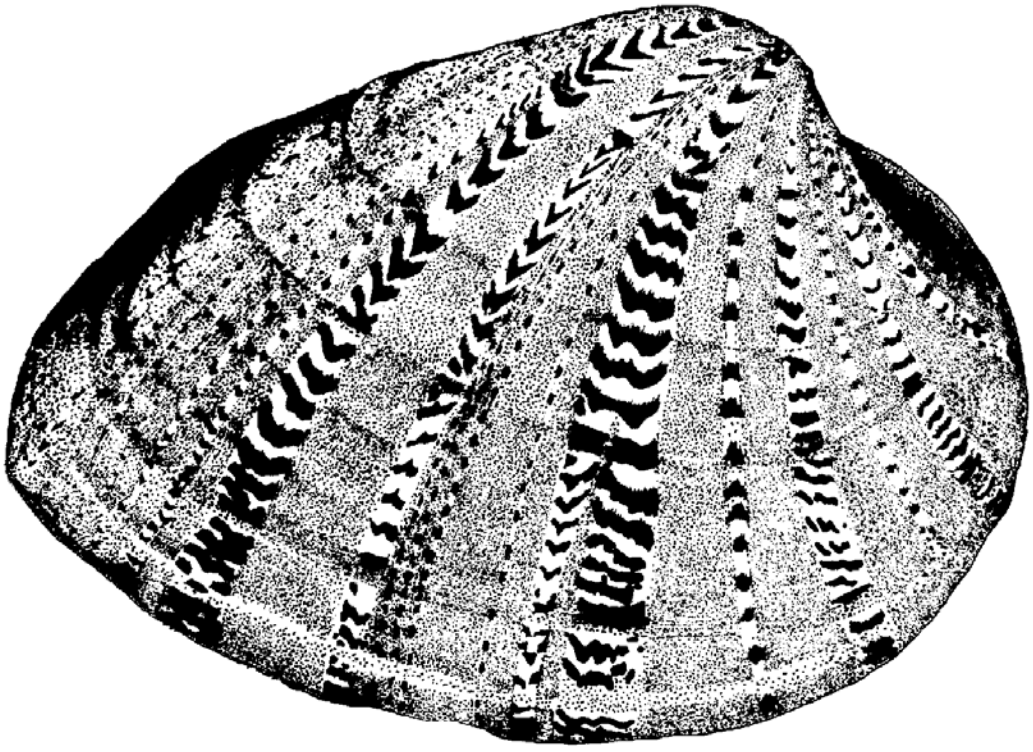
Ellipsaria

The Newsletter of the Freshwater Mollusk Conservation Society

Volume 7 – Number 3 **December 2005**



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Freshwater Mollusk Conservation Society Officers

Submissions for the April 2006 issue of *Ellipsaria* may be sent to the editor at any time but are due by **March 15, 2006**. 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 Note that submissions are not peer reviewed, but are checked for content and general editing.

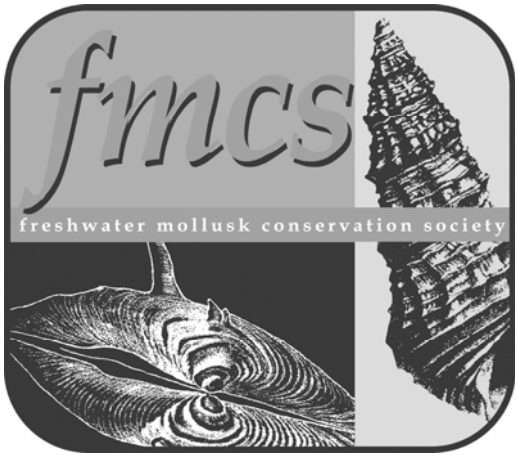
Please send change of address information to the Secretary, Patty Morrison.

Ellipsaria

NEWSLETTER OF THE FRESHWATER MOLLUSK CONSERVATION SOCIETY

Volume 7, No. 3 http://ellipse.inhs.uiuc.edu/FMCS/ December 2005

FMCS Reports:



FMCS 2006 Workshop
March 5-7, 2006
Columbus Zoo and Aquarium
Columbus, Ohio

Early Registration

The 2006 FMCS Workshop will be held at the Columbus Zoo and Aquarium in Columbus, Ohio from March 5-7, 2006. March 5 & 6 are full-day sessions, with March 7 being half-day. A registration form has been included with this newsletter, and will be available on the FMCS website. **Early registration ends February 24, 2006**.

Theme: Propagation and Captive Care of Freshwater Molluscs

This workshop will address the multitude of issues we face when attempting to propagate and maintain freshwater molluscs in captivity. The session will feature invited speakers to share their expertise on topics including:

- Making baby mussels and snails, a primer
- Caring for captive freshwater molluscs, including assessing overall health
- What to feed your charges
- Water chemistry
- Genetic issues
- Mussel parasites
- Case studies of reintroduction

The final half-day will be devoted to the legal, red-tape problems of what to do with your babies once you've made them. We anticipate that the talks will be published in a Proceedings later in the year.

FMCS Reports

FMCS Board Meeting Minutes

FMCS Board Meeting
November 1 - 2, 2005
Columbus Zoo and Aquarium, Columbus, OH

Janet Clayton was designated by John Van Hassel to act as Chair of Guidelines and Techniques Committee, so a quorum declared present.

Motion by Paul, second by Kevin, to accept minutes of Board meeting 5/23/05 and Business meeting 5/24/05 as published in the August 2005 edition of *Ellipsaria*. All in favor.

Treasurer's Report – total society assets $53,647.62. It appears we lost money on the 2005 Symposium.

Committee Reports

Environmental Quality and Affairs: Black carp comments deadline extended to December 2005, Bob Anderson sent a letter on behalf of FMCS. We sent a 2nd letter to Corps on proposed Tennessee River dredging. Corps will probably go through with the project anyway, wants FMCS to provide even more input. We cannot support it in its current form; the study design is not experimental and needs drastic restructuring. Big Sunflower River supp. EIS not out yet. Black water events in the Clinch and Powell, no action yet.

Mussel Status and Distribution: No report.

Gastropod Status and Distribution: Terrestrial folks want to create their own committee, but would stretch too thin. They can still do things under FMCS for their focus. Invite them to join the Gastropod committee, via the next *Ellipsaria* issue.

Guidelines and Techniques: This committee drafted and submitted the latest round of comments on the Tennessee River dredging project. Bob signed the letter and sent it out.

Information Exchange: *Walkerana* – We need to wait a little while longer for John Burch to wrap up outstanding manuscripts and commitments. It was first offered to us in 1999. Kevin will continue to communicate with Dr. Burch on a workable timeline for the transfer.

Ethan Nedeau has suggestions for a new format for *Ellipsaria*, also increase frequency and make it more like a color magazine. He's willing to seek funding for this. Six issues per year proposed. Initial purpose of *Ellipsaria* was as a replacement for Triannual Unionid Report by Dick Biggins. Now it's a tangible benefit of FMCS membership. In the future we may make it available on-line in pdf format, once *Walkerana* gets rolling under FMCS logo. Perhaps we can accommodate his suggestions on line, for less money.

Propagation, Restoration and Introductions: Issue raised as to how to manage propagation and release data; also applicable to translocation of adult mussels. Need to keep records and report, who did what where, monitoring results. Where do you keep the data? Who hosts the server? Need standard forms, etc. Maybe link to FMCS website. Some security and public access concerns. Possibly Natureserve would be a good place. Committee will develop a proposal. CFI may be doing something similar. Another issue with genetics database is that vouchers are not currently required. Committee will develop data fields needed and form.

Spring 2006 Workshop: Workshop planned for Spring 2006, March or April – Columbus Zoo would host on grounds at the Pavilion, minimal cost to participants. Want to publish proceedings on propagation and captive holding. Hope to have recommendations for facilities wanting to raise mussels, like a manual. Very timely and important, not redundant to previous workshops – lots of new info and new facilities coming on line. WQ, health, condition issues. Need for habitat driven considerations to be brought up as a primer for the latter 1-day session at next symposium. Site selection considerations. May include review of state and federal propagation plans at the Workshop. May be larger than just an afterthought to the nuts and bolts workshop. Now that we've raised them, what do we do with them? Day 1 and 2, biology, Day 3, possible half day presentations on propagation plans, and roundtable discussion. Aquatic Invertebrate Taxon Advisory Group gets requests for folks wanting to display mussels, need info on how to do it and where to get them from. Mussels are on their five-year action plan. AZA has national and regional meetings. Motion by Steve, second by Paul to have committee proceed with their planning for workshop sponsored by the FMCS in March 2006. All in favor.

Symposium 2007: Al Christian is the chair. Committee signed a contract with Peabody Hotel for March 11-15, 2007; rooms will be $95 per night. Time to start thinking about 2009. Russ Minton suggested they might host in Monroe, LA, possible St. Louis with Al Buchanan. Louisville, would be nice, maybe KY will be interested. Workshop 2008, may do something with SETAC, new protocols related to mussel toxicity testing. Jerry Farris proposed this, need to follow up with him. Question about possible joint meeting with AMS–no wide support at this time.

Awards: no activity to report.

Outreach: Recently put on a program in the northwest about mussels. They meet annually. We need to recruit these people, they are just learning about mussels. Kurt wants to step down as chair.

Nominations Committee: Survey not completed. Many folks asked to serve decline, give reason as "too busy." But not many names put forth in the first place. Suggest that all board members submit names for nomination each time. Would like to see more responses. Need to work on more nominations for special service awards too.

Old Business

FMCS chapters: Group in CA wants to form a chapter. Might invite a proposal from the chapter in order to be recognized. We have one paid member in CA now. Ask them what they have in mind.

Pacific Northwest mussel group: There is a core group of interested people forming in the northwest. They held a successful program this past year with 95 people present. Maybe we can invite some of them and pay their way to FMCS symposia. We could participate in their annual meetings. Highlight topics of use to them. They are enthusiastic and need a boost on the state of the science. Ask Allan Smith in OR for a list of attendees, and we can send them a membership form and maybe a free newsletter.

National Strategy: Possible need to revise. Rachel Muir led discussion. Need to document what has been accomplished already since FMCS formed and the strategy adopted, highlighting successes. Succinct new revised implementation strategy needed. Agencies can use it to focus research on needs. This ought to be a flagship document and should be cited more. How to re-publish? AFS is an option, Bioscience, or maybe FMCS when we get a journal. Or just publish on the web. Outreach is an important component of the strategy. Also need to include gastropods in the strategy. Rachel volunteered to take lead on revision of original document. Accomplishments document, then implementation document, need people to lead them. Maybe seek funding from NFWF to match funds to produce accomplishment document. *Conservation Biology in Practice* may be a good venue. Get responses back to Rachel; contact Ethan to see if he would help. Motion by Tom to have Board develop, under Rachel's lead, a plan to revise NSD. Paul second, all in favor.

New Business

There is a proposal from the Propagation Committee to establish a full Genetics Committee. There is a lot going on with the genetics topic alone: tissue database, coordinating field activities, software uses, emerging policy issues, protecting genetics diversity in the hatcheries and labs. AFS is doing something similar. Issues may be too much to deal with under existing committee. Will get more genetics folks involved directly in FMCS, working together. Includes systematics, population level genetics, etc. For the near future, form sub-committee under PRI Committee, have co-chair with that focus, then come forward with feedback/need for possible full committee to the membership for vote in 2007.

Secretary Patty Morrison suggested we post the membership info online through the Society website. She will work with Chris Mayer to put the information up.

Motion to adjourn by Janet, second by Paul, all in favor.
Submitted by Patty Morrison, FMCS Secretary

News & Announcements

NANFA Research Awards

The North American Native Fishes Association (NANFA) will award up to $1000 for research that can aid the conservation of North America's native fishes (particularly threatened or endangered). In 2006, a minimum of $1000 will be awarded to the most qualified applicant or applicants. The award may also be divided among one or more individuals. Award recipients will be asked to describe their research findings in a non-technical article for *American Currents* (NANFA's quarterly journal), and are invited to present their findings at the NANFA Annual Convention.

To qualify for the award, applicants must submit to NANFA a proposal of two double-spaced pages, a budget and timeline for the research, a one-page resume, and a letter of recommendation from an academic professor, research advisor or someone familiar with the applicant's background and research history. Applicant must also be a member of NANFA and can opt to join when they submit their proposals. The deadline for applying is January 20, 2006. The award decision will be announced by March 31, 2006. Additional details on the award are available from NANFA's website, http://www.nanfa.org. Questions about the award may be addressed to Dr. Bruce Stallsmith, Department of Biological Sciences, University of Alabama in Huntsville, Huntsville, AL 35899; 256-824-6992 or stallsb@uah.edu.

Black Carp

A Federal Register (FR) notice extending the public comment period on the proposed rule to add all forms (diploid and triploid) of live black carp to the list of injurious species under the Lacey Act published last week. The public comment period will be open through December 16, 2005. The original FR extension notice can be found at:
http://www.fws.gov/contaminants/OtherDocuments/BlackCarp_Extension.pdf
Related documents can be accessed at the following link:
http://www.fws.gov/contaminants/Issues/InvasiveSpecies.cfm
Submitted by Erin Williams

New AMS website: www.malacological.org

Publications

Paul J. Grobler, Jess W. Jones, Nathan A. Johnson, Braven Beaty, Jennifer Struthers, Richard J. Neves, and Eric M. Hallerman. 2005. Patterns of genetic differentiation and conservation of the slabside pearlymussel, *Lexingtonia dolabelloides* (Lea, 1840) in the Tennessee River drainage. Journal Molluscan Studies Advance Access published on October 10, 2005.

Abstract: http://mollus.oxfordjournals.org/cgi/content/abstract/eyi055v1

Jess W. Jones, Rachel M. Mair, and Richard J. Neves. 2005. Factors affecting survival and growth of juvenile freshwater mussels cultured in recirculating aquaculture systems. North American Journal of Aquaculture 67:210-220.

Valenti, T. W., D. S. Cherry, R. J. Neves, and J. Schmerfeld. 2005. Acute and chronic toxicity of mercury to early life stages of the rainbow mussel, Villosa iris (Bivalvia: Unionidae). Environmental Toxicology and Chemistry 24 (5):1242-1246.

Contact Greg Cope (greg_cope@ncsu.edu) for reprints of the following:

Gustafson, L. L., M. K. Stoskopf, A. E. Bogan, W. Showers, T. J. Kwak, S. Hanlon, and J. F. Levine. 2005. Evaluation of a nonlethal technique for hemolymph collection in *Elliptio complanata*, a freshwater bivalve (Mollusca: Unionidae). *Diseases of Aquatic Organisms*. 65(2):159-165.

Gustafson, L. L., M. K. Stoskopf, W. Showers, W. G. Cope, C. Eads, R. Linnehan, T. J. Kwak, B. Andersen, and J. F. Levine. 2005. Reference ranges for hemolymph chemistries from *Elliptio complanata* of North Carolina. *Diseases of Aquatic Organisms*. 65(2):167-176.

USGS Fact Sheet on Mussels:

Host Fish Identification and Early Life Thermal Requirements for the Federal Endangered Winged Mapleleaf Mussel

The winged mapleleaf mussel (*Quadrula fragosa*) is a Federal endangered species historically inhabiting at least 34 river systems in 12 Midwestern states. Only four populations are currently known to exist, including one confirmed reproducing population in the St. Croix National Scenic Riverway (NSR) bordering Minnesota and Wisconsin. Recovery efforts are limited by a lack of life history information, particularly which species of fish serve as host to the mussel's parasitic larvae (glochidia)

http://www.umesc.usgs.gov/reports_publications/fact_sheets/winged_mapleleaf.html

Contributed Articles

Winged Mapleleaf Juveniles Successfully Propagated in Cages

Susan (Rogers) Oetker, Nick Rowse, and Gary Wege
FWS Twin Cities Field Office, Minnesota

The endangered winged mapleleaf (*Quadrula fragosa*) historically ranged from Minnesota south to Tennessee, and from Kansas east to Ohio. Currently there are only four known populations: the St. Croix River in Minnesota and Wisconsin, the Bourbeuse River in Missouri, and the Ouachita and Saline Rivers in Arkansas. Recovery efforts are underway to develop propagation methods to reintroduce the species to suitable habitat elsewhere within its former range. Unlike many species currently being propagated, winged mapleleaf glochidia overwinter on the gills of their host fish, the channel and blue catfish. This presents a challenge for propagators, as holding infested fish at higher temperatures (e.g., normal laboratory water temperatures of about 50° Fahrenheit) causes juveniles to transform much more quickly than they would in the wild. The fate of these early transformers is typically grim, as returning them to the river at near-freezing temperatures in Minnesota is as unsuccessful as rearing them in the laboratory.

Due to the species' challenging life history, partners at the Fish and Wildlife Service's Twin Cities Field Office, Genoa National Fish Hatchery (NFH), and LaCrosse Fishery Resources Office worked with the Minnesota and Wisconsin Departments of Natural History, Macalester College, and St. Croix National Scenic Riverway worked to develop propagation methods appropriate for this species. In September 2004, a single gravid female was collected from the St. Croix River and the glochidia were transported to Genoa NFH, where 100 channel catfish were infested. These catfish were held in a raceway with cooling capabilities at or near river temperatures through the winter, and catfish survival was 99% through this time. In May 2005, these catfish were distributed in six propagation cages at two sites in the St. Croix River near Hudson, Wisconsin. The catfish were removed in June, after all juveniles had likely dropped from the fish.

In October, the cages were examined for juveniles. All three of the cages at the lower site had none, probably due to higher flow in the late spring as well as possible disturbance from anglers. However, the first cage examined at the upper site had 11 juveniles, approximately 2 – 3 mm in length. The remaining two cages were not disturbed, to minimize potential to wash juveniles out of the cages and to limit stress. These cages will be examined again in fall 2006.

In September 2005, biologists collected additional glochidia from gravid females in the St. Croix River, which were used to infest 300 channel catfish at Genoa NFH. These fish will be placed in cages in various sites in spring 2006. We will

continue to build on the knowledge gained so that this species will be successfully reintroduced to sites within its former range.

Texas Mussel Watch, a Citizen Based Volunteer Monitoring Program

Marsha M. Reimer and Lee Ann Linam
Wildlife Science, Research and Diversity Program
Texas Parks and Wildlife Department
3000 S. IH 35, Suite 100
Austin, Texas 78704

In 1998, Texas Mussel Watch (TMW), a Texas Parks and Wildlife Department (TPWD), Texas Nature Trackers Program, first trained a group of 20 volunteers to help TPWD document the presence or absence of freshwater mussel species in the rivers, lakes, streams, and ponds of Texas. Over 150 volunteers have participated in TMW workshops since the inception of the project, logged over 550 volunteer hours, covered over 80 sites in 16 Texas river systems, and recorded the presence 31 species of native freshwater mussels. During TMW workshops, participants are presented with information on the distribution, biology, and identification of unionids in Texas, as well as information on non-native species such as the Asian clam (*Corbicula fluminea*) and the zebra mussel (*Dreissena polymorpha*). Highlights include the discovery of the rare golden orb (*Quadrula aurea*) in the San Marcos River, Central Texas; the discovery of two species that had not previously been found in Austin County, the Texas lilliput (*Toxolasma texasensis*) and tapered pondhorn (*Uniomerus declivis*); and seven live Texas fawnsfoot (*Truncilla macrodon*), found in the Brazos River in Washington County. We are reaching out to more Texas citizens through partnerships with Texas Master Naturalist Chapters and Nature Centers.

Sometime around 1992, Congress ordered the U.S. Fish and Wildlife Service (USFWS) to monitor rare species across the country to ensure their survival. The USFWS came to TPWD for ideas on how best to do this. TPWD decided that there were many Texas citizens who are willing to volunteer to help monitor these rare species. That is how the Texas Nature Trackers program began. Texas Mussel Watch is a citizen based volunteer monitoring program under the Texas Nature Tracker umbrella.

Freshwater mussels in the family Unionidae are one of the most imperiled groups of animals in North America. Out of the 52 or 53 species of unionids in Texas, approximately 38% are imperiled. In 1998, about 20 volunteers were trained to monitor populations of freshwater mussels during the first Texas Mussel Watch (TMW) workshop. Since the beginning of TMW, over 150 volunteers have participated in TMW workshops throughout the state. TMW volunteers have logged over 550 hours, covered over 80 sites in 15 Texas river systems (Table 1), and recorded the presence of 31 species of native freshwater mussels (Table 2).

Table 1. Texas River Systems surveyed for freshwater mussels by Texas Mussel Watch volunteers

Texas River Systems
Big Cypress Bayou
Brazos
Colorado
Concho
Guadalupe
Little Wichita
Navasota
Neches
Nueces
Pedernales
Red
Sabine
San Jacinto
Trinity
Wichita

Table 2. Freshwater mussel species recorded by Texas Mussel Watch volunteers from 1998 to 2004 in 15 Texas river systems.

Freshwater Mussel Species
Amblema plicata
Anodonta suborbiculata
Cyrtonaias tampicoensis
Fusconaia flava
Lampsilis bracteata
Lampsilis hydiana
Lampsilis satura
Lampsilis teres
Lasmigona complanata
Leptodea fragilis
Ligumia subrostrata
Megalonaias nervosa
Obliquaria reflexa
Pleurobema riddelli
Potamilus ohiensis
Potamilus purpuratus
Pyganodon grandis
Quadrula apiculata
Quadrula aurea
Quadrula houstonensis
Quadrula mortoni
Quadrula nodulata
Toxolasma parvus
Toxolasma texasensis
Tritogonia verrucosa
Truncilla macrodon
Truncilla truncata
Uniomerus declivis
Uniomerus tetralasmus
Utterbackia imbecillis
Villosa lienosa

Texas Mussel Watch highlights include:

- Discovery of the rare golden orb (*Quadrula aurea*) in the San Marcos River, Central Texas
- Discovery of two species that were not previously found in Austin County, the Texas lilliput (*Toxolasma texasensis*) and tapered pondhorn (*Uniomerus declivis*)
- Discovery of seven live Texas fawnsfoot (*Truncilla macrodon*) in the Brazos River in Washington County
- Discovery of a recently dead immature sandbank pocketbook (*Lampsilis satura*) in the Neches River in Hardin County
- Discovery of a live smooth pimpleback (*Quadrula houstonensis*) in the Navasota River
- Asian clam (*Corbicula fluminea*) Texas County records were added the USGS database
- Zebra mussels (*Dreissena polymorpha*) were not observed

All TMW volunteers are required to attend a TMW workshop where they are placed on a scientific permit held by Marsha Reimer that allows them to handle live mussels and collect shells. Eighty-four volunteers are currently listed on this permit. A TMW workshop is a daylong experience, beginning with 4 to 6 hours of classroom time where participants are presented with information on the distribution, biology, and identification of unionids in Texas, with an emphasis on the species found in the local drainage basin. Workshop participants also receive information on non-native species such as the Asian clam (*Corbicula fluminea*) and the zebra mussel (*Dreissena polymorpha*). The data form is explained in detail before preparation is made to go out in the field. The second half of the workshop includes a field experience: workshop organizers will select a location in a nearby river or lake with a known population of mussels. Workshop participants then spend 1 to 2 hours in the field collecting mussel data.

We are hoping to reach out to more Texas citizens through partnerships with Texas Master Naturalist (TMN) Chapters and Nature Centers. There are 30 TMN Chapters statewide. The purpose of these partnerships is to enable TMN Chapters and other regional coordinators, such as Nature Centers, to promote TMW and train volunteer monitors, and to establish freshwater mussel monitoring stations where mussel surveys are conducted annually. Each participating partner receives an intense 8 to 10 hour 'train the trainer' workshop and a TMW regional mussel monitoring kit. The monitoring kit includes a TMW Training PowerPoint Presentation, a TMW Monitoring Notebook, *Freshwater Mussels of Texas* by Howells, Neck, and Murray, trays for a reference collection, Garmin GPS, regional species handouts, aquascopes, buckets, clip boards, and *America's Pearly Mussels* video and poster by Virginia Tech. Current partnerships include: Rolling Plains TMN in Wichita Falls, Capital Area TMN in Austin, Big Country TMN in Abilene, North Texas TMN in Dallas, and Mineola Nature Preserve in Mineola, TX.

The main goal of TMW is collecting freshwater mussel data, and through our outreach efforts we hope to enable long-term conservation of these species and appreciation among Texas citizens. For more information on this program and other Texas Nature Tracker programs, please visit our web site: www.tpwd.state.tx.us/trackers

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Mussel Studies

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Holston River, TN

Spiny riversnails, *Io fluvialis*, reintroduced into the free-flowing reaches of the Holston River upstream from Cherokee Lake are surviving and reproducing. Many small individuals and large adults were observed in early October. This was a quick snapshot to determine if they were still surviving since this location had not been sampled in two years because of high stream flows. Other reintroduction sites (French Broad River and Pigeon River) have yet to be evaluated for survival or reproduction. The Little River site was discontinued for further reintroductions because of heavy predation by muskrats.

Catspaw and White Catspaw

Streams containing the last known locations for the catspaw (*Epioblasma obliquata obliquata*) and white catspaw (*Epioblasma obliquata perobliquata*) will be searched for live individuals to be brought into captivity for culture and propagation. This is a joint recovery effort between USFWS Regions 3 and 4 and state personnel from Ohio, Indiana, and Kentucky. Sampling will commence this fall…flows permitting.

Big South Fork Cumberland River, TN and KY; Obed River, TN

Mussel monitoring will begin this spring in the Big South Fork National River and Recreation Area and Obed Wild and Scenic River (National Park Service). Permanent fixed station monitoring sites are established.

Northern Riffleshells Located in Conewango Creek, Allegheny River Basin, Pennsylvania, with a Note on New Records for the Zebra Mussel.

Ryan Evans[1] and Tamara Smith[2]
[1] Pennsylvania Natural Heritage Program/Western Pennsylvania Conservancy, 209 Fourth Avenue, Pittsburgh, PA, 15222; revans@paconserve.org
[2] Western Pennsylvania Conservancy, Northwest Field Station, 11881 Valley Road, Union City, PA 16438; tsmith@paconserve.org

Pursuant to surveys for pipeline replacements and dam removals, a total of 2,692 minutes was spent conducting freshwater mussel surveys in Conewango Creek in the

vicinity of Warren, Warren County, Pennsylvania. Three individuals of the northern riffleshell (*Epioblasma torulosa rangiana*) were located during survey work. Individuals measured 51 mm (male), 66 mm (female); one male not measured was estimated to be between 40 and 45 mm. Survey conditions were very good as northwestern Pennsylvania experienced low flows throughout the summer. Surveys were conducted in July – September of 2005.

Historically, the northern riffleshell was known from Conewango Creek at Russell, Warren County (Ortmann, 1909), which is approximately 12 km upstream of this site. It was thought be extirpated from Conewango Creek prior to this study. Overall, 16 species of freshwater mussels were located from the stream during our surveys.

In addition, a total of 6 individuals of the zebra mussel (*Dreissena polymorpha*) were found in 2 locations in lower Conewango Creek. However, only one individual zebra mussel was located below a small dam. The zebra mussel was first located in Conewango Creek in early July of 2005 north of Akley, Pennsylvania, at a boat launch (PA DEP, 2005). Zebra mussels have been known since about 1995 from Chautaqua Lake, which is within the upper Conewango Creek watershed in New York. This report establishes that the zebra mussel certainly has the potential to colonize the middle Allegheny River at or below Warren, PA.

Future plans for the stream include the removal of a small dam on the lower reaches, which could provide potential habitat for the northern riffleshell and other mussel species.

Literature Cited:

Ortmann, A.E. 1919. A monograph of the naiades of Pennsylvania. Part III: Systematic account of the genera and species. Memoirs of the Carnegie Museum 8(1): xvi -384.

Pennsylvania Department of Environmental Protection (PA DEP). 2005. PA DEP daily update for July 13, 2005. Accessed 11 November 2005 at http://www.depesf.state.pa.us/news/cwp/view.asp?a=3&q=466336.

Additional Observations Concerning *Ferrissia clessiniana* in North-Holland, North of the North Sea Channel, The Netherlands

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New records

In a previous report (Mienis, 2002) I reported the invasive freshwater limpet *Ferrissia clessiniana* (Jickeli, 1882), Fam. Planorbidae, from 11 localities in the province of North Holland, north of the North Sea Channel, which connects Amsterdam with the North Sea. Since then, I have collected this species from several other localities in the same area:

12-Marken, east of the Meuninger sluice west of the Rozewerf on *Typha*, 14 October 2003;
13-"De Hulk", recreation area south of Hoorn, on *Sparganium erectum*, 12 October 2005;
14-Beemster, in moat around Fort "Benoorden Purmerend", on *Sparganium erectum*, 17 October 2005.

Fluctuations in densities

This year I again sampled the known locality in Edam. In previous years, large differences in the density of *Ferrissia clessiniana* had been noticed on the leaves of *Nuphar luteum*: 20-50 snails/leaf in 1991 and only 0.3 snail/leaf (N=10) in 1998. This year the number of snails per leaf fluctuated between 5 and 48, with a mean number of 21.4 snails/leaf (N=10). These fluctuations in population densities fit the observations concerning invasive species made by Simberloff & Gibbons (2004) under the self-explaining title: "Now you see them, now you don't", to which I can add: "and look, they are back again".

An invasive species, but is it an exotic one?

There is no doubt that *Ferrissia clessiniana* has to be considered an invasive species not only in North-Holland, but also elsewhere in the Netherlands, and probably over large parts of Europe. However, the term "invasive species" may cover two complete different groups of invaders:

- species accidentally or intentionally introduced by man from distant faunal areas. Examples of aquatic molluscs now occurring in Western Europe and falling in this category include: *Potamopyrgus antipodarum* (J.E. Gray, 1853) from New Zealand, *Haitia acuta* (Draparnaud, 1805), *Pseudosuccinea columella* (Say, 1817), *Gyraulus parvus* (Say, 1817), *Micromenetus dilatatus* (Gould, 1841), *Planorbella duryi* (Wetherby, 1879) and *Musculium transversum* (Say, 1829) all from North America; and
- species living in nearby areas, which have managed to enlarge their natural range of distribution due to natural causes (population pressure) or man-induced changes in the climate. Numerous South-European terrestrial snails and slugs are slowly but steadily crawling northwards, and some have already invaded large parts of Western Europe in this way.

At least part of the expansion drift of *Ferrissia clessiniana* falls in the second category. Who can think of a better explanation for the sudden occurrence of that species in such countries like Israel, Italy, and France at almost the same time in the mid-fifties of the 20th Century? Changes in the irrigation techniques in agricultural areas along the river Nile and especially in its delta, the cradle of *Ferrissia clessiniana*, may have caused sudden changes in the population densities of many (semi-)aquatic animal species in that area. In our case, *Ferrissia* arrived most probably in Israel (and possibly also in Southern Europe) by means of aerial transport with migrating aquatic bugs, beetles, or birds

serving as the couriers. Other contacts did not exist between Egypt and Israel during that time. Once firmly established in the Middle East or Southern Europe, it was easier for this species to expand its range northwards. Man helps it now by importing *Nuphar* and *Nymphaea* infected with *Ferrissia* (and other snails) and selling them in so-called garden centers all over Europe.

Competition with the native *Acroloxus lacustris*

In Edam, a competition for space and food is going on between the invasive *Ferrissia clessiniana* and the native freshwater limpet *Acroloxus lacustris* (Linnaeus, 1758), Fam. Acroloxidae. In 1991, only a mean number of 0.03 *Acroloxus* snails was present on *Nuphar* leaves densely inhabited by *Ferrissia* (20-50 snails/leaf). Seven years later in 1998, *Acroloxus* had its density increased to 1.9 snails/leaf, while *Ferrissia* had dropped to 0.3 snails/leaf. However, another seven years later in 2005, the situation had changed in favour of *Ferrissia* with 21.4 snails/leaf and *Acroloxus* with only 0.3 snails/leaf.

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New records to Add to Inventory of Continental Mollusks (Gastropoda & Bivalvia) from Santa Catarina State, Southern Brazil

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The malacological inventory recently conducted in Santa Catarina´s state continental territory included reports of new mollusk species based on field research and some literature contributions (Breure 1975; Paraense 1966, 1975, 1982; Teles et al 1991; Schlemper Jr. et al 1996; MMA 2004). Nine new records of native limnic and terrestrial snails and one freshwater mussel/naiade were included, elevating the number known to 124 (102 Gastropoda: 11 Prosobranchia, 91 Pulmonata, and 22 Bivalvia: 17 Unionoida, 5 Veneroida), from previous field studies (Agudo 2004, 2005b). For a general overview of the zoogeographical records in this Brazilian territory, see Agudo (2005a).

Systematic Species List

Class BIVALVIA
- Order Unionoida
  - Family MYCETOPODIDAE Gray, 1840
    - *Mycetopoda siliquosa* Spix, 1827

Class GASTROPODA
- *Subclass Pulmonata*
  - Family PLANORBIDAE Rafinesque, 1815
    - *Biomphalaria peregrina* (d'Orbigny, 1835)
  - Family LYMNAEIDAE Rafinesque, 1815
    - *Lymnaea rupestris* Paraense, 1982
    - *Lymnaea viatrix* d´Orbigny, 1835
  - Family BULIMULIDAE Tryon, 1867
    - *Drymaeus papyraceus papyraceus* (Mawe, 1823)
    - *Simpulopsis* (*Eudioptus*) *araujoi* Breure, 1975
    - *Simpulopsis* (*Simpulopsis*) *pseudosulculosa* Breure, 1975
    - *Simpulopsis* (*Simpulopsis*) *wiebesi* Breure,1975
  - Family STROPHOCHEILIDAE Thiele, 1926
    - *Strophocheilus* (*Mirinaba*) *pudicus* Müller, 1774
  - Family HAPLOTREMATIDAE H. B. Baker, 1923 *
    - *Haplotrema catalinense* Hemphill, 1890

*new occurrence of Family

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Preliminary Notes on the Freshwater Mussels/Naiades of the Paraná State, Southern Brazil

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The State of Paraná (9,000 km^2 of territory, 25,000 hectares of private reserve areas of natural heritage) is part of Brazil's southernmost region, situated between the State of São Paulo to the north, Santa Catarina´s State to the south; western neighbors are Paraguay and Argentina, with the Atlantic Ocean, strongly cut out by bays, along the eastern border. Paraná has a unique terrain that is divided into the Coast, and the First, Second, and Third Plateaus. Each are well defined regions that are separated by mountains and cliffs. Protecting the largest continuous stretch of Atlantic Coastal Forest in the country, the Coast is the region between the Atlantic Ocean and the Serra do Mar coastal mountains. On the western slope of the mountains, with an average altitude of 900 meters, is the First Plateau, where the city of Curitiba is located. Farther to the west is the Serra de São Luiz do Purunã mountain range, leading to the Second Plateau, covered by "araucária" forest, portions of "cerrado" forest and rolling plains – known as the "Campos Gerais" (General Fields). Finally, heading towards the Boa Esperança (Good Hope) mountains in the central-south, or the "Cadeado" mountains to the north, we reach the Third Plateau, subdivided by the rivers Ivaí, Piquiri, and Iguaçu (Krüger & Netto 1998, pp. 9, 48).

Three great river basin systems irrigate the land: the basin of the Paranapanema River to the north; the basin of the Iguazú River to the south, and the basin of the Paraná River to the west (some small basins which discharge into the Atlantic Ocean form a fourth system). The cited complex of great river basin systems meet and integrate on the "Foz do Iguaçu", southwestern region, in the emblem with the neighboring countries of Paraguay and Argentina.

Continental malacological fauna in this part of southern Brazil is poorly documented, with prominence of the native giant terrestrial snail *Megalobulimus parafragilior* (Leme & Indrusiak, 1990) (a endemic species of the Forest Atlantic in danger of extinction, Family Megalobulimidae), but the regional freshwater mussels can be considered one of the elements of the malacological fauna best studied and known Brazilian South, immediate after the State of Rio Grande do Sul (Mansur 1970), with some references previously summarized in Agudo (2004 a). It was established that the available specific studies on these mollusks for the continental territory Paranaense are scarce. Available literature and examination of specimens obtained in field reveal a total of 14 species and subspecies (11 native and 3 exotics), distributed in 9 Unionoida (3 Mycetopodidae & 6 Hyriidae), 4 Veneroida (2 Corbiculidae & 2 Sphaeriidae), and 1 Mytiloida (Mytilidae). Of these, 7 are also confirmed in Santa Catarina's territory - SC (2 Mycetopodidae, 3 Hyriidae and 2 Corbiculidae - exotic invaders), besides the occurrence in both States of the genus *Sphaerium* Scopoli, 1777 (Mansur et al 1987, p. 197).

Bibliographical Antecedents

The zoogeographical coverage of the families Mycetopodidae and Hyriidae in the continent of South America (including the Brazilian territory of Paraná´s State), was revised in the literature (Ortmann 1921; Parodiz & Bonetto 1963, pp. 188, 196; Bonetto 1964; Haas 1969, pp. 510-578; Mansur et al 1987, p. 183). The commented occurrence of Mussels/Naiades species in the historical print reports for the Southern Brazilian Atlantic Coastal Plains (Bonetto 1964; Mansur 1970, pp. 66, 74) and the Iguazu (= Iguaçu) River Basin System in the neighboring State of Paraná (Morretes 1949, pp. 17-19, 25, 30; Zanardini 1965; Parodiz 1968, pp. 4, 10), previously revised in the specialized regional literature - summarized in its majority by Mansur (1970), are confirmed in this preliminary study:

Order UNIONOIDA

Family MYCETOPODIDAE

1. Morretes (1949, p. 25) mentions *Anodontites* (*A.*) *clessini* (Fischer, 1890), under the synonymy "*Anodontites* (*Styganodon*) *clessini* (Fischer, 1890)" for "Ribeirão in waterfall close to Curitiba, State of Paraná ".
2. Zanardini (1965) cited studies the species *Anodontites crispatus tenebricosus* (Lea, 1834), under the synonymy "*Anodontites* (*Stiganodon*) *tenebricosa* (Lea) 1834", in the hidrographical area of "Curitiba".
3. Mansur (1970, pp. 44-47) revises the species and places mentioned by Morretes (1949) and Zanardini (1965).
4. Simone (1994, pp. 180-181) cited specimens of *Anodontites trapesialis* (Lamarck, 1819) for "Paranapanema" and "Itaipu-Foz of Iguaçu ", in the West of Paraná - PR, deposited in the collection of the Museum of Zoology of the University of São Paulo - MZUSP.
5. Souza & Eiras (2002) studied the experimental infestation of larvae Lasídio (Lasidium) of the species *Anodontites trapesialis* (Lamarck, 1819) in fish starting from copies obtained in the "Lago Igapó II", Londrina, Paraná - PR.

Family HYRIIDAE

1. Ortmann (1921, pp. 469, 495, 499, 503, 644-647, 664-665, 668-669) describes two new freshwater mussels/naiades species for the Iguaçu´s (= Iguassú) River Basin*: Diplodon simillimus* and *Diplodon decipiens*.

2. Morretes (1949, pp. 17-19, 30) mentions the following species for Iguaçu's River Basin in the territory of the State of Paraná - PR:
   - *Diplodon martensi* (Ihering, 1893), under the synonymies "*Diplodon* (*D.*) *simillimus* Ortmann, 1921" to "Nundiaquara River, State of Paraná " (p. 17), "*Diplodon* (*D.*) *decipiens* Ortmann, 1921" for "tributary stream of Iguassú River, Serrinha, State of Paraná " (p. 18), and "*Diplodon* (*D.*) *suppositus* Simpson, 1900" to Paraná State (p. 19);
   - *Diplodon* (*D.*) *semigranosus* Simpson, 1914, for "Ponta Grossa, Paraná" (p. 19).
3. Bonetto (1964, pp. 325-326) specifically talks about the occurrence of the species:
   - *Diplodon ellipticus* (Wagner in Spix, 1827) and *Diplodon expansus* (Küster, 1856), both under "*Diplodon* (*D.*) *granosus multistriatus* (Lea, 1834)", in rivers of Atlantic Coastal Plain in the State of Paraná;
   - *Diplodon rotundus gratus* (Lea, 1860), under the synonymy *Diplodon* (*D.*) *rotundus fontaineanus* (Orbigny), in Atlantic Coastal Plain of Paraná to Iguapé River.
4. Zanardini (1965) cited and studies the species *Diplodon expansus* (Küster, 1856); *Diplodon martensi* (Ihering, 1893), under the synonymy "*Diplodon suppositus* Simpson 1900"; *Diplodon ellipticus* (Wagner in Spix, 1827), under the synonymy "*Diplodon multistriatus* (Lea, 1834)"; and *Diplodon charruanus* (Orbigny, 1835) in the hidrographical area of Curitiba.
5. Parodiz (1968, pp. 4, 10) mentions the species *Diplodon martensi* (Ihering, 1893) under the synonymies "*Diplodon decipiens* Ortmann, 1921" ("...the creek tributary of Iguazú River at Serrinha, Paraná, Brazil"), "*Diplodon simillimus* Ortmann, 1921" ("...Nhundiaquara River, at "Morretes", State of Paraná, Brazil"); and "*Diplodon suppositus* Ihering, 1893" ("...State of Paraná, Brazil").
6. Mansur (1970, pp. 65-66, 73-76, 78-80) finally revises the species and places mentioned by Morretes (1949), Bonetto (1964), Zanardini (1965) and Parodiz (1968).

Order VENEROIDA

Family CORBICULIDAE

Takeda et al. (2003) mention and study the occurrence of the limnic invader bivalve *Corbicula fluminea* (Müller, 1774) in the Paraná's River Alluvial Plain.

Family SPHAERIDAE

Morretes (1949, p. 30) mentions to the following species for Iguaçu's River Basin in the territory of the Paraná State: *Pisidium* sp and ? *Sphaerium* sp, to "Paraná" (p. 30).

Order MYTILOIDA

Family MYTILIDAE

1. Takeda et al (2003) study the occurrence of the limnic invader bivalve *Limnoperna fortunei* (Dunker, 1857), in the Reservoir of "Hydroelectric Usina of Itaipú", in the Paraná's River Alluvial Plain (Municipal district of "Porto Rico"), as well as in other reservoirs of the State of Paraná (close to the Municipal district of "Curitiba").
2. Alberti (2003) and Ozelame (2003) present results, recommendations, and technical summaries of the "I South American Encounter of Integration of Actions for Control of the Gold Mussel (*Limnoperna fortunei*)", accomplished in the "Central Hydroelectric of Itaipú", in "Foz de Iguaçu", Paraná State - Brazil, seeking to control the progress of this invader.
3. Mansur (2003) cited the exotic limnic species *Limnoperna fortunei* (Dunker, 1857) accomplishing an accelerated migration in direction the nascent of the existent fluvial systems in the Brazilian territory since it appeared 14 years ago in "La Plata River", Argentina, in 1991, the Paraná State river basins (in small reservoirs near "Curitiba" city, p. 26) among them.
4. Mansur et al (2004, pp. 35, 37) comment on the exam of specimens of *Limnoperna fortunei* (Dunker, 1857) coming from "Itaipú" (high Paraná River), and the entrance (probable accidental) of the species in the Lake of the it Dam of "Itaipú".
5. Agudo (2004 a, c) foresees and alerts on the imminent future entrance of the invasive exotic mussel *Limnoperna fortunei* (Dunker, 1857) in Santa Catarina's State through the "Iguaçu's River Basin".

Results - Systematic Species List

Class BIVALVIA
- Order UNIONOIDA
  - Family MYCETOPODIDAE (3)
    - *Anodontites clessini* (Fischer, 1890)
    - *Anodontites crispatus tenebricosus* (Lea, 1834) *
    - *Anodontites trapesialis* (Lamarck, 1819) (!) *

  (!) Examined material: 1 specimen, collected (23/02/2003) by Prof. Eng. of Fishing César Ademar Hermes, in "Fishery Nursery Dam" located close to the "Reservoir of the Hydroelectric of Itaipu" (approx. 18 km), District São Clemente, Municipal District of Santa Helena, West of the Paraná State.

  - Family HYRIIDAE (6)
    - *Diplodon charruanus* (d´Orbigny, 1835)
    - *Diplodon ellipticus* (Wagner in Spix, 1827) *
    - *Diplodon expansus* (Küster, 1856) *
    - *Diplodon martensi* (Ihering, 1893) *
    - *Diplodon rotundus gratus* (Lea, 1860)
    - *Diplodon semigranosus* Simpson, 1914
- Order VENEROIDA
  - Family CORBICULIDAE (2)
    - *Corbicula fluminea* (Müller, 1774) *
    - *Corbicula largillierti* (Philippi, 1844) (!) *

  (!)Examined material: 3 specimens, collected in field (?/02/2003) by Prof. Eng. of Fishing César Ademar Hermes, in "Reservoir of the Hydroelectric of Itaipu" (?), District São Clemente, Municipal District of Santa Helena, West of the Paraná State.

  - Family SPHAERIDAE (2)
    - *Pisidium sp*
    - *Sphaerium sp*
- Order MYTILOIDA
  - Family MYTILIDAE (1)
    - *Limnoperna fortunei* (Dunker, 1857)

* species occurs in Santa Catarina State.

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Larger Lilliputs?

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Toxolasma parvus (Barnes, 1823) is the type species of a unionid genus having 8 currently accepted members in Canada and the United States (Turgeon et al. 1998). Commonly known as the lilliput, it is found throughout the Mississippi River drainage from western New York to Minnesota, and from southern Canada southward to central Texas (Parmalee and Bogan 1998). It is widespread and locally abundant in the Midwest (Cummings and Mayer 1992).

The type locality for *Toxolasma parvus* is the Fox River in Wisconsin, where it was collected by H.R. Schoolcraft, a member of the Northwest Expedition of the early 1820s (Call 1896). Mathiak (1979) found the species to be confined largely to the southern half of Wisconsin. Mathiak's (1979) five-year statewide mussel survey resulted in data for 42 species which he quantified in 3 ways: *T. parvus* ranked 20th in number of localities at which it was found (17 out of 1876 total), 26th in number of specimens collected (41 out of 8898 total), and 18th in number of counties in which the mussel was taken (16 of the 72 counties).

A half century earlier, Baker (1928) had concluded that this species was very rare in Wisconsin, finding it at none of the sites he studied personally. He gave reports from only five counties for the species he called *Carunculina parva* and a variety he had named *Carunculina parva cahni* (Baker 1927). Noting Baker's (1928) comment that it appeared to be a rare species in the state, Mathiak (1979) hypothesized that, due to the ease of overlooking specimens because of their small size, this mussel would prove to be much more common than earlier records had indicated.

Baker (1928) described this, the smallest species in the state, as having marked sex differences in the adult shell, with the female being more inflated than the male, having its greatest height at the posterior end, which is more broadly rounded than in the male shell. He documented this difference with length, height, and diameter (width) measurements, with all females having greater dimensions than the male. Female shells were 4-9% longer, 17-25% higher, and 11-22% wider.

Using specimens from the mollusk collection of the Milwaukee Public Museum (MPM), this report adds data on the distribution of *Toxolasma parvus* in Wisconsin and makes a morphometric analysis of the traits which have been used to give evidence of dimorphism in the shells of this species.

METHODS

In December 1990, a longstanding dam across the Milwaukee River in the City of Milwaukee was opened to provide a more natural flow to the river, causing a considerable drawdown of the upstream water level north of the dam site in Milwaukee County, Wisconsin. The resulting mud flats covered an estimated total of 92 acres on both sides of the river. Due to the relatively sudden decline in water level subsequent to the opening of the dam, many mollusks especially mussels were unable to relocate to deeper water and could be seen the following spring stranded on the exposed, gently sloping muddy margins of the former river bottom.

On 11 April 1991, an attempt was made to assess the impact of the drawdown on the mollusk population. Specimens hand-collected from the mud flats were those recently dead and thus were assumed to have been alive at the time the water was drawn down. *Toxolasma parvus* was the third most abundant mussel species found in the survey area, after *Lasmigona complanata* and *Pyganodon grandis*. Data on three shell traits were gathered for each of the 17 *T. parvus* individuals in this sample: (1) total length, (2) height, and (3) width. Morphometric traits were measured to the nearest 0.1 mm with a dial caliper.

RESULTS AND DISCUSSION

In this Milwaukee River sample, *Toxolasma parvus* lengths ranged from 28.7-43.2 mm, with 36.9 mm the mean. The range for heights was 16.1-22.7 mm with a mean of 20.1 mm and that for widths was 12.1-21.6 mm with a mean of 17.2 mm. Height/length ratios ranged from 0.525 to 0.566, with 0.544 the mean.

Calling it the smallest and most beautiful ("nacre very brilliant") unionid, Barnes (1823) gave its dimensions as: 19.1-30.5 mm for length, 10.2-15.2 mm for height, and 8.9-13.3 mm for width–given here as converted from his original description. Cummings and Mayer (1992) listed a maximum length of 38 mm for *Toxolasma parvus*, but 65% of the specimens in the Milwaukee River sample exceeded that. The greater size of this Milwaukee River population matches it more closely with Baker's (1927, 1928) southeastern Wisconsin variety *Carunculina parva cahni*, which he described as distinctly larger than typical, having lengths from 22.5-45.5 mm. Baker also used another shell trait, the width index (width/length), to differentiate between this longer, more inflated form and the typical morph. Baker's index values were 50-55% for the variety, in comparison to the typical index of 40-45%.

Baker (1928) had reviewed research which had found some significant correlations between size proportions and factors such as stream size when comparing specimens of the same unionid species collected from different types of habitats. For some unionids at least, statistical studies had supported the generalization that small stream specimens had smaller widths than those of larger streams. Baker (1928) expressed the possibility that there might be a relationship between this sort of ecological factor and the size differences observed in the lilliput that he had called a separate variety or form, with this larger *C. p. cahni* being from a large lake type of habitat, under which Baker also included quiet ponds and the expansions of rivers. Prior to the drawdown, for many years this portion of the Milwaukee River was certainly more lake-like with significant reduction in stream flow.

However, in contrast to the large size shown by these Milwaukee River specimens, a lot (MPM Mollusk Collection #180791-20) that Mathiak collected from a similar habitat on the Mississippi River corresponds more closely in size to Baker's (1928) typical smaller morph (Table 1). Means for length, height and width for this lot were: 22.9 mm, 13.3 mm and 9.8 mm. Height/length ratios ranged from 0.567 to 0.609. Mathiak found these *Toxolasma parvus* at the northeast corner of Goose Island just south of La Crosse Wisconsin, an area of slow water and mud bottom upstream from the Genoa dam (ME Havlik, pers. comm. 2005). Even though he agreed that there was some evidence to support a relationship between the combination of stream size and water flow and the size and shape of unionids, Baker (1928) had concluded that it was only one of the influences on a species' "inherent tendency to vary" in this regard.

Call (1896), in reducing the number of species named in this group to those he thought valid, faulted predecessors for sometimes erecting a new species on the basis of size differences that he had determined were due instead to intraspecific sexual dimorphism. Using ratios calculated by dividing shell lengths (L) by heights (H) and by widths (W) for 4 specimens he called *Unio glans* (=*Toxolasma pullus*), he found no overlap between the sexes. For the two longest males, L/H ranged from 1.60 -1.66 and for the two longest females it was 1.50 - 1.55. L/W ratios ranged from 2.00 - 2.15 for the males and 1.76 -1.83 for the females. Within *Carunculina parva* but not *C. p. cahni*, Baker (1927, 1928) too associated differences in the width index with sexual dimorphism. Though width index values calculated from his shell measurements show some overlap (Table 1), he called the sex differences "marked in the adult," with the female being more cylindrical and swollen. More recently, shell sexual dimorphism has been shown to be inconsistent in *Toxolasma parvus*, and histological evidence of hermaphroditism has been reported, at least in some populations (van der Schalie 1970).

Soft parts were not available to include sexual morphology as part of this study, but the shell measurements were graphed (Figure 1) to look for the presence of a dimorphism in shell widths. Greater width values were generally associated with shells of larger size overall, rather than some of the specimens with large heights and lengths having the relatively smaller widths that would be expected if a narrow morph did exist. The widest lilliput (21.6 mm) had the lowest height/length ratio (0.525), and the narrowest (12.1 mm) had the highest ratio (0.566). That growth pattern gives a slight slope to the graphed data, indicating a tendency for larger size overall to bring some change in proportion to the shells, with height and width increasing at relatively greater rates than length. However, no evidence of two separate morphs based on degree of inflation was detected, with all values lying roughly along a single line.

The Milwaukee River drawdown offered a unusual opportunity in 1991 to locate a population of this small and therefore infrequently collected species. The specimens collected documented the presence of *Toxolasma parvus* in Milwaukee County and were used for this morphometric study of shell traits that have been used previously to give evidence for the possible existence of two morphs, one inflated and one more compressed, within this species.

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Table 1. Range of measured shell traits from *Toxolasma parvus* samples. The nomenclature of the original sources is used for the male/female and the typical/"*cahni*" comparison data from the literature. Milwaukee and Mississippi River lots are from the MPM collection.

	Length (mm)	Width Index	N	Source
Carunculina parva males	21.0-30.0	39-43%	4	Baker 1898, 1928
Carunculina parva females	24.0-25.0	42-44%	3	Baker 1898, 1928
Carunculina parva typical	21.0-30.0	39-44%	7	Baker 1898, 1928
Carunculina parva cahni	22.5-45.5	50-55%	5	Baker 1928
Toxolasma parvus	28.7-43.2	43-50%	17	Milwaukee River
Toxolasma parvus	15.0-28.9	35-46%	5	Mississippi River

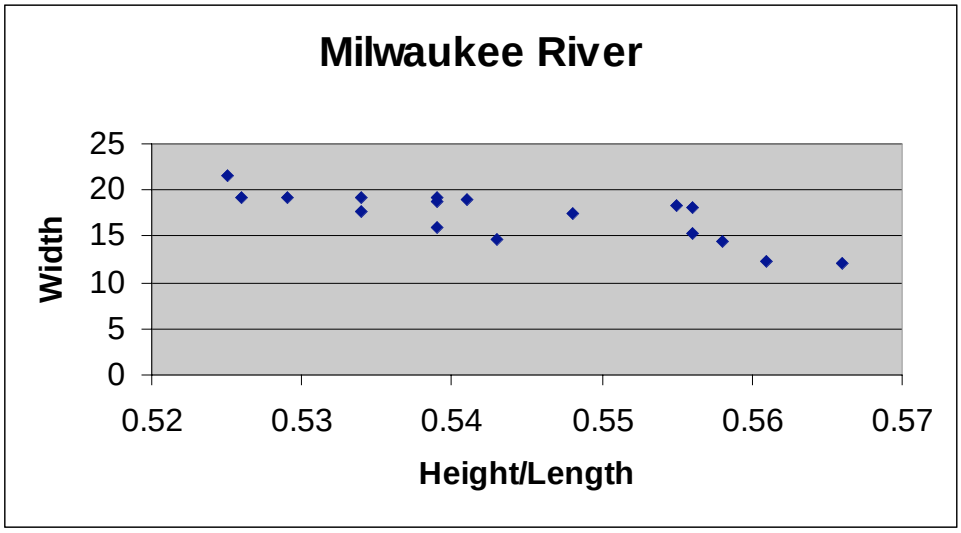

Figure 1. Graphed results for width measurements (to the nearest 0.1 mm) versus height/length ratios from Milwaukee River lilliput specimens (*n* =17).

Mussel Diversity Downstream of Future Dam Reconstruction Site is Similar to That Observed Nearly 20 Years Ago

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Water impoundment is thought to have several deleterious impacts on unionids (Layzer *et al.* 1993). Impoundments have been constructed in many Midwest rivers and streams. Nearly half of the mussel species living in Minnesota are listed as endangered or threatened, or species of special concern (Sietman 2003). The purpose of this survey was to describe freshwater mussel resources and habitat immediately upstream and downstream of the Morehouse Park dam in the Straight River at Owatonna, Minnesota, which will be rebuilt in 2006.

During June 2005 we surveyed for mussels using three procedures: systematic sampling along transect lines spaced 25 ft. apart up and downstream of the dam, a qualitative search of all apparent habitats, and searching the shoreline for empty valves. The water was cloudy, even under normal flow conditions, so we searched the riverbed tactilely. We recorded all living animals and empty valves, and a qualitative description of the riverbed. Voucher specimens have been deposited at the Bell Museum of Natural History, University of Minnesota.

We encountered a variety of mollusks. Eight mussel species were observed during transect work and nine during the 1.6 person-hour species search (Table 1). Four of these species are listed as special concern or threatened by the state of Minnesota. No valves were observed along the shoreline. We saw a variety of different sized individuals of several species indicating reproduction has occurred recently at this location. Riverbed substrate upstream of the dam was comprised primarily of silt and sand. The highest quality habitat and greatest diversity and abundance of mussels occurred downstream of the dam where the substrate was mostly unconsolidated gravel and sand with scattered cobble. We also observed a single, dead, non-indigenous Chinese mystery snail (*Cipangopaludina chinensis*).

Table 1. Mussel species observed at site. SC-special concern, T-threatened. Nomenclature follows Turgeon *et al*. (1998). * range of sizes observed.

	Transect		Search		Minnesota
Species	Live	Dead	Live	Dead	listing
Anodontoides ferussacianus		1			
Elliptio dilatata	4	15	5	11	SC
*Lampsilis siliquoidea**	14	19	4	31	
*Lasmigona complanata**	27	32	24	17	
Lasmigona compressa			2		SC
*Lasmigona costata**	6	3	5	4	SC
Potamilus alatus	7		1	3	
*Pyganodon grandis**	1	21	1	17	
*Strophitus undulatus**	7	3	6	2	
Venustaconcha ellipsiformis			2	3	T

Even though water and habitat quality appeared to be relatively low at this site, compared to streams we've studied in the St. Croix River and Rainy River watersheds, we observed a fairly diverse mussel community. Mussel diversity at this site has not changed dramatically since 1987 when Davis (1988) recorded nine species at the Morehouse Dam in Owatonna. Davis (1988) observed one species that we did not observe (empty *Ligumia recta* valves), and we observed two species at the dam not encountered by him (*A. ferussacianus* and *L. compressa*), although he collected them at nearby sites. Unconsolidated substrate, which made up most of the substrate at this site, is thought to be relatively poor habitat for many mussel species (McMahon 1991). There are important mussel resources near the dam that should be protected or relocated if fine sediment will be entering the Straight River during Morehouse Park Dam improvement.

This project was administered by Tor Hansen and funded by Barr Engineering, Minneapolis, Minnesota.

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Development of a Mollusc Fauna in a Storage Reservoir for Run Off Rainwater on the Isle of Terschelling, the Netherlands, 2

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In a previous report I reviewed the freshwater molluscs observed in a storage reservoir for run off rainwater near Midsland on the Isle of Terschelling, the Netherlands, in the autumns of 2002-2004 (Mienis, 2005). It resulted in the recording of respectively two, seven, and eight freshwater snails. This year I spent another week on that island during the period of 1-8 October 2005. On the 3rd

of October, I had the opportunity to sample the storage reservoir. Compared with the situation in the autumn of 2004, the reservoir contained much more water. Also, the aquatic vegetation had increased significantly and the first willows got a foothold in the middle of the reservoir.

All the species recorded in the past from this artificial biotope were still present. In addition, three new species were collected: two aquatic snails and the first bivalve. These additional species are *Bithynia tentaculata* (Linnaeus, 1758), *Anisus vorticulus* (Troschel, 1834), and *Musculium lacustre* (Mueller, 1774). *Bithynia* and, too a lesser degree, *Musculium* were expected to be among new potential colonizers. The first is commonly encountered in the nearby polder ditches, the second is less common on Terschelling and can even be classified as a rare species there (Visser, 1974 &1982). The find of *Anisus vorticulus* was a real surprise, since it had not been reported previously from Terschelling (Visser, 1982). However, the extremely dense aquatic vegetation and the relatively clear water form a preferred habitat for this rare species in the Netherlands (Gittenberger et al., 1998).

Species so far observed in the storage reservoir near Midsland, Terschelling, are enumerated in the following table.

Mollusc species collected from the storage reservoir, by date:

Scientific name*	09.10.2002	01.10.2003	05.10.2004	03.10.2005
***Bithynia leachii* (Sheppard, 1823)**	-	+	+	+
***Bithynia tentaculata* (Linnaeus, 1758)**	-	-	-	+
***Lymnaea stagnalis* (Linnaeus, 1758)**	+	+	+	+
Radix balthica* (Linnaeus, 1758)*	-	+	+	+
Radix labiata* (Rossmaessler, 1835)**	-	+	+	+
***Anisus vortex* (Linnaeus, 1758)**	+	+	+	+
***Anisus vorticulus* (Troschel, 1834)**	-	-	-	+
***Gyraulus albus* (Mueller, 1774)**	-	+	+	+
***Planorbarius corneus* (Linnaeus, 1758)**	-	-	+	+
***Planorbis planorbis* (Linnaeus, 1758)**	-	+	+	+
***Musculium lacustre* (Mueller, 1774)**	-	-	-	+

* In the nomenclature I have followed Falkner et al., 2001 and Falkner et al, 2002.

** Until recently this species was known as *Radix ovata* (Draparnaud, 1805).

*** This seems to be the correct name for *Radix peregra* auct. non Müller, 1774.

In summarizing the data obtained so far, one thing has become clear: during each successive year the freshwater mollusc biodiversity in the storage reservoir for run off rainwater near Midsland on the Isle of Terschelling, the Netherlands, has steadily increased from two species in 2002 to eleven in 2005. As stated before, several additional species can be expected to settle in the reservoir in the near future (Mienis, 2005). It will be interesting to see how long this process will continue and how many species will ultimately settle in this man-made pool.

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2005 St. Croix River Research Rendezvous abstracts

The following abstracts were selected from presentations and posters given at the 17th annual meeting of the St. Croix River Research Rendezvous. This meeting brings together scientists, resource managers, agency staff, high school teachers and students, and interested public to learn about research plans and findings in the St. Croix River watershed. The meeting was held on October 18, 2005 at the Warner Nature Center near 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 17, 2006 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).
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ASSESSING THE SPREAD OF ZEBRA MUSSELS IN THE ST. CROIX RIVER USING DENSITY MEASUREMENTS AND NATIVE MUSSELS

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The St. Croix National Scenic Riverway was the first wild and scenic river unit of the National Park System, in 1968. The Riverway is considered a nationally significant resource for its richness and abundance of freshwater mussels (~40 species, the greatest in the Upper Mississippi watershed) and is recognized for its outstanding recreational and biological assets. The diversity of unionids within the Riverway is well documented and many threats to that diversity have been identified. This faunal group will be severely impacted by a zebra mussel infestation and from other exotic invasions. Freshwater mollusks are a keystone faunal group of freshwater systems and their potential loss is unacceptable.

In order to understand the invasion of zebra mussels into the St. Croix, measurements of density were taken within the known infestation zone (the last 21 miles of river). Anecdotal evidence from the upper Mississippi River suggests zebra mussel colonization predominates on native mussel beds, especially when substrates are less favorable for recruitment (e.g., sand, silt, etc.). Therefore, sample locations were chosen based on native mussel bed survey work previously conducted by the second author. Six locations were identified from Stillwater, MN, to Prescott, WI, reflecting the range of habitats and hydrology found in the infestation zone. Thirty 1/8-meter quadrate samples were collected by divers at each of the locations. These samples were processed off river, frozen and examined under magnification. Data collected will aid managers who are creating policy based on the spread and intensity of the invasion.

The presentation will showcase the methods established to determine zebra mussel densities on the lower river, and present results of not only this invasive, but of Asian Clams and snails found during the sampling events. It will also highlight management decisions resulting from this information.

SMALL MUSSEL DENSITY STILL LOW AT INTERSTATE STATE PARK, ST. CROIX RIVER, MINNESOTA AND WISCONSIN

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The St. Croix River at Interstate State Park, Minnesota and Wisconsin, houses a dense and diverse freshwater mussel assemblage. Included in the assemblage are the federally endangered winged mapleleaf (*Quadrula fragosa*) and Higgins eye (*Lampsilis higginsii*), and twelve state-listed species. We have quantitatively sampled the mussel assemblage at this location 6 times since 1992 (about every 2-3 years). In 1992 the overall density of mussels at Interstate averaged 38.4 mussels/m^2. The density declined to a low of 14.6 mussels/m^2 in 2002, with a slight rebound to 18.5 mussels/m^2 in 2005. We partitioned sampled mussels into large ($\geq$ 30 mm shell length) and small ($<$ 30 mm) size classes. Large mussel density did not change significantly over this period, from a high of 22.6 mussels/m^2 in 1995 and 1998, to a low of 13.9 mussels/m^2 in 2002, and 15.5 mussels/m^2 in 2005. We observed significant differences in small mussel density from a high of 19.2 mussels/m^2 in 1992 to a low of 0.8 mussels/m^2 in 2002, with a slight rebound to 3.0 mussels/m^2 in 2005. The densities of small mussels from 2002 and 2005 are significantly lower than earlier years. We further partitioned small mussels into 3 size classes: 0-10 mm, 10-20 mm and 20-30 mm. There were significant declines in the density of 10-20 mm and 20-30 mm mussels from 1992 through 2005. There were no significant differences in the density of the smallest mussels (0-10 mm) among years, with 1992 having 0.56 mussels/m^2 and 2005 having approximately half that number (0.27 mussels/$m^{2)}$.

Several factors influence these trends. We collected relatively few of the smallest mussels and variance was large. Although density of the smallest mussels ($\leq$ 1 year) did not change, there were significant declines in slightly older mussels suggesting there

is little difference in juvenile recruitment but a difference in juvenile survivorship. Also, the decline in the number of small mussels is not equally distributed across species. Small *Truncilla truncata* declined from 2.2 mussels/m^2 in 1992 to 0.25 mussels/m^2 in 2005, a 10-fold decline in density. The densities of small *Truncilla donaciformis* and *Fusconaia flava* declined from 0.5 mussels/m^2 in 1992 to 0 in 2002 and 2005, and 0.3 small mussels/m^2 in 1992 to 0 in 2002 and 2005, respectively. During the same period, small *Actinonaias ligamentina* density remained relatively constant, ranging from 0.13 mussels/m^2 in 2005 to 0.22 mussels/m^2 in 1992. Finally, there was a significant increase in the amount of fine sediment at Interstate between 1992 and 2005. Average particle size (phi) dropped from 4.8 to 0.8, meaning the fraction of substrate comprised of sand increased from 38% in 1992 to 64% in 2005. The causes for increased sediment accumulation at Interstate State Park are unknown, but careful monitoring of this site and changes in discharge levels are needed.

A QUANTITATIVE SURVEY OF THE UNIONID MUSSEL COMMUNITIES BELOW FOUR DAMS ON THREE WISCONSIN TRIBUTARIES OF THE ST. CROIX RIVER

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During the summer of 2005, students from Grantsburg High School and their instructor quantitatively analyzed the mussel communities below four dams on the Yellow, Clam and Wood Rivers in northwestern Wisconsin. An additional high density site on the Yellow River was sampled as a comparison control. At each site, mussels and substrate were collected from 100 quadrats (0.25 m^2). Substrate was separated into five size classes and weighed, and all mussels were identified, measured and aged using annular rings. A numbered vinyl tag was attached to the first 200 mussels at each site for future growth analysis. The Wood River below the Memory Lake Dam had the highest diversity with 20 species while the Yellow River below the Spooner Dam had the lowest diversity with only 6 species. The highest densities occurred at the control site on the Yellow River with 27.5 mussels/m^2, and on the Clam River at the Clam Lakes Dam with 26.9 mussels/m2 and the Clam Falls Dam with 19.0 mussels/m^2. The Memory Lake Dam site had the lowest density with only 9.2 mussels/m^2. The oldest mussel community occurred at the Yellow River control site with a mean of 17.3 annular rings/mussel while the youngest site was the Memory Lake Dam site with a mean of 8.2 annular rings/mussel.

OBSERVATIONS OF NON-Lampsiline Unionid MANTLE DISPLAYS and GLOCHIDIA RELEASE

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[3]Macalester College, Department of Biology

Freshwater mussels have evolved impressive strategies to promote the transfer of glochidia to their hosts. Among these, modification of the mantle as a host attractor or lure is the most well known. Members in the Tribe Lampsilini are the only group with published accounts describing such lures. We document for the first time mantle modifications in non-lampsiline unionids presumably used to attract host fish. We observed mantle displays in five species, *Cyclonaias tuberculata*, *Quadrula fragosa*, *Q. metanevra*, *Q. pustulosa*, and *Tritogonia verrucosa*, all of which are members of the Tribe Quadrulini, a monophyletic group within the subfamily Ambleminae. Displaying individuals contained mature glochidia, which were occasionally released when the display was touched. *Cyclonaias tuberculata* and *Q. pustulosa*, had similar displays, while the displays of other species were different in appearance. Displays were static, but appeared to be enlarged at night for *T. verrucosa*. These structures do not appear to mimic known aquatic animals, e.g. minnow, but might resemble a novel food item to entice a fish strike, or perhaps is associated with the release of a chemical attractant.

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CREATION OF A GLOCHIDIA KEY FOR ST. CROIX RIVER NATIVE MUSSELS THAT PRODUCE SMALL GLOCHIDIA

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Minnesota is home to 48 native freshwater unionid mussel species. The St. Croix River alone contains 43 species including the last known reproducing population of the federally endangered winged mapleleaf, *Quadrula fragosa* (Conrad, 1835). Mussels have the

highest ratio of species listed as threatened, endangered, or of special concern, making them the most endangered group in North America. Mussels play important roles in the aquatic ecosystem by filtering particulates and serving as a valuable food source for a variety of animals. Yet, many basic aspects of their life cycle are unknown. The mussel reproductive cycle includes a parasitic stage where the larva (glochidium) must attach to the gills or fins of a host fish or they will die. If the larva attaches to a suitable host species, the glochidium is encapsulated in a cyst where it undergoes transformation into a juvenile, which then drops off of the host fish. Some mussel species can use a variety of host fishes, but others specialize upon only a few. For many species, the host or hosts are unknown. If host information is limited, as is the case with *Quadrula fragosa*, then mussel conservation strategies may not be effectively implemented. The best way to confirm that a fish serves as a host for a particular mussel species is to observe glochidia metamorphosis from naturally infested fish. To facilitate identification of unknown glochidia valves from naturally infested fish, a key was created for small glochidia based on shell morphology and dimensions measured from scanning electron micrographs. Keys to mussel glochidia are needed to facilitate the identification of glochidia that fall from naturally infested fishes. Glochidia release periods can be pinpointed by using this key to identify glochidia collected by drift sampling.

Suggested reading:

Hoggarth, M. A. 1999. Descriptions of some of the glochidia of the Unionidae (Mollusca: Bivalvia). Malacologia 41: 1-118.

Williams, J. D., M. L. Warren, Jr., K. S. Cummings, J. L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries, 18:6-22.

ASSESSING GENETIC DIVERSITY WITHIN AND AMONG POPULATIONS OF TWO MUSSELS OF THE GENUS *QUADRULA*

Matthew J. Cox, Daniel J. Hornbach, Paul J. Overvoorde, and Mark C. Hove
Macalester College, Department of Biology

With the rise of molecular techniques, we now have powerful new tools to inform conservation efforts. By examining the genetic diversity within and between populations, we can characterize the amount of genetic variability that exists between two or more populations. This in turn can influence the decision of biologists to treat groups of organisms as a single conservation unit or to treat them separately. We are currently working on a project to assess the genetic diversity within and among populations of two freshwater mussels: *Quadrula quadrula* (common mapleleaf) and *Quadrula pustulosa* (pimpleback). We have collected tissue samples from populations on the St. Croix and Mississippi rivers. Two molecular markers have been chosen for sequencing: the mitochondrial gene ND1 and the nuclear-encoded internal transcribed spacer region ITS-1. After sequencing we will assess the sequences to characterize the diversity present. These findings will put into context the genetic makeup of other mussel species in this genus, such as the endangered *Quadrula fragosa* and will build on earlier work we conducted using restriction fragment length polymorphisms of ITS-1 to differentiate among various *Quadrula* species.

Suggested reading:

King, TL, Eackles, MS, Gjetvaj, B, Hoeh, WR. 1999. Intraspecific phylogeography of *Lasmigona subviridis* (Bivalvia: Unionidae): conservation implications of range discontinuity. Molecular Ecology 8:S65-S78.

Serb, JM, Buhay, HE, Lydeard, C. 2003. Molecular systematics of the North American freshwater bivalve genus *Quadrula* (Unionidae: Ambleminae) based on mitochondrial ND1 sequences. Molecular Phylogenetics and Evolution 28:1-11.

ADAPTIVE CLUSTER SAMPLING OF ST. CROIX RIVER FRESHWATER MUSSELS AT FRANCONIA, MINNESOTA

Daniel J. Hornbach, Mark C. Hove, and Ben D. Dickinson
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Estimating population size of endangered or threatened species is often difficult due to low organism density. Typically a large number of samples must be collected to estimate population size. Another approach is to utilize adaptive cluster sampling, which increases sampling efficiency for organisms that are spatially clustered. 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 studies have shown that some of these species are most commonly found in areas of high mussel density. We initiated the study by randomly selecting twenty 50-m2 cells from a 2 km 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 twenty cells sampled, ten were high density. We initiated adaptive cluster sampling in these ten high-density cells. We randomly selected ten 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 four adjacent quadrats. Neighboring cells were sampled until no additional target species were observed.

We collected target species from three of ten 50-m2 high -density cells. These included 5 *Cyclonaias tuberculata*, 2 *Quadrula fragosa* and 2 *Lampsilis higginsii*. Four of these individuals were collected from one adaptive sampling location. We are processing data to estimate population sizes and habitat characteristics for these three species. We plan to examine population size and habitat characteristics of these species at Interstate State Park during the summer of 2006, and determine the efficacy of this sampling technique in a river reach with higher mussel density.

Suggested reading:

Smith, D. R., R. F. Villella, and D. P. Lemarie. 2003. Application of adaptive cluster sampling to low-density populations of freshwater mussels. Environmental and Ecological Statistics 10: 7-15.

ANALYSIS OF SUSPENDED SEDIMENT TRANSPORT DATA IN THE ST. CROIX RIVER

Emily Kushner[1], Kelly MacGregor[1], Elena Evans[1], Daniel Hornbach[2], Mark Hove[2], Matthew Cox[2], and Ben Dickinson[2]
[1]Macalester College, Department of Geology. [2]Department of Biology

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 collected by the Metropolitan Council near Stillwater show a decrease in suspended sediment concentration in the lower part of the river over the last 28 years. Other work (Hornbach and others) demonstrates a decrease in the grain size of bed sediment at Interstate Park since 1990. During this same time, a 96% decline in the juvenile mussel population was also recorded at Interstate. Both Interstate and Franconia are home to two federally endangered freshwater mussel species, the winged mapleleaf (*Quadrula fragosa)* and the Higgins Eye Pearlymussel (*Lampsilis higginsii*). We need to better understand the controls on sediment transport in order to understand the causes for this decline in the juvenile mussel populations and to evaluate future threats to these species.

In summer 2004, we began sampling suspended sediment (both surface water and near-bed) at various inshore and outshore locations along a 10-mile stretch of the St. Croix River (St. Croix Falls to Osceola). In summer 2005, we continued suspended sediment sampling at Wild River, Interstate Park, and Franconia. Most of our 2004 samples were collected during moderate discharges (4000-5000 cfs), while the 2005 samples were collected across a much greater range of discharges (1700-9500 cfs). These data will allow us to explore the controls on sediment transport by considering the relationship between suspended sediment concentration and instantaneous water discharge, mean daily discharge, water velocity, and other factors. Using these rating curves we can calculate total suspended sediment load. Sediment cores taken from the Lake St. Croix (Triplett and others) provide a comparison to long-term sedimentation rates. We hope to better understand the controls on sediment transport and deposition in the river over daily to decadal timescales, and to further explore the impact of sedimentological changes in the river on freshwater mussel populations.

BEDLOAD SEDIMENT TRANSPORT IN THE ST. CROIX RIVER

Elena Evans[1], Kelly MacGregor[1], Daniel Hornbach[2], Mark Hove[2], Emily Kushner[1], Matthew Cox[2], and Ben Dickinson[2]
[1]Macalester College, Department of Geology, [2]Department of Biology

Rivers shape the landscape through the transport of both water and sediment. A long term study of the middle and lower St. Croix River by Hornbach and others (see http://www.macalester.edu/~hornbach/St.Croix/index.html) has examined the relationship between native mussel populations and bed sediment grain size. This work suggests that bed sediment distribution, stability and transport are likely critical to the health and longevity of mussel communities.

During the summer of 2005, we initiated the collection of bed sediment at several locations on the St. Croix River both above and below the St. Croix Falls Dam. Bed sediment transport depends on shear stress conditions in the river (which in turn is controlled by water velocity, river gradient, and water depth) as well as the grain size distribution of particles resting on the bed. We made measurements of bedload transport across a wide range of water discharges during this time with a Helley-Smith sampler. The associated rating curves for different parts of the river will be critical for predictions of sediment transport and for consideration of the effect of bedload on mussel habitats. Earlier work suggests that while bed sediment grain size is relatively unchanged, below the St Croix Falls dam a fining trend unlike the other study areas is present. Further analysis of our bedload transport data (which is notoriously difficult to collect) will allow us to quantify changes to the physical fluvial environment over time.

Suggested reading:

http://www.geog.soton.ac.uk/research/nfrc/bedload1.pdf

EVALUATING THE POTENTIAL ENVIRONMENTAL FATE AND EFFECTS OF AQUACULTURE DRUG USE IN U.S. INTENSIVE AQUACULTURE

M. P.Gaikowski, L.J. Schmidt, Carol D. Lowenberg, and W.H. Gingerich
U.S. Geological Survey, Upper Midwest Environmental Sciences Center (UMESC)

U.S. Food and Drug Administration (FDA) approval is currently being sought for several waterborne or oral therapeutants for use in aquaculture to control mortality associated with a variety of bacterial or parasitic diseases of cultured freshwater fish. Each drug's potential environmental fate and effects following discharge after aquaculture use must be characterized prior to FDA approval. The risk characterization for a drug integrates available fate and degradation data with projected use and discharge patterns at U.S. aquaculture facilities to predict environmental introduction concentrations (EIC). These EIC estimates are then compared with available effects data to develop a probabilistic estimate of environmental risk of drug discharge. Risk ratios may indicate the need for further refinement of the available database (e.g. better degradation information, additional toxicity tests, improved discharge estimates). Previous U.S. Geological Survey (USGS) research focused on the development and validation of simple models to predict waterborne effluent concentrations following typical production raceway treatments and the development of hatchery survey information to characterize aquaculture drug use. Current USGS research is focused on the validation of existing dilution models in a broad spectrum of hatcheries and on the integration of national water chemistry databases into the risk assessment process. Expansion of existing dilution models to a broad spectrum of hatcheries will improve FDA's confidence in the EIC estimates generated during the environmental risk assessment – providing a more realistic estimate of exposure to the aquatic ecosystem. Improving these models will also provide information on realistic exposure durations if additional aquatic toxicity tests are required. The integration of water chemistry information into the environmental risk assessment will allow FDA reviewers to highlight those specific watersheds that may be particularly vulnerable to a drug based on the surface water pH, hardness, or other variable. By integrating actual hatchery locations with this water chemistry database, we can specifically identify those hatcheries whose discharge may result in unacceptable drug concentrations based on receiving water chemistry. Furthermore, the integration of these data sets into the regulatory decision making process may improve the protection of critical aquatic ecosystems that support threatened and endangered species (Figure 1) while still allowing hatcheries to use desperately needed pharmaceuticals to control disease in culture fish.

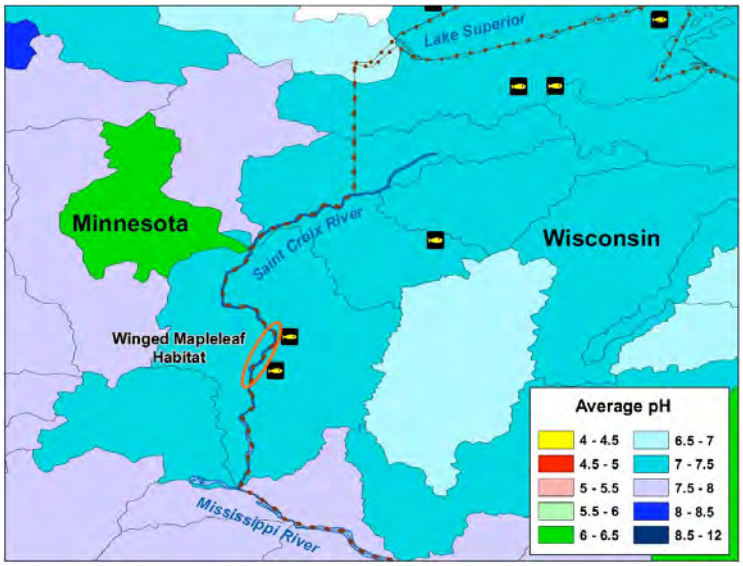


Figure 1. Average surface water pH and fish hatchery location relative to the habitat of the endangered winged mapleleaf mussel *Quadrula fragosa* in the St. Croix River.

Reminders

Please send your 2006 FMCS dues to Heidi

FMCS Workshop – March 5-7, 2006:
advance registration ends February 24, 2006

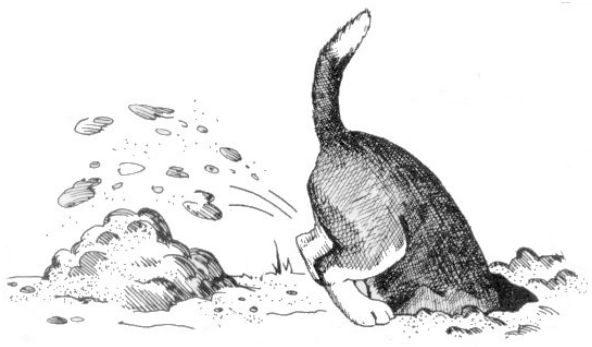
FMCS Address Changes:

Raven Lawson
Arkansas State University
P.O. Box 2203
State University, AR 72467

Steve Ahlstedt – new email address: bigshelldaddy@bellsouth.net

New mailing address:
Illinois Natural History Survey
1816 S. Oak Street
Champaign, IL 61820

Helpful Hints from Hoppy:



Hoppy Says — No such thing as safe mining. Toxic brew (gray water…what they call it and permitted) or black-water (what we call it) kills mussels! Keep up the fight to save our mussel resources.

Submitted by Steve Ahlstedt

PROPAGATION AND CAPTIVE CARE WORKSHOP
GENERAL REGISTRATION FORM

The Freshwater Mollusk Conservation Society and the Columbus Zoo and Aquarium are pleased to host a propagation and captive care workshop, March 5-7, 2006, at the Columbus Zoo and Aquarium, Columbus, Ohio. To register, please complete the form, enclose a check for the appropriate amount, and mail to: Heidi Dunn, FMCS Treasurer (see below).

Name: _____ Affiliation: _____

Address: _____

City: _____ State: _____ Zip: _____ Date: _____

Daytime Phone: _____ Fax: _____ E-mail: _____

Circle the appropriate registration level and **indicate if you wish a copy of Proceedings**:

FMCS Workshop Participant	Advance Registration (until February 24, 2006)	On-Site Registration (February 24 – March 6, 2006)	If you plan to complete On-site registration please notify: Tom Watters, 614-292-6170, Watters.1@osu.edu Otherwise, prompt receipt of workshop registration materials may not be possible.
Student FMCS member	$80.00	$100.00	
Student non-member	$95.00*	$115.00*	
FMCS Registrant	$100.00	$120.00	
Regular Non-FMCS Registrant	$130.00*	$150.00*	
Proceedings (later in 2006)	$25.00	$25.00	

* includes FMCS membership
Registration includes 3 continental breakfasts, 2 lunch buffets, breaks, 1 dinner social, 1 mixer (cash bar)

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Please make checks payable to the FMCS
Mail the completed form and the check to:
Heidi Dunn, FMCS Treasurer
1417 Hoff Industrial Park
O'Fallon, MO 63366

FMCS Federal ID # 43-1855280
Deadline for refund registration fee is February 24, 2006

Amount enclosed: _____

Freshwater Mollusk Conservation Society

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

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C/O Heidi Dunn, Treasurer
1417 Hoff Industrial Park
O'Fallon, MO 63366

Phone: 636-281-1982
Fax: 636-281-0973
Email: Hdunn@ecologicalspecialists.com

Taxa group(s) of interest: Unionids ____ Gastropods ____ Sphaeriids ____

Let us know if you are interested in joining any of the following FMCS committees:

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Membership dues are collected annually at the beginning of each year - please renew now!

Freshwater Mollusk Conservation Society
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If you are interested in joining a committee, please contact the appropriate chair.

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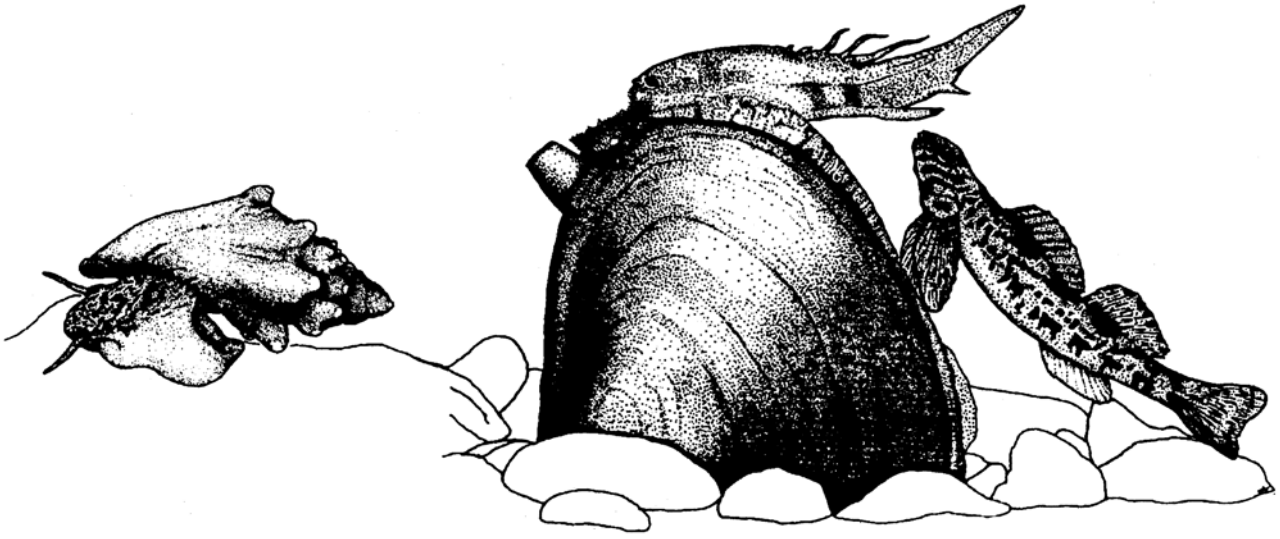
http://my.fit.edu/~rtankers/unio.htm

Freshwater Mollusk Conservation Society



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