährdung von Muscheln durch den Bisam [*Ondatra zibethica* (Linné)]. *Nachrichtenblatt der Ersten Vorarlberger Malakologischen Gesellschaft*, 9: 18-20.
- Taurer, M.M. 2007. Die Grossmuschelpopulationen im Eggerteich (Kärnten, Österreich). *Carinthia*, 197./117: 279-286.

Additional localities of the freshwater snail *Tarebia granifera* from Israel with a note on the presence of another tropical invasive gastropod *Thiara scabra*

Henk K. Mienis

National Collections of Natural History, Department of Zoology, Tel Aviv University, IL-69978 Tel Aviv, Israel and
National Natural History Collections, Berman Building, Hebrew University of Jerusalem, IL-91904 Jerusalem, Israel
mienis@netzer.org.il

Recently Ben-Ami (2006) recorded the Quilted melania *Tarebia granifera* (Lamarck, 1822), Fam. Thiaridae, a tropical invasive freshwater snail, from four localities in the

Bet Shean Valley, Israel: 'En Avoqa, 'En Saharon, 'En Tayyon and Ein umm Sidra. These localities were also mentioned by Sivan, Ben-Ami & Heller (2007).

Recent fieldwork, carried out by Dr. Menachem Goren and Dr. Reuven Ortal, has revealed the presence of this tropical invasive freshwater snail at two other localities: 'En Kaftor, leg. M. Goren, 27 November 2007 (TAU MO 59100/15) and Nahal Amal, leg. R. Ortal, 21 January 2008 (HUJ and TAU MO 59556/numerous juveniles). Both localities are situated in the Bet Shean Valley in Israel. At all the known localities adult and juvenile specimens were present, which forms a clear indication that breeding populations are established in that region. Interestingly all the springs ('En and Ein/Ain are respectively the Hebrew and Arabic words for spring) are isolated from each other.

According to Ben-Ami (2006) the invasive *Tarebia granifera* seems to replace the local Red-rim melania *Melanoides tuberculata* (Müller, 1774).

Fieldwork carried out in Nahal Qibbuzim, a stream in the same Bet Shean Valley, revealed the presence of another tropical invasive gastropod: the Rough melania *Thiara scabra* (Müller, 1774), Fam. Thiaridae. The same species has been found in the meantime also in the Sea of Galilee. The following records of this new species for the fauna of Israel are now known:

BET SHEAN VALLEY: Nahal Qibbuzim, eastern part, leg. I. Guata, 8 May 2006 (TAU MO 59518/2); idem, western part, leg. Y. Hershkovic, 23 July 2007 (TAU MO 60007/3); idem, central part, near parking lot, leg. R. Ortal, 21 January 2008 (TAU MO 60010/numerous adults and juveniles); idem, central part, leg. Y. Krotman, 11 February 2008 (TAU MO 59715/5).

SEA OF GALILEE: 'En Gev, on the beach of the harbour, opposite the fish restaurant, leg. Z. Lewy, 5 November 2007 (HUJ and TAU MO 59596/numerous shells); Qevuza Kinneret, in drift along the banks, leg. U. Werner-Reis, 17 December 2007 (HUJ and TAU MO 59470/numerous shells).

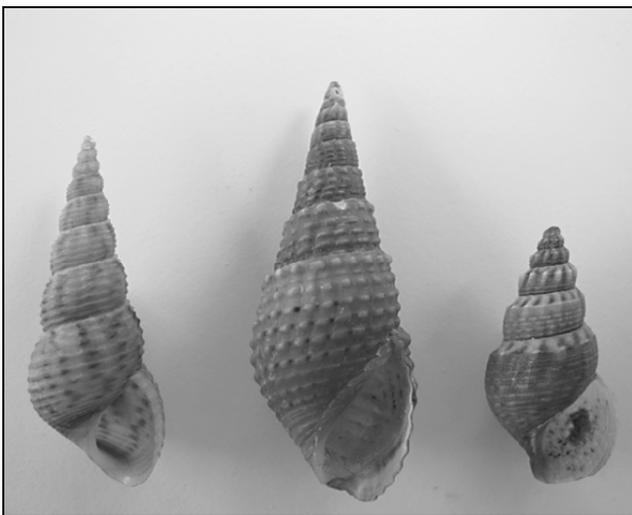


Fig. 1. Left to right: *Melanoides tuberculata*, *Tarebia granifera* and *Thiara scabra*. Photo: Dana Mienis.

The presence of *Thiara scabra* in the Sea of Galilee forms an alarming event. In a relatively short time this species seems to have built up dense populations according to the thousands of shells found in drift on the banks of the lake near 'En Gev and Qevuza Kinneret. This lake forms the major source for potable water in Israel and its water is carried by means of the National Water Carrier to many areas throughout Israel. How *Tarebia granifera* and *Thiara scabra* have managed to reach Israel is still a riddle.

Acknowledgements

I like to thank Dr. Ze'ev Lewy (Geological Survey of Israel, Jerusalem), Dr. Reuven Ortal (Israel Nature and National Parks Protection Authority, Jerusalem), U. Werner-Reis (Hebrew University of Jerusalem), Dr. Menachem Goren, Dr. Revital Ben-David-Zaslow, Ifat Guata, Yaron Hershkovic, Yaron Krotman and Osnat Mor (all Tel Aviv University) for donating the mollusc material to the National Mollusc Collections of the Tel Aviv University (TAU MO) and the Hebrew University of Jerusalem (HUJ) or for supplying background information.

References

- Ben-Ami, F. 2006. First report of the invasive freshwater snail *Tarebia granifera* (Lamarck, 1816) (Gastropoda: Thiaridae) from Israel. *The Nautilus*, 120 (4): 156-161.
- Sivan, N., Ben-Ami, N. Heller, J. 2007. Taxonomy of Pliocene and Quaternary Thiaridae (Gastropoda) of Israel. *Journal of Conchology*, 39 (4): 411-424.

Mollusk fauna occurrence in irrigated rice fields of the Southern Brazil: a preliminary general report

A. Ignacio Agudo-Padrón¹ & Jaime Vargas de Oliveira²

¹Projeto Náíade (Naiad Project), Avulsos Malacológicos, Caixa Postal 010, 88010-970 Centro, Florianópolis, Santa Catarina, SC, Brasil. ignacioagudo@gmail.com

²Instituto Rio Grandense do Arroz – IRGA/EEA, Av. Bonifácio Carvalho Bernardes, 1494, Caixa Postal 29, 94930-030, Cachoeirinha, Rio Grande do Sul, RS, Brasil. irgafito@via-rs.net

The advancing invasion of several limnic and terrestrial mollusks species, mainly natives and exotics gastropods, and the damage that these animals can cause to the irrigated rice systems and other agricultural productions, besides interest for veterinary, medical, and sanitation applications (public health problems), makes it more and more important to focus on pest management. Delivering adequate information about aquatic snails and improving knowledge about pest management is essential to control this growing threat, and Brazil is a clear example of this situation (Agudo 2007).

The States of Santa Catarina (SC) and Rio Grande do Sul (RS), important national producers of irrigated rice, are part of Brazil's southernmost region. The Uruguay River basin is the principal irrigation source for both states. Present research focuses on the occurrence of mollusks on the irrigated rice (*Oryza sativa* L.) field systems, and its

identification and characterization as agricultural plagues, developed in the headquarter of the Rice Experimental Station of the IRGA, Municipal District of Cachoeirinha, Rio Grande do Sul (RS) State (Fig. 1).

This aspect of the regional natural history has been poorly documented, with only few known species cited in previous bibliographical records, summarized in progress in the present study (Prando & Bachia 1995; Oliveira et al 1999 a, b, c; Richinitti & Petrini 1999; Pereira et al 2000 b; several authors 2005).

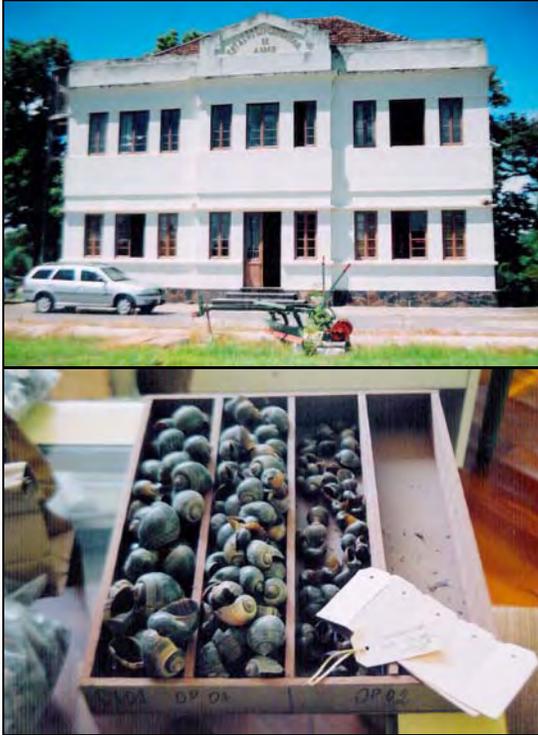


Figure 1. Headquarters of the Rice Experimental Station, IRGA (top), and *Pomacea canaliculata* (bottom).

Preliminary analyses of 1,780 specimens (Fig. 1) among freshwater/limnic gastropods (some terrestrial forms) and bivalves, collected in fields of irrigated rice in six Municipal Districts places of the State of Rio Grande do Sul: Cachoeirinha, Restinga Seca, Capivari do Sul, Formigueiro, Viamão & El Dorado do Sul, between of October 2007 (southern Spring) and January 2008 (southern Summer), produced the following result:

Systematic Species List and Comments

Class GASTROPODA

Subclass Prosobranchia

Family AMPULLARIIDAE

Pomacea canaliculata (Lamarck, 1804)(*)*(1,492 samples)**

Present in all the related Municipal Districts; native species of “serious emergent agricultural plague” in the State (Oliveira et al 1999 a, b, c; Richinitti & Petrini 1999) (Fig. 1), generating great damages. Surprisingly, it invaded the territories of the Asian southeast in the 1980's via intentional human introduction as alimentary resource, and may turn into a serious “exotic plague” and threatens the production of rice, devastating this

principal local food (Damborenea & Darrigran 2001/2; Ghesquiere 2005).

*Naturally depredated locally by the birds *Aramus guarauna* (Linnaeus, 1766) (Limpkin) and *Rostrhamus sociabilis* (Vieillot, 1817) (Snail kite).

**Previous collection in little pond of “Morro das Furnas”, Municipal District of Torres (July 7, 2006), by the first author.

Asolene platae (Maton, 1809)*(21 samples)

Present in 4 Municipal districts: Cachoeirinha, Capivari do Sul, Formigueiro, and Viamão.

*Naturally depredated locally by the birds *Aramus guarauna* (Linnaeus, 1766) (Limpkin) and *Rostrhamus sociabilis* (Vieillot, 1817) (Snail kite).

Subclass Pulmonata

Family PLANORBIDAE

Biomphalaria tenagophila tenagophila (d’Orbigny, 1835)(*)*(234 samples)

Present in 2 Municipal districts: Cachoeirinha and Restinga Seca.

*Confirmed intermediate host of “Schistosomiasis”, serious tropical zoonose of parasitic nature with medical and sanitation applications (Agudo 2006).

Drepanotrema depressissimum (Moricand, 1839)*(8 samples)

Present in 2 Municipal districts: Cachoeirinha and Restinga Seca

*Observed in abundance (January 2008) in the irrigated rice fields of the IRGA Experimental Station, Cachoeirinha Municipal District.

Biomphalaria tenagophila guaibensis Paraense, 1984 (2 samples)

Present in the Municipal District of Restinga Seca.

Family PHYSIDAE

Aplexa (Stenophysa) marmorata (Guilding, 1828)(*)*(8 samples)

Present in 2 Municipal districts: “Cachoeirinha” and “Restinga Seca”

*Observed in great abundance/proliferation and in full reproductive activity (January 2008) in the irrigated rice fields of the IRGA Experimental Station, Cachoeirinha Municipal District.

Family BULIMULIDAE

Bulimulus tenuissimus (d’Orbigny, 1835)(*)*(1 sample)

Present in the Municipal District of “Cachoeirinha”

*Native terrestrial species, recognized as severe agricultural plague of vegetables in some places of Santa Catarina's State (Agudo 2007).

Class Pelecypoda = Bivalvia

Order Unionoida

Family MYCETOPODIDAE

Anodontites sp*(2 samples)

Present in the artificial dams places of the IRGA Experimental Station, Cachoeirinha Municipal District.

*Naturally depredated in the local environment by the bird *Aramus guarauna* (Linnaeus, 1766).

Family HIRIIDAE

Rhipidodonta charruana (d’Orbigny, 1835) (2 samples)

Present in the artificial dams places and irrigation channels of the IRGA Experimental Station, Cachoeirinha Municipal District.

Order Veneroida

Family CORBICULIDAE

Corbicula fluminea (Müller, 1774) (10 samples)

Present in the irrigation channels of the IRGA Experimental Station, Cachoeirinha Municipal District.

In these experimental fields (Oliveira et al 1988, 2005; Menegat et al 2006: 32, 132), the aquatic fauna includes several aquatic insects, dark freshwater turbellarians (planarians), crustacea Ostracoda (very abundant), and some fish species. The malacological fauna identified belongs with the studies in the Gravataí River Basin (Veitenheimer-Mendes et al 1992: 74) and other close localities of the State (Pereira et al 2000 a, b, 2001).

Based specifically on Simone (2006: 214), they were examined in the headquarters of the Experimental Station of IRGA two terrestrial shells of *Megalobulimus musculus* (Bequaert, 1948) (MEGALOBULIMIDAE), coming from the Municipal district of Caçapava do Sul, interior lands of the RS State (very abundant in the locality), collected by the IRGA Researcher Thais F. S. de Freitas.

In the State of Santa Catarina, *Physa acuta* Draparnaud, 1805 (= *cubensis* Pfeiffer, 1839), a global little species of the family Physidae, comes as severe malacological plague of the irrigated rice, generating great damages (Prando & Bachia 1995).

Finally, registrations in the specialized literature (Prando & Bachia 1995; Agudo 2004; several authors 2005: 92, among others) still denounce the occurrence in the regional fields of irrigated rice of the next freshwater pulmonate snail species:

Lymnaea columella (Say, 1817)(*)*

*Sudamerican species of the family Lymnaeidae, confirmed intermediate host of “Fasciolose or Fasciolíase”, serious zoonose of parasitic nature with immediate interest for veterinarian, medical and sanitation applications (Beck 1993; Marques et al 2003; Agudo 2006).

Biomphalaria glabrata (Say, 1818)(*)*

Biomphalaria straminea (Dunker, 1848)*

*Confirmed intermediates hosts of “Schistosomiasis”, serious tropical zoonose of parasitic nature with immediate interest for medical and sanitation applications (Teles et al 1991: 351-fig; Carvalho et al 1998; Passos 1998; Agudo 2006).

Biomphalaria peregrina (d'Orbigny, 1835)(*)

(*) Species in both States.

References:

Agudo, A.I. 2004. Preliminary report on the freshwater mollusks fauna of Mampituba river basin, Santa Catarina State, southern Brazil. *Ellipsaria* 6(1): 10-11.
Agudo, A.I. 2006. Intermediate host mollusks (Gastropoda: Pulmonata) of parasitic diseases in Santa Catarina's State, Southern Brazil, with inclusion of new records to add to regional inventory. *Ellipsaria* USA, 8(2): 11-13.

Agudo, I. 2007. Moluscos na condição de pragas no Brasil (Mollusks in the condition of plagues in Brazil). São Paulo, SP: Conquiliologistas do Brasil (Shell Club), January 2007. <http://www.conchasbrasil.org.br/materias/pragas/visaogeral/>
Beck, A.H. 1993. Fasciolose. *A Hora Veterinária*, Porto Alegre, (75): 65-70.
Carvalho, O. dos S.; I.M. Nunes & R.L. Caldeira. 1998. First report of *Biomphalaria glabrata* in the State of Rio Grande do Sul, Brazil. *Memórias do Instituto Oswaldo Cruz*, Rio de Janeiro, 93(1): 39-40.
Ghesquiere, S. 2005. Apple Snails (Ampullariidae). Available in: <http://www.applesnail.net> .
Marques, T.; S. Márcia & M.L. Scroferneker. 2003. Fasciola hepatica infection in cattle and buffaloes in the State of Rio Grande do Sul, Brazil. *Parasitologia Latinoamericana*, Santiago de Chile, 58(3-4): 169-172.
Menegat, R.; M.L. Porto, C.C. Carraro & L.A.D. Fernandes (Coords.). 2006. Atlas Ambiental de Porto Alegre. Porto Alegre, RS: UFRGS, 256 p., 1 CD-Rom.
Oliveira, J. . de; H.V. Ramirez & V.G. Menezes. 1999 a. Controle de moluscos (*Pomacea canaliculata*) em arroz irrigado no sistema pré-germinado. Pelotas, RS: EMBRAPA Clima Temperado, Anais da XXIII Reunião da Cultura do Arroz Irrigado, Agosto 2-5 de 1999:413-414.
Oliveira, J.V. de; H.V. Ramirez & V.G. Menezes. 1999 b. Avaliação de danos do molusco (*Pomacea canaliculata*) em arroz pré-germinado. Pelotas, RS: EMBRAPA Clima Temperado, Anais do 2º Encontro Estadual do Sistema de Arroz Pré-Germinado e 1º Seminário do Arroz Pré-Germinado do Mercosul, Torres, RS, Agosto 12-14 de 1998: 155-156.
Oliveira, J.V. de; H.V. Ramirez & V.G. Menezes. 1999 c. Danos do molusco (*Pomacea canaliculata*) em arroz irrigado no sistema pré-germinado. Piracicaba, SP: USP, Anais e Ata da VII Reunião Sul Brasileira sobre Pragas de Solo, Piracicaba, SP, Outubro 19-20 de 1999: 80-81.
Oliveira, M. de L.A.A. de; M.T.M. B. das Neves, T. Strehl, R.L.D. Ramos & O. L. Bueno. 1998. Vegetação de macrófitas aquáticas das nascentes do Rio Gravataí, Rio Grande do Sul, Brasil – Levantamento preliminar. *Iheringia, Sér. Bot.*, Porto Alegre, (38): 67-80.
Oliveira, M. de L.A.A. de; R.A. Balbuena & R.M. Senna. 2005. Levantamento florístico de fragmentos florestais na bacia hidrográfica do rio Gravataí, Rio Grande do Sul, Brasil. *Iheringia, Sér. Bot.*, Porto Alegre, 60(2): 269-284.
Passos, A.D.C. 1998. Controle da Esquistossomose: diretrizes técnicas. Brasília, DF: Ministério da Saúde/Fundação Nacional da Saúde, 70 p.
Pereira, D.; H.G. Konrad & N.I. Paloski. 2000 a. Gastrópodos límnicos da Bacia do Rio Camaquã, RS, Brasil. *Acta Biológica Leopoldensia*, 22(1): 55-66.
Pereira, D.; I.L. Veitenheimer-Mendes, M.C.D. Mansur & M.C.P. da Silva. 2000 b. Malacofauna límnic do sistema de irrigação da microbacia do Arroio Capivara, Triunfo, RS, Brasil. *Biociências*, Porto Alegre, 8(1): 137-157.
Pereira, D.; L.A. Inda, J.M. Consoni & H.G. Konrad. 2001. Composição e abundância de espécies de moluscos do bentos marginal da microbacia do arroio Capivara, Triunfo, RS, Brasil. *Biociências*, Porto Alegre, 9(1): 3-19.
Prando, H.F. & R.E. Bachia. 1995. Ocorrência e controle de moluscos gastrópodes em arroz irrigado no sistema pré-germinado, em Santa Catarina. Porto Alegre, RS: IRGA, Anais XXI Reunião da Cultura do Arroz Irrigado, Setembro 20-22 de 1995: 229-231.

Richinitti, L.M. & J.A. Petrini. 1999. Moluscos gastrópoda: nova praga do arroz pré-germinado no RS. Pelotas, RS: EMBRAPA Clima Temperado, Anais do 2º Encontro Estadual do Sistema de Arroz Pré-Germinado e 1º Seminário do Arroz Pré-Germinado do Mercosul, Torres, RS, Agosto 12-14 de 1998: 157-159.

Several authors. 2005. Arroz irrigado: recomendações técnicas da pesquisa para o Sul do Brasil. Santa Maria, RS: Sociedade Sul-Brasileira de Arroz Irrigado, IV Congresso Brasileiro de Arroz Irrigado & XXVI Reunião da Cultura do Arroz Irrigado, Santa Maria, Agosto 09-12 de 2005, 159 p.

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

Teles, H.M.S.; P.A.C. Pereira & L.M.Z. Richinitti. 1991. Distribuição de *Biomphalaria* (Gastropoda, Planorbidae) nos Estados do Rio Grande do Sul e Santa Catarina, Brasil. *Revista de Saúde Pública*, São Paulo, 25(5): 350-352.

Veitenheimer-Mendes, I.L.; V.L. Lopes-Pitoni, M.C.P. da Silva, J.E. de Almeida-Caon & N.T. Schröder-Pfeifer. 1992. Moluscos (Gastropoda e Bivalvia) ocorrentes nas nascentes do Rio Gravataí, Rio Grande do Sul, Brasil. *Iheringia, Sér. Zool.*, Porto Alegre, (73): 69-76.

Occurrence of the invasive exotic freshwater snail *Melanoides tuberculatus* (Müller, 1774) in Santa Catarina State, Southern Brazil, and the potential implications for the local public health

A. Ignacio Agudo

Projeto Naiade (Naiade Project), Avulsos Malacológicos-AM
Caixa Postal (P. O. Box) 010, 88010-970 Centro,
Florianópolis, Santa Catarina – SC, Brasil
iagudo@intergate.com.br – <http://www.malacologia.com.br>

The afro-asiatic limnic gastropod *Melanoides tuberculatus* (Müller, 1774), family Thiaridae, has been studied as the invasive exotic intermediate host of some human parasitic diseases and is known to displace native species in the environment. Reports concerning its introduction in Latin America started in the 1960s, and it is now distributed in all countries of the area.

The first record in the Brazilian territory was in 1967 in the State of São Paulo, southeastern region, with several registrations dispersed in the country (Fernandez et al 2002, 2003). The origin of its introduction in Brazil stays unknown, but is probably linked to the plant and freshwater ornamental fish trade (Fernandez et al 2003). In the Brazilian southernmost region it is known in Paraná and Santa Catarina (Fernandez et al 2003; Agudo-Padrón 2008).

Regarding the medical importance of this limnic snail, close to the little native freshwater/eurihaline *Heleobia piscium* (= *australis*) (d'Orbigny, 1835) (Agudo-Padrón 2006), it acts as potential intermediate host of *Paragonimus westermani* (Kerbert, 1878), responsible for Paragonimiasis, a serious tropical parasitic disease that it involves in its natural life cycle several species of crabs and shrimps used for human consumption (Thiengo et al 2005; Thiengo 2007), another recognized problem of public health involving vectorial mollusks of parasitic diseases directly related to the

denominated "inadequate environmental sanitation" (Agudo 2006; Agudo-Padrón 2006).

Particularly in the State of Santa Catarina, the first reports of this exotic species are quite recent (Agudo 2003, 2004, 2007), limited to limnic coastal places (Fig. 1) of the Municipal districts of Balneário Camboriu (first registration in the North coast, Spring 2002) and Palhoça (second and third registrations in the coast Center-South, Summer 2003) (Thiengo 2003; Fernandez et al 2003; Agudo & Bleicker 2004, 2006; Thiengo et al 2007).



Arte: Boletim AM

Fig. 1. Current known distribution of the freshwater invasive exotic gastropod *Melanoides tuberculatus* in Santa Catarina.

On January 09 2008, it was examined by us in a located fish market in the Bairro Balneário Ponta do Papagaio, Municipal District of Palhoça, from a recently near fresh shipment of native eurihaline sea shrimps *Litopenaeus schmitti* (Bunkenroad, 1936) and/or *Farfantepenaeus paulensis* (Pérez Farfante, 1967) - total of 18 kg in humid weight - conditioned in thermal box with dirty ice, getting our attention immediately the mixed presence of varied organic debris of vegetable origin and some minerals, besides abundant small snails, indicating an evident recent capture of the crustaceans, very probably in a near coastal sea area (estuary of some local river mouth?) domain of the growth of mangroves. With the owners' authorization, an immediate exam and selection of the material contained in the shipment was accomplished, being found mixed with the crustaceans the following limnic/eurihaline malacological material (humid weight oscillated between 90 grams and 1 kg) deposited in the Malacological Collection of the ECZ/CCB/UFSC - Universidade Federal de Santa Catarina, under the care of the malacologist Prof. Ms. Kay Saalfeld:

- *Melanoides tuberculatus* (Müller, 1774) –
Prosobranchia/THIARIDAE: 5.652 fresh specimens with
several sizes. Vectorial species, intermediate host of
“Paragonimiasis”
- *Biomphalaria straminea* (Dunker, 1848) –
Pulmonata/PLANORBIDAE: 39 fresh specimens.
Vectorial species, intermediate host of “Schistosomiasis”
(Agudo-Padrón 2006).
- *Pomacea canaliculata* (Lamarck, 1804) –
Prosobranchia/AMPULLARIIDAE: 8 little specimens and
1 adult fragment.

The owners of the fish market told us the shrimp shipment had been acquired on that same day in a “warehouse of fish” located in the regional colony of fishermen of the Barra do Aririú, a few kilometers North in the Palhoça Municipal District, just in coastal area with access to the estuary and mouth of the Aririú River Basin, with discharge into the South bay of Florianópolis – Santa Catarina Island, inside the Parque Estadual da Serra do Tabuleiro.

In conclusion, it is evidenced the disregard for the low quality control and sanity presented by the products marketed openly at fish markets and “interposed of fish” in the coastal region of Santa Catarina, and the necessary alert of sanitary/medical interest concerning the immediate high vulnerability and occurrence potential of the parasitic disease Paragonimiasis, that can come to be verified through the consumption of crustaceans eventually polluted with the worm *Paragonimus westermani*, he saw *Melanoides tuberculatus* – or the native freshwater snail *Heleobia piscium* (= *australis*).

References:

- Agudo, A.I. 2003. Freshwater mollusks inventory (Gastropoda & Bivalvia) of Santa Catarina State, Southern Brazil. FMCS Newsletter *Ellipsaria*, Champaign, Illinois - USA, 5(1):12-13.
- Agudo, A.I. 2004. The freshwater mollusk fauna of Santa Catarina State, Southern Brazil: a comprehensive general synthesis. FMCS Newsletter *Ellipsaria* 6(1):11-12.
- Agudo, A.I. 2006. Intermediate host mollusks (Gastropoda: Pulmonata) of parasitic diseases in Santa Catarina’s State, Southern Brazil, with inclusion of new records to add to regional inventory. FMCS Newsletter *Ellipsaria* 8(2): 11-13.
- Agudo, A.I. 2007. Continental land and freshwater molluscs in Santa Catarina State, Southern Brasil: a general review of current knowledge. TENTACLE, Honolulu, USA, (15):11-14. <http://www.hawaii.edu/cowielab/Tentacle.htm>
- Agudo, A.I., & Bleicker, M.S. 2004. Malacofauna recente da Baixada do Massiambú, Município Palhoça, Santa Catarina - SC. Brasília, DF: Resumos XXV Congresso Brasileiro de Zoologia, Mollusca: 284-285.
- Agudo, A.I., & Bleicker, M.S. 2006. Moluscos exóticos no Estado de Santa Catarina. *Informativo SBMa*, Rio de Janeiro, 37(157): 6-8.
- Agudo-Padrón, A.I. 2006. iogeografia das doenças transmissíveis por moluscos etores no Estado de Santa Catarina, com ênfase na “Angiostrogilíase abdominal”. Florianópolis, SC: Universidade do Estado de Santa Catarina - UDESC, Trabalho de Conclusão de Curso Bacharelado em geografia, I-XVIII + 98 p., 45 figs., 4 tabs.

- Agudo-Padrón, A.I. 2008. Non-marine mollusc diversity in Paraná State, Southern Brasil. TENTACLE, Honolulu, Hawaii - USA, (16): 10-13.
- Fernandez, M., Thiengo, S., & Simone, L.R.L. 2002. Distribuição atual de *Melanoides tuberculatus* e de *Corbicula fluminea* no rasil. São Paulo, SP: Programa, Resúmenes y Anales del V Congreso Latinoamericano de Malacologia, Ecologia: 22-230.
- Fernandez, M.A., Thiengo, S.C., & Simone, L.R.L. 2003. Distribution of the introduced freshwater snail *Melanoides tuberculatus* (Gastropoda: Thiaridae) in Brazil. *The Nautilus*: 117(3): 78-82.
- Thiengo, S.C. 2003. Distribuição atual do molusco introduzido *Melanoides tuberculatus* (Müller, 1774)(Gastropoda; Thiaridae) no Brasil. Rio de Janeiro, RJ: Resumos XVIII Encontro Brasileiro de Malacologia: 24.
- Thiengo, S.C. 2007. Helmintoses de interesse medico-veterinário transmitidas por moluscos no Brasil. *In*: Santos, S. B. dos; Pimenta, A. D., Thiengo, S. C., Fernandez, M. A. & Absalão, R. S. Tópicos em Malacologia – Ecos do XVIII Encontro Brasileiro de Malacologia. Ed. Sociedade Brasileira de Malacologia, Rio de Janeiro: 287-294.
- Thiengo, S.C., Barbosa, A.F., Coelho, P.M., & Fernandez, M.A. 2005. Moluscos exóticos com importância médica no Brasil. Brasília, DF: I Simpósio Brasileiro sobre Espécies Exóticas Invasoras, Comunicação Oral: 1-14. Disponível em: http://www.mma.gov.br/invasoras/capa/does/co/silvana_carvalho.pdf
- Thiengo, S.C., Fernandez, M.A., Mattos, A.C., & Barbosa, A.F. 2007. Dispersão do molusco introduzido *Melanoides tuberculatus* (Müller, 1774) (Gastropoda: Thiaridae) no Brasil. *In*: Santos, S. B. dos; Pimenta, A. D., Thiengo, S. C., Fernandez, M. A. & Absalão, R. S. Tópicos em Malacologia – Ecos do XVIII Encontro Brasileiro de Malacologia. Ed. Sociedade Brasileira de Malacologia, Rio de Janeiro: 101-106.

Freshwater mussel news (Unionoida: Hyriidae) from Paraná State, Southern Brazil region

A. Ignacio Agudo

Projeto Naiade (Naiade Project), Avulsos Malacológicos-AM
Caixa Postal (P. O. Box) 010, 88010-970 Centro,
Florianópolis, Santa Catarina – SC, Brasil
iagudo@intergate.com.br – <http://www.malacologia.com.br>

Recently, the identity of the freshwater mussel/naiad *Diplodon expansus* (Küster, 1856) was confirmed at Lagoa Dourada (Golden Lagoon) (25° 14' 461”S; 50° 02' 935”W), a singular deep circular crater permanently full of water (Fig. 1-left) located in the Vila Velha Ecological State Park, Second Plateau of the Paraná State, PR, altitude of 917 meters (Agudo 2008: 10-Fig. 1, 11-Fig. 3), through the contribution of Meyer et al (2008 a), previously commented by us (Agudo 2007) and historically referred initially for the area in MORRETES (1949: 19 = *Diplodon* (*D.*) *semigranosus* Simpson, 1914) for “Ponta Grossa, Paraná” (Agudo 2005: 10).

Other geographical indications (new place record) of freshwater naiads for the State includes registrations of the same species, *Diplodon expansus*, increased for the Piraquara River, fluvial current of third order belonging to

the High Iguazú River basin (Meyer et al 2008 b; Oliveira et al 2008; Martim et al 2008), located in the First Plateau of the State, between the city of Curitiba and coastal of the Serra do Mar (Agudo-Padrón 2007; Agudo 2008: 10-Fig. 1, 11-Fig. 2).



Figure 1. Panoramic view of Lagoa Dourada, located in Vila Velha Ecological State Park), Municipal District of Ponta Grossa, Paraná State, PR

Finally, in the one that the conservation situation refers, *Diplodon expansus* (Küster, 1856), Family Hyriidae Swainson, 1840, in the global IUCN category "Vulnerable" (MMA 2004; Agudo-Padrón 2008: 12), and included in the Brazilian Plan of Recovery and of Administration for Species of Pisces and Aquatic Invertebrates (MMA 2006; Agudo-Padrón 2008: 12).

References:

Agudo, A.I. 2005. Preliminary notes on the freshwater mussels/naiades of the Paraná State, Southern Brazil. FMCS Newsletter *Ellipsaria*, 7(3): 9-11.
 Agudo, A.I. 2007. Some observations about continental mollusks (Gastropoda & Bivalvia) in two ecological parks of Paraná State. Southern Brazil. FMCS Newsletter *Ellipsaria*, 9(1): 10-11.

Agudo, A.I. 2008. Non marine mollusc diversity in Paraná State, Southern Brasil. IUCN/SSC Newsletter Tentacle, Honolulu, USA, (16):10-13.
 Agudo-Padrón, I. 2007. Inventário preliminar dos moluscos continentais ocorrentes no Estado do Paraná, sul do Brasil. Rio de Janeiro, RJ: Resumos XX Encontro Brasileiro de Malacologia, Agosto 05 a 10 de 2007: 219.
 MMA – Ministério do Meio Ambiente (Brazilian Ministry of the Environment). 2004. Lista adicional das espécies de invertebrados aquáticos e peixes ameaçados de extinção. Instrução Normativa no. 5 de 21 Março 2004. Brasília, DF: Diário Oficial da União-Seção 1, #102, 28/05/2004:136-138.
 MMA – Ministério do Meio Ambiente (Brazilian Ministry of the Environment). 2006. Elaboração de planos de recuperação e de gestão para espécies de peixes e invertebrados aquáticos. Brasília, DF: FNMA, Edital no. 02/2006, Abril de 2006, 36 p.
 Martins, J.K.P.; A.A.N. Meyer & E. Oliveira. 2008. Freqüência e caracterização histológica de marsúpios em *Diplodon expansus* (Mollusca, Bivalve, Hyriidae). Curitiba, Paraná: Resumos XXVII Congresso Brasileiro de Zoologia, Fevereiro 17 a 21 de 2008: P- 594.
 Meyer, A.A. N.; E. Oliveira, L. Gnoatto, T.A.P. Januario & V. Hauer. 2008 a. Análise histológica de gônadas de bivalves da classe Hyriidae da Lagoa Dourada, Parque Estadual de Vila Velha, Pr., Brasil. Curitiba, Paraná: Resumos XXVII Congresso Brasileiro de Zoologia, Fevereiro 17 a 21 de 2008: P- 1695.
 Meyer, A.A.N.; E. Oliveira, J. Martim, A. Ponchek & E. Cardon. 2008 b. Caracterização histológica das gônadas e análise do ciclo reprodutivo de *Diplodon expansus* (Mollusca, Bivalve, Hyriidae) do Rio Piraquara, Paraná Brasil. Curitiba, Paraná: Resumos XXVII Congresso Brasileiro de Zoologia, Fevereiro 17 a 21 de 2008: P- 648.
 Morretes, Frederico Lange de. 1949. Ensaio de Catálogo dos Moluscos do Brasil. Arq. Mus. Paranaense, Curitiba, 8:5-216.
 Oliveira, E.; A.A. Meyer, C. Sereneski, F. Sávio & J. Martins. 2008. Análise histológica da massa visceral de *Diplodon expansus* (Mollusca, Bivalve, Hyriidae) do Rio Piraquara. Curitiba, Paraná: Resumos XXVII Congresso Brasileiro de Zoologia, Fevereiro 17 a 21 de 2008: P- 557.

2006 and 2007 St. Croix River Research Rendezvous Abstracts

The following abstracts were selected from presentations and posters given at the 18th and 19th annual meetings of the St. Croix River Research Rendezvous. Scientists, resource managers, agency staff, high school teachers and students, and interested public attend this meeting to learn about research plans and findings in the St. Croix River watershed. The 2006 meeting was held on October 17, and 2007 meeting on October 16 at the Warner Nature Center near Marine on the St. Croix, Minnesota. The next Rendezvous meeting will take place on October 21, 2008 at the same location. Abstracts from several previous meetings are available on the Saint Croix Watershed Research Station's web site:

<http://www.smm.org/scwrs/programs/rendezvous/>

Submitted by Mark Hove, Macalester College, Mark_Hove@umn.edu

2006 Abstracts

THE 2006 ST. CROIX NUTRIENT REDUCTION AGREEMENT-THE SCIENCE BEHIND THE POLICY

Randy S. Ferrin, St. Croix Basin Water Resources Planning Team

In April 2006, the Wisconsin Department of Natural Resources and the Minnesota Pollution Control Agency signed a historic agreement to work together towards a twenty-percent reduction in phosphorus loading in the St. Croix Basin. In the agreement, the two agencies affirmed their desire to:

1. Jointly evaluate and establish water quality standards related to eutrophication which are applicable to Lake St. Croix by the end of 2009;
2. In partnership with the St. Croix Basin Water Resources Planning Team, perform a point and non-point source nutrient loading study and develop an implementation plan by June 30, 2009;
3. Coordinate and improve water quality monitoring and assessment capabilities to track progress on the achievement of the recommended twenty percent phosphorus reduction goal for Lake St. Croix; and
4. Provide continued staff and funding support to the St. Croix Basin Water Resources Planning Team.

The agreement was the culmination of years of work by the St. Croix Basin Water Resources Planning Team (Basin Team) to provide a sound scientific basis for the reduction goal. This presentation briefly summarizes the agreement and the science that went into the goal setting process and illustrates how good science and good interagency communication can result in good policy. Future steps in implementing the goal will also be briefly highlighted.

Suggested reading

St. Croix Basin Water Resources Planning Team. 2004. St. Croix Basin Phosphorus-Based Water Quality Goals. MPCA publication. www.pca.state.mn.us/water/basins/stcroix

ANALYSIS OF SEDIMENT TRANSPORT DATA AND CALCULATION OF HISTORICAL SEDIMENT LOAD, ST. CROIX RIVER, MN/WI

Emily Kushner¹, Kelly MacGregor¹ and Dan Hornbach²

¹Macalester College, Department of Geology, ²Macalester College, Department of Biology

Sediment budgets in river networks are notoriously difficult to construct but can be extremely important for quantifying both short and long-term changes to fluvial environments. Adequate sediment supply is critical for in-channel, bar, and near-shore ecosystems (both aquatic and terrestrial), as well as for recreation and navigation purposes. Hydrologic and sedimentologic conditions in the St. Croix River play a significant role in the stability of native freshwater mussel populations. The transport of sediment controls overall geomorphology, riverbed composition, and water turbidity, all of which are important to mussel habitat. Data shows a decrease in suspended sediment concentration, a decrease in the grain size of bed sediment, and a 96% decline in the juvenile mussel population in the last decade below the only major dam in the river system. The St. Croix River is home to two federally endangered mussel species; we need to better understand the controls on sediment transport to understand the causes for this decline and to evaluate future threats to these species.

In conjunction with mussel habitat analysis, we have collected surface and near-bed suspended sediment, as well as bedload samples since 2004. Discharge in the St. Croix typically ranges from 1,000-20,000 cfs. Samples collected during a range of discharges (1,700-10,000 cfs) along with other suspended sediment transport data (1974-2003, USGS) will allow us to explore the controls on sediment transport which include discharge, water velocity, depth, shear stress, shear velocity, and stream power. Preliminary analyses show a positive correlation between suspended sediment concentration and discharges above 5,000 cfs. Using these rating curves we calculate total sediment load over the past century. Further work will allow us to understand the controls on sediment transport and deposition over daily to decadal timescales, and to explore the impact of sedimentological changes on mussel populations.

USING HYDRAULIC PARAMETERS TO PREDICT MUSSEL DENSITY

D.J. Hornbach¹, M.C. Hove¹ and K.R. MacGregor²

¹Macalester College, Department of Biology, ²Macalester College, Department of Geology

Freshwater mussels are among the most endangered animals in North America. Changes in water quality, land use, and modification of rivers have been implicated in their decline. The St. Croix River is home to a dense and diverse assemblage of mussels and serves as an important refuge for these organisms. Despite their importance in rivers little is known about factors that control their distribution and abundance. Simple habitat factors, such as water velocity, depth and substrate type, are not strong predictors of abundance or diversity. The use of more complex hydraulic parameters shows promise. We randomly selected 40 locations in a 5 km stretch of the St. Croix River between Interstate Park and Franconia, MN. At each location we sampled 3 1-m² quadrats quantifying mussels. We collected sediment samples from 1 quadrat to determine sediment size. Depth and velocity were measured with an acoustic Doppler current profiler under different discharge levels allowing us to measure the range of hydraulic stresses experienced by the river bottom. Complex hydraulic parameters (Froude number, Reynolds number, shear velocity, boundary Reynolds number, shear stress and laminar flow) were calculated. The Froude number differentiates tranquil from turbulent flow in the water column. The Reynolds number differentiates laminar and turbulent flow in the water column (or at the sediment/water interface for the boundary Reynolds number). Shear stress is a measure of the tangential forces acting on the streambed by the water column and is likely important to substrate stability. The laminar flow layer describes the thickness of near-bed laminar flow, which may be important for filter-feeding organisms. Mussel density was significantly correlated with these parameters (except Reynolds number), with large numbers of mussels corresponding to high Froude number, shear stress, turbulent flow, and thin laminar flow layers. Analyses of covariance using the hydraulic parameters as a covariate and location

(Franconia or Interstate) showed that there was a significant interaction between location and the hydraulic parameters Froude number, shear velocity and shear stress. The Froude number, shear velocity and shear stress are all higher at Interstate which harbors a greater density of mussels than Franconia. These hydraulic parameters suggest that Franconia is a more depositional riverbed environment, which may account for the overall lower mussel density there. These data suggest that reach-scale hydraulic measurements may be helpful in determining habitat.

ADAPTIVE CLUSTER SAMPLING OF FRESHWATER MUSSELS IN THE ST. CROIX RIVER

Ben Dickinson, Mark Hove, and Dan Hornbach, Macalester College, Department of Biology

Estimating population size of endangered or threatened species is often difficult due to low density. Typically a large number of samples must be collected to estimate population size with confidence. An alternative approach is adaptive cluster sampling, which increases sampling efficiency for organisms that are spatially clustered, such as freshwater mussels. Adaptive cluster sampling involves selecting sites randomly, but collecting additional samples from neighboring cells when a target species is encountered. We developed a modified adaptive cluster sampling technique to estimate population size of federally endangered *Quadrula fragosa* and *Lampsilis higginsii*, and Wisconsin state endangered (Minnesota threatened) *Cyclonaias tuberculata* in the St. Croix River. Previous research has shown that these species are most commonly found in areas of high mussel density. Therefore we implemented a two-stage stratified sampling design to maximize sampling effort in areas more likely to be inhabited by target species.

In 2005 we randomly selected 20 50-m² cells from a two kilometer river reach near Franconia, Minnesota. We sampled three 1-m² quadrats from each cell and if at least 4 mussels were found in one quadrat we labeled the cell "high mussel density." Of the 20 cells sampled, 10 were high density. We initiated adaptive cluster sampling in these 10 high-density cells. We randomly selected 10 1-m² quadrats within each high density cell, and collected substrate samples, measured hydrologic parameters, and counted and identified living and dead mussels. When a target species was found we sampled the four adjacent quadrats. Neighboring cells were sampled until no additional target species were observed. We collected 750 mussels at Franconia, including target species from three of 10 50-m² high-density cells. Of the target species, we found 6 *Cyclonaias tuberculata* (0.8% of the population), 2 *Quadrula fragosa* (0.27%) and 3 *Lampsilis higginsii* (0.4%). Four of these individuals were collected from one adaptive cluster.

In 2006 we applied this sampling technique at Interstate State Park, Minnesota. This area has much higher mussel density than found at Franconia, with 19 mussels per square meter being considered "high density". Eight of the 20 randomly selected 50-m² cells were high density, five of which contained *Lampsilis higginsii* and/or *Quadrula fragosa* individuals. We collected 3205 total mussels, 194 *Cyclonaias tuberculata* (6.1% of total population), 6 *Lampsilis higginsii* (0.19%), and 15 *Quadrula fragosa* (0.47%). 10 of the 15 *Quadrula fragosa* were in clusters, as well as four of the six *Lampsilis higginsii*, indicating that these rare mussels are often spatially clustered, and that adaptive cluster sampling may be an effective way to find these clusters. We had to stop using *Cyclonaias tuberculata* as a target species because they were so abundant that we triggered adaptive cluster sampling at almost every site. This suggests a population threshold at which adaptive cluster sampling becomes inefficient and simple random sampling is more effective. We are currently processing data from both 2005 and 2006 to estimate population sizes and habitat characteristics for these three mussel species.

2007 Abstracts

THE USE OF ADAPTIVE CLUSTER SAMPLING TO ESTIMATE THE POPULATION SIZES OF *QUADRULA FRAGOSA* AND *LAMPSILIS HIGGINSII* IN THE ST. CROIX RIVER BETWEEN INTERSTATE PARK AND OSCEOLA, WI

Daniel J. Hornbach¹, Mark C. Hove¹ and Jill Medland²

¹Macalester College, Department of Biology, ²National Park Service, St. Croix National Scenic Riverway

The winged mapleleaf mussel (*Quadrula fragosa*) and the Higgins' eye pearlymussel (*Lampsilis higginsii*) are federally endangered species. The stretch of the St. Croix River from Interstate Park to Osceola, WI contains one of only two known reproducing populations of *Q. fragosa* and is one of only two of the essential habitat areas for *L. higginsii* that have not been infested with zebra mussels (*Dreissena polymorpha*).

For proper management of these endangered species it is important to have reasonable estimates of the population size. Stratified adaptive cluster sampling (ACS) has been shown to be effective for sampling rare and clustered populations. Freshwater mussels are sedentary organisms making them prime candidates for ACS, especially when implementing a two-stage design (Smith *et al.* 2004) Hornbach *et al.*, (1996) found *Q. fragosa* to be clustered and associated with higher overall mussel density.

We sampled the area between St. Croix Falls, WI and just upstream of Osecola, WI. This region was divided into 3 sites: Interstate, Franconia and Peaslee Lake. We sampled 0.21 km² at Interstate and estimate there are 4250 *Q. fragosa*. The density of *Q. fragosa* at Franconia is much lower than at Interstate and we estimate there are 2400 individuals. No *Q. fragosa* were found at Peaslee Lake. There is a great deal of error associated with these estimates (coefficient of variation of 50-66%) and we did not

sample a prime area for *Q. fragosa* between Folsom and Blast Islands (0.3 km² we did not sample because of past intensive sampling and movement of *Q. fragosa* for propagation purposes). With this prime area included we estimate there are approximately 13,000 *Q. fragosa* in the area between Interstate Park to Franconia.

The mean *L. higginsii* density varied from 0.008-0.015 individuals/m² (coefficient of variation of 66-167%) at the three sites. We estimate a total of about 8,900 individuals in the areas we sampled. If we were to include the area not sampled we estimate a total *L. higginsii* population of 14,400 individuals in this area.

ACS, while helpful in estimating population size was more effective for *Q. fragosa* than *L. higginsii*, because of the more clustered nature *Q. fragosa* individuals. We recommend using two-stage stratified sampling with simple random sampling rather than ACS for future population estimates.

References

Smith, D.R., J.A. Brown, and N.C.H. Lo. 2004. Application of Adaptive Cluster Sampling to Biological Populations, pp. 75-122. In Thompson, W.L. Sampling Rare and Elusive Species: Concepts Designs, and Techniques for Estimating Population. Island Press, Washington, DC.

Hornbach, D. J., J. G. March, T. Deneka, N. H. Troelstrup, and J. A. Perry. 1996. Factors influencing the distribution and abundance of the endangered winged mapleleaf *Quadrula fragosa* in the St. Croix River, Minnesota and Wisconsin. American Midland Naturalist 136(2): 278-286.

2006 STATUS REPORT ON THE ACCOMPLISHMENTS OF THE INTERAGENCY MUSSEL COORDINATION TEAM

Gary Wege, U.S. Fish and Wildlife Service, Twin Cities Ecological Services Field Office

Dennis Anderson, U.S. Army Corps of Engineers

Since 2000, a variety of conservation measures have been implemented for the federally endangered Higgins eye (*Lampsilis higginsii*) and winged mapleleaf (*Quadrula fragosa*) by the U.S. Army Corps of Engineers with assistance from the interagency Mussel Coordination Team. Conservation activities were required by a Biological Opinion for continued operation and maintenance of the federal 9-Foot Channel Project on the Upper Mississippi River System (UMRS). Major accomplishments include: 1) identifying host fish for winged mapleleaf; 2) hatchery and cage propagation of Higgins eye and winged mapleleaf; 3) stocking adult, subadult, and juvenile Higgins eye into the UMR and tributaries to establish five new and viable populations; 4) collecting sexually mature Higgins eye at age 4 that were stocked as subadults; 5) collecting subadult Higgins eye at population establishment sites where infested fish were released; 6) developing marking techniques for stocked subadults; 7) testing a floating cage system; 8) developing a Geographic Information System mussel database and Internet web site; 9) determining thermal requirements for transformation of Higgins eye and winged mapleleaf glochidia; and 10) implementing conservation activities for other native mussels.

Report available online from authors

SPATIAL AND TEMPORAL CHANGES IN ST. CROIX MUSSEL COMMUNITIES AND HABITAT

Alese Colehour, Daniel J. Hornbach and Mark C. Hove, Department of Biology, Macalester College

The St. Croix National Scenic Riverway holds most of the mussel species native to the upper Mississippi River basin. The Riverway habitats are home to many threatened and endangered mussel species including federally listed winged maple leaf (*Quadrula fragosa*) and Higgins eye (*Lampsilis higginsii*). The objective of this study is to describe temporal and spatial changes in mussel species richness and substrate composition at four sites in the St. Croix River and suggest possible reasons for these changes.

Sediment "diversity" is important to mussel communities that likely depend on larger rocks as protection from rushing currents while smaller pebbles and sand allow them to burrow for anchoring and as a means to avoid predation. Juvenile mussels attach to small sand grains for the first few years of life, and later take on a burrowing life style. Subsequently, sediment composition and stability are thought to be especially important for young to survive to reproductive age.

One of the sites in this study (Wild River) is located above the hydroelectric dam at St. Croix Falls, WI while the other three sites (Interstate, Franconia and Osceola) are found within an 11 kilometer stretch below the dam. Mussels and sediment were excavated from 0.25 m² quadrats and passed through a series of 6 sieves. Mussels were identified and the sediment was weighed to assess sediment size. Sampling took place at each of the four sites 5-7 times since 1991. "Sediment diversity" was calculated using the proportions of each sediment size.

The range of sediment diversity found at each site since 1991 is 0.0 (essentially all sand) to -0.78 (equal mass of each sediment size). The average number of mussels found at Interstate and Wild River each sampling year was 739 and 612 respectively, while Franconia averaged only 146 and Osceola 122 adult mussels. Sediment was also the coarsest and most diverse at Interstate and Wild River with fine sediments being found at the most downstream sites, Franconia and Osceola. Sediment diversity positively

correlates with changes in mussel density since mussels utilize a range of sediment sizes as described above. Since 1991, sediment diversity has decreased at all four sites and mussel diversity also decreased during this time although the change was not statistically significant. Based on flow data obtained daily from the USGS website at St. Croix Falls there has been a pattern of decreasing discharge since 1991. Decreased flow allows finer sediments to settle in the riverbed, decreasing sediment diversity and appears to be negatively impacting mussels.

Increased development, sediment build-up behind the St. Croix Falls dam, a change in dam operations, and flooding may be causing an increase in fine sediment and a decrease in sediment diversity. If federally listed mussel species populations are to remain healthy in the St. Croix River, conservation and propagation efforts may be required in current and former ranges in the Riverway.

CLEAN BOATS CLEAN WATERS – OUTREACH ON THE ST. CROIX NATIONAL SCENIC RIVERWAY, 2007

Byron Karns, National Park Service, St. Croix National Scenic Riverway
Wade Miller, Department of Biology, Macalester College

As a response to the continuing threat to Wisconsin's inland waters from aquatic invasive species (AIS), the Dept. of Natural Resources, University of Wisconsin Extension and Sea Grant, have partnered to educate boaters entering the state's waters. Inspectors are now stationed at boat landings across the state to instruct the boating public on how to best reduce the risk to the public's lakes and rivers from aquatic species introductions. Since 2006, the St. Croix National Scenic Riverway has hired and supervised staff to work the river's Wisconsin boat landings. This increases the coverage at the western edge of the state and may reduce the number and spread of aquatic invasive species. We believe the continuation of the inspection program has merit in providing accurate information, updates and prevention skills. The value of staff presence at the landings reflects the importance of this issue.

Keywords: AIS, Outreach, Lake St. Croix, Boaters

HABITAT FACTORS AND MUSSEL ASSEMBLAGE OF FEDERALLY ENDANGERED MUSSEL SPECIES

Skadi von Reis Crooks, Lucia Wang, Mark C. Hove and Daniel J. Hornbach, Department of Biology, Macalester College

Unionid mussels are long-lived filter feeders and useful as indicators of the quality of riverine environments. Overall mussel density is decreasing at several locations in the St. Croix River (Hornbach *et al.*, 2006), with juvenile mussel density decreasing by as much as 96% in some reaches below St. Croix Falls in the last decade (Kushner *et al.*, 2006). These declines are especially concerning since two federally endangered species, winged mapleleaf (*Quadrula fragosa*) and Higgins eye (*Lampsilis higginsii*), are found in the St. Croix River.

We sought to determine those habitat factors that differed significantly between mussel communities with and without federally endangered mussels. We also sought to identify mussel species within mussel communities that are significantly associated with the federally endangered mussel species. Mussel community and habitat data collected at three locations (Interstate, Peaslee Lake, and Franconia) during the past three years were analyzed using JMP 3.2.2 (SAS Institute, Cary, NC). A t-test was used to determine significant differences in habitat measures between sites containing only non-endangered species and sites that contained one of the endangered species. Chi-square analysis was used to assess the significance of unionid aggregations.

Mussel density, species richness, and sediment size were significantly greater at locations with federally endangered species. A correspondence analysis revealed correlations among a variety of environmental factors and the distribution of species. We observed significant relationships between mussel assemblage and two of the habitat factors: sediment size and FST (a direct measure of shear stress that combines depth and flow). We used canonical scores to graphically display the relationship between these habitat factors and species assemblage. The presence of the majority of the species, including winged mapleleaf, was correlated with small to medium sized sediment and high FST. Fewer species, including Higgins eye, showed a correlation with lower FST and coarser sediment. Higgins eye was significantly associated with threeridge in their assemblage. Winged mapleleaf was significantly associated with both Wabash pigtoe and monkeyface. These factors may be useful in future efforts to identify river reaches suitable for relocating adult winged mapleleaf or Higgins eye or for planting propagated juveniles. These results demonstrate the need for detailed information on habitat preferences for the detection and preservation of key habitats for endangered mussel populations.

A COMPARISON OF GENETIC VARIATION BETWEEN POPULATIONS OF POCKETBOOK AND PIMPLEBACK MUSSELS ABOVE AND BELOW THE ST. CROIX FALLS DAM

Suzy Szumowski, Sarah Boyer, Daniel J. Hornbach and Mark C. Hove, Department of Biology, Macalester College

Mussels play an important role in freshwater habitats. As filter feeders, they are highly sensitive to water quality, and often are the first to suffer the ill effects of degraded water. There are forty-eight species of mussels native to Minnesota, and more than half of them are listed as endangered, threatened, or of special concern. The St. Croix River is a superior habitat for mussels likely due to relatively light human disturbance in the watershed, although since 1903 there has been a hydroelectric dam at St. Croix Falls. In

addition to altering water discharge patterns, hydroelectric dams can affect the temperature, oxygen concentration, and suspended sediment content of a river. It is also significant that the St. Croix Falls and the dam have acted as a geographic barrier to upstream fish travel. Since the life cycle of mussels involves a larval growth phase in which the mussel is dependant on a fish host for transportation, this barrier could greatly affect the dispersal of populations. Both *Lampsilis cardium* and *Quadrula pustulosa* are known to have multiple fish hosts, primarily catfishes for *Q. pustulosa* and sunfishes and perches for *L. cardium*. It has been observed in previous studies that the mussel assemblages above and below the St. Croix Falls differ, and that this variability is not likely to be a result of variation in microhabitat factors, such as substrate composition and water velocity (Hornbach 2001).

To determine the extent to which the dam isolates mussel populations above and below the dam we collected small tissue samples from the mantles of 20 *L. cardium* and 20 *Q. pustulosa* at four locations; two above the dam and two below the dam. *L. cardium* and *Q. pustulosa* were chosen as representatives of different subfamilies (Lampsilinae and Ambleminae, respectively) found to vary in prevalence above vs. below the dam. Also, as related species found in the St. Croix River, *Lampsilis higginsii* and *Quadrula fragosa* are endangered; *L. cardium* and *Q. pustulosa* served as proxies. DNA was extracted from the tissue clippings and processed using molecular techniques in order to sequence the NDI gene, which is commonly used in bivalve genetic studies and encodes NADH dehydrogenase 1, an essential enzyme in cellular respiration processes. The NDI sequences were edited and aligned using Sequencer and MacClade. Preliminary data from one of the below dam sites indicates the percent of polymorphic sites in the NDI gene to be 1.7% for *L. cardium* and 6.4% for *Q. pustulosa*.

Further Reading

Hornbach, D.J. 2001. Macrohabitat factors influencing the distribution and abundance of najads in the St. Croix River, MN and WI, USA, pp. 213-230. In G. Bauer and W. Wachtler [eds] Ecology and Evolutionary Biology of the Freshwater Mussels Unionoidea. Ecological Studies Vol. 145. Springer-Verlag: Berlin.

Watters, G.T. 1999. Freshwater mussels and water quality: A review of the effects of hydrologic and instream habitat alterations. Proceedings of the First Freshwater Mollusk Conservation Society Symposium. 261-174.

SAVING AN ENDANGERED MUSSEL: HABITAT OF THE HIGGINS EYE PEARLYMUSSEL

Cassie Warren, Daniel J. Hornbach and Mark C. Hove, Department of Biology, Macalester College

The Higgins Eye Pearlymussel (*Lampsilis higginsii*), a federally endangered freshwater bivalve, can be found in the St. Croix, Mississippi, and (rarely) Wisconsin Rivers. Facing a shrinking habitat range and a growing threat of invasion by zebra mussels (*Dreissena polymorpha*), the survival of the Higgins Eye species requires immediate but carefully calculated human intervention. To address the increasing threat of Higgins Eye extinction, some have considered the merits of relocating individuals to areas less vulnerable to human-related disturbances and zebra mussel invasion. The purpose of this study was to determine the characteristics of typical habitat for Higgins Eye so that appropriate habitats can be chosen for relocation.

Since 1990, Dan Hornbach and his team have monitored mussel populations and the natural environment surrounding them in several regions of the St. Croix River. Data on mussel density, substrate composition, bottom flow, and depth were collected at 9 sites along the St. Croix River between 1990 and 2007. In eighteen years of monitoring, a mere 35 Higgins' Eye mussels have been found, along with 15,988 mussels of other species. Using the data set compiled in those eighteen years, we have attempted to create a model predicting the presence or absence of *L. higginsii* using the variables available.

Given our statistical tools and the limited availability of locations with Higgins Eye present, it proved impossible to create an accurate model predicting the presence of Higgins Eye. However, since there was a significant relationship between total mussel density and the presence of Higgins Eye, we created a model predicting mussel density. We infer that habitat characteristics correlated with high mussel density will also then be associated with the presence of Higgins Eye.

This study revealed that greater water depth, lower bottom flow, and coarser substrate are all positive contributors to greater mussel density, supporting the theory that greater substrate stability provides higher quality mussel habitat. Therefore, if relocation of Higgins Eye becomes the last option to save them from habitat destruction and zebra mussel invasion, areas with high levels of mussel density (areas with greater depth, lower bottom flow, and coarser substrate) would be ideal choices for relocation habitat.

CHANGING AGE STRUCTURES IN POPULATIONS OF ZEBRA MUSSELS IN THE ST. CROIX NATIONAL SCENIC RIVERWAY

Byron Karns, National Park Service, St. Croix National Scenic Riverway
Emily Sabo, Department of Biology, Macalester College

Zebra mussels have been a threat to the St. Croix watershed since the early 1990. In 1992, the first mussels were discovered in the Mississippi above the confluence with the St. Croix River. The first boat discovered with attached zebra mussels was in 1994 and reproduction was pinpointed by 2000. There is a critical need to understand the implications of an ever expanding and increasing number of zebra mussels in the river. This is a high priority for the NPS and ACoE and other natural resource management agencies. The NPS will gather information about the age structure of these populations to determine recruitment, growth rates, and

mortality. This will aid in determining the affects of this animal on native fauna, including freshwater mussels. Anecdotal accounts of periodic, but substantial zebra mussel die-offs in large river systems in the Midwestern U.S. have been noted in the last several years. Details from the Illinois and Upper Mississippi rivers, suggest an early season recruitment followed by a late season population crash. However, these observations have been casual and not systematic or well documented. In order to predict impacts to river biota, an organized assessment of seasonal population dynamics of zebra mussels in a large river system is necessary. The St. Croix River is a 6th order system with moderate zebra mussel infestations within the downstream most 22 miles, and especially in the lower 6 miles below the Kinnickinnic Narrows. In 2006, densities of this invasive animal reached over 700m² within this last pool. The affects of large numbers of zebra mussels in freshwater systems in North America have been well documented. Particularly, native mussels have been severely impacted by direct food and oxygen competition and indirectly by shell colonization. If, however, condition in certain river systems allow for veliger settlement and establishment, but limit growth through maturity, implication for management are numerous.

Keywords: Zebra Mussels, Population Dynamics, Lake St. Croix, Water Quality

AQUATIC HABITAT CLASSIFICATION ON THE ST. CROIX NATIONAL SCENIC RIVERWAY

Haibo Wan¹, James Perry¹, Randy Ferrin² and Brenda Moraska Lafrancois³

¹Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota, ²St. Croix National Scenic Riverway, National Park Service, ³Midwest Region, National Park Service

This project designed a classification system of the aquatic habitats within the St. Croix National Scenic Riverway. The system can serve as the framework for future monitoring and management of the Riverway.

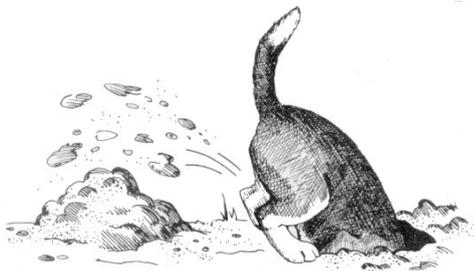
We developed the classification at two levels: segment and reach. Segments are approximately 15+ km (10+ miles) in distance. Reaches are nested within segments and are approximately 1.5+ km (1+ mile). Segments were demarcated using physical properties, the most notable of which were tributary outlets and channel slopes; they also incorporated information such as ecoregion, land use/land cover, riparian vegetation, and channel substrate. Segments integrate environmental impacts on the aquatic communities through hydrologic processes and sediment dynamics that occur at three spatial scales: basin, riparian zone, and channel. Reaches were demarcated on the basis of channel substrate composition (*i.e.*, frequency of different particle sizes, including boulders, cobbles, gravels, sands, silt, and clay). We took videos of the substrate at the thalweg every 400 m along the Riverway during summer 2004. Proximal sites with similar substrate composition were grouped into reaches. We selected substrate as the principal classification variable for two reasons: (1) diversity and abundance of benthos are related to size and heterogeneity of substrate materials and (2) fine materials (*i.e.*, sand, silt, clay) are a part of the sediment dynamics within the entire basin and could indicate land use change. Also, loading from sediment and nutrients is currently the primary management concern in the St. Croix Basin.

We tested that physical classification framework with mussel community data (from Doolittle 1988), using TWINSPAN cluster analysis. Five clusters were identified; all five are spatially consistent with our segments, suggesting that segment is an effective unit for mussel resource management. No mussel community pattern was found at a scale finer than segment. Mussels are substrate selective; some species require coarse substrate (*i.e.*, boulder, cobble, pebble, gravel). Almost all sites with fine substrate (*i.e.*, sand, silt, clay, muck, mud) had the lowest mussel species richness (<3 species) and abundance (<5 individuals). It is apparent that siltation, a common result of aggressive land use, has the potential to make significant, negative changes in the mussel community on the Riverway, but those changes would be more likely in some reaches than others.

Further Reading

Wan H, Perry J, Ferrin R, Lafrancois B. Aquatic habitat classification on the St. Croix National Scenic Riverway (draft). St. Croix Falls (WI): National Park Service, St. Croix National Scenic Riverway

Helpful Hints from Hoppy:



**Hoppy Says — Ahh spring...
don't get lost in the sauce...
make everyday a buffet day!**

Submitted by Steve Ahlstedt

Freshwater Mollusk Conservation Society

Standing Committees and Chairs

If you are interested in joining a committee, please contact one of the appropriate chairs.

Awards

W. Gregory Cope – North Carolina State, Dept. Environ. & Molecular Toxicology, Box 7633, Raleigh, NC 27695-7633
919-515-5296; greg_cope@ncsu.edu

Teresa Newton – Upper Midwest Environmental Science Center, 2630 Fanta Reed Rd., LaCrosse, WI 54603
608-781-6217; tnewton@usgs.gov

Environmental Quality and Affairs

Ryan Evans – Kentucky State Nature Preserves Commission, 801 Schenkel Lane, Frankfort, KY 40601
502-573-2886 x102; fax: 2355; Ryan.Evans@ky.gov

Steve McMurray – Missouri Department of Conservation, 1110 S. College Ave., Columbia, MO 65201
573-882-9909; stephen.mcmurray@mdc.mo.gov

Gastropod Status and Distribution

Paul D. Johnson – Alabama Aquatic Biodiversity Center, Route 3, Box 86, Marion, AL 36756
334-683-5000; paul.johnson@dcnr.alabama.gov

Genetics

David J. Berg – Miami University, 546 Mosler, Oxford, OH 45069
513-785-3246; bergdj@MUOhio.edu

Guidelines and Techniques

Chuck Howard – TVA, Natural Heritage Program, 400 W Summit Hill Dr., WT 11C-K, Knoxville, TN 37902
865-632-2092; cshowar1@tva.gov * *new address, phone, and email address* *

Janet Clayton – West Virginia Division of Natural Resources, PO Box 67, Ward Road, Elkins, WV 26241
304-637-0245; janetclayton@wvdnr.gov

Information Exchange

Al Buchanan – 1001 S. Johnmeyer Lane, Columbia, MO 65203
573-445-1521; gandalfpoint@yahoo.com

G. Thomas Watters – Museum of Biological Diversity, The Ohio State University, 1315 Kinnear Road, Columbus, OH 43212
614-292-6170; Watters.1@osu.edu

Mussel Status and Distribution

Arthur E. Bogan – North Carolina State Museum of Natural Sciences, 4301 Reedy Creek Road, Raleigh, NC 27607
919-733-7450 x 753; arthur.bogan@ncmail.net

James D. Williams – U.S. Geological Survey, 7920 NW 71st Street, Gainesville, FL 32653
352-264-3475; JDWilliams@usgs.gov

Outreach

Andy Roberts – USFWS, 101 Park DeVille Drive, Suite A, Columbia, MO 65203
573-234-2132 x 110, andy_roberts@fws.gov

Tom Jones – Marshall University, 110 Heather Court, Scott Depot, WV 25560
304-389-5832; jonest@marshall.edu

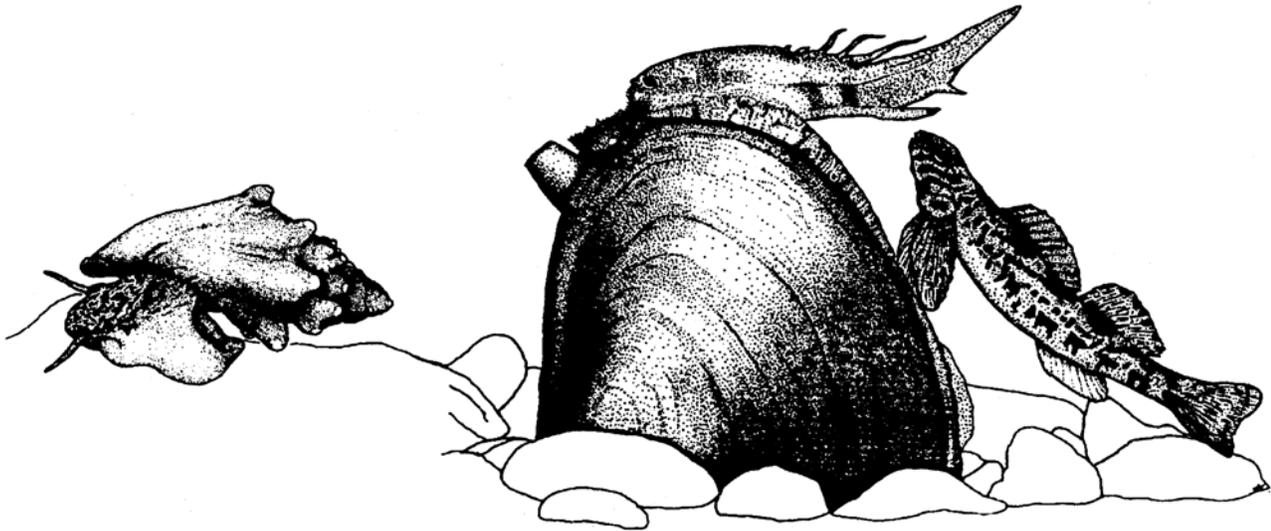
Propagation, Restoration, and Introduction

Tony Brady – Genoa Fish Hatchery, S 5689 State Road 35, Genoa, WI 54632
608-689-2605; tony_brady@fws.gov

Symposium Committee –2009

Catherine Gatenby – White Sulphur Springs National Fish Hatchery, 400 E Main S., White Sulphur Springs, WV 24986
303-536-1361; Catherine_Gatenby@fws.gov

Freshwater Mollusk Conservation Society



... dedicated to the advocacy and conservation science of freshwater molluscan resources