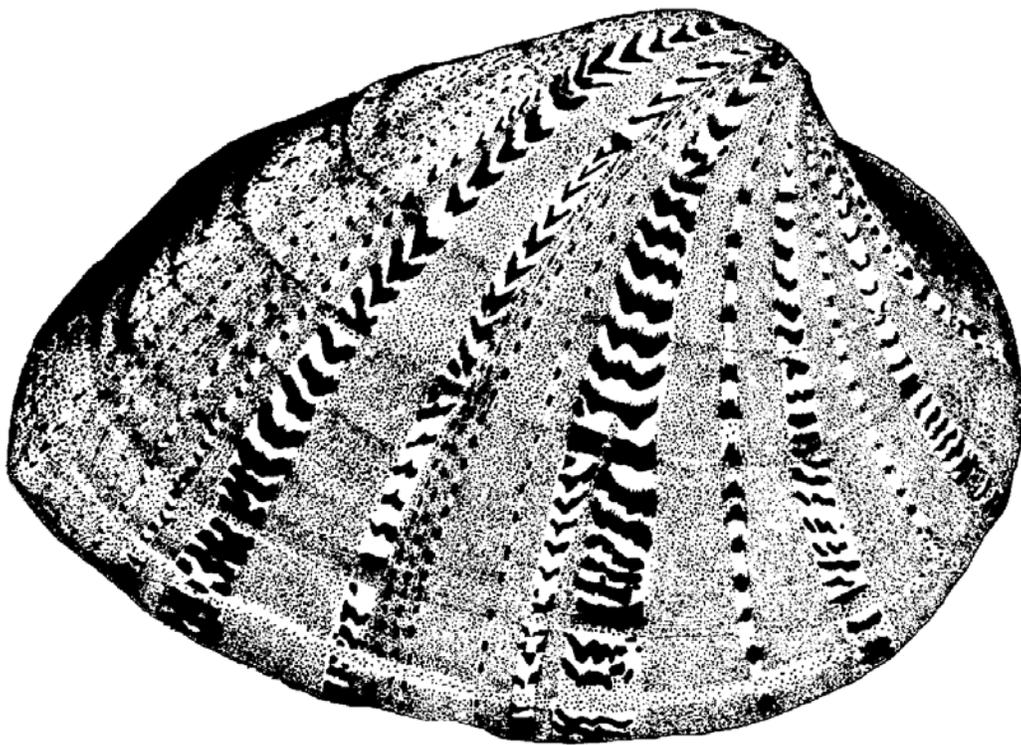


Ellipsaria

The Newsletter of the Freshwater Mollusk Conservation Society

Volume 6 - Number 3

December 2004



In this issue:

Officer Nominations

2005 Symposium - Final Call for Abstracts

Student Travel Awards deadline

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Submissions for the April 2005 issue of *Ellipsaria* may be sent in at any time but are due by March 10, 2005. Anyone may submit an article but you must be a member of FMCS to receive *Ellipsaria*. 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; please send submissions to the editor.

Submissions to *Ellipsaria* are not peer reviewed, but are checked for content and general editing.

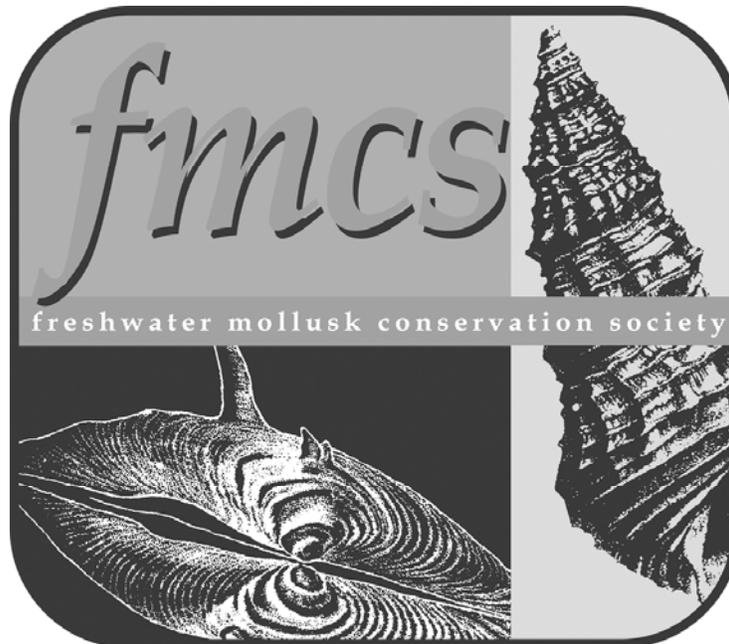
Thanks to Jeremy Tiemann for help assembling and mailing this newsletter.

Please send change of address information to the Secretary, Rita Vilella.

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

FMCS Reports

FMCS Officer Nominations

The FMCS is seeking nominees for the position of **president-elect and secretary**. Think of whom you would like to nominate and then send in your nomination! Nominees must be current FMCS members in good standing.

The new **president-elect** will take office in May of 2005, become president in 2007, and then serve as past-president until 2009 for a total of **six** years of service.

The **secretary** will take office in May 2005 and serve for **two** years. Rita Vilella has indicated a desire to let another person serve in this position. Many thanks to Rita for her many years of service to FMCS.

The deadline for nominations is December 24th, 2004. The nominations committee will select the two candidates for each office who receive the most nominations and who are willing to run for that office. Position statements from the candidates will be mailed out with the ballots after nominations close. Send nominations to:

Leroy Koch
U.S. Fish and Wildlife Service
3761 Georgetown Road
Frankfort, KY 40601
502.698.0468
leroy_koch@fws.gov

REMINDER—Student Travel Awards Available for 2005 FMCS Symposium

CALLING ALL STUDENTS (both undergraduate and graduate) To facilitate your participation in the 4th Biennial Symposium of the Society to be held May 15-18, 2005 in St. Paul, Minnesota, travel awards are being offered by the Society. Support is provided via an award of \$100 to \$300 (actual amount depends on the number of qualified applicants) to help defer the cost of travel and accommodations. It is anticipated that approximately 10 to 30 awards will be made for the 2005 Symposium. A complete application package must be submitted to Dr. David J. Berg, FMCS Student Awards Committee, Miami University, Department of Zoology, Oxford, OH 45056 on or before **December 17, 2004**.

For more details, see the Awards Committee web site at <http://ellipse.inhs.uiuc.edu/FMCS/Awards/index.html> Contact Dr. David J. Berg at bergdj@muohio.edu or at 513.529.3174 for more information.

FMCS 2005 Symposium May 15 - 18, 2005 Radisson Riverfront Hotel St. Paul, Minnesota

FINAL CALL FOR ABSTRACTS

The 4th Biennial Symposium of the Freshwater Mollusk Conservation Society will be held at the Radisson Riverfront Hotel in St. Paul, Minnesota from May 15-18, 2005. The 2005 meeting will be co-hosted by the Upper Mississippi River Conservation Committee (UMRCC). Members of the UMRCC's ad hoc mussel team are working with FMCS to bring a strong local flavor to the discussion and information exchange. A registration form has been included with this newsletter, and is available on the FMCS website. Early registration ends March 27, 2005.

**ABSTRACTS MUST BE RECEIVED BY
DECEMBER 17, 2004**

Theme

“Are Your Natives Restless? Holistic Strategies for Conserving Freshwater Mollusks during Exotic Species Invasions”

Rationale

The invasion of exotic species into the freshwaters of North America and elsewhere in the world has placed additional stress on an already imperiled freshwater mollusk fauna. Vital ecosystems for preserving freshwater mollusks like the Mississippi, Ohio, Tennessee, and other large rivers unfortunately also serve as conduits for the rapid dispersal and colonization of exotic species, where they often have adverse effects on native species. Scientists from a variety of disciplines including ecology, fisheries biology, malacology, conservation biology, engineering, hydrology, and others are working together to help mitigate the potential spread and negative effects of exotic species. These folks need your help! The 2005 symposium will provide an opportunity for biologists and others to share ideas, exchange information, and engage in the interpersonal networking needed to support the conservation of our native freshwater molluscan resources.

Think critically about your own research, and its association with other research projects, and its implications relative to the following interrelated topics:

- Native Species Relocation
- Artificial and Natural Refugia
- Native Species-Exotic Species Interactions
- Population Biology
- Alteration of Ecological Conditions
- Influence on Nutrient and Food Resources
- Parasites and Contaminant Flux

...and other topics related to exotic species interactions with native species.

Instructions for Authors – Final Call for Abstracts

We are requesting abstracts associated with the above theme and others associated with the following topics: Habitat and Conservation, Range-wide Status and Distribution (co-authorship is encouraged), Life History and Ecology, Evolution and Phylogenetics, Outreach and Education, Propagation and Reproduction, Recovery, and Contaminants and Water Quality.

Instructions for Abstract Preparation and Submittal

Submittal form: Abstracts should be submitted as an email attachment in Microsoft Word® or Rich Text format to Greg Cope (greg_cope@ncsu.edu). File name should include presenter's last name and initials (e.g., jonesjm.doc). Acknowledgment of abstract receipt, if requested, will be provided by e-mail.

Limit abstracts to 300 words or less (including title, authors and affiliations). Abstracts with greater than 300 words will be edited.

Submittal format: The abstract should contain the title in **BOLD, CAPITAL** letters, followed by the author(s), and address(es). Underscore the presenter's name. Skip one line and begin the text including a clear summary of presentation including objectives, results, and conclusions. Example:

PROPAGATION OF FRESHWATER MUSSELS IN A CLOSED RECIRCULATING SYSTEM, Shane D. Hanlon¹, Jay F. Levine², Lori Gustafson², and Chris Eads². ¹U.S. Fish and Wildlife Service, Southwestern Virginia Field Office, 330 Cummings Street, Abingdon, VA 24210; ²College of Veterinary Medicine, North Carolina State University, Raleigh, NC 27606.

We renovated a preexisting wet laboratory located at North Carolina State University for purposes of propagating . . .

At the bottom of the page, type:

1. The name, address, telephone, fax, and e-mail of the presenting author
2. Preference for Platform or Poster presentation and willingness (yes or no) to convert from one format to another
3. Regular or Student* attendee

*Note: All students submitting abstracts, provided they meet eligibility requirements, will be judged for best student platform or poster presentation, unless otherwise indicated.

Oral Presentation Requirements

Not to exceed 20 minutes (15 minutes for talk and 5 minutes for questions and answers). Slides and LCD projector visual aids only (no overheads).

Poster requirements

The poster should be readable from 5 feet, titles from 10 feet; and should not exceed a size of 4 feet high by 8 feet wide. Authors must be present at the designated poster session.

**ABSTRACTS MUST BE RECEIVED
BY DECEMBER 17, 2004**

Accommodations

The Radisson Riverfront Hotel rate is \$100 per night, single or double occupancy. To guarantee this rate, rooms must be booked by **April 15, 2005**. Please call 651-292-1900 or 800-333-3333 for reservations. Check-in time is 4 p.m. and check-out time is 12 noon. The Radisson Riverfront is located along the Mississippi River on Kellogg Boulevard in downtown St. Paul, Minnesota.

***** Please plan to book your room with the Radisson Riverfront. FMCS meeting room rental costs are based upon the number of hotel rooms booked by members. We need to book at least 100 rooms each night to ensure reasonable meeting room costs. Please tell the hotel receptionist you are attending the FMCS symposium when making your reservation so the society will receive credit for the rooms reserved. *****

Travel

The Radisson Riverfront Hotel does not provide complementary shuttle service from the airport. However, the SuperShuttle will provide transportation to and from the Radisson Riverfront for \$12 one-way or \$22 round trip. Call 612-827-7777 for reservations. The hotel parking ramp is \$12.50/day for registered hotel guests.

Submitted by Greg Cope, Symposium Program Chair

FMCS Board Meeting Frankfort, Kentucky November 17, 2004

Minutes as printed in *Ellipsaria* Vol. 6, No. 2 were accepted.

Treasurers Report

The FMCS account has \$52,914.00. We collected over \$10,000 in dues this year with a small profit made on both workshops (profit of about \$3000 from the genetics workshop). Funds of approximately \$2000 were spent for having a FMCS presence at the AFS meeting. We have spent \$4500 for the newsletter and \$4000 on tee shirts printed for the workshops, making a profit of \$1200 from sale of those shirts. The outreach committee put together an FMCS traveling booth for a cost of \$2200, and there were small credit card and bank fees.

Symposium

A summary of arrangements was presented. The board recommended a change to the schedule: social on Sunday evening, poster session Monday evening, committee meetings during lunch Monday with the FMCS board meeting after the last Monday session. Sponsorships are needed and a solicitation will be in *Ellipsaria*. Have received 7 abstracts to date.

Committee Reports

Awards

Solicitation for nominations will be placed in *Ellipsaria*.

Outreach

The freshwater mussel session and FMCS poster and booth were well received at AFS.

Information Exchange

The first Walkerana issue published by FMCS will most likely be the latter part of 2005 or in 2006.

Environmental Affairs

A letter from FMCS commenting on the experimental dredging proposal was sent with our comments considered in the revised plan. John van Hassel, chair of the Guidelines and Techniques Committee sent the draft plan to the committee for review and comment. The society is preparing a letter expressing our concerns about the black water events (release of coal fines) on the Clench and Powell Rivers. A letter will be prepared offering the expertise of FMCS members to serve on a freshwater mussel panel being proposed by the Pennsylvania Fish and Boat Commission. We are waiting for the supplemental EIS on the Big Sunflower River to review and comment. The sheepsnose (*Plethobasus cyphus*), now a candidate, is present in the area.

Mussel Status and Distribution

Bob Butler has a database for Cumberlandian mussel species that can be used in the mussel atlas distribution maps. The board suggested the committee determine the funding needs to present at the next board meeting.

Nominations

Nominations are needed for the offices of president elect and secretary, both are for 2 year terms. Committees should be thinking about nominations for new committee chairs. Leroy will put a call for nominations in this *Ellipsaria*.

Guidelines and Techniques/Commercial

Freshwater mussel shells are being sold again to Japan.

Other Business

The Mussel Mitigation Trust will be dissolved by the end of this year. The Trust has offered a small sum as seed money to look into setting up the process for a trust to accept a large sum of funds should they come along. This would change our current status and it is not clear what these changes would mean. Heidi Dunn will check on what our status will allow us to do. Patty Morrison will follow up with Kari Duncan about the Fish and Wildlife Foundation and whether funds can be added to the foundation account instead.

The board took up the issue of waiving registration fees. The board has agreed to waive the registration fee for plenary speakers and those speakers having international travel. Additional waivers are up to the organizers of

workshops and symposia; however, approval is needed by the FMCS board.

A suggestion was brought to the board to consider apparel with the new FMCS logo that is slightly dressier than t-shirts, such as a collared shirt, that can be worn by members when asked to speak at events. The cost will be explored.

Workshop for 2006

Several ideas were put forth including health issues of persons surveying in freshwater systems and stream restoration for freshwater mussels. The board favors the latter which would include habitat restoration, FERC relicensing, and presentation of case studies. Heidi will explore further a workshop on stream restoration and mussels.

2007 Symposium

A request for volunteers and location for the 2007 symposium will be in the next *Ellipsaria*. A location that was mentioned was St. Louis.

FMCS Committee Reports

Awards

Remember to get your award nominations to Greg asap!

Environmental Quality and Affairs

No report.

Gastropod Status and Distribution

No report.

Guidelines and Techniques

Nothing new to report.

Information Exchange

Nothing new to report.

Mussel Status and Distribution

No report.

Outreach

Atypically, Outreach has nothing to report

Submitted by Kurt Welke

Propagation, Restoration, and Introduction

Genetics Workshop Wrap-up

The Genetics Workshop made a profit of approximately \$3,750.00, which was reported at the FMCS Board meeting in Frankfort, Kentucky, in November. A profit and loss statement of expenses and incomes was discussed with board members and given to Heidi Dunn, FMCS Treasurer.

2005 Symposium, St. Paul, Minnesota

It is now time to start thinking of new ideas and directions for the Propagation and Restoration Committee. Our Committee has been busy over the last few years, hosting the Mussel Propagation Workshop in 2002 and the Genetics Workshop in 2004. Both of these workshops provided

important discussions on topics that will continue to be of interest and concern to society members. However, at the 2005 FMCS Symposium in St. Paul, MN, interested society members should plan on meeting to discuss new ideas for the committee to pursue. Selection of Chair for the committee also will be discussed. So, bring your ideas to St. Paul and be ready to get involved with FMCS and the Propagation and Restoration Committee.

Submitted by Jess Jones

Symposium

See page 2 for details of the 2005 symposium.

REMINDER – Call for 2005 FMCS Professional Award Nominations

Do you know someone who has made worthwhile contributions to mussel conservation or to the Society either through donating their professional time or expertise or through their scientific endeavors? Consider nominating them for one of the FMCS Professional Awards. Nominations and supporting documentation are due on

31 January 2005.

See the Awards Committee web site at <http://ellipse.inhs.uiuc.edu/FMCS/Awards/index.html> for more details. Contact Dr. Greg Cope at greg_cope@ncsu.edu or at 919.515.5296, for more information.

FMCS Symposium at AFS Meeting

The freshwater mussel symposium at the American Fisheries Society meeting was spectacular! The trade-show booth sucked in the curious with amazing video and "eye-candy" displays, and the symposium presenters wowed the fish-heads with stunning slides and stellar performances. If you see any of the presenters – Watters, Graf, Barnhart, Haag, Szafoni, Gordon, Kitchel, Newton, and Cummings – or the Host with the Most (Welke), be sure to give them a pat on the back. A much deserved thanks goes to all for taking time out of their busy schedules to give the FMCS a "plug".

Submitted by Jeremy Tiemann

News & Announcements

The Roger Williams Park Museum of Natural History's Malacological Collections

James (Jay) R. Cordeiro

NatureServe, 11 Avenue de Lafayette, 5th Fl., Boston, MA
02111 *and*

Division of Invertebrate Zoology, American Museum of
Natural History, Central Park West at 79th Street, New York,
NY 10024

jay_cordeiro@natureserve.org

The Roger Williams Park Museum of Natural History (institutional acronym = RWP) is Rhode Island's only natural history museum and is located in the Roger Williams Park Zoo in Providence. Collections are 15% cultural and 85% natural history including approximately 8000 lots of recent mollusks, mostly from Rhode Island and other New England states. Between four and eight percent of these are composed of freshwater mussels. The core of the collection is based on the Horace Francis Carpenter Collection. Carpenter was a chemist and mineralogist whose company refined gold and silver as well as amateur conchologist and mineralogist who collected during the late 18th and early 19th centuries. His collection includes some 4000 specimens mostly from Rhode Island and documented in his "Shell-bearing Mollusca of Rhode Island" published in several early editions of the journals, *Random Notes on Natural History*, *The Conchologists' Exchange*, and *The Nautilus*. The museum would like to encourage use of the collections for scientific or educational purposes through visitation or temporary loan. Contact information is as follows:

Roger Williams Park Museum of Natural History

Roger Williams Park

Providence, RI 02905

Curator of Collections: Marilyn R. Massaro

e-mail: mmassaro@musnathist.com

Phone: (401) 785-9457 ext. 248

<http://www.osfn.org/museum>

Method Now Available to Recover Damages after Mussel Kills

In 2003, the Freshwater Mussel Conservation Society and the American Fisheries Society released the first-ever procedures for states to recover damages for lost mussels. These procedures are included as part of AFS's long-standing methods used by states to recover damages for fish kills. States are encouraged to employ these procedures after mussel kills as a method to discourage harmful activities that can impact mussel populations, and if state rules permit, as a source for funds to potentially restore or

enhance damaged mussel populations. The document, known as AFS Special Publication 30: Investigation and Monetary Values of Fish and Freshwater Mussel Kills, contains comprehensive methods for quantifying the extent of fish and freshwater mussel kills and for assessing restitution based on replacement cost for organisms lost in the kill. Tables containing replacement cost values for all freshwater mussel species are included. State agencies are encouraged to use this publication to begin recovering damages after mussel kills. If you have questions, please contact Rob Southwick at rob@southwickassociates.com. Copies of Special Publication 30 can be obtained from AFS: <http://64.224.98.53/publications/catbooks/x51030.shtml>

Pearls Exhibition

Pearls: A Natural History will be at the Milwaukee Public Museum from March 5 until June 26, 2005. This traveling exhibit was organized by the American Museum of Natural History, New York, in collaboration with The Field Museum, Chicago. This is an incredible exhibit, not just pretty pearls, but the whole science and history of pearls, including our own Midwest pearl button industry!

More information is available on the museum website: <http://www.mpm.edu/Pearls.html>

Submitted by Kurt Welke

OSU Website Additions

The Division of Molluscs website has two new sections:

- 1) How to determine the hosts for a freshwater mussel. Freshwater mussels have obligate parasitic larvae that may be rather host specific. How do you determine which fish are good hosts? A visual walkthrough of how it's done at the Columbus Zoo & Aquarium Freshwater Mussel Research Facility. Includes videos.
- 2) Virtual Villosa - a look at this North American freshwater mussel genus with photos and maps.

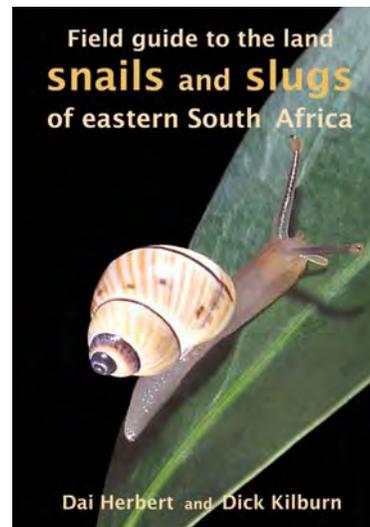
Link to the sites through the Mollusc Division URL at:

<http://www.biosci.ohio-state.edu/~molluscs/OSUM2>

G. Thomas Watters

Publications

Field Guide to the Land Snails and Slugs of Eastern South Africa



Authored by Dai Herbert and Dick Kilburn, this is the first comprehensive field guide to the snails and slugs of any part of sub-Saharan Africa, with descriptions and distribution maps for over 280 species and almost 600 photographs. It is a book not only about shells, but also about living animals and their biology, behaviour and conservation. The book is 340 pages (240X170 mm, full colour) and includes keys to families, colour photos, line drawings, and much more.

Published by the Natal Museum, this book celebrates 100 years of malacological research at the museum. The selling price is SAR290.00, excluding postage. Copies can be ordered from Dai Herbert at: dherbert@nmsa.org.za

Other publications:

Thorsen, W.A., Forestier, D., Sandifer, T., Lazaro, P.R., Cope, W.G., and Shea, D. 2004. Elimination rate constants of 46 polycyclic aromatic hydrocarbons in the unionid mussel, *Elliptio complanata*. *Archives of Environmental Contamination and Toxicology* 47: 332-340. Contact Greg Cope (greg_cope@ncsu.edu) for a reprint.

Contributed Articles

A Reach Scale Comparison of Fluvial Geomorphological Conditions of Freshwater Mussel Beds: Differences between the Haves and Have Nots

Andrew J. Peck, John L. Harris, and Alan D. Christian
Department of Biological Sciences, Arkansas State University

The White River basin of eastern Arkansas is a moderately sized, non-wadeable, sand-clay-gravel-bed river system. Christian (1995) and Harris and Christian (personal communication) identified mussel beds in the lower White River which, historically, have been commercially viable. Through field surveys commencing in the mid-1990's through 2000, 110 historically commercially viable beds have been classified as currently substantial or historically substantial, based on mussel densities within the bed. Utilizing this existing location and density information, the objective of this project is to assist in the definition of physical habitat ranges for freshwater mussels in the lower White River.

For this study, 12 sites were selected: six currently have high mussel densities (>10 mussels per m²) and six currently have low mussel densities (0-10 mussels per m²) (Christian 1995; Harris and Christian personal communication). All sites were resurveyed in 2004 to verify the accuracy of the selections. For each of the 12 sites, three sets of habitat sequences, each consisting of four habitat types (i.e. a glide, a riffle, a run, and a lateral scour pool), were located, flagged, and mapped.

Analysis of the sediment and hydraulic regimes of the sites are being examined over multiple stage events and between two regions along the river continuum. The suite of parameters being explored at each of the sites includes velocity profiles, bedload transport, total suspended sediment (TSS), and discharge. Throughout each of the study reaches, velocity profile information is being collected to assess hydraulic forces including Froude numbers and critical shear stress (Gordon *et al.* 1995). A more focused effort is the analysis of the sediment regime of the mussel beds which is being studied using mass-balance equations of both bedload and TSS.

We have collected data over a spring/summer moderate to high flow and a late summer / early autumn low flow. A final data collection effort will occur during late winter / early spring high flow. The main focus of this project is to provide some level of definition to the physical habitat ranges of freshwater mussels in the lower White River, AR. However, this information may also prove useful to managers and engineers currently planning resource extraction activities within the basin and in other low-

gradient systems in the southern U.S. Collaborators on this project are the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers – Memphis District, and the Arkansas Field Office of The Nature Conservancy.

Christian, A.D. 1995. Analysis of the commercial mussel beds in the Cache and White rivers in Arkansas. M.S. Thesis. Arkansas State University, State University, AR.
Gordon, N.D., T.A. McMahon, and B.L. Finlayson. 1992. Stream hydrology: an introduction for ecologist. John Wiley & Sons, Ltd, West Sussex, England.

Mussel Studies

Steve Ahlstedt
U. S. Geological Survey, Knoxville, TN 37921
(865) 545-4140 x.17
ahlstedt@usgs.gov

Clinch and Powell Rivers, TN/VA

Every five years since 1979 mussels in the Clinch and Powell Rivers are quantitatively evaluated (quadrant sampling). This has established long-term trend monitoring for mussel populations in both drainages. It was determined that only 12 sites would be evaluated in 2004 (6 each in both rivers). Sampling in both rivers is completed and mussel densities and species composition continue a downward trend in the Powell River and on the Virginia side of the Clinch River. However, gains in mussel densities and species compositions on the Tennessee side of the Clinch (1994 and 1999) especially T & E species and short-term brooders are now starting a downward trend. Of concern, is the amount of coal fines showing up in Tennessee from mining operations in Virginia. Black-water events from coal washings are a serious problem and unless it's stopped, we will lose one of the last great places for mussel biodiversity in the country. A final report is being prepared for the FWS-Cookeville, TN.

Cumberland Plateau – Upper Caney Fork, TN

Survey efforts in the upper Caney Fork drainage found some new populations of *Pleurobema gibberum*, *Venustachoncha sima*, and undescribed *Lasmigona* sp cf *holstonia*. Five individuals each of *Venustachoncha* and *Lasmigona* were collected and sent to Dr. Randy Hoeh for genetic sequencing. Apparently, the only population of *P. fabula* in the upper Caney Fork exists in Cane Creek. A final report is being prepared for the FWS-Cookeville, TN.

Recovery Plan Development for Tennessee and Cumberland River Basins

Efforts are underway to develop a recovery plan for mussels in the Tennessee and Cumberland River basins. This is a joint effort at identifying the most critically rare species and prioritizing which species to concentrate on first that are recoverable or offer the best chances for success. Some species are at critical low levels and may not survive the

next ten years. State and federal agencies involved with this process include: TN, KY, VA, NC, USGS, and FWS. Plans are to have a draft for review by December.

Project Summary: Programmatic Biological Assessment for *Potamilus capax* in Arkansas

Heidi E. McIntyre¹, Jerry L. Farris¹, and Alan D. Christian^{1,2}

¹Department of Environmental Sciences, Arkansas State University

²Department of Biological Sciences, Arkansas State University

The Arkansas State Highway and Transportation Department Planning and Research Division, in cooperation with the Federal Highway Administration, requested proposals in late 2003 for a habitat restoration plan and programmatic biological assessment of the endangered fat pocketbook, *Potamilus capax*, in Arkansas. The objectives of this research are 1) to determine success of relocation efforts for *P. capax* associated with highway construction projects by determining survivorship, movements and/or mortality, condition factor, and fecundity of relocated and non-relocated adults and sub-adults, 2) to determine success of propagation efforts resulting from highway construction projects by documenting survivorship of juveniles after return to field and population enhancement (recruitment), and 3) to determine impacts to *P. capax* and the associated mussel community at highway construction sites by determining sediment deposition downstream of construction site and determining condition factor of mussels pre and post construction.

To date we have been developing in house protocols for three measures of physiological fitness / condition (glycogen, RNA/DNA ratios, and lipid content) each representing three differential time scales. This study and techniques have been developed to provide important information regarding the potential impacts from relocation efforts. Small non-lethal tissue snips will be taken pre- and post-relocation and frozen at -70C until analysis. Glycogen will be analyzed via modified phenol-sulfuric acid technique (Naimo *et al.* 1998). RNA and DNA will be analyzed via QIAGEN RNA/DNA Mini-Kit (QIAGEN Inc. USA) and lipids will be analyzed via vanillin phosphoric acid technique (Van Handel 1985). Resident, source, and relocated individuals will be compared over time.

Naimo, T.J., E.D. Damschen, R.G. Rada, and E.M. Monroe. 1998. Nonlethal evaluation of the physiological health of unionid mussels: methods for biopsy and glycogen analysis. *Journal of the North American Benthological Society* 17:121-128.

Van Handel, E. 1985. Rapid determination of total lipids in mosquitoes. *Journal of the American Mosquito Control Association* 1:302-304.

Life History and Ecology of the State Special Concern Ouachita Creekshell (*Villosa arkansasensis* (Lea 1852))

Sara E. Seagraves¹, Jerry L. Farris², and Alan D. Christian¹

¹Department of Biological Sciences, Arkansas State University

²Department of Environmental Sciences, Arkansas State University.

Villosa arkansasensis (Lea 1852) is endemic to the streams of the Ouachita Mountains of Arkansas and Oklahoma and is listed as a species of special concern in Arkansas (Harris *et al.* 1997). The objectives of this project include: 1) conduct a status survey of *V. arkansasensis* to provide information on relative abundance, population demographics and habitat use, 2) conduct life history study to determine timing of reproduction, age / size at sexual reproduction, measure growth and determine age, and determine host fish suitability and describe glochidia using electron microscopy, 4) conduct a mark and recapture study to determine population size and mortality rates and, 5) conduct a behavioral study that measures vertical and horizontal migration and investigates if a relationship between spatial patterns and reproduction exists.

The status survey sites in the Ouachita and Saline Rivers for this project were selected from sites previously documented to have *V. arkansasensis* (Harris and Gordon 1988). We have completed the status survey and physical habitat characterization on 19 sites in the Saline and Ouachita River drainages.

We have chosen four primary study sites for host suitability and behavioral studies. We recently prepared two of the four sites for the horizontal migration study as well as the mark-recapture study, marking the individuals, taking measurements and sexing them. At this time we determined the female mussels become gravid in October and like other *Villosa* species we believe them to be long term over-wintering brooders. Host suitability trials are expected to begin in the late winter early spring of 2005.

Harris, J.L., and M.E. Gordon. 1988. Status survey of *Lampsilis powelli* (Lea, 1852). Final Report 14-16-0004-87-066, United States Fish and Wildlife Service, Jackson, Mississippi.

Harris, J.L., P.J. Rust, A.D. Christian, W.R. Posey, II., C.L. Davidson, and G.L. Harp. 1997. Revised status of rare and endangered Unionacea (Mollusca: Margaritiferidae, Unionidae) in Arkansas. *Journal of the Arkansas Academy of Science* 51:66-89.

Life History of the Arkansas fatmucket, *Lampsilis powellii* (Lea, 1852)

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Twenty-two species of Arkansas' 75 native mussels are listed as endangered, threatened, or of special concern. Factors contributing to declines include habitat alteration, water quality degradation, and commercial harvest. The US Fish and Wildlife Service listed *Lampsilis powellii* as threatened in 1990 and in 1992 developed a species recovery plan. Objectives of this study included 1) determination of *L. powellii* relative abundance and population demographics; 2) examination of reproductive biology including period of gravidity and glochidia release; 3) identification of suitable fish hosts; and 4) characterization and assessment of habitat use by *L. powellii*. Surveys were conducted at 34 sites on the Saline, Ouachita, and Caddo rivers in Arkansas. Collected *L. powellii* were measured, sexed, and inspected for gravidity. Host suitability trials were conducted with gravid females and potential fish hosts collected during spring of 2003 and 2004. Study sites were characterized using Basin Area Stream Surveys and assessed using US EPA Rapid Bioassessment Protocol for wadeable streams and water quality analyses. Twenty-eight species of mussels were identified including 137 *L. powellii*. Females were observed gravid from March – October 2003 and in April 2004. During these trials, suitable fish hosts were exclusively from the family Centrarchidae, with the most successful hosts being *Micropterus punctulatus* and *M. salmoides*. A total of 337 and 329 juveniles were reared during 2003 and 2004, respectively. *L. powellii* were collected from mid channel pool, glide, and run habitat types with gravel substrate. Measured water chemistry variables during this study suggest that additional monitoring is warranted to ensure adequate ranges in support of aquatic life. This study elaborates upon information necessary for the successful conservation and management of a threatened species.

Assessment and Habitat Evaluation of Native Freshwater Mussel Resources of Buffalo National River

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National Parks can play a crucial role in the preservation and restoration of native mussel communities, acting as areas of

habitat refugia, and a recent challenge to park managers with native mussel resources call for parks to become more involved in management of their native mussel resources. Buffalo National River (BUFF) accepts this challenge and has formed a cooperative partnership with Arkansas State University in order to begin a three-year effort to document the native mussel communities of the Buffalo River. In conjunction with ASU, BUFF will begin a three-year effort to fully document the location, status, and habitat requirements of native mussels within the Buffalo River.

Buffalo National River is a 150-mile long free-flowing stream in northern Arkansas famous for its scenic beauty as well as canoeing, fishing, and other recreational opportunities. The National Park Service's jurisdictional boundary includes a continuous 132-mile river corridor from near the headwaters to the confluence with the White River. Eleven percent of the watershed is within BUFF's boundaries. Remaining lands within the watershed are a mix of public and private ownership: Ozark National Forest (26%), Arkansas Game and Fish Commission (3%), and private (60%).

The objectives of the study are to: 1) examine the full length of the river's main channel for undocumented mussel beds and to relocate historic sites (Meek and Clark 1912; Harris 1996); 2) document the location and basic habitat parameters of all located mussel beds; 3) perform qualitative surveys of beds to produce an estimate of mussel species richness; 4) search for the potentially extirpated mussels, black sandshell (*Ligumia recta*) and bleufer (*Potamilus purpuratus*), and the endangered scaleshell (*Leptodea leptodon*); 5) revisit 12 qualitative sites to perform quantitative surveys 6) perform a comprehensive geomorphic reach assessment in and around the mussel beds; and 7) install cross-section monuments for the implementation of long-term monitoring for the 12 selected mussel beds.

During the summer of 2004, 35% of the river was searched and 38 mussel sites were documented. Sixteen of these sites were new. To date, 22 native species and one non-native, *Corbicula*, have been documented. Positioning of mussel aggregates within the channel tend to be in flood protected areas and spaced 5 to 7 bankfull widths apart. Most mussel aggregates have been found in riffle-run and pool type habitats with ranges in depth between 0.3 to 1.1m and velocities 0.02 to 0.83m/s. Community species richness and diversity exhibit a tendency to be associated with substrates that are predominately cobble surrounded by small to medium boulders.

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Taxonomic Problems Among Freshwater Mussels in Texas: Future Work for the Gel Jocks

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When Texas Parks and Wildlife Department (TPWD) began formal work with freshwater mussels in 1992, a number of taxonomic problems quickly became apparent. Some of these remain unresolved at this time. For now, when asked how many unionid species are present in Texas, a not-so-solid “we’re not entirely sure” is the best we can provide at present.

Flat floater *Anodonta suborbiculata* was not native to Texas (Strecker 1931), but invaded over the past 70 years or so (Howells et al. 1996). In May 1993, TPWD obtained specimens of a floater that appeared morphologically intermediate between giant floater *Pyganodon grandis* and flat floater. These animals had shells that were darker in color, more elongate, and less deep bodied than flat floater and had beaks that were slightly elevated above the hinge line. Similar specimens were found about this same time in Mississippi. A reservoir drawdown in December 1993 seems to have eliminated this form in Texas. Subsequent collections produced individuals that were more akin to typical flat floaters and tissue samples from the original specimens were lost in a freezer malfunction. The disposition of both the Texas and Mississippi animals remains unresolved.

Similarly, a *Strophitus* from the Texas-Louisiana border area is far more inflated than typical creeper *S. undulatus*, with a pronounced posterior ridge and hinge teeth. It has been considered an odd local morph of creeper (Howells et al. 1996), a western population of southern creekmussel *S. subvexus* (Vidrine 1993), and possibly an undescribed species in the genus (P. Hartfield, pers. comm.). Although tissue from this and other *Strophitus* has been obtained, lack of tissue from true *S. subvexus* specimens continues to preclude resolving the status of this unionid.

Among the quadrulids, both starch-gel electrophoresis (Howells et al. 1996) and DNA (Serb et al. 2003) analysis demonstrated that gulf mapleleaf *Quadrula nobilis* appeared distinct from mapleleaf *Q. quadrula* and southern mapleleaf *Q. apiculata*. However, this distinction is still not widely recognized, in part, because it is not entirely clear where *Q. nobilis* ends and *Q. quadrula* begins. Additionally, the disposition of “*Unio aspera*” and several variants of the *nobilis*-types also remains unclear and unstudied.

Among the pimpleback species in Texas, western pimpleback *Q. mortoni* has been shown to support specific

designation (Serb et al. 2003), but most ecophenotypes in Texas and elsewhere remain unexamined biochemically, including the “*nodifera*” form and others that may be true pimpleback *Q. pustulosa* (Howells 2002). Further, DNA analyses published thus far on the pimpleback quadrulids have failed to comparatively include smooth pimpleback *Q. houstonensis* from the Colorado and Brazos systems.

Electrophoretic analysis failed to find a difference between Texas lilliput *Toxolasma texasiensis* and western lilliput *T. mearnsi*. Even “lilliputs” that were large, heavy-shelled specimens were not genetically distinct electrophoretically (Howells 1997). But, both were clearly different from lilliput *T. parvus*. However, *T. parvus* used in the analysis were only from a small sample from the Rio Grande.

Among the other enigmatic Texas mussels, the western form of bleufer *Potamilus purpuratus* called “*coloradoensis*” is likely to deserve specific status (Roe and Lydeard 1998). An inflated form of paper pondshell *Utterbackia “imbecillis”* may be a unique taxon as well. Morphologically odd pistolgrips *Quadrula [Tritogonia] verrucosa* from western Texas beg for genetic examination. The pondhorns (*Uniomereus*) in Texas include both *U. tetralasmus* and *U. declivis*, but most populations appear morphologically intermediate between these taxa and preliminary electrophoretic analysis has been completely unrevealing. The placement of *Potamilus metnecktai* in this genus or in *Disconaias* will remain a “best guess” until genetic examinations are performed and glochidia found and described.

Although morphological features can be important, resolution of these taxonomic questions awaits needed DNA analyses and offer challenges to future biochemical geneticists. Further, such efforts should be initiated soon. Mussels are vanishing. If, for example, any distinction ever existed between false spike *Quincuncina mitchelli* in Central Texas and forms in the Rio Grande, the issue is likely to remain unresolved due to the near extinction of this species in Brazos, Colorado, and Guadalupe drainages and apparent extirpation from the latter.

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New “Old Records” of Asian Clam *Corbicula fluminea* in Texas

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The Asian clam is widely recognized worldwide as an undesirable molluscan invader (McMahon 1983). Since its original discovery on Vancouver Island, British Columbia, in 1924 (Counts 1981) and in the Columbia River, Washington, in 1938 (Burch 1944), numerous authors have documented its spread across North America (Britton and Morton 1979; Counts 1986), including its invasion of Texas (Britton and Murphy 1977; Britton and Morton 1979).

In Texas, Metcalf (1966) first collected Asian clams in drainage canals of the El Paso area in 1964. By 1969, they were reported to be in the lower Rio Grande Valley (Murray 1971). It has been suggested that a general west to east invasion occurred across the state (McMahon 1982). However, Asian clams were discovered in Kentucky in 1958 and Tennessee in 1959 (see summary in Counts 1986), and later in Louisiana in 1961 (Dundee and Harman 1963). Early records in the western and central U.S. have led some to speculate that Texas may have been invaded simultaneously from both the east and west (Britton and Morton 1979).

In the late 1990s, a shell dealer in California sent RGH a collection of freshwater bivalves from Texas that had been in storage for many years. Many of these specimens were collected in southeastern Texas by Mrs. E.J. Merrin in 1962 and 1963. Merrin used cloth-paper labels, an unusual typeface printing, and collection numbers, including a comma. One specimen in this group was an Asian clam listed as unidentified species (3), Village Creek, near Village Mills, Texas, with the collection number “, 3”. Although, the label lacked a date and the collector’s name, it was printed on the same paper, with the same typeface, and same type of collection number as her other labels. It was a

tantalizing suggestion that Asian clams may have been present in waters just north of Beaumont a year or two before being observed by Metcalf in El Paso. However, in the absence of more data, the exact origins of the Village Creek material remains uncertain.

In 2004, during a review of historic Texas Asian clam records and specimens, JBW discovered a specimen (HMNS.MAL.33672) in the museum’s collection that had been obtained alive by Paul McGee in September 1958 from the Neches River below Town Bluff Dam at B.A. Steinhagen Reservoir, in Jasper and Tyler counties, Texas, over six years sooner and 550 miles east of the previous Texas record. More over, Asian clams (HMNS.MAL.35549) from the El Paso area collected in July 1964 by the late Connie Boone were also present in the HMNS collection and predate Metcalf’s record for November that year.

The McGee specimen collected in 1958 from the Neches River places this species in Texas sooner than generally recognized, predating both the El Paso specimens collected in 1964 and those in Louisiana in 1961. It also supports the hypothesis that Texas may have been invaded from both the east and west at approximately the same time.

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An Odd Find of *Ferrissia clessiniana* on the Isle of Terschelling, the Netherlands

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In early October 2004 I visited Terschelling, one of the islands in the north of the Netherlands, separated from the mainland by the Wadden Sea. Its land- and freshwater molluscs are well known to me because I was a regular visitor of this beautiful island during the sixties. During the past ten years I have spent almost one week on Terschelling during my annual visits to my relatives there.

Last year I collected freshwater molluscs in an artificial lake called the “Doodemanskisten” near West-Terschelling. Due to the dry hot summer of 2003 the water had fallen to an extremely low level and the bottom of the lake had partially fallen dry. Only two gastropods were encountered: a local species *Bithynia tentaculata* (Linnaeus, 1758) and an exotic one *Haitia acuta* (Draparnaud, 1805). The latter is of North American origin and is now well established throughout the Netherlands. However, on Terschelling it had been collected for the last time in 1962 at a quite different locality more than 15 km to the east (Mienis, 2004).

On October 5, 2004, I again sampled the “Doodemanskisten”. The lake was completely filled with water and I encountered five different species of gastropods: *Valvata cristata* Mueller, 1774, *Haitia acuta* (Draparnaud, 1805), *Anisus vortex* (Linnaeus, 1758), *Gyraulus albus* (Mueller, 1774), and *Ferrissia clessiniana* (Jickeli, 1882). The *Valvata*, *Anisus* and *Gyraulus* species are of local origin, the *Haitia* and *Ferrissia* species are considered exotic. The latter was a real surprise because it had not been recorded previously from Terschelling. *Ferrissia clessiniana* is a tiny freshwater limpet originally described from the delta of the river Nile near Alexandria, Egypt (Jickeli, 1882). It is also known as *Ferrissia wautieri* (Mirolli, 1960), which is now considered a junior synonym, the latter has been based on material found in Italy.

This species became extinct in Europe during the Quaternary, but invaded that area again towards the middle of the 20th Century (Calas, 1954; Wautier & Odièvre, 1959). It has turned out a rather aggressive, invasive species often forming extremely dense populations at new sites, but almost disappearing in the following years (Mienis, 2002).

How did this species reach the “Doodemanskisten”? Freshwater limpets are known for their ability to reach new sites by adhering to the elytra of aquatic beetles and

Hemiptera (Rees, 1965; van Regteren Altena, 1968). However, this was probably not the case in this lake. All specimens were found adhered to the undersides of floating leaves of Water lilies, *Nymphaea* species, in spite of the fact that no Water lilies are growing in the lake. Moreover, quite a number of entire plants of the Water hyacinth *Eichhornia crassipes* and Water lettuce *Pistia stratiotes*, both exotic aquatic plants of American origin, were floating on the water in the same corner of the lake as the cut off leaves of the Water lilies. All three species are common pond plants and are often offered for sale in so-called garden centers. In my opinion somebody living in the vicinity of the lake removed superfluous water plants from his garden pond and dropped the material in the “Doodemanskisten”. If this scenario is correct then it shows how easily springs, streams, canals, and lakes can be infected with commercial, exotic species.

Ferrissia clessiniana has recently been reported from a similar artificial lake on Vlieland, another Wadden Sea island (de Winter & van Leeuwen, 2004).

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A Graveyard of *Planorbella duryi* forma *seminole* on the Shores of Lake Albano, Italy

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The North American Rams-horn species *Planorbella duryi* (Wetherby, 1879) is a well-known world-wide aquarium

species. Unfortunately it often becomes a pest in aquariums because of its prolific rate of reproduction. Surplus specimens are often dumped in a nearby stream, pond, or lake, and, if it finds suitable habit, starts to reproduce. This Rams-horn species has probably reached Lake Albano, some 25 km from Rome, Italy in this manner. Manganelli et al. (1995) reported it from that lake as *Helisoma duryi*.

Since 1597, the village of Castel Gandolfo, on the shore of Lake Albano, has harboured the summer palace of the Pope. It is a highly appreciated tourist attraction. This year one of my colleagues at the Tel Aviv University, Dr. Micha Ilan, was among them. According to him, the shores of Lake Albano were littered with millions of empty, white shells. He took a handful of them to the National Mollusc Collection of the Tel Aviv University. By far the majority of them turned out to belong to a scalarid form of *Planorbella duryi*, which was described by Pilsbry (1934: 35-38, fig. 2) as *Helisoma duryi seminole* (Pilsbry, 1934). Pilsbry reported this curious snail from Lake Eustis, the type locality, and several other lakes in Florida. This forma *seminole* Pilsbry, 1934 is distinguished from the nominal form by its semi-scalarid and distinctly angulated early whorls. None of the shells from Lake Albano showed a typical planorbid form as in the nominal form of *Planorbella duryi*. *Planorbella duryi* forma *seminole* resembles in form and size *Planorbella scalaris* (Jay, 1939) but differs from the latter by its wider umbilicus.

The sample collected by Dr. Ilan included > 50x *Planorbella duryi* forma *seminole* and another North-American species, *Haitia acuta* (Draparnaud, 1805) (= *Physella acuta* in Turgeon et al., 1998) (3x), plus two native species *Bithynia tentaculata* (Linnaeus, 1758) (8x) and *Radix auricularia* (Linnaeus, 1758) (1x).

The cause of the die off of *Planorbella duryi* forma *seminole* in such extremely large numbers in Lake Albano could not be established.

I like to thank Dr. Micha Ilan for donating this interesting sample of the Seminole rams-horn to the National Mollusc Collection of the Tel Aviv University.

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Additional Information Concerning the Conquest of Europe by the Invasive Chinese Pond Mussel *Sinanodonta woodiana* 10. News from the Netherlands, Belgium, and the Czech Republic

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In 2004, little new information has been published concerning the further conquest of Europe by the invasive Chinese Pond Mussel *Sinanodonta woodiana* (Lea, 1834). Yet some data are presented here concerning the Netherlands, Belgium, and the Czech Republic.

The Netherlands

Thanks to Paul Veenliet's website, www.vijvervisinfo.net/index.html, we know that living specimens of the Chinese Pond Mussel are for sale in the Netherlands as so-called biofilters since 2003. Photographs of such specimens have been placed on the internet: www.studiocinqo.com/p_veenvliet/2_mussels_S_%20woodiana.htm. Veenliet's observations seem to be correct because my colleague at the Zoological Museum of Amsterdam (ZMA) Robert G. Moolenbeek came across adult specimens in a garden-center "Intratuin" in Kortenhoeve on August 15th, 2004 (ZMA, two adult, but already dead specimens), while I found it under similar conditions in a garden-center "Overvecht" in ZO-Beemster on September 27th, 2004 (ZMA, one living, juvenile specimen). Most likely the Chinese Pond Mussel occurs in ponds in public parks or private gardens throughout the Netherlands, however, so far nobody has ever reported any find of it (see also Mienis, 2003).

Belgium

Keppens & Mienis ([2003] 2004a) published in Dutch about finds of the Chinese Pond Mussel in a recreation-pond in Diest, Belgium, in the hope it would result in more records of this invasive mussel species from the Flemish part of Belgium. In the meantime, a translation of this article in French has been published elsewhere (Keppens & Mienis, 2004b) in order to reach the Walloons among the Belgian population. "Unfortunately" nobody has responded so far on these calls for additional information. This lack of any response can be interpreted twofold: a general lack of interest for freshwater mussels in Belgium or the fishpond in

Diest is indeed so far the only place in Belgium where this species has managed to settle.

The Czech Republic

Until recently two records of *Sinanodonta woodiana* were known from the Czech Republic (Beran, 2004): the river Dyje or Thaya in South Moravia since 1996, and a fishpond near Zehunsky rybnik in Central Bohemia since 2001. Novak (2004) has recently reported on a third locality: a fishpond near Chropynsky rybnik in Central Bohemia, where it occurs since 2003. This exotic mussel may be expected to live in fishponds elsewhere in the Czech Republic.

Acknowledgement

I thank Robert G. Moolenbeek (Amsterdam) for showing me the specimens collected by him, which are now permanently stored in the Zoological Museum of Amsterdam.

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Preliminary General Inventory of Continental Mollusks (Gastropoda & Bivalvia) from Santa Catarina State, Southern Brazil

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In agreement with Oliveira & Almeida (2000), surveying the malacofauna of a region or state is important for several reasons, such as: agricultural fauna, medicinal-veterinarian,

plagues, food, and ecological features. The continental mollusks of the Santa Catarina's state, southern Brazil, are poorly known (Agudo 2004 b). Information on species composition, geographical extent, history, and conservation status is largely unpublished or widely scattered in the literature. Most studies in the State have focused on the marine malacofauna (Agudo 2004 a, b).

Malacological inventories conducted in this territory from 1996 (Agudo 2004 a-f) until present (October 2004) found 110 terrestrial and freshwater mollusks species, including 89 Gastropoda* and 21 Bivalvia**. (*27 corresponding to freshwater forms (Agudo 2004 e), involving a total of 11 Prosobranchia and 78 Pulmonata, with 24 Families and 52 Genus. ** 16 Unionoida & 5 Veneroida (Agudo 2004 e), including 4 Families and Genus.)

In the absence of a general inventory (Agudo 2004 d, e), this work is the first step towards a comprehensive inventory of the continental malacological fauna of the state of Santa Catarina. For a general idea of the zoogeographical records in this territory, see Agudo (2004c).

Systematic Species List

Class GASTROPODA

Subclass Prosobranchia

Family AMPULLARIIDAE Gray, 1824 (7)

Asolene megastoma (Sowerby, 1825)

Felipponea iheringi (Pilsbry, 1983)

Pomacea bridgesii (Reeve, 1856)

Pomacea canaliculata (Lamarck, 1819)

Pomacea insularum (Orbigny, 1839)

Pomacea paludosa (Say, 1829)

Pomacea sordida (Swainson, 1822)

Family HELICINIDAE Latreille, 1825 (1)

Helicina brasiliensis Gray, 1824

Family HYDROBIIDAE Troschel, 1857 (2)

Heleobia piscium (= *australis*) (Orbigny, 1835)*

Potamolithus catharinae Pilsbry, 1911

*Obs.: Estuarine/freshwater species (Rios 1994, p. 50; Pereira et al 2000, p. 153)

Family THIARIDAE Troschel, 1857 – Preston, 1915 (1)

Melanoides tuberculatus (Müller, 1774)

Subclass Pulmonata

Family SUCCINEIDAE Beck, 1837 (1)

Omalonyx unguis (Ferussac in d'Orbigny, 1841)

Family ANCYLIDAE Rafinesque, 1815 (1)

Gundlachia (= *Hebetancylus*) *moricondi* (Orbigny, 1846)

Family CHILINIDAE Gray, 1828 (3)

Chilina fluminea (Orbigny, 1835)

Chilina globosa Frauenfeld, 1881

Chilina parva Martens, 1868

Family ELLOBIIDAE Muhlefeld, 1816 (2)

Melampus coffeus (Linnaeus, 1758)*

Pedipes mirabilis (Mohlfeld, 1816)**

*Obs.: Estuarine/terrestrial species (Abbott 1989, p. 55; Rios 1994, p. 221; Oliveira & Almeida 1999, p. 7)

**Obs.: Estuarine/freshwater species (Abbott 1989, p. 55; Rios 1994, p. 222; Oliveira & Almeida 1999, p. 7)

- Family PHYSIDAE Fitzinger, 1833 (3)
Physa acuta (= *cubensis*) Draparnaud, 1805
Stenophysa (= *Aplexa*) *marmorata* Guilding, 1828
Stenophysa (= *Aplexa*) *rivalis* (Maston & Rackett, 1898)
- Family LYMNAEIDAE Rafinesque, 1815 (1)
Pseudosuccinea (= *Lymnaea*) *columella* Say, 1817
- Family PLANORBIDAE Rafinesque, 1815 (7)
Biomphalaria glabrata (Say, 1818)
Biomphalaria occidentalis Paraense, 1981
Biomphalaria oligoza Paraense, 1981
Biomphalaria straminea (Dunker, 1848)
Biomphalaria tenagophila (Orbigny, 1835)
Bulinus tropicus (Krauss, 1848)
Drepanotrema cimex (Moricand, 1838)
- Family VERONICELLIDAE Gray, 1840 (9)
Belocaulus angustipes (Heynemann, 1885)
Phyllocaulis boraceiensis Thomé, 1976
Phyllocaulis soleiformis (Orbigny, 1835)
Phyllocaulis tuberculosus (Martens, 1868)
Phyllocaulis variegatus (Semper, 1885)
Sarasinula dubia (Semper, 1885) Thomé, 1972
Sarasinula linguaeformis (Semper, 1885) Thomé, 1972
Sarasinula plebeia (Fischer, 1868)
- Family SUBULINIDAE Crosse & Fischer, 1877 (6)
Subulina octona Bruguiere, 1792
Lamelaxis gracilis Hutton, 1834
Lamelaxis micra Orbigny, 1835
Leptinaria unilamellata (Orbigny, 1835)
Obeliscus obeliscus (Moricand, 1838)
Rumina decollata Linnaeus, 1758
- Family ARIONIDAE Gray in Turton, 1840 (2)
Arion silvaticus (Lohmander, 1937)
Arion subfuscus (Draparnaud, 1805)
- Family LIMACIDAE Rafinesque, 1815 (4)
Deroceras (= *Agriolimax*) *laeve* (= *laevis*) (Müller, 1774)
Lehmannia valentiana (Férussac, 1823)
Limax flavus Linnaeus, 1758
Limax maximus (Linnaeus, 1758)
- Family ACHATINIDAE Swainson, 1840 (1)
Achatina fulica (Bowdich, 1822)
- Family BULIMULIDAE Tryon, 1867 (7)
Bulimulus tenuissimus (Orbigny, 1935)
Drymaeus acervatus Pilsbry, 1895
Drymaeus magus Wagner, 1827
Leiostracus zebra (Spix, 1827)
Oxystila pulchella (Spix, 1827)
Simpulopsis sulculosa Férussac, 1819
Thaumastus largillierti (Phillippi, 1845)
- Family MEGALOBULIMIDAE Leme, 1973 (8)
Megalobulimus granulatus (Rang, 1831)
Megalobulimus gummatum Hidalgo, 1870
Megalobulimus haemastomus (Scopolis, 1786)
Megalobulimus proclivis (Martens, 1888)
Megalobulimus toriii Morretes, 1937
Psiloicus (= *Megalobulimus*) *oblongus* Müller, 1775
Psiloicus (= *Megalobulimus*) *oblongus elongatus* Bequaert, 1948
Psiloicus (= *Megalobulimus*) *oblongus musculus* (Bequaert, 1948)
- Family STROPHOCHEILIDAE Thiele, 1926 (4)
Strophocheilus (= *Mirinaba*) *erythrosoma* (Pilsbry, 1895)
Strophocheilus (= *Mirinaba*) *planidens* Michelin, 1831
Strophocheilus (= *Mirinaba*) *unidentatus* (Sowerby, 1825)
Gonyostomus turnix Gold, 1846
- Family ODONTOSTOMIDAE Pilsbry & Vanatta, 1898 (8)
Odontostomus catharinae (Pfeiffer, 1856)
Odontostomus fasciatus (Potiez & Michaud, 1838)
Odontostomus punctatissimus (Lesson, 1830)
Odontostomus revei (Deshayes, 1851)
Cyclodontina angulata (Wagner, 1827)
Cyclodontina inflatus (Wagner, 1827)
Cyclodontina ringens (Dunker, 1847)
Macrodonates grayanus (Pfeiffer, 1845)
- Family XANTHONYCHIDAE Strelb & Pfeiffer, 1879 (1)
Bradybaena similaris (Férussac, 1821)
- Family STREPTAXIDAE Gray, 1806 (2)
Streptaxis iheringi Thiele, 1927
Artemon mülleri Thiele, 1927
- Family HELICIDAE Rafinesque, 1815 (1)
Cornu (= *Helix*) *aspersum* (= *aspersa*) (Müller, 1774)
- Family SYSTROPHIIDAE Thiele, 1926 (4)
Entodina gionensis Morretes, 1940
Happia besckei (Dunker, 1847)
Happia microdiscus Thiele, 1927
Happia vitrina mülleri Thiele, 1927
- Family ZONITIDAE Mörch, 1864 (2)
Euconulus martinezi (Hidalgo, 1869)
Oxychilus nitidus (Müller, 1774)
- Family PUNCTIDAE Morse, 1864 (1)
Punctum (Toltecia) pilsbryi (Scott, 1957)
- Class PELECYPODA = BIVALVIA
- Order Unionoida
- Family MYCETOPODIDAE Gray, 1840 (9)
Mycetopoda legumen (Martens, 1888)
Anodontites crispatus tenebricosus (Lea, 1834)
Anodontites ferrarisi (Orbigny, 1835)
Anodontites iheringi (Clessing, 1882)
Anodontites lucidus (Orbigny, 1835)
Anodontites trapesialis (Lamarck, 1819)
Anodontites sp
Leila blainvilliana (Lea, 1834)
Monocondylaea minuana Orbigny, 1835
- Family HYRIIDAE Swainson, 1840 (7)
Diplodon aethiops (Lea, 1860)
Diplodon ellipticus (Wagner in Spix, 1827)
Diplodon expansus (Küster, 1856)
Diplodon hildae Ortmann, 1921
Diplodon martensi (Ihering, 1893)
Diplodon pilsbryi Marshall, 1928
Diplodon rhuacoicus (Orbigny, 1835)
- Order Veneroida
- Family CORBICULIDAE Gray, 1847 (2)
Corbicula fluminea (Müller, 1774)
Corbicula largillierti (Phillippi, 1844)
- Family SPHAERIIDAE Deshayes, 1854 (3)
Sphaerium observationis (Pilsbry, 1911)
Eupera klappenbachi Mansur & Veitenheimer, 1975
Eupera platensis Doello-Jurado, 1921

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High School and University Researchers Verify Flathead Catfish as Host for Pistolgrip (*Tritogonia verrucosa*)

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Pistolgrip, *Tritogonia verrucosa* (Rafinesque, 1820), is rare in several upper Midwest states. Listed in Iowa, Minnesota, and Wisconsin, we wanted to assist resource managers better manage the species by expanding our understanding of host fish(es) utilized by pistolgrip glochidia.

We followed standard protocol for conducting laboratory host suitability tests (Neves *et al.* 1985). Gravid pistolgrip were collected from and later returned to the St. Croix River boundary waters between Minnesota and Wisconsin. We used glochidia

from three pistolgrip to conduct host suitability trials. Trials were conducted at four locations, the University of Minnesota's Wet Laboratory and in advanced biology classrooms at Amery, Grantsburg, and Webster high schools. The high schools are located in the upper St. Croix River watershed. We siphoned aquaria and counted glochidia and juvenile pistolgrip 2-3 times a week. A mussel was considered a juvenile when foot movement was observed. Fish nomenclature follows Robins *et al.* (1991).

We conducted host suitability trials on 15 fish species (6 families).

Amery High School

Instructor – Steve Schieffers, students - Tom Cahill, Matt Corbett, Pauline Coulemens, Jake Cramlet, Nick Cramlet, Kelly Evenson, David Kazmarski, Jake Lewis, Brant Luehman, Lacy Morse, Catie Pinger, Christa Pinger, Richard Schiel, John Spitzer

We found that freshly released pistolgrip glochidia should be exposed to fish in less than 12 hours.

Species	Number tested	Glochidia attachment period (days)	Species	Number tested	Glochidia attachment period (days)
black crappie		*	channel catfish		*
bluegill		*	brown bullhead		*

* - Glochidia did not attach to fish

Grantsburg High School

Instructor – Matt Berg, students – Aaron Berner, Mandy Bjerke, Craig Briggs, Scott Crawford, Ashley Cunderla, Julie DeMarre, Sarah Evensen, Doug Folk, Kaelyn Friese, Tyra Gaffney, Mike Geiger, Traci Griffith, Ryan Hansen, Amber Hess, Samantha Hess, Sara Jensen, Dan Johnson, Michael Johnson, Whitney Johnson, Kevin Juleen, Josh LaMerre, Alex Lindau, Amanda Lisiecki, Vanessa McKinley, Maria Manning, McKenna Marek, Christine McConnell, Kevin Milligan, Melissa Moody, Kerissa Morrin, Kerissa Nelson, Natasha Olson, Carlos Perez, Nick Ryan, Krista Wallace, Kristina Westberg, Jeremy Woodrich, Reily Yerigan

Species	Number tested	Glochidia attachment period (days)	Species	Number tested	Glochidia attachment period (days)
black crappie	1	1-4	brown bullhead	3	4-6
bluegill	1	1-4	channel catfish	1	2-6
black bullhead	3	1-4	largemouth bass	4	1-4

University of Minnesota (UMN)

Species	Number tested	Glochidia attachment period (days)	Species	Number tested	Glochidia attachment period (days)
shortnose gar	1	1-4	brown bullhead	1	*
fathead minnow	15	1-4	channel catfish	5	4-8
hornyhead chub	6	1-4	slender madtom	1	21-24
black bullhead	5	1-4	stonecat	2	1-4
blue catfish	6	1-4	white bass	1	1-4

* Died prior to study completion

We recovered 4169 juvenile pistolgrip from four flathead catfish 31-69 days after glochidia infestation. Glochidia diameter increased approximately 2-5 times during encystment.

Webster High School

Instructor – Greg Widiker, students – Loren Benjamin, Allen Lemonds, Bryan Maloney, Trent Mulroy, Peter Postler, Josh Proffit, Laura Proffit, Tyler Starks, Peter Wilson, Nate Wolf

Species	Number tested	Glochidia attachment period (days)	Species	Number tested	Glochidia attachment period (days)
black bullhead	4	*	smallmouth bass	5	1-4
yellow bullhead	2	8-10	walleye	2	1-4
channel catfish	4	4-8			

*Died prior to study completion

Our results are consistent between our laboratories and published work. Channel catfish and black bullheads were tested at more than one of our laboratories and no juvenile mussels were collected. These negative results are consistent with earlier trials we conducted at the UMN (Kurth and Hove 1997, Pepi and Hove 1997). Howells (1997) described pistolgrip glochidia metamorphosis on flathead catfish in the laboratory. These results suggest flathead catfish are important in sustaining pistolgrip populations.

We thank Amery, Breck, Grantsburg, and Webster high schools, Macalester College, University of Minnesota's Undergraduate Research Opportunities Program, St. Croix National Scenic Riverway (NPS), and Wisconsin Dept. Natural Resources' Bureau of Endangered Resources for supporting this project.

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2004 St. Croix River Research Rendezvous abstracts

The following abstracts were selected from presentations and posters given at the 16th annual meeting of the St. Croix River Research Rendezvous. This meeting brings together scientists, resource managers, agency staff, and interested public to learn about research plans and findings in the St. Croix River watershed. The meeting was held on October 19, 2004 at Marine on the St. Croix, Minnesota and sponsored by the Saint Croix Watershed Research Station. The next Rendezvous meeting will probably take place in October 2005 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/rendezvous.php>).

Mark Hove, Macalester College, Hove@Macalester.edu

2003 AND 2004 FOLLOW-UPS ON A MUSSEL TRANSLOCATION FROM MISSISSIPPI RIVER MILE 818.9, COTTAGE GROVE, MN

Marian E. Havlik
Malacological Consultants

In May 2003 and June 2004 we conducted follow-ups of a 2002 mussel translocation from Mississippi River Mile 818.9. The 52258 m² area (1500 X 375 feet) extended from the LDB to the Main Channel. The translocation, done prior to burial of a wastewater disposal pipe, yielded a mean mussel density of 0.38/m² among 19630 mussels, 7.33% of which were Minnesota endangered (2) and threatened (5) species.

In May 2003 609 live mussels were recovered from two Translocation Sites; 515 were numbered and hash-marked mussels. *Arcidens confragosus* had a 98.7% survival, and *Quadrula nodulata* had a 98.3% survival; the survival of all numbered special status mussels was 98.36%. The overall survival of all marked and numbered mussels was 97.2%. About 3% of numbered mussels showed little growth.

In June 2004, *Arcidens confragosus* (96.7% survival) and *Quadrula nodulata* (98.9% survival) represented 42.2% of the 448 mussels found. Of the numbered mussels, 81 (33.3%) were new to the follow-up measuring and aging process. The overall survival of all hash-marked and numbered mussels was nearly 95%. About 12.7% of the numbered mussels showed little or no growth; most of these were older mussels that would be expected to have a very slow growth rate. Most numbers on T & E mussels were still legible in 2004. No numbered mussels moved into the sandy area upstream of Translocation Site 1; the substratum was mostly mud with woody debris.

After two years, the overall survival of all marked mussels was nearly 96%, with an overall survival of nearly 98% of the numbered mussels from a shallow, muddy habitat. Similar percentages of various age classes were recovered in all 3 years. Slightly more *Dreissena* were found in 2003 than in 2002, while none were found in 2004. Several PVC pipes marking the project site remained in place; therefore construction impacts were unlikely to have extended past the marked area.

Special Status Species	2002 numbered	2003 recovered /survival	2004 recovered /survival	Recovered 3X /survival
Live species /measured & aged	572(23 species) [392 (68.5%) recovered in 2003 & 2004]	311 (18sp. +5) 12.6% had disturbance rings	243 (15 sp. + 1) 10.7% had disturbance rings	162; 2 year survival = 97.95% (384/392)
<i>Q. nodulata</i>	464	98.3% of 232	98.9% of 183	
<i>A. confragosus</i>	84	98.7% of 76	96.7% of 58	
<i>T. verrucosa</i>	1	100% (1)		100%
<i>O. olivaria</i>	7	100% (1)	100% (2)	100%
<i>L. recta</i>	1	100% (1)		100%

SUGGESTED READINGS

Kelner, D. E. and M. Davis. July 2002. Final Report: Mussel (Bivalvia: Unionidae) survey of the Mississippi National River and Recreation Area corridor, 2000-01. Contract report to the National Park Service, Mississippi National River and Recreation Area and the Great Lakes Network Inventory & Monitoring Program. Minnesota Department of Natural Resources, Division of Ecological Services, St. Paul, MN. 43 pp. + appendices.

PRELIMINARY ANALYSES OF BED AND SUSPENDED SEDIMENT DATA IN THE ST. CROIX RIVER

Kelly MacGregor¹, Daniel Hornbach², Mark Hove², Emily Kushner¹, Matthew Cox², Erik Hankin¹, and Ben Dickenson²
Macalester College, Dept. of Geology¹ & Dept. of Biology²

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; too much sediment (or too little) can be a detriment to biota, including mussels and host fish. Hornbach and others (see <http://www.macalester.edu/~hornbach/St.Croix/index.html>) have been collecting bed sediment and limited suspended sediment data at various locations along the St. Croix River since 1990 in an effort to understand controls on mussel diversity and population. These data, along with data collected by other agencies (e.g., Triplett and others, 2003; Metropolitan Council, 2004), can also be used to examine trends in sediment transport and/or sediment delivery to the river over time.

In summer 2004, we continued the collection of bed sediment in conjunction with quadrat surveying for mussel research, and initiated sampling of suspended sediment (both surface water and near-bed samples) at various locations along the river. We developed rating curves (relating suspended sediment concentration and mean daily water discharge) for several locations along the St. Croix River during summer 2004, and compared these to historical data. In addition, we examined trends in bed sediment grain size over the last decade. Preliminary analysis suggests that while bed sediment grain size is relatively unchanged in most of the study areas, there has been a fining trend in the region below the St. Croix Falls dam. Suspended sediment data are more limited (both spatially and temporally), but suggest that transport dynamics and sediment sources along the St. Croix River may have changed over the last half century.

SUGGESTED READINGS

Bernard N. Lenz. 2004. USGS Water Resources Investigations Report 03-4334, Analysis of Streamflow and Water-Quality Data at Two Long-Term Monitoring Sites on the St. Croix River, Wisconsin and Minnesota.
Laura D. Triplett, Mark B. Edlund, and Daniel R. Engstrom, 2003. A Whole-Basin Reconstruction of Sediment and Phosphorous Loading to Lake St. Croix. Final Project Report to the Metropolitan Council Environmental Services. St. Croix Watershed Research Station Report.

THE STATE OF THE BASIN AND POSSIBLE NUTRIENT MANAGEMENT SCENARIOS

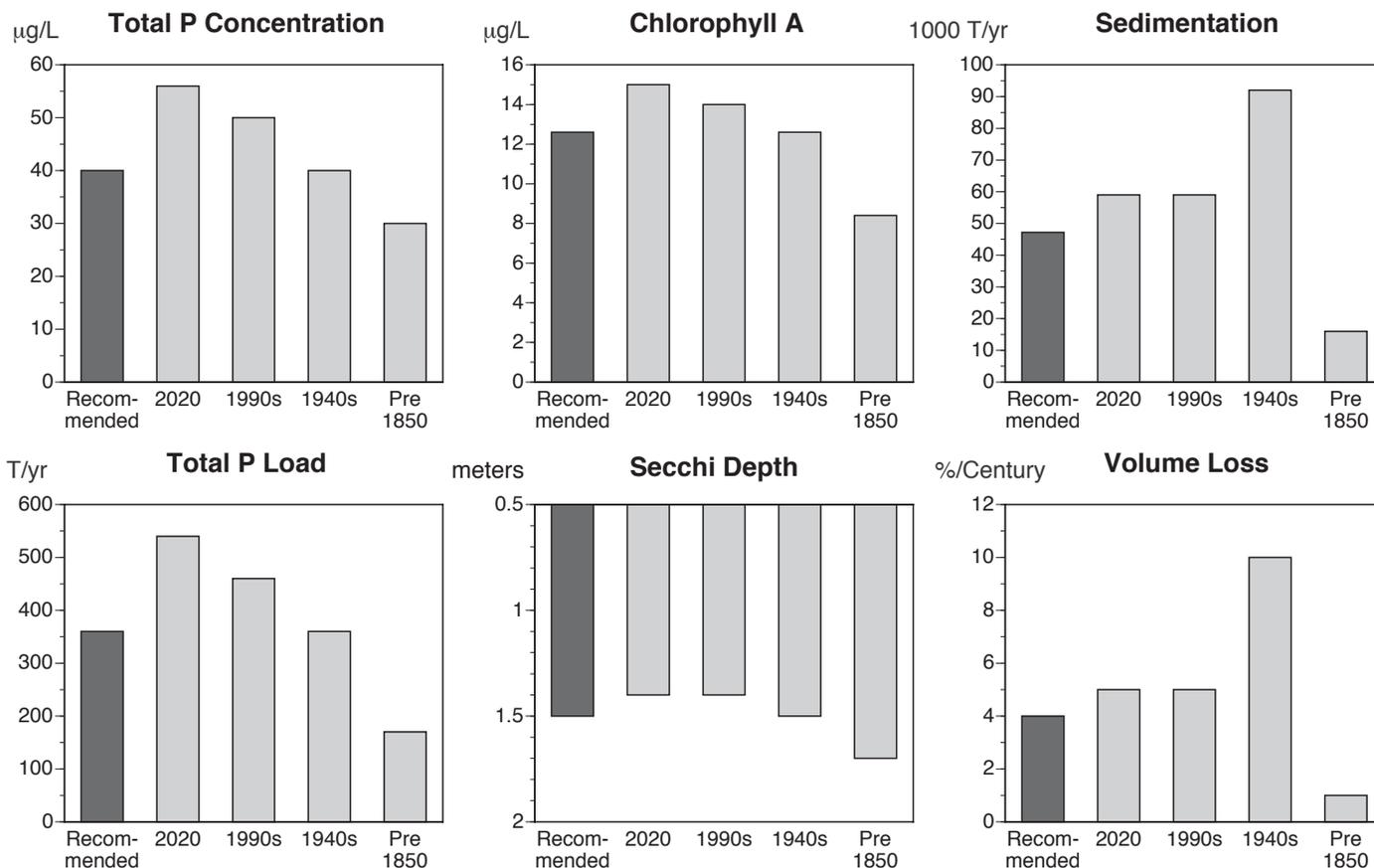
Nutrient Technical Subcommittee, St. Croix Basin Water Resources Planning Team,
 Buzz Sorge, Chairman

Several water quality studies evaluating various water quality nutrient attributes were included in a collaborative evaluation process to develop nutrient water quality goal scenarios for Lake St. Croix. The Nutrient Technical Subcommittee of the St. Croix Basin Water Resources Planning Team reviewed and summarized tributary nutrient loading studies, sediment paleoecological studies, long term water quality monitoring studies, historical point source nutrient loading studies, land use studies, population growth studies and water quality modeling studies. The collaborative assessment of the various studies was then used to develop water quality management scenarios, which were used to predict various future water quality conditions in Lake St. Croix.

Lake St. Croix was chosen as an integration site for representing water quality conditions across the St. Croix River Basin. Water quality scenarios were developed for four conditions in Lake St. Croix:

1. Nutrient conditions prior to European settlement.
2. Nutrient conditions present in the 1940's, a time where major change in nutrient conditions occurred in Lake St. Croix.
3. Nutrient conditions present in the 1990's.
4. Projected water quality conditions in 2020 given current management and regulations remain unchanged with a projected population increase of 39% in the lower basin.

The results of the collaborative assessment were used to develop a decision making matrix and recommended water quality goals for Lake St. Croix. The recommended water quality goals (Figure 1.) represent a modest reduction in the current annual total phosphorus loading and the May-September medial total phosphorus concentration in Lake St. Croix.



LONG-TERM POPULATION DYNAMICS OF UNIONOID MUSSELS IN THE ST. CROIX RIVER, MINNESOTA AND WISCONSIN, USA

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The diverse mussel community in the St. Croix River is a nationally recognized resource. We quantitatively assessed mussel communities and habitat from 1991-2003 at 8 locations. Each location was sampled a minimum of 3 times during this period, with three locations being sampled 5 times. Thirty-five species of mussels were collected in quantitative samples, although the river contains >40 species of unionoids including two federally endangered species. Mussel density varied from 2.5 to 38.5 mussels/m², depending on year and location. Large mussel density (≥ 30 mm shell length) declined over the period at most sites, with an average decline of 57%. The decline was not statistically significant due to the large within-site variability in density. Likewise there was a decline in small mussel density (<30 mm shell length), averaging 69%. These declines were statistically significant, especially at sites located downstream of a hydroelectric dam on the river. Shell-length frequency diagrams suggest there has been little recruitment or there is low juvenile survival among many dominant species at many sites. At some sites there has been an increase in fine sediments, although this is variable among sites. The site with the greatest decline in small mussel density has had the largest increase in fine sediments and is located just downstream of the hydroelectric dam. This site houses the largest known population of the endangered winged mapleleaf (*Quadrula fragosa*) and one of the few populations of endangered Higgins eye (*Lampsilis higginsii*) not threatened by the invasive zebra mussel, *Dreissena polymorpha*. The causes for the overall decline in the health of the mussel communities are unknown but could include an increased human population in the watershed, the invasion of zebra mussels in lower reaches of the river, and increased recreational use of the river.

SUGGESTED READING

Hornbach, D. 2000. Macrohabitat factors influencing the distribution of naiads in the St. Croix River, Minnesota and Wisconsin, USA. Pages 213-230 in Ecology and evolution of the freshwater Unionoida. Bauer, G, and K. Wachtler (Eds.). Springer-Verlag, Berlin, Germany. 394 pp.

BLUE CATFISH AND CHANNEL CATFISH ARE SUITABLE HOSTS FOR THE ENDANGERED WINGED MAPLELEAF MUSSEL

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The winged mapleleaf mussel is a federally listed species that has received considerable management attention in recent years. Once found throughout many Midwestern rivers, only two known populations exist, one of which is in a 10-mile stretch of the St. Croix National Scenic Riverway that borders Minnesota and Wisconsin. This population is at risk from zebra mussel infestation, effects of variable water releases from an upstream hydropower dam, and an incomplete knowledge of its life history. One of the factors limiting the recovery of this species, as listed in its recovery plan, is the lack of data on which fish species serve as hosts for its glochidial larvae (mussel larvae require a fish host to complete their life cycle). In 1997, a team of biologists from universities and government began working together to identify potential fish hosts for this endangered mussel. Prior to 2003, we had evaluated over 60 fish species (comprising 14 taxonomic families) but had achieved very limited success, and only with certain catfish species (Family Ictaluridae). Much of these early efforts were limited by finding sufficient numbers of gravid females. In the fall of 2003, winged mapleleaf had a strong reproductive year and we were able to expose glochidia to four Ictalurid species (blue catfish, channel catfish, flathead catfish, and slender madtom). About 8 to 12 weeks after the fish were exposed (19-22°C), we recovered about 11,000 living juveniles from blue catfish and about 9,000 juveniles from channel catfish. Most of the juveniles produced by the blue catfish were placed into the St. Croix River near existing mussel beds and their survival rate will be checked periodically. The remaining juveniles are being used experimentally to test over-winter survival rate at two laboratory temperatures. These data show that blue and channel catfish are suitable hosts for this federally listed species. Thus, these data can be used in subsequent years to artificially propagate juveniles to augment existing populations of the winged mapleleaf within its historic range of the Upper Mississippi River System.

A PRELIMINARY QUALITATIVE SURVEY OF UNIONID MUSSELS IN SEVEN WISCONSIN TRIBUTARIES OF THE ST. CROIX RIVER

Matthew Berg and Grantsburg High School Biology Students
Grantsburg, Wisconsin

During the summers of 2003-04, twenty-seven students from Grantsburg High School and their instructor collected 2093 live mussels at 112 sites on the Yellow, Clam, Wood, Trade, Apple, Willow and Kinnickinnic Rivers of northwestern Wisconsin. Rivers were sampled from near their sources to the confluence with the St. Croix River. A timed 1 person/hr search was conducted at each site. A total of 18 live species were found with an additional two species represented by empty valves. The Yellow River (72.4 mussels/site) and Wood River (17.4 mussels/site) had the highest mean density while the Kinnickinnic River (0.0 mussels/site) and the Apple River (5.4 mussels/site) had the lowest. *Anodontoides ferussacianus*, *Lampsilis siliquoidea*, *Lasmigona compressa*, *Pyganodon grandis*, and *Strophitus undulates* had the widest distribution, being found in all but the Kinnickinnic River. Future research will include qualitative sampling at additional sites combined with quantitative methods at selected sites. In addition, GIS and ordination analysis will look at how substrate, flow rate, available fish hosts, water quality and land usage may impact mussel assemblages in these rivers.

THERMAL REQUISITES FOR GROWTH OF ST. CROIX RIVER WINGED MAPLELEAF MUSSEL (*Quadrula fragosa*) GLOCHIDIA AND EXCYSTMENT OF TRANSFORMED JUVENILES FROM HOST-FISH

Mark T. Steingraeber¹, Michelle R. Bartsch², John A. Kalas¹, and Teresa J. Newton²

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Blue catfish (*Ictalurus furcatus*) and channel catfish (*Ictalurus punctatus*) were infested with St. Croix River winged mapleleaf mussel (*Quadrula fragosa*) glochidia and reared at different temperature regimes during three host-fish identification tests that commenced in our laboratory on 3 October 2003. Groups of glochidia-infested fish were held in aquaria at a near constant and unseasonably warm water temperature (19.6°C daily mean) throughout the first test to accelerate the rate at which glochidia might transform into juvenile mussels. Most glochidia that remained encysted on the gills of fish after the first week of this test grew and successfully transformed into viable juvenile mussels that were recovered several weeks later. Peak recovery of juvenile mussels during this test occurred 31 to 35 days after the channel catfish were infested (620 to 700 cumulative water temperature units) and 37 to 41 days after the blue catfish were infested (740 to 820 cumulative water temperature units). Meanwhile, additional channel catfish used in the two remaining tests were infested with glochidia from the same stock used in the first test, but were subsequently maintained in raceways at colder water temperatures (12.6°C daily mean) for the next 47 days. Fish used in the second test were then placed in individual aquaria supplied with water at a temperature (19.5°C daily mean) similar to that of the first test. Peak recovery of juvenile mussels from fish maintained under this thermal regime occurred 70 to 74 days after infestation (1,060 to 1,140 cumulative water temperature units). Comparisons of the time and cumulative water temperature units required to recover juvenile mussels from channel catfish reared under these two thermal test regimes allowed us to empirically estimate: the minimum daily mean temperature (9.25°C) required for winged mapleleaf glochidia to grow and transform into juvenile mussels; and the cumulative water temperature units of net daily growth (~395 to 436°C@d) needed to achieve peak transformation and recovery of juvenile winged mapleleaf mussels. Remaining channel catfish used in the third test were subsequently maintained in a more realistic thermal regime that closely followed the reported daily mean water temperature of the St. Croix River from mid-November 2003 through June 2004. Peak recovery of juvenile mussels from fish in this test began on 21 June 2004, 261 days after infestation (453°C@d of growth), and just 7 days later than we estimated it should. Test results also suggest that daily mean water temperatures within the 17 to 20°C range are adequate to initiate peak excystment of juvenile winged mapleleaf mussels from the gills of their host-fish. These early life-history findings will soon be applied in active propagation programs to help augment, re-establish, and recover winged mapleleaf populations within the historic range of this endangered species.

SUGGESTED READINGS

Kempinger, J.J. 1988. Spawning and early life history of lake sturgeon in the Lake Winnebago System, Wisconsin. *Amer. Fish. Soc. Symp.* 5:110-122.

U.S. Fish and Wildlife Service. 1997. Winged mapleleaf (*Quadrula fragosa*) recovery plan. U.S. Fish and Wildlife Service, Fort Snelling, MN. 69 pp.

Helpful Hints from Hoppy:



Hoppy Says—if you have holes or rips in your wet suit, dry suit, waders, gloves, boots, or felt coming off boots...use Goop! Excellent glue that can be purchased at your local hardware store.

Submitted by Steve Ahlstedt

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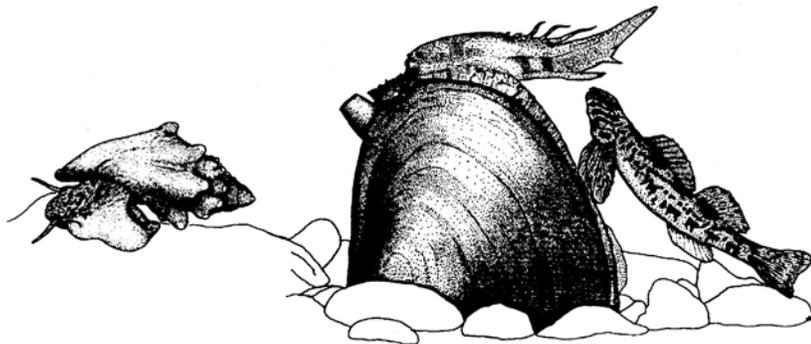
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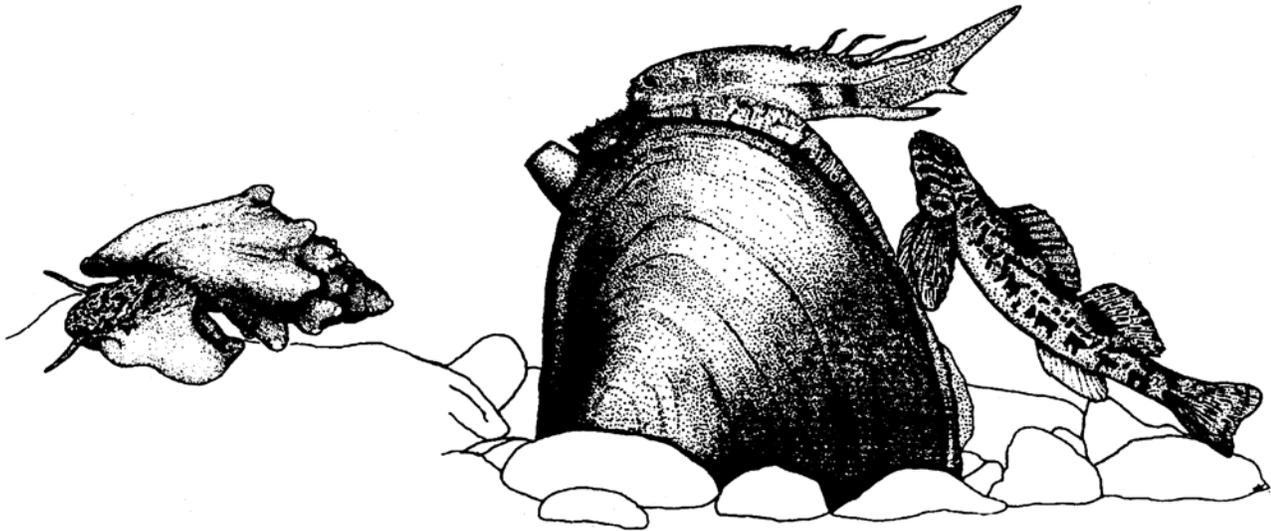
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