International Symposium of the Freshwater Mollusk Conservation Society

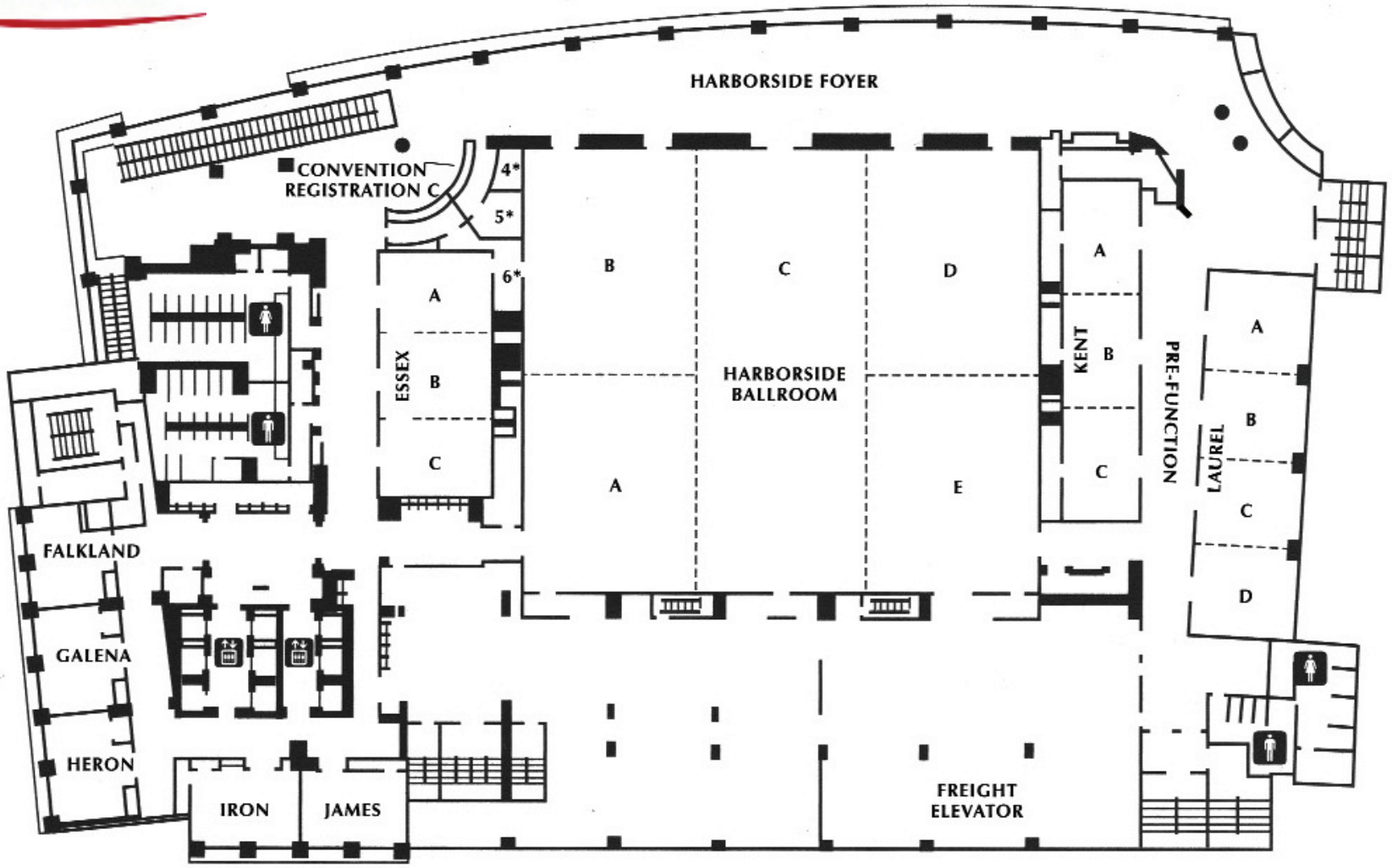
Meeting Program and Abstracts

Healthy Mollusks = Healthy Rivers = Healthy People

19 - 24 April 2009 * Marriot Waterfront * Baltimore, Maryland

This is the 6th Biennial Symposium of the FMCS

Marriott
BALTIMORE
WATERFRONT



Program Cover Artwork by Mike Pinder, Virginia Department of Game and Inland Fisheries
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International Symposium of the Freshwater Mollusk Conservation Society

The Freshwater Mollusk Conservation Society (FMCS) is devoted to the advocacy for, public education about, and conservation science of freshwater mollusks, North America's most imperiled fauna.

Acknowledgement of Sponsors

Many agencies, companies and individuals provided financial support for this symposium. The Freshwater Sponsors provided ≥ $5000, Pearl Sponsors provided $2500, Gold Sponsors provided $1500, Silver Sponsors provided $1000, and Bronze Sponsor provided $500. Symposium financial sponsors are as follows:

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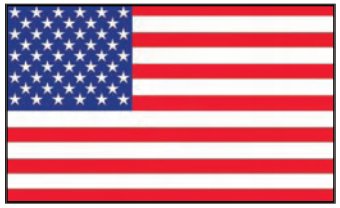
Welcome!

On behalf of the organizing committee, we want to welcome you to the International Symposium of the Freshwater Mollusk Conservation Society, which is also the 6th Biennial Symposium of the FMCS. The theme of the International Symposium is Healthy Mollusks = Healthy Rivers = Healthy People. If you have any questions regarding the symposium sessions please feel free to contact any of the Symposium Committee members listed on page 2. Enjoy!

Boa vinda!

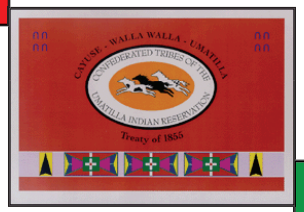
Welcome!



Welcome!

Ayukii!

Boa vinda!



Niix maycqi!

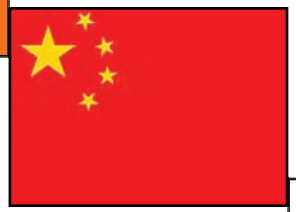
Vítáme vás!

Welcome!

Fáilte!

Fáilte!

Willkommen!



huānyíng ni!

Bienvenido!

Croeso!

Wëllkomm!

Welcome!

She:kon!

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Entertainment: Kike and Miguel with Steve Bloom

Kike and Miguel hail from Chile and Argentina. They deliver a unique blend of Latin contemporary dance music and soulful ballads. Their CD, "Kike and Miguel", is a compilation of traditional ballads and original music inspired by musical styles of Spain, Argentina, Chile, Brazil, Cuba, and Ecuador. Steve Bloom is a Cross-Cultural Percussionist in Cuban, Latin, Brazilian, Jazz, Blues, Rock and Roll, New Age, Celtic, Persian and Middle Eastern music styles. He has toured in over a dozen countries. The Washington Post, John Pitcher, writes "…Steve Bloom has never met a rhythm he couldn't master.

International Symposium of the Freshwater Mollusk Conservation Society

19-24 April 2009 * The Marriot Waterfront * Baltimore, Maryland

Healthy Mollusks = Healthy Rivers = Healthy People

Sunday, 19 April 2009

1pm – 4pm: FMCS Board Meeting – Harborside Ballroom A

4pm – 6pm: Committee Meetings

*** **Note: All Committee Meetings will be held in Harborside Ballrooms A & B unless otherwise noted in the schedule**

1pm – 7pm: Registration – Harborside Foyer

7pm – 10:30pm: Welcome reception at National Aquarium

*** **Note: Symposium name tags required for National Aquarium entrance. Attendees will enter through the main doors. All exhibits except the dolphin show will be open, including the rainforest and Australia exhibits.**

*** **Note: Posters presenters can begin setting up at 2pm Sunday. All posters should remain up until 3pm Tuesday for judging and must be taken down before 5pm Tuesday**

Monday, 20 April 2009

7am – 5pm: Registration – Harborside Foyer

8am – 10am: Plenary Session – Harborside Ballroom C

10am – 10:20 am: Break

10:20am – 11:50 am: Plenary Session – Harborside Ballroom C

11:50 am – 1pm: Lunch on your own and Committee Meetings

12pm – 1pm: Environmental Quality and Affairs Committee Meeting – Harborside Ballroom A

1pm – 3pm: Session 1A **-** Status of Mollusks on Tribal Lands – Harborside Ballroom A
Session 1B – Evolution and Systematics I – Harborside Ballroom B

3pm – 3:20 pm: Break

3:20 pm – 5:20 pm: Session 2A – Systems and Community Ecology I – Harborside Ballroom A
Session 2B – Pearls – Harborside Ballroom B

5pm - 6:30pm: Guidelines and Techniques Committee Meeting - James

5:20 pm - Dinner on your own; Committee Meetings

6:30 pm – 8:30 pm: Poster Session – Harborside Ballroom C

7:30pm – 10:30pm: Social – Harborside Ballroom C/Foyer

Tuesday, 21 April 2009

8am – 9:40 am: Session 3A – Systems and Community Ecology II – Harborside Ballroom A
Session 3B – Physiology, Life History and Population Ecology I – Harborside Ballroom B

9:40 am – 10am: Break

10am – 12pm: Session 4A **-** Conservation of Margaritiferidae I – Harborside Ballroom A
Session 4B – Physiology, Life History and Population Ecology II – Harborside Ballroom B

12pm – 1pm: Lunch on your own and Committee Meetings – Harborside Ballrooms A & B

1pm – 3pm: Session 5A – Conservation of Margaritiferidae II – Harborside Ballroom A
Session 5B – Water Quality and Ecotoxicology II – Harborside Ballroom B

3pm – 3:20 pm: Break

3:20 pm – 5:20 pm: Session 6A – Status, Distribution and Sampling I – Harborside Ballroom A
Session 6B - Advances in Propagation I – Harborside Ballroom B

5pm – 7pm: Awards Committee Meeting - Iron

5:30pm - Dinner on your own

5:30pm - 6:30pm: Committee Meetings; Guidelines and Techniques – James; Propagation – Ballroom A

7pm – 11pm: Social and Auction – Ballroom C

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Wednesday, 22 April 2009

8am – 9:40 am: Session 7A – Systems and Community Ecology III – Harborside Ballroom A
Session 7B – Physiology, Life History and Population Ecology III – Harborside Ballroom B

9:40 am – 10am: Break

10am – 12:00 pm: Session 8A **-** Habitat and Community Restoration – Harborside Ballroom A
Session 8B – Evolution and Systematics II – Harborside Ballroom B

12pm – 1:30 pm: Business Luncheon

1:40 pm – 3:20 pm: Session 9A – Maritime, Roads and Rails – Harborside Ballroom A
Session 9B – Advances in Propagation II – Harborside Ballroom B

3:20 pm – 3:40 pm: Break

3:40 pm – 5pm: Session 10A – Status, Distribution and Sampling II - Harborside Ballroom A
Session 10B - Physiology, Life History and Population Ecology IV – Harborside Ballroom B

5pm – 7pm: Dinner on your own
Committee Meetings

Tours and Mussel Field Trip

Thursday, 23 April 2009

Tours:

1) Smithsonian National Museum of Natural History & Smithsonian National Museum of the American Indian – **Depart Baltimore Marriot at 9am**

2) The Smithsonian National Zoological Park - **Depart Baltimore Marriot at 9am**

Mussel Field Trips:

1) Freshwater Mussel Field Trip (Potomac River and Nanjemoy Creek – **Depart Baltimore Marriot at 8:30am**

Hatchery Field Trips

Friday, 23 April 2009

White Sulphur Springs National Fish Hatchery (Aquatic Resource Recovery Center) – **Depart Baltimore Marriot 8:30am**

Saturday, 24 April 2009

Virginia Department of Game and Inland Fisheries Aquatic Wildlife Conservation Center – **Depart General Lewis Inn (Lewisburg, WV) 8:30am**

Sunday, 25 April 2009

Virginia Tech Freshwater Mollusk Conservation Center – **Tour 9am - 11:30 am; Depart for Baltimore 1pm**

International Symposium of the Freshwater Mollusk Conservation Society

Plenary Session Schedule

8:00 am – 8:30 am : Introductions (Dr. Catherine Gatenby, Symposium Chair and Dr. James G. Geiger, Assistant Regional Director for Fisheries, USFWS)

8:30 am – 9:15 am : Bryan Arroyo, Assistant Director for Endangered Species, USFWS

9:15 am – 10:00 am : "Conservation and Management of Freshwaters in a Changing World" (Robin Abell, Senior Freshwater Conservation Biologist Conservation Science Program, World Wildlife Fund)

10:00 am – 10:20 am : Break

10:20 am – 11:05 am : TBA

11:05 am – 11:50 am : "Healthy Bivalves = Healthy Watersheds: Rebuilding Bivalve Biodiversity, Populations and Ecosystem Services as a Basis of Ecosystem Restoration" (Dr. Danielle Kreeger, Science Coordinator for the Partnership for the Delaware Estuary and Associate Professor, Drexel University)

Plenary Session Biographies

Dr. James G. Geiger (Jaime)

Dr. James G. Geiger was appointed Assistant Regional Director- Fisheries for the Northeast Region, U.S. Fish and Wildlife Service in Hadley, Massachusetts in November, 2000. Jaime provides management leadership for programs, issues, and policies relative to the protection of fish and wildlife resources throughout the Region with emphasis on recovery, restoration, and management of interjurisdictional fish species and their related habitats.

Bryan Arroyo

Bryan Arroyo is the Assistant Director for the Endangered Species Program, having previously held the position of Deputy Assistant Director. Previously, he was the Assistant Regional Director for Ecological Services in the Southwest Region since December 1998. As Assistant Regional Director, Bryan led regionwide implementation of the Endangered Species Act, Environmental Contaminants, Federal Activities, Habitat Conservation, Partners for Fish and Wildlife, and the Coastal Program

Robin Abell

Robin Abell is a conservation biologist and directs the freshwater science group in WWF's Conservation Science Program. She specializes in developing approaches for broad-scale conservation planning to protect freshwater biodiversity. Her first major project with WWF was a conservation assessment of North America's freshwater ecoregions, and she is the lead coordinator for Freshwater Ecoregions of the World. She has also helped to develop ecoregion-based conservation strategies for a number of high-priority ecoregions, including the Amazon/Guianas and Mekong. Her research interests include the use of protected areas to conserve freshwater systems, and she is an active member of the World Commission on Protected Areas' new Freshwater Taskforce.

Dr. Danielle Kreeger

Dr. Danielle Kreeger Science Coordinator for the Partnership for the Delaware Estuary and Associate Professor, Drexel University is an ecologist with more than 25 years of experience working as a research scientist and educator. She currently serves as science director for the Partnership for the Delaware Estuary, where she represents the National Estuary Program's scientific interests by leading and participating in collaborative science and technical teams that address the goals set forth by the organization's Comprehensive Conservation Management Program. Her other responsibilities include organizing a biennial Delaware Estuary Science Conference and charting science, management and restoration needs in the Estuary. In addition to her work for the Partnership, she maintains appointments as associate research professor at Drexel University and senior research scientist with the Academy of Natural Sciences.

Plenary Session Abstracts

CONSERVATION AND MANAGEMENT OF FRESHWATERS IN A CHANGING WORLD. Robin Abell, World Wildlife Fund - United States, 1250 24th St. NW, Washington, DC 20037.

Inland water systems and species are on average around the world more imperilled than their terrestrial and marine counterparts. The future will likely see an expansion of water infrastructure development, land cover conversion, invasive species, and unsustainable resource use, among other threats, as human populations grow and communities respond to climate change-induced alterations to water resources. Effectively conserving and managing inland water biodiversity and the ecological functions that underpin essential ecosystem services will require more than maintaining the conservation status quo.

Conservation and management strategies must acknowledge both the ever more globalized nature of threats to inland water systems, often from distant markets, and the need to apply local solutions. A subset of emerging conservation strategies seeks to transform markets by working with multinational corporations to improve the production practices of the inputs they source. Other more local strategies are increasingly scaled to the threats they are attempting to address. Managers are now moving from restoring individual riffles to evaluating how best to address catchment impacts through a range of complementary approaches, including but not limited to non-traditional applications of protected areas, implementation of environmental flows, and payment for ecosystem services, all within the context of integrated river basin management. These strategies and others will need to be designed against the backdrop of climate change, which may create strong incentives for new infrastructure to reduce water-related risk but may also provide openings for more integrated water resource planning and management.

None of these strategies is a silver bullet for inland water systems, and the efficacy of most has yet to be rigorously evaluated. Undertaking evidence-based conservation will help to clarify which strategies work and in what circumstances, and will provide exciting research opportunities for a new generation of scientists and practitioners.

HEALTHY BIVALVES = HEALTHY WATERSHEDS: REBUILDING BIVALVE BIODIVERSITY, POPULATIONS AND ECOSYSTEM SERVICES AS A BASIS OF ECOSYSTEM RESTORATION. Danielle A. Kreeger; Partnership for the Delaware Estuary, One Riverwalk Plaza, Suite 202, 110 S. Poplar Street, Wilmington, DE 19801; and Robert D. Brumbaugh; The Nature Conservancy, Global Marine Team, PO Box 420237, Summerland Key, FL 33042.

The decline of bivalve biodiversity, abundance, and their attendant ecosystem services signifies a drop in environmental integrity at both local and watershed scales. Freshwater mussels and marine bivalves are often the dominant functional component in aquatic food webs from the headwaters to the coast, improving water quality, enriching sediments, and adding habitat complexity. For example, in the Delaware Estuary, estimated summertime water processing rates by eastern oysters (~10 billion L/h), a freshwater mussel species (~10 billion L/h), and an estuarine mussel (~60 billion L/h) suggests that populations of all three species furnish an important service across the entire freshwater-estuarine gradient. Unfortunately, all three bivalves from headwaters to the ocean are severely threatened by a host of anthropogenic factors.

Integrating the full diversity of native bivalves in conservation and restoration efforts could potentially provide new opportunities to improve the health of coastal watersheds, especially considering the connectivity between tidal and non-tidal areas. For example, revitalization of native mussels in rivers may improve water quality downstream, thereby benefiting estuarine species. In turn, reef-building oysters can furnish estuarine habitat for diadromous fish that, when upstream, serve as hosts for glochidia of freshwater mussels.

As we move toward ecosystem-based approaches to conserving, managing, and restoring aquatic resources, bivalve shellfish arguably represent the best taxonomic group to target for integrating these efforts because they live throughout non-tidal and tidal waters, occupy diverse niches, and can dominate the structural and functional ecology. One means to bridge the divide between freshwater and marine sectors may be to frame conservation and restoration targets based on ecosystem goods and services. A "natural capital" approach offers a common language and quantifiable currencies to promote the health of all native bivalve assemblages, and thereby the health of whole watersheds.

International Symposium of the Freshwater Mollusk Conservation Society

Platform Sessions

Platform Session 1A: Status of Mollusks on Tribal Lands		Platform Session 1B: Evolution and Systematics I	
Monday (04/20) 1:00-3:00 pm - Harborside Ballroom A		**Monday (04/20) 1:00-3:00 pm - Harborside Ballroom B**	
Moderator: Joyce Barkley, Virginia Tech University, Blacksburg, VA		*Moderator: Kevin Cummings, Illinois Natural History Survey, Champaign, IL*	
PL 01 1:00-1:20	**THE HISTORICAL AND CULTURAL IMPORTANCE OF FRESHWATER MUSSELS TO THE MEMBERS OF THE CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION (CTUIR), NORTHEASTERN OREGON.** D. A. Nez, C. A. O'Brien, and J. BrimBox	**PL 07 1:00-1:20**	**THERE ARE ABOUT 300 SPECIES OF FRESHWATER MUSSELS IN NORTH AMERICA. IS THAT A LOT?** D. L. Graf and K.S. Cummings
PL 02 1:20-1:40	**OVERVIEW OF THE RESEARCH EFFORTS ON CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION (CTUIR) TREATY LAND, NORTHEASTERN OREGON.** C. A. O'Brien, J. BrimBox, K. Mock, D. Nez, D. Wolf, T. Kasahara, and D. Kreeger	**PL 08* 1:20-1:40**	**INTRASPECIFIC ECOPHENOTYPIC TRENDS IN FRESHWATER MUSSELS (UNIONOIDA).** A. Zieritz and D.C. Aldridge
PL 03* 1:40-2:00	**INFLUENCES OF FRESHWATER MUSSELS ON IROQUOIS CULTURE AND TRADITIONS.** J. L. Barkley	**PL 09 1:40-2:00**	**CONSERVATION GENETICS OF THE FEDERALLY THREATENED LOUISIANA PEARLSHELL MUSSEL (MARGARITIFERA HEMBELI).** K. J. Roe
PL 04 2:00-2:20	**FRESHWATER MUSSEL PRESENCE AND ROLE ON DECISION MAKING PROCESS FOR FEDERAL, STATE, AND TRIBAL AGENCIES ON THE GRASSE RIVER SUPERFUND SITE, MASSENA, NY.** J. L. Jock	**PL 10 2:00-2:20**	**PHYLOGENY AND DISTRIBUTION OF THE NORTH AMERICAN *ALASMIDONTA* (BIVALVIA: UNIONIDAE).** A. E. Bogan, M.E. Raley, Y. Huang, T.L. King and J.F. Levine
PL 05 2:20-2:40	**FRESHWATER MUSSELS IN THE KLAMATH RIVER - A KARUK TRIBAL PERSPECTIVE.** R. Reed	**PL 11* 2:20-2:40**	**PHYLOGEOGRAPHY OF THE ROUND PEARLSHELL, *GLEBULA ROTUNDATA* (Lamarck, 1819) (BIVALVIA:UNIONIDAE).** N. A. Johnson, J.D.Williams, and J.D.Austin
PL 06 2:40-3:00	**ABUNDANCE, DIVERSITY AND DISTRIBUTION OF FRESHWATER MUSSELS IN TWO NORTHERN CALIFORNIA RIVERS WITHIN KARUK ANCESTRAL TERRITORY.** E. A. Davis, A. T. David. R. Reed and K. M. Norgaard	**PL 12* 2:40-3:00**	**MOLECULAR PHYLOGENETIC AND GEOMETRIC MORPHOMETRICS ANALYSES ON *OBOVARIA JACKSONIANA* (FIRERSON, 1912) AND *VILLOSA ARKANSASENSIS* (LEA, 1862) (BIVALVIA: UNIONIDAE).** K. Inoue, J.L. Harris, D.M. Hayes, and A.D. Christian

*** Student Presentation**

Platform Session 2A: Systems and Community Ecology I		Platform Session 2B: Pearls	
Monday (04/20) 3:20-5:20 pm - Harborside Ballroom A		**Monday (04/20) 3:20-5:20 pm - Harborside Ballroom B**	
Moderator: Kenneth M. Brown, Louisiana State University, Baton Rouge, LA		*Moderator: Dan Hua, Virginia Tech, Blacksburg, VA*	
PL 13 3:20-3:40	**POPULATION ASSESSMENT AND POTENTIAL FUNCTIONAL ROLES OF NATIVE MUSSELS IN THE UPPER MISSISSIPPI RIVER.** T. Newton, J. Rogala, S. Zigler, B. Gray, M. Davis, H. Dunn and J. Kern	**PL 19* 3:20-3:40**	**OVERVIEW OF FRESHWATER PEARL PRODUCTION AND STATUS BY THE VARIOUS MUSSEL SPECIES IN THE WORLD.** D. Hua
PL 14 3:40-4:00	**LANDSCAPE LEVEL FACTORS SUCCESSFULLY PREDICT THE DIVERSITY, ABUNDANCE AND DISTRIBUTION OF MUSSELS IN LOUISIANA RIVERS.** K. M. Brown, R. Bambarger, M. Kaller, and W. Daniel	**PL 20* 3:40-4:00**	**OVERVIEW OF FRESHWATER PEARL PRODUCTION IN CHINA.** H. B. Wen, D. Hua, R.B. Gu, G.C. Xu, P. Xu, and P. Ge
PL 15* 4:00-4:20	**THE ROLE OF FISH HOSTS, LOCAL AND LANDSCAPE FACTORS IN DETERMINING UNIONID ABUNDANCE, DIVERSITY AND COMMUNITY COMPOSITION IN LOUISIANA COASTAL PLAIN RIVERS.** W. M. Daniel, K. M. Brown, W. Kelso, and R. Bambarger	**PL 21 4:00-4:20**	**GENETIC VARIABILITY IN FOUR WILD AND TWO FARMED STOCKS OF THE CHINESE FRESHWATER PEARL MUSSEL (HYRIOPSIS CUMINGII) ESTIMATED BY MICROSATELLITE DNA MARKERS.** J. L. Li, G. L. Wang, and Z. Y. Bai
PL 16 4:20-4:40	**ESTIMATING POPULATION SIZE AND ECOLOGICAL IMPACT OF FRESHWATER MUSSELS IN THE UPPER DELAWARE RIVER.** W. A. Lellis, J. C. Cole, B.S.J. White, D. R. Smith, D. A. Kreeger, and C. A. Campbell	**PL 22 4:20-4:40**	**EMBRYONIC DEVELOPMENT OF LAMPROTULA LEAI AND ITS POTENTIAL PEARL CULTURE STUDY.** G. F. Zhang, S. J. Xu, and A. P. Fang
PL 17 4:40-5:00	**ASSESSING THE IMPORTANCE OF AMERICAN EEL (*ANGUILLA ROSTRATA*) TO FRESHWATER MUSSELS POPULATIONS IN THE SUSQUEHANNA RIVER.** J. Devers, J. Cole, B.S.J. White, S. Minkkinen, and W. Lellis	**PL 23 4:40-5:00**	**OPEN**
PL 18* 5:00-5:20	**PREDICTING THE UNSEEN: ESTIMATING MUSSEL SPECIES RICHNESS IN THE UPPER GREEN RIVER.** J. S. Helton and J. B. Layzer	**PL 24 5:00-5:20**	**OPEN**

*** Student Presentation**

Platform Session 3A: Systems and Community Ecology II		Platform Session 3B: Physiology, Life History and Population Ecology I	
Tuesday (04/21) 8:00-9:40 am - Harborside Ballroom A		**Tuesday (04/21) 8:00-9:40 am - Harborside Ballroom B**	
Moderator: Caryn Vaughn, University of Oklahoma, Norman, OK		*Moderator: Tony Brady, U. S. Fish and Wildlife Service, Genoa, WI*	
PL 25 8:00-8:20	**INTERACTIVE EFFECTS OF MUSSEL COMMUNITIES AND ENVIRONMENTAL CONDITIONS ON PRIMARY PRODUCTION IN RECIRCULATING MESOCOSMS.** C. C. Vaughn, D. E. Spooner, H. S. Galbraith, and D. C. Allen	**PL 30 8:00-8:20**	**POPULATION VIABILITY ANALYSIS FOR THE ENDANGERED FAT THREERIDGE MUSSEL (*AMBLEMA NEISLERII*).** K. J. Herrington, P. S. Miller, J. Ziewitz, and S. C. Pursifull
PL 26* 8:20-8:40	**EFFECTS OF SHEAR STRESS ON DISPERSAL OF JUVENILE MUSSELS (AMBLEMA PLICATA) IN THE UPPER MISSISSIPPI RIVER.** J. A. Daraio, L. J. Weber, and T. J. Newton	**PL 31 8:20-8:40**	**INFLUENCE OF ENVIRONMENTAL FACTORS ON REPRODUCTION OF TWO SYMPATRIC SPECIES OF ANODONTITES (MYCETOPODIDAE: UNIONOIDA) IN THE CENTER OF SOUTH AMERICA.** C. T. Callil
PL 27* 8:40-9:00	**MUSSEL DIVERSITY DESTABILIZES SUBSTRATES AT HIGH FLOWS.** D. C. Allen and C. C. Vaughn	**PL 32* 8:40-9:00**	**ANALYZING VARIATION OF METAMORPHOSIS SUCCESS.** A. K. Crownhart, M. J. Pillow, J. Miao, and M. C. Barnhart
PL 28 9:00-9:20	**A MUSSEL SURVEY AND TRANSLOCATION IN THE IOWA RIVER, IOWA CITY, IOWA, SEPTEMBER 2006 AND 2007.** M. E. Havlik	**PL 33 9:00-9:20**	**IDENTIFICATION OF ECOLOGICALLY RELEVANT FISH HOSTS FOR POPENAIAS POPEII.** T. D. Levine, B. K. Lang, and D. J. Berg
PL 29* 9:20-9:40	**ASSESSMENT OF THE SHORT AND MODERATE TERM EFFECTS OF RELOCATION ON THE FITNESS AND BEHAVIOR OF POTAMILUS CAPAX (GREEN 1832) AND QUADRULA QUADRULA (RAFINESQUE, 1820).** A. J. Peck, J. L. Harris, J. L. Farris, AND A. D. Christian	**PL 34 9:20-9:40**	**BUILDING A MUSSEL PRODUCTION PROGRAM FROM SCRATCH – THE SHEEPNOSE STORY.** T. R. Brady, M. Hove, B.E. Sietman

*** Student Presentation**

Platform Session 4A: Conservation of Margaritiferidae I		Platform Session 4B: Physiology, Life History and Population Ecology II	
Tuesday (04/21) 10:00 am-12:00 pm - Harborside Ballroom A		**Tuesday (04/21) 10:00am-12:00 pm – Harborside Ballroom B**	
Moderator: Jurgen Geist, Technische Universität München-Weihenstephan, Germany		*Moderator: Bill Henley, Virginia Tech, Blacksburg VA*	
PL 35 10:00-10:20	**INTEGRATION OF ECOLOGICAL AND MOLECULAR TOOLS FOR EFFECTIVE CONSERVATION OF FRESHWATER MOLLUSKS: THE EXAMPLE OF EUROPEAN FRESHWATER PEARL MUSSELS (*MARGARITIFERA MARGARITIFERA L.*).** J. P. Geist	**PL 41 10:00-10:20**	**CALCIUM MOVEMENTS ON THE SHELL FORMATION IN *ANODONTA CYGNEA*: AN OVERVIEW.** J. Machado and M. Lima
PL 36 10:20-10:40	**A PEARLMUSSEL'S *(MARGARITIFERA AURICULARIA*) VIEW OF ECOSYSTEM DYNAMICS – FROM SINGLE SHOAL TO WHOLE DRAINAGE, THROUGH PEOPLE AND OTHER ALIENS.** C. R. Altaba	**PL 42 10:20-10:40**	**HEALTH AND STRESS ASSESSMENT IN FRESHWATER MUSSELS FOLLOWING TRANSLOCATION TO A CAPTIVE SETTING.** B. A. Wolfe, M. J. Burkhard, S. Leavell, R. B. Weiss, K. Kuehnl, H. Valentine, and G. T. Watters
PL 37 10:40-11:00	**A CATCHMENT MANAGEMENT APPROACH TO THE CONSERVATION AND RESTORATION OF PROTECTED MARGARITIFERA MARGARITIFERA POPULATIONS IN THE REPUBLIC OF IRELAND.** E. A. Moorkens	**PL 43 10:40-11:00**	**CLEARANCE RATE AS A NON-LETHAL MEASURE OF CONDITION IN FRESHWATER MUSSELS HELD AT DIFFERENT STOCKING DENSITIES.** M. A. Patterson, C. M. Gatenby, R. A. Mair, and J. L. Devers
PL 38 11:00-11:20	**CONSERVATION AND RESTORATION OF A FRESHWATER PEARL MUSSEL (MARGARITIFERA MARGARITIFERA) POPULATION IN NORTHERN ENGLAND.** I. A. Killeen	**PL 44 11:00-11:20**	**NON-LETHAL ESTIMATION OF PHSYIOLOGICALLY ACTIVE SOFT-TISSUE MASS IN FRESHWATER MUSSELS USING SHELL MORPHOMETRICS.** J. J. Kovatch, D. M. Sovic, and T. G. Jones
PL 39 11:20-11:40	**IMPACT OF TURBIDITY AND SEDIMENTATION ON RECRUITMENT, GROWTH AND HOST FISH OF *MARGARITIFERA MARGARITIFERA*.** M. Osterling	**PL 45 11:20-11:40**	**HISTOLOGICAL EVALUATIONS OF ORGAN TISSUES FROM UNIONID MUSSELS.** W. F. Henley and R. J. Neves
PL 40* 11:40-12:00	**FRESHWATER MUSSELS (BIVALVIA: UNIONOIDA) OF THE UPPER KENNEBECASIS RIVER, NEW BRUNSWICK, CANADA WITH EMPHASIS ON *MARGARITIFERA MARGARITIFERA*.** M. C. Sollows and K. R. Munkittrick	**PL 46 11:40-12:00**	**EFFECTS OF COAL MINING DISCHARGES ON JUVENILE MUSSELS AND COMMONLY TESTED ORGANISMS.** N. Wang, C. Ingersoll, J. Kunz, C. Ivey, W. Brumbaugh, C. Kane, S. Alexander, B. Evans, R. Neves, D. Hua, C. Walker, J. Jones, R. Mair, N. Eckert, and S. Bakaletz

*** Student Presentation**

Platform Session 5A: Conservation of Margaritiferidae II		Platform Session 5B: Water Quality and Ecotoxicology II	
Tuesday (04/21) 1:00-3:00 pm - Harborside Ballroom A		**Tuesday (04/21) 1:00-3:00 pm - Harborside Ballroom B**	
Moderator: Cristian R. Altaba, University of the Balearic Islands, Spain		*Moderator: W. Greg Cope, North Carolina State University, Raleigh, NC*	
PL 47* 1:00-1:20	**DEVELOPING PROTOCOLS FOR INTRODUCTIONS OF CAPTIVE-BRED MARGARITIFERA MARGARITIFERA (L.) INTO THE WILD.** C. D. Wilson, D. Roberts, S. J. Preston, J. Provan and A. Keys	**PL 53 1:00-1:20**	**DEVELOPMENT AND APPLICATION OF METHODS FOR CONDUCTING WHOLE-SEDIMENT TOXICITY TESTS WITH JUVENILE FRESHWATER MUSSELS.** C. Ingersoll, J. Besser, W. Brumbaugh, N. Kemble, J. Kunz, N. Wang
PL 48 1:20-1:40	**CONSERVATION AND PROPAGATION OF THE FRESHWATER PEARL MUSSEL (MARGARITIFERA MARGARITIFERA L.) IN THE LUXEMBOURG ARDENNES (EUROPE).** F. Thielen, L. Masura, M. Molitor, A. Arendt, S. Terren, G. Motte, H. Selheim and S. Miseré	**PL 54 1:20-1:40**	**A CONTINUED IMPACT TO FRESHWATER MUSSEL POPULATIONS, INCLUDING THE FEDERALLY ENDANGERED CAROLINA HEELSPLITTER (LASMIGONA DECORATA), IN THE LYNCHES RIVER IN SOUTH CAROLINA FOLLOWING CONTAMINATION FROM GOLDMINE OPERATIONS.** T. W. Savidge and T. E. Dickinson
PL 49 1:40-2:00	**CAPTIVE BREEDING AND JUVENILE CULTURE OF THE FRESHWATER PEARL MUSSEL(*MAGARITIFERA MAGARITIFERA*) IN WALES, UK. RESTORATION OF A CRITICALLY ENDANGERED SPECIES.** J.V. Taylor and K. J. Scriven	**PL 55* 1:40-2:00**	**ACUTE TOXICITY OF COPPER AND AMMONIA TO GLOCHIDIA OF TWO MUSSEL SPECIES INSIDE AND OUTSIDE OF CONGLUTINATES.** M. J. Pillow, A. K. Crownhart, R. L. Bronde1, M. C. Barnhart, and N. Wang
PL 50 2:00-2:20	**A KEYSTONE INTERACTION OF EUROPEAN RIVERS: FISH HOSTS OF THE GIANT PEARLMUSSEL MARGARITIFERA AURICULARIA, A REVIEW.** M. A. López, E. Gisbert, and C. R. Altaba	**PL 56* 2:00-2:20**	**BEATING THE HEAT: UPPER THERMAL TOLERANCES OF THE EARLY LIFE STAGES OF FRESHWATER MUSSELS.** T. J. Pandolfo , W. G. Cope, R. B. Bringolf, M. C. Barnhart
PL 51 2:20-2:40	***MARGARITIFERA MARGARITIFERA* RESTOCKING ACTIVITIES IN SAXONY/GERMANY.** M. J. Lange	**PL 57* 2:20-2:40**	**BIOACCUMULATION OF PLATINUM GROUP METALS IN THE FRESHWATER MUSSEL ELLIPTIO COMPLANATA.** J. W. Mays, W. G. Cope, T. J. Kwak, and D. Shea
PL 52 2:40-3:00	**SUCCESSFUL SPECIES PROTECTION MEASURES FOR THE FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA L.*) IN LOWER SAXONY, IN THE NORTH OF GERMANY.** R. Altmuller	**PL 58* 2:40-3:00**	**NA+,K+-ATPASE ACTIVITY AS A BIOMARKER OF LEAD EXPOSURE IN FRESHWATER MUSSELS.** S. Mosher and W. G. Cope

*** Student Presentation**

Platform Session 6A: Status, Distribution and Sampling I		Platform Session 6B: Advances in Propagation I	
Tuesday (04/21) 3:20-5:20 pm - Harborside Ballroom A		**Tuesday (04/21) 3:20-5:20 pm - Harborside Ballroom B**	
Moderator: Dr. Gerrie Mackie, University of Guelph, Guelph, ON		*Moderator: Tom Watters, Ohio State University, Columbus, OH*	
PL 59 3:20-3:40	**STRATEGIES FOR CONSERVING AND PROTECTING MOLLUSK SPECIES AT RISK AND THEIR HABITATS IN ONTARIO, CANADA.** G. L. Mackie	**PL 65* 3:20-3:40**	**DEVLOPEMENT OF A SUITABLE DIET FOR ENDANGERED JUVENILE OYSTER MUSSELS, EPIOBLASMA CAPSAEFORMIS (BIVALVIA:UNIONIDAE), REARED IN A CAPTIVE ENVIRONMENT.** M. E. Vincie, R. J. Neves, C. M. Gatenby, S. R. Craig, E. McLean
PL 60* 3:40-4:00	**RICHNESS AND CONSERVATION STATUS OF ARKANSAS FRESHWATER GASTROPODS.** M. Hayes, A. D. Christian, W. R. Posey II, and R. L. Minton	**PL 66 3:40-4:00**	**A SUITABLE DIET, FEED CONCENTRATION, AND CULTURE SYSTEM FOR REARING JUVENILE NORTHERN RIFFLESHELL, EPIOBLASMA TORULOSA RANGIANA.** R. A. Mair, C. M. Gatenby, and R. J. Neves
PL 61* 4:00-4:20	**UNIONID MUSSELS AS BY-CATCH IN LARGE RIVER BENTHIC TRAWLS.** S. P. Reese, S. Collins, M. Kinsey, C. Swecker, and T. G. Jones	**PL 67* 4:00-4:20**	**PROPAGATION AND GROW-OUT OF LARGE-SIZED JUVENILES FOR RELEASE, AND ASSESSMENT OF RESTORATION IN THEIR NATAL RIVERS.** D. Hua, Y. Jiao, R. J. Neves and N. King
PL 62* 4:20-4:40	**PREDICTIVE MODELING OF FRESHWATER MUSSEL SPECIES ELLIPTIO DILATATA AND ELLIPTIO COMPLANATA IN THE APPALACHIANS.** A. R. Mynsberge, J. M. Strager, M. P. Strager, and P. M. Mazik	**PL 68* 4:20-4:40**	**DEXAMETHASONE TREATMENT OF NON-HOST FISH TO INDUCE TRANSFORMTATION OF JUVENILE MUSSELS.** J. A. Johnson, J. Wisniewski, and R.B. Bringolf
PL 63 4:40-5:00	**SURVEY OF THE MUSSELS OF THE MONONGAHELA RIVER IN PENNSYLVANIA.** S. Collins, M. Kinsey, S. Reese, and T. Jones	**PL 69* 4:40-5:00**	**INVESTIGATIONS IN THE IN VITRO METAMORPHOSIS OF FRESHWATER MUSSELS.** C. Owen, J. Alexander, and M. McGregor
PL 64* 5:00-5:20	**RANGE EXTENTION OF ANODONTA SUBORBICULATA TO INCLUDE POPULATIONS WITHIN WEST VIRGINIA.** M. E. Kinsey, S. Collins, S. Reese, and R. Talyor	**PL 70 5:00-5:20**	**RECOVERING THE RIFFLESHELL: THE PROPAGATION AND TRANSLOCATION OF A FEDERALLY ENDANGERED FRESHWATER MUSSEL TO OHIO.** G.T. Watters, T. Gibson, C.B. Kelly, K. Kuehnl, M. Kibbey, K. Harraman, J. Cramer and H. Albin

*** Student Presentation**

Platform Session 7A: Systems and Community Ecology III		Platform Session 7B: Physiology, Life History and Population Ecology III	
Wednesday (04/22) 8:00-9:40 am - Harborside Ballroom A		**Wednesday (04/22) 8:00-9:40 am - Harborside Ballroom B**	
Moderator: William A. Lellis, U. S. Geological Survey, Wellsboro, PA		*Moderator: Wendell Haag, U. S. Forest Service, Oxford, MS*	
PL 71 8:00-8:20	**FRESHWATER MUSSEL STUDIES IN THE NAVIGATIONAL POOLS OF THE ALLEGHENY RIVER, PENNSYLVANIA.** T. A. Smith and E. S. Meyer	**PL 76 8:00-8:20**	**CHARACTERIZING IN-STREAM HABITAT OF DWARF WEDGEMUSSEL IN THE DELAWARE RIVER WATERSHED.** J. C. Cole and W.A. Lellis
PL 72 8:20-8:40	**GASTROPODS IN TIGUA RIVER, SAN FERNANDO, BUKIDNON, PHILIPPINES.** G. Galan and M. Pepito	**PL 77 8:20-8:40**	**DETERMINING TENNESSEE HEELSPLITTER (LASMIGONA HOLSTONIA) PRESENCE/ABSENCE THROUGH PREDICTIVE MODELING.** B.T. Watson and K.J. Ryan
PL 73 8:40-9:00	**TESTING HABITAT SUITABILITY MODELS WITH MUSSEL TRANSLOCATIONS.** B. J. K. Ostby and R. J. Neves	**PL 78 8:40-9:00**	**SEASONAL POPULATION DYNAMICS OF LAMPSILIS FASCIOLA IN TWO SOUTHERN ONTARIO RIVERS.** T. J. Morris
PL 74 9:00-9:20	**GROWTH OF CAGED RAINBOW MUSSELS IN TWO UPPER TENNESSEE RIVER BASIN STREAMS DRAINING DIFFERENT LAND USES.** B. Evans, C. Kane, N. Eckert, A. Wood, D. Garst, and R. Mair	**PL 79 9:00-9:20**	**AGE, GROWTH, AND POPULATION DEMOGRAPHY OF THREE FRESHWATER MUSSEL SPECIES (BIVALVIA: UNIONIDAE) IN THE CLINCH RIVER, TN, U.S.A.** J. W. Jones and R. J. Neves
PL 75 9:20-9:40	**WHAT CAN BIOCHRONOLOGY OF MUSSEL SHELL RINGS REVEAL ABOUT HEALTHY MOLLUSKS AND HEALTHY RIVERS?** A. L. Rypel, W. R. Haag	**PL 80 9:20-9:40**	**LONG-TERM PATTERNS OF RECRUITMENT IN FRESHWATER MUSSEL POPULATIONS.** W. R. Haag and M. L. Warren, Jr.

*** Student Presentation**

Platform Session 8A: Habitat and Community Restoration		Platform Session 8B: Evolution and Systematics II	
Wednesday (04/22) 10:00 am-12:00 pm - Harborside Ballroom A		**Wednesday (04/22) 10:00am-12:00 pm - Harborside Ballroom B**	
Moderator: Monte McGregor, KY Dept. Fish and Wildlife Resources, Frankfort, KY		*Moderator: Daniel Graf, University of Alabama, Tuscaloosa, AL*	
PL 81 10:00-10:20	**ESTABLISHMENT OF THE CLINCH POWELL CLEAN RIVERS INITIATIVE.** B. Beaty	**PL 87 10:00-10:20**	**HISTORICAL DEMOGRAPHY AND GENE FLOW OF THREE FRESHWATER MUSSEL SPECIES (BIVALVIA: UNIONIDAE) IN THE CLINCH RIVER, TN, U.S.A.: GENETIC EVIDENCE FOR POPULATION EXPANSION AND CONTRACTION DURING THE HOLOCENE.** J. W. Jones, R. J. Neves and E. M. Hallerman
PL 82 10:20-10:40	**DEVELOPING A MODEL FOR ASSESSING THE SUITABILITY OF POTENTIAL SITES FOR THE RESTORATION OF FRESHWATER PEARL MUSSEL POPULATIONS.** L. Hastie	**PL 88 10:20-10:40**	**SPECIES RICHNESS AND CONSERVATION STATUS OF ARKANSAS' UNIONOID BIVALVES.** J. L. Harris, W. R. Hoeh, W. R. Posey II, C. L. Davidson, S. Rogers Oetker, J. L. Farris, J. M. Serb, K. Inoue, D. L. Hayes, M. E. Gordon, and A. D. Christian
PL 83 10:40-11:00	**DO SMALL DAMS ENHANCE FRESHWATER MOLLUSK HABITATS?** M. M. Gangloff	**PL 89 10:40-11:00**	***PHYSA NATRICINA* AND TAXONOMY IN THE FRESHWATER SNAIL FAMILY PHYSIDAE.** J. B. Burch, J. Keebaugh and T. Lee
PL 84 11:00-11:20	**EVALUATION OF A FISH LADDER'S CONSERVATION BENEFIT TO MUSSELS IN THE BROAD AND CONGAREE RIVERS, SOUTH CAROLINA, USA.** J. E. Price, C. B. Eads, M. E. Raley	**PL 90 11:00-11:20**	**PHYLOGEOGRAPHY OF ELLIPTIO COMPLANATA ALONG A PORTION OF THE ATLANTIC SLOPE.** C. L. Elderkin
PL 85 11:20-11:40	**A TEXAS TREASURE: NATIVE AQUATIC PLANT RESTORATION IN A SPRING-FED RIVER.** S. E. Seagraves, M. Mullins, M. Alexander, and R. Doyle	**PL 91 11:20-11:40**	**A NEW SPECIES OF FRESHWATER MUSSEL, GENUS ANODONTA (BIVALVIA: UNIONIDAE), FROM THE COASTAL PLAIN DRAINAGES OF ALABAMA, FLORIDA, AND MISSISSIPPI, USA.** J. D. Williams, A. E. Bogan and J. T. Garner
PL 86 11:40-12:00	**RESTORATION OF FOUR RARE AND ENDANGERED MUSSELS IN THE BIG SOUTH FORK CUMBERLAND RIVER.** M. A. McGregor, J. J. Culp, A. C. Shepard, F. Vorisek, S. Ahlstedt, S. Bakalytz., and L. Koch	**PL 92 11:40-12:00**	**PHYLOGENETIC ANALYSES AND CLASSIFICATION: PROBLEMS IN PARADISE.** A. E. Bogan J. L. Harris, J. D. Williams, and W. R. Hoeh

*** Student Presentation**

Platform Session 9A: Maritime, Roads and Rails: Impacts and Opportunities		Platform Session 9B: Advances in Propagation II	
Wednesday (04/22) 1:40-3:20 pm - Harborside Ballroom A		**Wednesday (04/22) 1:40-3:20 pm - Harborside Ballroom B**	
Moderator: Leroy Koch, U. S. Fish and Wildlife Service, Frankfort, KY		*Moderator: M. Christopher Barnhart, Missouri State University, Springfield, MO*	
PL 93 1:40-2:00	**DAMS AND ZEBRAS: THE HISTORICAL LOSS OF FRESHWATER MUSSELS IN THE OHIO RIVER MAINSTEM.** G T. Watters and C. J. Myers Flaute	**PL 98 1:40-2:00**	**MOLLUSC CULTIVATION AND RECOVERY AT VIRGINIA'S AQUATIC WILDLIFE CONSERVATION CENTER.** N. L. Eckert, J. J. Ferraro, A. E. Wood, J. Orr, and M. J. Pinder
PL 94 2:00-2:20	**EFFECTS OF DAM FAILURE ON UNIONIDS IN WINTER: CLAMSICLES OF 2005.** J. L. Clayton and P. A. Morrison	**PL 99 2:00-2:20**	**SPAWNING, PROPAGATION AND CULTURE OF GREEN RIVER MUSSELS.** K R. Moles and J. B. Layzer
PL 95 2:20-2:40	**SAMPLING MUSSEL COMMUNITY IN CONJUNCTION WITH A LOCK ADDITION AT KENTUCKY LOCK AND DAM: DETECTING COMMUNITY CHANGE.** J.B. Sickel, C. E. Lewis, A.T. Miller, J. E. Peck, and R.N. Tippit	**PL 100 2:20-2:40**	**INSIGHTS ON FRESHWATER BIVALVES "IN VITRO" CULTURE.** J. Machado, P. Lima, Manuel Lopes Lima, U. Kovitvadhic, S. Kovitvadhid
PL 96 2:40-3:00	**NOVEL COST EFFECTIVE TECHNIQUES TO MAP SUBSTRATE AND DEPTH OVER LARGE AREAS.** C. D. Swecker, S. Collins, and T. G. Jones	**PL 101 2:40-3:00**	**FLOATING UPWELLER SYSTEMS FOR POND CULTURE OF FRESHWATER MUSSELS.** C. Barnhart, A. Roberts, S. McMurray, and S. Faiman
PL 97 3:00-3:20	**MITIGATION RULE 2008: OPPORTUNITIES FOR DEVELOPMENT OF A FRESHWATER MUSSEL HABITAT IN-LIEU-FEE PROGRAM.** J. B. Spence	**PL 102 3:00-3:20**	**OPEN**

*** Student Presentation**

Platform Session 10A: Status, Distribution and Sampling II		Platform Session 10B: Physiology, Life History and Population Ecology IV	
Wednesday (04/22) 3:40-5:00 pm - Harborside Ballroom A		**Wednesday (04/22) 3:40-5:00 pm - Harborside Ballroom B**	
Moderator: Heidi Dunn, Ecological Specialists, Inc.		*Moderator: Jess W. Jones, U. S. Fish and Wildlife Service, Blacksburg, VA*	
PL 103 **3:40-4:00**	**THE CHRONICLES OF GASTROPODA: THREE SHORT STORIES ABOUT AQUATIC SNAILS IN ILLINOIS.** J. S. Tiemann and K. S. Cummings	**PL 107** **3:40-4:00**	**DONATION OF HISTORIC FRESHWATER MUSSEL SHELLS TO THE PAUL W. PARMALEE MALACOLGICAL COLLECTION: A RARE EARLY TEACHING COLLECTION?** G. R. Dinkins
PL 104 **4:00-4:20**	**ADDITIONS TO THE KNOWN FINGERNAIL CLAM (SPHAERIIDAE-PISIIDAE) FAUNA OF WEST VIRGINIA WITH ADDITIONAL COMMENTS ON NEW RECORDS OF AQUATIC SNAILS FOR THE STATE.** R. W. Taylor	**PL 108** **4:00-4:20**	**MUSSEL AND MUSSEL-HOST ASSOCIATIONS IN MARYLAND.** C. A. Campbell, R.H. Hilderbrand, and W.A. Lellis
PL 105 **4:20-4:40**	**STATUS AND DISTRIBUTION OF MARYLAND'S FRESHWATER MUSSELS.** J. M. McCann, D. J. Feller, and D. F. Brinker	**PL 109** **4:20-4:40**	**MUSSELS ABOVE THE FALLS.** J. J. Jenkinson
PL 106 **4:40-5:00**	**STATUS EVALUATION OF FOUR MUSSEL SPECIES BY THE FISH AND WILDLIFE SERVICE.** S. R. Oetker, A. Boyer, K. McPeek, R. Butler, and L. Ragan	**PL 110** **4:40-5:00**	**LONG TERM QUALITATIVE MONITORING OF FRESHWATER MUSSELS IN THE CONASAUGA RIVER, MURRAY/WHITFIELD COUNTIES, GEORGIA.** G. R. Dinkins, P. D. Johnson, and S. A. Ahlstedt

*** Student Presentation**

PL 01

THE HISTORICAL AND CULTURAL IMPORTANCE OF FRESHWATER MUSSELS TO THE MEMBERS OF THE CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION (CTUIR), NORTHEASTERN OREGON. Donna A. Nez, Christine O'Brien, and Jayne BrimBox, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fish & Wildlife Programs, PO Box 638, Pendleton, Oregon 97801.

Historically freshwater mussels were an important resource for tribal peoples of the Columbia River Basin. Freshwater mussels were used for multiple purposes, including food and ornamental shell. Although the use of mussels has declined in recent decades, their harvest remains a reserved treaty right for members of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The objectives of this talk are to illustrate the historical use and importance of freshwater mussels to tribal members, discuss the changes in the historical landscape that have occurred on tribal lands, and explain how freshwater mussels fit into the "First Foods" approach that is used to guide natural resource management on tribal lands.

NOTES: _____

PL 07

THERE ARE ABOUT 300 SPECIES OF FRESHWATER MUSSELS IN NORTH AMERICA. IS THAT A LOT? D. L. Graf [1] and K. S. Cummings [2]. [1]University of Alabama, MH Bryant Hall Box 870345, Tuscaloosa, AL 35487. [2]Illinois Natural History Survey, 1816 S. Oak Street, Champaign, IL 61820.

It sure is. We have made an extensive re-evaluation of the secondary literature in order to describe the global diversity of freshwater mussels (Bivalvia: Unionoida). Using the MUSSEL Project Database, we assigned each species to one or more geographical regions (Nearctica, Neotropica, Afrotropica, Palearctica, Indotropica, and Australasia) and subregions, and each genus was assigned to the lowest possible taxonomic rank. Based upon our analysis, there are 842 Recent freshwater mussel species (in six families) worldwide, with 302 (36%) of them (in two families) found in North America. We will discuss the geographical and taxonomic diversity of freshwater mussels and place the North American assemblage into a global context. Our worldwide species checklist is available on the MUSSEL Project Web Site (http://www.mussel-project.net/) under the heading, *Unionoida cum Grano Salis*. This research was funded by grants from the National Science Foundation.

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PL 02

OVERVIEW OF THE RESEARCH EFFORTS ON CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION (CTUIR) TREATY LAND, NORTHEASTERN OREGON. Christine A. O'Brien, Jayne BrimBox, Karen Mock[1], Donna Nez, David Wolf, Tamao Kasahara[2], and Danielle Kreeger[3] Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fish & Wildlife Programs, PO Box 638, Pendleton, Oregon 97801. [1]Utah State University, Wildland Resources Department, 5230 Old Main Hill, Logan, UT 84322. [2]Utah State University, College of Natural Resources, 5210 Old Main Hill, Logan, UT 84322. [3]Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia PA 19103.

Freshwater mussels are culturally important to northwestern Native Americans and are a vital component of intact salmonid ecosystems. The objectives of this talk are to summarize the scientific findings of the first 5 years of research, and discuss some of the outreach and training efforts currently underway. In 2003 the CTUIR began its freshwater mussel project in order to better manage, restore and protect this valuable resource. The approach taken by the CTUIR was multi-pronged, and included distributional surveys, genetic studies, habitat characterizations, relocation trials, reproductive biology studies, and physiological analysis. The freshwater mussel project also began outreach efforts so that other Tribal members better understood the project's work. Most recently, CTUIR project employees have trained other researchers and organizations to conduct freshwater mussel surveys, including members of the Susanville Indian Rancheria in California.

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PL 08*

INTRASPECIFIC ECOPHENOTYPIC TRENDS IN FRESHWATER MUSSELS (UNIONOIDA). A. Zieritz[1] and D.C. Aldridge[1]. [1]Department of Zoology, University of Cambridge, Downing Street, CB2 3EJ Cambridge, UK.

Unionoids show a wide inter- and intraspecific range in their shell morphologies. Understanding which factors drive particular patterns in, for example, shell shapes and the mechanisms involved could help us in various fields of research such as taxonomy, ecology and palaeontology. We assessed morphological variability within three British unionoid species, comparing populations of two habitats (i.e. marinas and main channel) of the River Thames, UK. In *Unio pictorum*, both traditional and modern morphometric techniques consistently separated shell morphotypes from the two habitats. Individuals from the marinas grew faster, larger, more elongated and more pointed dorso-posterior margins than those from the river. Although the other two unionoid species of the study area did not show the same pattern in relative shell elongation, a consistent ecophenotypic trend in the shape of the dorso-posterior margin was present in all three species studied. This implies that the latter shell character might have broader ecological significance which is further supported by Fourier shape analyses on unionoid populations from more than 30 UK water bodies which show the same ecophenotypic pattern in the shape of the dorso-posterior margin. With respect to habitat factor(s), our results indicate that differences in hydrological characters (such as maximum current velocities) of the habitats might be triggering the observed differences in shell forms. Sediment composition was found not to be important. To test if the shell morphotypes observed are adaptations or non-adaptive 'reactions' to the environment, reciprocal transplant experiments were carried out. Results so far indicate that the typical shell forms in their respective habitats might not result in higher fitness levels than transplanted morphotypes and thus, might not be adaptive to the conditions encountered during the experimental period. Finally, preliminary results of an ongoing study assessing the relative role of morphological differences and random genetic drift on population genetics using AFLPs will be presented.

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PL 03*

INFLUENCES OF FRESHWATER MUSSELS ON IROQUOIS CULTURE AND TRADITIONS. Barkley, J. L., Virginia Tech, Department of Fisheries & Wildlife, Blacksburg, VA 24061

The original Iroquois tribes in New York State are; Mohawk, Oneida, Onondaga, Cayuga and Seneca, from east to west respectively. Since the early Iroquois had no writing system of their own, they depended upon the spoken word to pass down their history, traditions, and rituals. As an aid to memory, the Iroquois used shells and shell beads strung on rope or made into belts with specific patterns, with each pattern having a specific story related to it. Freshwater mussel shells were originally used for this purpose but later, with Dutch traders expanding into their area, brought beads (wampum) made from the quahog clam to trade for furs. In addition to using shells for communication and decoration, freshwater mussels were collected as a supplementary food source. In modern times, the Iroquois no longer utilize mussels for food. However, with the decline in mussel populations and increase in water contamination, mussels are being considered for use as bio-indicators to environmental health.

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PL 09

CONSERVATION GENETICS OF THE FEDERALLY THREATENED LOUISIANA PEARLSHELL MUSSEL (MARGARITIFERA HEMBELI). Kevin J. Roe, Department of Natural Resource Ecology and Management, Iowa State University, Ames, IA 50011

Margaritifera hembeli is one of five members of the freshwater mussel family Margaritiferidae in North America and one of three species found in the southeastern U.S. *Margaritifera hembeli* occupies a restricted range and is has been found in only the Red River drainage in the state of Louisiana. Population distribution of *M. hembeli* has been described as patchy, typically large beds of mussels are found in shallow areas in small streams with stable substrate that are separated from other such beds by areas of less stable substrate inhabited by few or no individuals. In addition, extant populations of *M. hembeli* are bisected by the Red River into two separate sub-populations and there is a possibility that these sub-populations, as well as smaller populations within them will exhibit significant genetic differentiation from each other. Information on genetic diversity and degree of genetic connectivity between extant populations is a critical part of developing an effective conservation plan including: developing parameters and priorities for population augmentation or species re-introduction. Prior examination of population variation in *M. hembeli* using allozymes (Curole et al. 2004) found little variation but those authors recommended further investigations using hyper-variable loci such as microsatellites. An on-going survey of *M. hembeli* populations using species-specific microsatellite markers has revealed variation between and among populations. A preliminary analysis of these data will be presented and the implications discussed.

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PL 04

FRESHWATER MUSSEL PRESENCE AND ROLE ON DECISION MAKING PROCESS FOR FEDERAL, STATE, AND TRIBAL AGENCIES ON THE GRASSE RIVER SUPERFUND SITE, MASSENA, NY. J. L. Jock. St. Regis Mohawk Tribe, Environment Division, 412 State Rte. 37, Akwesasne, NY 13655.

Freshwater mussels may play a significant role in the determination of clean-up objectives and remedy decisions in the Lower Grasse River in northern New York. Historical surveys in the 1970's indicate there are 17 known species of mussel fauna in the Grasse River drainage. The Grasse River is significant coastal habitat and a free-flowing river for 29 river miles (until the first impassable dam) draining into the St. Lawrence River. The lower 7 miles are impacted by industrial processes and is currently under review for a near future USEPA Remedy Decision to mitigate for extensive PCB contamination. In addition to the contaminants, a recent Multi-functional Hydrodam proposal is being considered to be constructed upstream of the Superfund site, thus potentially impacting another 8 miles of viable mussel habitat. The St. Regis Mohawks have reserved resource rights to the Grasse River to preserve traditional practices and culture, and have concerns regarding mussel protection on both projects. Qualitative and quantitative mussel surveys have been conducted in 2007 and 2008 for the purposes of the FERC Hydrodam review, and results suggest that healthy populations of mussels are still present. Agency reviewers have more recently become increasingly interested in the mussel fauna abundance, diversity, and depths of bioturbation in the lower Grasse River for project related decisions regarding water quality, habitat alterations, and sediment remedial alternatives. This presentation will provide a brief overview of the status of the FERC and Superfund Projects to date, relative to the significance of freshwater mussels in the Grasse River, and the involvement of a Tribal Agency.

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PL 10

PHYLOGENY AND DISTRIBUTION OF THE NORTH AMERICAN *ALASMIDONTA* (BIVALVIA: UNIONIDAE). A. E. Bogan[1], M. E. Raley[1], Y. Huang[2], T. L. King[3] and J. F. Levine[4]. [1]North Carolina State Museum of Natural Sciences, Research Laboratory, MSC 1626, Raleigh, NC 27699-1626. [2]Division of Primary Oral Health Care, School of Dentistry University of Southern California, Los Angeles, CA 90089-0641. [3]USGS-Leetown Science Center, 11649 Leetown Road, Kearneysville, WV 25430. [4]Aquatic Epidemiology and Conservation Laboratory, College of Veterinary Medicine North Carolina State University, Raleigh, NC 27606.

Alasmidonta currently contains 12 species including 3 species presumed extinct. Six species of *Alasmidonta* occur in North Carolina, including the presumed extinct *Alasmidonta robusta*. Tissue samples from all extant species of *Alasmidonta* were included in a test of the monophyly of the genus. Systematic relationships of the recognized species were examined using mitochondrial DNA sequences from cytochrome oxidase c subunit 1 (COI) and NADH dehydrogenase subunit (ND1). *Alasmidonta* (*Prolasmidonta*) *heterodon* and *Alasmidonta* (*Pressodonta*) *viridis* are recovered as significantly different from other members of the genus, and we recommend the two subgenera be elevated to generic level. *Alasmidonta varicosa* is split into two separate taxa. *Alasmidonta raveneliana* is represented by two separate conservation units corresponding to the French Broad and Little Tennessee River basins. Further work is needed to understand the variation in *A. marginata* between the upper Mississippi River and the Ohio River drainage populations.

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PL 05

FRESHWATER MUSSELS IN THE KLAMATH RIVER – A KARUK TRIBAL PERSPECTIVE. Ron Reed, Karuk Tribe of California, Department of Natural Resources, PO Box 281, Orleans, CA 95556.

The Karuk Tribe of California is the second largest tribe in the state with over 3,400 tribal members. The location of our ancestral homeland stretches from northern California into Oregon along the Klamath River that once produced over one million Chinook salmon annually. Because the Klamath River is fortified by mountains and rough terrain, the Karuk people were not contacted by modern society until the 1850's. It was during this time the Karuk people were disrupted from managing the natural resources that permanently altered a sustainable way of life and interrupted ecological processes and functions in place. Modern management principles differ significantly from the Karuk's holistic management philosophy, which was based on a spiritual relationship with Mother Earth and the belief system that all living creatures are our relations. Freshwater mussels have played a significant role in tribal sustenance, culture and ceremony, however the loss of salmon have until recently overshadowed the condition of mussel populations on the Klamath River. Recent studies have found mussels could be unfit for consumption due to high concentrations of toxic substances, including the blue green algae recently linked to the habitat created by the Klamath River dams. Through the process of cultural revitalization in a modern context, the tribe has discovered the unique role mussels play in the ecology of the river; filtering the water, as a food source, and as a fish parasite dependant upon salmon runs. Current studies of freshwater mussel populations on the Klamath River by the Karuk Tribe will be presented, with cultural uses of freshwater mussels by the tribe, opportunities for restoration of historic mussel populations, and implications for natural resource management.

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PL 11*

PHYLOGEOGRAPHY OF THE ROUND PEARLSHELL, *GLEBULA ROTUNDATA* (Lamarck, 1819) (BIVALVIA:UNIONIDAE). N. A. Johnson[1], J. D.Williams[2], and J. D.Austin[1,3]. [1] University of Florida, Fisheries and Aquatic Sciences, Gainesville, FL 32653., [2]Florida Museum of Natural History, Gainesville, FL 32611. [3]University of Florida, Wildlife Ecology and Conservation, Gainesville, FL 32611.

The genus *Glebula* (Conrad, 1853) is monotypic, restricted to Gulf Coast drainages, and known to occur from the Ocklockonee River in Florida west to the Guadalupe River in eastern Texas. We are investigating the phylogeographic structure of *Glebula rotundata* throughout its range using mitochondrial DNA sequences of two protein-coding genes (*CO1* and *ND1*). Thus far, forty-three individuals from seven major river basins east of the Mississippi River have been sequenced. Maximum sequence divergence of *CO1* and *ND1* haplotypes are 0.72% and 0.89%, respectively. Sequence analyses reveal congruent patterns between individuals for both genes and haplotype sharing between adjacent drainage basins east of the Mississippi. Results will be presented in light of geologic history of the region and several biological features of *G. rotundata*, both of which make it particularly likely that recent gene flow has been important in its evolution.

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PL 06

ABUNDANCE, DIVERSITY AND DISTRIBUTION OF FRESHWATER MUSSELS IN TWO NORTHERN CALIFORNIA RIVERS WITHIN KARUK ANCESTRAL TERRITORY. E. A. Davis, A. T. David. R. Reed and K. M. Norgaard, Karuk Tribe of California, Orleans, CA and Whitman College, Department of Environmental Studies, Walla Walla, WA.

Freshwater mussels are an integral component of freshwater ecosystems. Historically they formed an important part of the diets and material culture of indigenous peoples throughout North America, including the Karuk Tribe of California. In North America, 75% of freshwater mussel species are considered imperiled. Because of their sensitivity to human-induced changes and role as bio-indicators, it is important to advance our understanding of this taxon. This study examines freshwater mussel abundance, diversity, distribution, and habitat preference in the Klamath and Salmon rivers of Northern California. Forty sites on the mid-Klamath and 14 sites on the lower Salmon were snorkel-searched for the presence of mussels; all sites are within Karuk ancestral territory. Historical and contemporary use of mussels by local Karuk tribal members was assessed through interviews. Three mussel genera (*Margaritifera*, *Gonidea*, and *Anodonta*) were found, with *Gonidea* abundant and well-distributed within the Klamath, *Margaritifera* present in low numbers, and *Anodonta* present at a single site. Only *Margaritifera* were found in the Salmon River. Mussels were situated in microhabitats that protected them from strong currents and high flow events. Chi-squared goodness of fit tests showed that mussels are located in sand, gravel and bedrock substrates more often than expected given the substrates' area coverage of sites. Preliminary interviews indicated that mussels remained a significant portion of Karuk traditional diet until the mid-20th century and continue to function as a ceremonial food today.

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PL 12*

MOLECULAR PHYLOGENETIC AND GEOMETRIC MORPHOMETRICS ANALYSES ON *OBOVARIA JACKSONIANA* (FIRERSON, 1912) AND *VILLOSA ARKANSASENSIS* (LEA, 1862) (BIVALVIA: UNIONIDAE). Kentaro Inoue[1], John L. Harris[2], David M. Hayes[1], and Alan D. Christian[1, 2, 3]. [1]Environmental Sciences Graduate Program, Arkansas State University, P.O. Box 847, State University, AR 72467. [2]Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, AR 72467. [3]Department of Biology, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA 02125

The special concern southern hickorynut, *Obovaria jacksoniana*, occurs from the Mississippi Interior Basin to Mobile drainage. Its close congener the Ouachita creekshell, *Villosa arkansasensis*, is often difficult to differentiate from *O. jacksoniana* based on conchological characters. Since both species have been ranked with conservation status, determining genetic divergences of both species are important for conservation. The goal of this study was to determine genetic divergence and morphological similarities between *O. jacksoniana* and *V. arkansasensis*. In order to achieve this goal, we conducted molecular phylogenetic and geometric morphometric analyses. For phylogenetic analyses, we used both mtDNA and nuclear DNA sequences. Seventy specimens of *O. jacksoniana* and 21 specimens of *V. arkansasensis* were collected from the Mississippi and Mobile drainages. We also used other species in genera *Obovaria* and *Villosa* to support evolutionary relationships. For morphometric analysis, we analyzed conchological characteristics of 188 individuals of *O. jacksoniana* and 49 individuals of *V. arkansasensis*. Our resulting phylogenetic analyses did not support monophyletic groupings of both *Obovaria* and *Villosa,* as both *O. jacksoniana* and *V. arkansasensis* occurred within same phylogenetic clade. Nevertheless, our morphometrics results showed that both species have distinct shell morphologies differentiation, however, some specimens showed intermediate shapes, which causes misidentification between species. These results suggest that species we called *V. arkansasensis* may be synonymous species as *O. jacksoniana,* although shell morphologies are distinct via occupying different habitat types.

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PL 13

POPULATION ASSESSMENT AND POTENTIAL FUNCTIONAL ROLES OF NATIVE MUSSELS IN THE UPPER MISSISSIPPI RIVER. T. Newton[1], J. Rogala[1], S. Zigler[1], B. Gray[1], M. Davis[2], H. Dunn[3] and J. Kern[4]. [1]USGS Upper Midwest Environmental Sciences Center, La Crosse, WI. [2]MN Department of Natural Resources, Lake City, MN. [3]Ecological Specialists, O'Fallon, MO. [4]Kern Statistical Services, Sauk Rapids, MN.

Managers in the Upper Mississippi River (UMR) are using reductions in the river's water levels during summer to more closely mimic historical water levels and rehabilitate habitats for vegetation and other desirable species. Concerns for the effects of these actions on mussel populations threatened to halt these multi-million dollar projects. We conducted systematic surveys of mussels in three reaches (each ranging between 2100-4700 ha) of the UMR to estimate the number, spatial distribution, and recruitment of mussels and to identify potential roles of mussels in this ecosystem. We sampled between 281 and 379 sites in each reach; at each site divers obtained two 0.25 m^2 total substrate samples. All live mussels were counted, measured for shell length, and aged. Reach-wide population estimates (95% CL) were 190 (153, 227), 61 (46, 76), and 212 (169, 255) million mussels, at densities of 4.3, 2.9, and 4.5 mussels/m^2. The number of live species in each reach ranged from 16 to 23. We saw evidence of recruitment for a number of species; 40-62% of the reach-wide populations were young mussels < 5 yrs. Spatial patterns varied with reach, but generally, more mussels were encountered in the impounded portion of each reach. Total biomass, estimated from length-mass regressions, ranged from 4.1-6.2 g dry tissue/m^2 and production ranged from 0.4-0.6 g C/m^2/yr. These data suggest that the UMR contains an abundant, diverse, and reproducing mussel community that likely serves important functional roles in this ecosystem.

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PL 19*

OVERVIEW OF FRESHWATER PEARL PRODUCTION AND STATUS BY THE VARIOUS MUSSEL SPECIES IN THE WORLD. D. Hua, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

Freshwater pearl culture technology was noted in China about 2,000 years ago when Swedish naturalist Linnaeus discovered its use in 1761. Commercial freshwater pearl culture initiated in Japan and China, however, only dates back to the late 1960s and early 1970s. Cockscomb mussel C*ristaria plicata* was initially used in the pearl culture industry in China. Gradual changes in technology and, more importantly, in the mussel used, (triangle sail mussel, *Hyriopsis cumingii*), resulted in the production of better quality, lustrous round pearls in a greater variety of colors. Today, China produces 95% of freshwater pearls sold in the world market, with the estimated annual production of 1500 mt and exports of 600 mt. In Japan, Biwa pearly mussel *Hyriopsis schlegelii* collected initially from Lake Biwa has been used for freshwater pearl production since the 1960s. In recent decades, freshwater pearl culture techniques have been adopted in other countries such as India, Bangladesh, Thailand, Vietnam, and the United States. *Lamellidens marginalis*, *L. corrianus*, and *Parreysia corrugata* have been experimented with for pearl culture in India. Four freshwater pearly mussels *L. marginalis*, *L. corrianus*, *L. phenchooganjensis* and *L. jenkinsianus* have been identified and used for freshwater pearl production in Bangladesh. *Chamberlainaia hainesiana*, *Hyriopsis desowitzi*, and *H. myersiana* experimentally produced pearls in Thailand. *Hyriopsis cumingii*, *C. bialata*, *Anodonta elliptica* and *A. jourdyi* were studied for pearl production in Vietnam. Native washboard (*Megalonaias nervosa*), threeridge (*Amblema plicata*), and pink heelsplitter (*Potamilus alatus*) have revealed the greatest potential to produce image, nucleated and non-nucleated pearls in the United States.

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PL 14

LANDSCAPE LEVEL FACTORS SUCCESSFULLY PREDICT THE DIVERSITY, ABUNDANCE AND DISTRIBUTION OF MUSSELS IN LOUISIANA RIVERS.

Kenneth M. Brown[1], Raynie Bambarger[2], Michael Kaller[2], and Wes Daniel[1], [1]Department of Biological Sciences and [2]College of Renewable Natural Resources, Louisiana State University, Baton Rouge, Louisiana.

The Southeastern United States has the most diverse and imperiled freshwater mussel fauna in the world, but what factors determine abundance and distribution has received little study. In one study, we tested whether mussel species richness and abundance in four rivers in south-eastern Louisiana were related to local factors, or riparian-, or basin-scale land use and geology. Both total mussel abundance and diversity were significantly higher in the lower basins of each river. Principal components analysis suggested the lower basins had more stable flow, less agricultural impact, and larger, forested riparian buffer zones. Our results agree with other landscape level studies suggesting geomorphology and land use impact mussel diversity and abundance. In a second study, we looked at the role of local and landscape level factors in explaining the distribution of an endangered mussel, the heel splitter *Potamilus inflatus*, in the Amite River. A discriminant analysis indicated that landscape level factors also best explained the distribution of this species, at a riparian scale of 100 m on either side of the stream, and 1000 m upstream of a site. Percentage of the riparian zone occupied by undisturbed wetland forest was positively associated with heel splitter abundance, while percentage occupied by residential development was negatively related to heel splitter abundance. Managers of freshwater mussels should thus consider reducing agriculture use in and urbanization of riparian zones, and GIS-based models can effectively predict mussel diversity and abundance for resource managers.

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PL 20*

OVERVIEW OF FRESHWATER PEARL PRODUCTION IN CHINA.

H. B. Wen [1], D. Hua[2], R. B. Gu[1], G. C. Xu[1], P. Xu[1], X. P. Ge[1], [1] Key Laboratory of Genetic Breeding and Aquaculture Biology of Freshwater Fishes , Ministry of Agriculture , Freshwater Fisheries Research Center, Chinese Academy of Fishery Sciences , Wuxi, China 214081, [2] Virginia Polytechnic Institute and State University, VA. 24061. USA)

China has the largest freshwater pearl production and export in the world. Mussels used for freshwater pearl production in China are mainly triangle sail mussel (*Hyriposis cuminigii*), and Cockscomb mussel (*Cristara plicata*). The total freshwater pearl culture area in China reached 1,000,000 ha in 2008, in the provinces of Zhejiang, Hunan, Jiangsu, Jiangxi, Anhui, Sichuan, Fujian and Hubei. The annual freshwater pearl production increased dramatically from 5 tons in 1978 to 1600 tons in 2007, occupying 95% of the global market. The cultured pearls are mainly exported to Japan, Korea, Russia, India, Pakistan, Europe and America. New techniques in pearl culture have been further developed in China since 2000 such as preceding artificial propagation, stimulating juvenile growing, standardizing nucleated implantation, and modifying culture methods. An overview of the historic pearl culture in China shows that further development in the pearl industry requires; genetic improvement through selective breeding of native species; the use of non-native species; and improvement of pearl quality.

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PL 15*

THE ROLE OF FISH HOSTS, LOCAL AND LANDSCAPE FACTORS IN DETERMINING UNIONID ABUNDANCE, DIVERSITY AND COMMUNITY COMPOSITION IN LOUISIANA COASTAL PLAIN RIVERS. W. M. Daniel [1], K. M. Brown [1], W. Kelso [2], R. Bambarger [2] [1] Biological Sciences Department, Louisiana State University, Baton Rouge, LA 70803 [2] School of Renewable Natural Resources, Louisiana State University, Baton Rouge, LA 70803

The southeastern United States has the most diverse unionid communities in the world. Strayer (2008) lists dispersal, habitat, fish hosts, food and enemies as important in determining mussel diversity and abundance. To determine the relative role of several of these factors, we sampled 44 sites, representing 10 stream systems in the coastal plain of Louisiana for mussels, fish, and various habitat variables along 2000 m reaches. Our goal was to indentify and model the factors that determine the abundance, diversity, and community composition of mussels. We found a significant relationship between mussel diversity and stream order. Fish diversity was less dependent on stream size. Mussel diversity was not significantly related to fish diversity, although the relationship was somewhat clearer when only known host fish were included. We are currently identifying host fish for as many mussels as possible to examine the host-mussel relationship more closely. Fewer mussel species were found in sand than in silt substrata, and we are currently conducting substrate choice experiments to determine if this is due to active choice, or the fact that silt predominates in lower river basins. We are also collecting data on predictability of stream flow at higher order sites. Our long term goal is to include site variables like substrate, fish assemblage composition, and landscape variables like land use in a multivariate model to determine their role in predicting mussel diversity, to help state wildlife personnel manage rivers to conserve mussel assemblages.

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PL 21

GENETIC VARIABILITY IN FOUR WILD AND TWO FARMED STOCKS OF THE CHINESE FRESHWATER PEARL MUSSEL (HYRIOPSIS CUMINGII) ESTIMATED BY MICROSATELLITE DNA MARKERS. J. L. Li[1], G. L. Wang[2], and Z. Y. Bai[3]. Aquaculture Division, E-Institute of Shanghai Universities, Shanghai Fisheries University, 334 Jungong Road, Shanghai 200090, China

The freshwater mussel *Hyriopsis cumingii* is the most important economic species that has been used for the pearl culture industry in China. However, limited information about its genetic diversity and stock structure is available. We genotyped 119 individuals from two cultured stocks and 240 individuals from four wild stocks from Poyang Lake for eight microsatellite markers to know the genetic status of these stocks. We detected a total of 96 alleles at the eight loci in the six stocks. The four wild stocks showed slightly higher allelic diversity than the two cultured stocks, while the two cultured stocks showed slightly higher degree of inbreeding (f=0.10–0.11) as compared to the four wild stocks (f=0.02–0.10). FST analysis did not detect significant genetic differentiation among the four wild stocks, suggesting the four wild stocks from Poyang Lake could be regarded as one population. Estimation of effective population size (Ne) using the standardized temporal variance in allele frequencies reveled that the Ne of one cultured stock was smaller than that of the wild stock in Poyang Lake. AMOVA revealed that the variation within stocks was 95.82%, whereas the variation among stocks explained only 4.18% of the total variance. Genetic differentiation between cultured and wild stocks was statistically significant. Our data indicate that although the two cultured stocks still contained high allelic and gene diversity, random genetic drift and inbreeding have led to reduction of genetic diversity of farmed stocks and an increase in population differentiation. Measures should be taken to prevent further erosion of genetic diversity. Microsatellites could be used to monitor changes in genetic variation of farmed stocks.

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PL 16

ESTIMATING POPULATION SIZE AND ECOLOGICAL IMPACT OF FRESHWATER MUSSELS IN THE UPPER DELAWARE RIVER. W. A. Lellis[1], J. C. Cole[1], B. S. J. White[1], D. R. Smith[2], D. A. Kreeger[3], and C. A. Campbell[1]. [1]USGS Leetown Science Center, Wellsboro, PA 16901; [2]USGS Leetown Science Center, Kearneysville, WV 25430; [3]Partnership for the Delaware Estuary, Wilmington, DE 19801.

A double-sampling study design was used to estimate species composition and population size of freshwater mussels in the upper Delaware River (NY, PA, NJ). A qualitative survey at the 200m reach scale was first conducted of an entire 125 mile stretch of the mainstem to determine mussel species composition, distribution, and relative abundance. A randomized quantitative survey based on CPUE was then conducted of a subsample of the 200m reaches to determine mussel density and population age structure. Population size was then calculated and summed for each 200m reach by application of a regression equation of CPUE on density applied to the surface area of each reach. Survey data indicate that of the nine species of mussels found, the eastern elliptio (*Elliptio complanata*) uniformly comprised 98% of the total population of approximately 2 million mussels (>10mm) per river mile. Energetic modeling indicates this one species may provide significant ecosystem services during certain seasons and flow conditions.

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PL 22

EMBRYONIC DEVELOPMENT OF *LAMPROTULA LEAI* AND ITS POTENTIAL PEARL CULTURE STUDY. G. F. Zhang[1], S. J. Xu[2], and A. P. Fang[3], 1. Jinhua College of Profession and Technology, Jinhua 321007 China; 2. Jinhua Jewel Pearl Institute, 3.Jinhua Wellwant New Aquaculture Technology Co. Ltd. Jinhua 321017 China.

The characteristics of embryonic development and glochidium structure of a Chinese freshwater mussel *Lamprotula leai* were studied using the microphotographic techniques in order to guide propagation and juvenile culture. Results showed that the fertilized eggs were isolecithal eggs and resided in the inner and outer gills of the gravid mussels for the embryonic development. The embryonic development of *L. leai* were synchronized and could be divided into 6 stages: oosperm, cleavage, blastocyst, gastrulae, young glochidia in membrane and glochidia. *L. leai* eggs were holoblastic and spiral at the cleavage stage. The unfertilized eggs were degenerated in the mussel gills. The gills of gravid mussels showed color change along with the embryonic development. We also found that the environmental changes could cause the early release of eggs. This finding has the significant meanings in the propagation approach of this species. The feasibility of pearl culture in *L. leai* was also studied, resulted in white pearls with good quality.

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PL 17

ASSESSING THE IMPORTANCE OF AMERICAN EEL (*ANGUILLA ROSTRATA*) TO FRESHWATER MUSSELS POPULATIONS IN THE SUSQUEHANNA RIVER. Julie Devers[1], Jeffrey Cole[2], Barbara St. John White[2], Steve Minkkinen[1], and William Lellis[2]. [1]Maryland Fishery Resources Office, USFWS, 177 Admiral Cochrane Dr., Annapolis, MD 21401. [2]Leetown Science Center, Northern Appalachian Research Laboratory, USGS,176 Straight Run Road, Wellsboro, PA 16901.

In comparison with nearby rivers where eastern elliptio (*Elliptio complanata*) population estimates are in the millions, eastern elliptio density in the Susquehanna River and tributaries is low. Lower numbers of eastern elliptio could be linked to the lack of American eel (*Anguilla rostrata*) passage over 4 dams in the Susquehanna River. Results of host fish studies indicate that American eels were likely the primary host for eastern elliptio in the Susquehanna River prior to dam construction in the lower part of the river. To learn more about the effects of eel blockages on eastern elliptio populations, we assessed the recruitment status of eastern elliptio in the Susquehanna River drainage above and below the first eel blockage, Conowingo Dam. Recruitment was assessed by conducting qualitative and quantitative surveys of previously surveyed stream reaches in the Susquehanna River watershed with the highest density of eastern elliptio. All mussels in the quantitative survey were measured and a subsample was aged. In addition, fish surveys were conducted at several of the high density eastern elliptio sites above and below Conowingo Dam. Population estimates at the sites in the Susquehanna River with the highest densities were much lower than population estimates of the same species in the Delaware River. Length frequency analyses indicate that where eels occur below Conowingo Dam, eastern elliptio are smaller (<0.05) than those at 6 sites above the dam. These results suggest that eastern elliptio recruitment has been limited in recent years.

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PL 23

OPEN

PL 18*

PREDICTING THE UNSEEN: ESTIMATING MUSSEL SPECIES RICHNESS IN THE UPPER GREEN RIVER. J. S. Helton[1], and J. B. Layzer[2]. [1]Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, P.O. Box 5114, Cookeville, TN 38505. [2] U.S. Geological Survey, Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, P.O. Box 5114, Cookeville, TN 38505.

The number of species collected during a sampling event is rarely equal to the true number of species in an area because rare species often are not detected. Statistically estimating species richness is an alternative to increasing sampling effort. In many cases estimates may reveal sites where further sampling is needed. At least 59 mussel species have been reported form the upper Green River in the 200-km long reach between Lock and Dam 6 and the Green River Dam. Presently, at least 51 species are believed to be extant in this stretch. Several of these species are so rare that they are detected infrequently. We sampled 20 sites in this reach of river for up to 8 years, with a variety of sampling designs. Despite differences in sampling design, the method of collecting quadrat samples remained consistent across sites and years. We used 7 non-parametric methods to estimate species richness. The five best performing methods produced estimates that ranged from 31 to 35 % higher than the number of species collected in the sampling event. These higher estimates compared favorably with our multi-year cumulative species list for each site.

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PL 24

OPEN

PL 25

INTERACTIVE EFFECTS OF MUSSEL COMMUNITIES AND ENVIRONMENTAL CONDITIONS ON PRIMARY PRODUCTION IN RECIRCULATING MESOCOSMS. Caryn C. Vaughn[1], Daniel E. Spooner[2], Heather S. Galbraith[1], and Daniel C. Allen[1]. [1]Oklahoma Biological Survey, Department of Zoology, and Graduate Program in Ecology and Evolutionary Biology, University of Oklahoma, Norman, OK 73019. [2]Biology Department, Trent University, Peterborough, Ontario K9J 7B8 CA.

Effects of unionid mussels on nutrient recycling vary with hydrologic and trophic conditions, but where nutrients are limiting the conversion of suspended material to dissolved nutrients by mussels stimulates primary production. In addition, mussel species have different physiological traits that result in their excreting nutrients at different rates depending on both external environmental conditions and the species composition and biomass of the rest of the mussel community. To examine the relationship between mussel feeding behavior (measured as clearance rates), fertilization through mussel excretion, primary production, mussel community composition and seasonal environmental conditions, we conducted experiments in replicated, re-circulating mesocosms. Species treatments (N=34) included *Actinonaias ligamentina, Amblema plicata, Fusconaia flava* and *Obliquaria reflexa* in monoculture, all possible species pairs, all four species, and an 8 species treatment, at densities of 4, 8 and 16 mussels per mesocosm. The experiment was repeated across three seasons (spring, summer and fall), with each species treatment replicated 5 times per season in 10-day runs. Ammonia contributed to the water column by unionids was greatest on day 3 and was highest in treatments with the greatest mussel densities. Chlorophyll in the water column was higher in higher density treatments, and increased over time, because of an ammonia fertilization effect (nutrient subsidies from mussel excretion). Higher ammonia and chlorophyll levels were due primarily to the presence of one species, *Actinonaias ligamentina*, which is both larger and has a higher ammonia excretion rate under summer conditions.

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PL 30

POPULATION VIABILITY ANALYSIS FOR THE ENDANGERED FAT THREERIDGE MUSSEL (*AMBLEMA NEISLERII*). K. J. Herrington[1], P. S. Miller[2], J. Ziewitz[1], and S. C. Pursifull[1]. [1]U.S. Fish and Wildlife Service, Panama City Field Office, 1601 Balboa Ave, Panama City, FL 32465. [2]IUCN / SSC Conservation Breeding Specialist Group, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124

We developed a population viability analysis (PVA) for the endangered fat threeridge (*Amblema neislerii*) to evaluate the current status of the population and explore which demographic parameters may be the most sensitive to alternative management practices. A stage-structured, female-only population matrix model of fat threeridge demography was developed with input data on stage-specific fecundity and survival rates. Stage classes and associated survival and fecundity estimates were derived either from available fat threeridge data or by using data from the closely related congener, *Amblema plicata*. Because of uncertainty around our measured adult survival estimate of 0.89, we evaluated three different levels of adult survival (low=0.89, moderate=0.91 and high=0.98). Results of PVA simulations indicate that under low adult survival, the population of fat threeridge in the Apalachicola River is in a long-term, relatively slow decline. In contrast, the high adult survival estimate leads to a population that shows a fairly vigorous 8% rate of increase in the long-term. The sensitivity of the models to measurement uncertainty of the different demographic parameters was also evaluated to decide which parameters are most important to the model output. Results indicate that female adult survival has the greatest impact on long-term population dynamics. At this time we believe the most appropriate estimate of adult survival is the lower bound estimated from field data, and the fat threeridge population in the Apalachicola River is in a long-term, relatively slow decline. However, results of the elasticity analysis stress the importance of more reliable estimates of adult female survival and its variability over time, in order to improve our understanding of the population dynamics of the fat threeridge in the Apalachicola River.

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PL 26*

EFFECTS OF SHEAR STRESS ON DISPERSAL OF JUVENILE MUSSELS (*AMBLEMA PLICATA)* IN THE UPPER MISSISSIPPI RIVER. Joseph A. Daraio[1], Larry J. Weber[1], and Teresa J. Newton[2]. [1]IIHR—Hydroscience and Engineering, Iowa City, IA 52242; [2]USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.

Knowledge of the dynamics of juvenile release from host fish, dispersion with flow, and settlement on the river bed is a key piece for understanding the formation of mussel beds. The hypotheses that bed shear stress has a significant effect on final settling distribution of juvenile mussels, and that the magnitude of these effects is a function of flow rate are tested using a 3-D computational fluid dynamics (CFD) models at five flow rates in a reach of the Upper Mississippi River. Juvenile mussels were modeled as passive particles after drop off from host fish using stochastic Lagrangian particle tracking. Simulations were run with different values of critical shear stress (Pa), $_c$ = •, 0.1, and 0.05, with the latter two values determined using the Shields diagram, which sets the magnitude of bed shear stress above which juvenile mussels are re-suspended in flow. Shear stress significantly reduced the area settled and increases settling density. Juvenile settling was positively correlated with bed shear stress when drop off from host fish was assumed uniform throughout the river, but settling was negatively correlated with bed shear stress when host fish were assumed to be in shallow water (< 1 m deep) at the time of juvenile drop off. At the lowest modeled flow rate, the effects of shear stress on dispersal of juveniles was limited to areas in the main channel. The use of a 3-D CFD model has allowed us to demonstrate that shear stress can significantly influence dispersal of juvenile mussels in this large river.

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PL 31

INFLUENCE OF ENVIRONMENTAL FACTORS ON REPRODUCTION OF TWO SYMPATRIC SPECIES OF ANODONTITES (MYCETOPODIDAE: UNIONOIDA) IN THE CENTER OF SOUTH AMERICA. C. T. Callil, Department of Biology and Zoology, Biosciences Institute, Federal University of Mato Grosso. Av. Fernando C. Costa s/no. Cuiabá, MT, Brazil.

The reproductive cycle of two species of Mycetopodidae, family of freshwater bivalve exclusive of South America, has been studied for a hydrological cycle, in a lake from wetland drained by the river Cuiabá in northern limit of the Pantanal, Mato Grosso state, Brazil. The genus *Anodontites* Bruguière, 1792, shows an interspecific variability when considered the sexual category of species. Through histological analysis found that *A. trapesilis* differs from *A. elongatus* in several aspects. Besides being hermaphroditic while *A. elongatus* is dioecious, *A. trapesialis* presented a total reversion of reproductive follicles after the removal of gametes characterized as a phase of inactivity gonadal not observed in *A. elongatus*. The quantitative analysis of cellular elements, showed that gametogenesis is continuous with peaks of maturation and disposal of gametes between April and June The variation of the number of ova during the sampling period showed significant differences both for *A. trapesialis* ($F = 60.15$, $P < 0.000$) while for *A. elongatus* ($F = 28.74$, $P < 0.00$). The process of spermiogenesis was still in both species. Meanwhile, *A. elongatus* showed significant differences when considered their stage of development and temporal variation (MANOVA, Wilks lambda = 0318 df1 = 36, df2 = 1077, $P < 0.001$). The proliferative stadium is characterized by clusters of primordial cells to differentiate into clusters of sperm called "spermballs", featuring the species in this study as espermatozeugmatas. This set of information comprises a database that subsidizes programs the maintenance of biodiversity and monitoring the quality of inland waters, using freshwater bivalve as sentinels and indicators of environmental changes.

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PL 27*

MUSSEL DIVERSITY DESTABILIZES SUBSTRATES AT HIGH FLOWS. Daniel C. Allen and Caryn C. Vaughn. Oklahoma Biolgical Survey, Ecology and Evolutionary Biology Graduate Program, and Department of Zoology; University of Oklahoma; 111 E. Chesapeake St. Norman, OK 73019.

Recent investigations suggest that freshwater mussels prefer habitats that have stable substrates during high flow periods. Additionally, some authors have suggested that mussels themselves stabilize substrates, making habitat more favorable for mussels. Therefore, we designed and experiment to investigate the influence of freshwater mussels on substrate stability during high flows, but also to investigate the influence of mussel species identity and community composition on substrate stabilization. We used three species of mussels; *Actinonaias ligamentina*, *Amblema plicata*, and *Quadrula pustolosa*. Mussel community structure was manipulated by using 8 mussel diversity treatments (3 treatments of each species alone, all possible 2 species combinations, and a three species combinations, and a no mussel control) and by using two mussel densities (55 and 110 mussels per m^2). These densities were chosen because 55 mussels/m^2 is a typical mean density at mussel beds in SE Oklahoma, and 110 mussels/m^2 is a naturally occurring high density. Each diversity treatment was replicated at each density 12 times at current speeds of ~0.85 m/s in 8 recirculating stream channels. We found that total mussel density had significant stabilizing and destabilizing effects on substrate, and found that mussel species richness significantly destabilized substrates. Overall, *A. ligamentina* destabilized substrates relative to controls, while *A. plicata* and *Q. pustulosa* had no overall effect on substrate stability. Interestingly, when all three species were present, mussels had a stronger destabilizing effect on substrates than predicted additively from individual species performances. We think that the protrusion of mussel shells into the water column may increase near-bed turbulence and scouring forces, an effect that we think is strongly influenced by shell morphology and burrowing depth of mussel species.

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PL 32*

ANALYZING VARIATION OF METAMORPHOSIS SUCCESS. Andrea K. Crownhart, Michael J. Pillow, Jingjing Miao, and M. Christopher Barnhart, Missouri State University, 901 S. National Avenue, Springfield, MO 65897.

Larval parasitism is a critical stage in the Unionid lifecycle. Factors that limit glochidial attachment and metamorphosis on the fish host are not well understood. Even in suitable host species, differences in metamorphosis success (percent of attached glochidia that metamorphose) are observed among individual fish. We examined metamorphosis success (M%) among individual fish for several different mussel-host species pairs. Untransformed glochidia and metamorphosed juveniles were recovered quantitatively from each fish. Mean M% of 7 lampsiline species was 75-95%, including 3 *Lampsilis* species on largemouth bass, *Ligumia recta* on walleye, and 2 *Potamilus* species and *Ellipsaria lineolata* on freshwater drum. However, M% of these species varied among individual fish from near zero to 100%, with the mean CV=14%. We infected drum with *E. lineolata* and *P. alatus* simultaneously to test whether individual differences in M% among fish were species-specific. Metamorphosis success of both species was highly correlated among individual hosts (R^2=0.86). This result argues that the differences in M% among individual fish were not related to species-specific epitopes and immune recognition processes. Metamorphosis success was significantly correlated with infection intensity in some species pairs, with R^2 up to 0.3, but was positive in some pairs and negative in others. Variation in M% was unusually high in two mussel species: *Leptodea leptodon* on freshwater drum and *Quadrula fragosa* on blue catfish. Mean M% was 40-66% and CV was 58%, 4 times higher than the other mussels tested. The glochidia of these two species are unusually small (<80 µm) and grow during the period of encapsulation on the host. Understanding individual variation in M% among hosts might provide clues to the basis of host specificity.

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PL 28

A MUSSEL SURVEY AND TRANSLOCATION IN THE IOWA RIVER, IOWA CITY, IOWA, SEPTEMBER 2006 AND 2007. Marian E. Havlik**,** Malacological Consultants, La Crosse, WI 54601-6609.

A quantitative and qualitative mussel survey was conducted at a new bridge site on the Iowa River, Iowa City, Iowa, September 2006. Seventeen species were found, including records for *Corbicula fluminea*, plus juveniles of 7 living unionid species. Mean densities were 0.76 mussels/m^2, but shoreline riprap created favorable mussel habitat in several areas. Depths were 0.5-1.0 m. Mitigation was recommended for construction impacts on listed mussels. A mussel translocation was conducted September 2007. Among 19 live species 42 *Tritogonia verrucosa*, and 3 *Lampsilis teres anodontoides* were recovered. No federally endangered mussels were found. An Iowa endangered *Ellipsaria lineolata* was found (probably the first since 1925). Large *Potamilus alatus* represented nearly 25% of the mussels. Two species alive in 2006 were not found in 2007. Two species were represented by empty shells. Over 350 mussels were marked on one valve with numbered bee tags, or a glue mark. We felt that these markings might be scoured off prior to IADNR follow-ups. So, listed mussels were engraved with the same number on the opposite valve, and common mussels were hash-marked on the opposite valve (serious flooding occurred June 2008). Most mussels were translocated upstream by IADNR except that *L. t. anodontoides* had not done well when previously translocated by IADNR. At the end of the project, we distributed some mussels, nearby, from the surface. Mussel populations have generally greatly decreased throughout Iowa. But the 27 species remaining throughout the length of the Iowa River are remarkable; 23 species have been recorded from Johnson County, Iowa since 2005. Based on age and size classes, most species appear to have minimal to moderate reproduction in Iowa City, IA.

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PL 33

IDENTIFICATION OF ECOLOGICALLY RELEVANT FISH HOSTS FOR *POPENAIAS POPEII*. T. D. Levine[1], B. K. Lang[2], and D. J. Berg[3]. Department of Zoology, Miami University, [1]Oxford, OH 45056 and [3]Hamilton, OH 45011. [2]Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe, NM 87507.

The obligate reliance of freshwater mussels on aquatic vertebrates as hosts of glochidia creates significant complications in understanding mussel life history and demography, and in development of effective conservation strategies. The typical approach for identifying these hosts is via laboratory trials that identify potential host species, but do not reveal which of these species are actually used by mussel populations. Laboratory trials identified 23 of 30 species as potential hosts for *Popenaias popeii*. We conducted repeated surveys of fishes from the Black River, NM to determine which species were infested with *P. popeii* glochidia, and to measure the prevalence and intensity of infestations. We calculated an "ecological host index" that integrates fish abundance with infestation prevalence and intensity. Surveys collected 2,658 individuals from 21 species of fish; of these, 249 individuals had encysted glochidia. Three species of catostomids had relatively low-to-moderate abundance, moderate-to-high prevalence, and high intensity of infestations; one species of cyprinid had moderate abundance, high prevalence and high intensity. All other species had low abundance or prevalence, and low intensity. *Carpiodes carpio, Moxostoma congestum*, and *Cyprinella lutrensis* had much higher ecological host indices than any other species. Infestations on benthic-dwelling catostomids were on the face and operculum, while those on the water-column-dwelling *C. lutrensis* were on the gills. We conclude that the list of ecologically relevant host species is much smaller than the list of potential hosts identified in laboratory trials. Successful conservation and restoration of unionid populations will require the presence of this much smaller set of host species.

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PL 29*

ASSESSMENT OF THE SHORT AND MODERATE TERM EFFECTS OF RELOCATION ON THE FITNESS AND BEHAVIOR OF POTAMILUS CAPAX (GREEN 1832) AND QUADRULA QUADRULA (RAFINESQUE, 1820). Andrew J. Peck[1], John L. Harris[2], Jerry L. Farris[1], and Alan D. Christian[1,3] [1]Environmental Sciences Graduate Program, Arkansas State University, State University, Arkansas 72467, [2]Environmental Division, Arkansas State Highway & Transportation Department, Little Rock, Arkansas,[3]Department of Biology, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA 02125.

Previous examinations of relocation as a conservation strategy for freshwater mussels typically report survivorship rates, but have not examined how relocation activities may affect the fitness and behavioral traits of relocated individuals. This study examined the effect of relocation on survival, fitness, and movement patterns of *Potamilus capax* (Green 1832) and *Quadrula quadrula* (Rafinesque, 1820) in the St. Francis River Basin of eastern Arkansas. Survival rates for *P. capax* and *Q. quadrula* relocated in May 2005 and monitored for 25 months were - 93.75% and 96.08%, respectively, and were not significantly different from survival rates of the resident population. Results of fitness testing, using Total Glycogen and Total Lipids, revealed significant differences between source and receiving streams, species, and season. The overall effect of relocation on fitness of both species was not significant. Movement for both species was evaluated through total displacement and bearing and indicated *P. capax* displaced significantly further than *Q. quadrula* and in a more consistent downstream direction. Displacement analysis of within species treatments (relocated vs. non-relocated) were were not statistically significant. Based on these results, relocation, appears to have little influence on the short and moderate term physiology and behavior of *P. capax* and *Q. quadrula*. We will finish our talk with a discussion of our experimental design of a complimentary study exploring a bridge replacement project where mussels remain *in-situ*.

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PL 34

BUILDING A MUSSEL PRODUCTION PROGRAM FROM SCRATCH – THE SHEEPNOSE STORY. T. R. Brady[1] M. Hove[2], B.E. Sietman[3] [1]Genoa National Fish Hatchery S5631 State Road 35 Genoa, WI 54632, [2] Macalester College, 1600 Grand Ave., St. Paul, MN 55105, [3] Minnesota Department of Natural Resources, 500 Lafayette Road, St. Paul, MN 55155

The sheepnose mussel (*Plethobasus. cyphyus*) is a species of medium and large rivers throughout much of the interior basin and highlands of eastern North America, and is a candidate for federal protection. Though the sheepnose is the most broadly distributed and comparatively stable member of the genus, little is know about its life history, the lack of which prohibits any restoration efforts. Genoa National Fish Hatchery is currently working with the Minnesota Department of Natural Resources and Macalester College, MN to research the brooding period, host fishes, and culture techniques needed to implement a full scale production program for the sheepnose mussel. Over the past two field seasons we examined the glochidia brooding period and conducted host suitability trials to identify fish species that facilitate glochidial metamorphosis. At latitude of 44° N, female sheepnose with swollen gills were observed as early as 5 June, but the first viable glochidia were not collected until the first week of July. We found 15 fish species, mostly cyprinids that successfully produced sheepnose transformer juveniles. With this information and future research efforts we hope to initiate a production program for use in restoration efforts.

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PL 35

INTEGRATION OF ECOLOGICAL AND MOLECULAR TOOLS FOR EFFECTIVE CONSERVATION OF FRESHWATER MOLLUSKS: THE EXAMPLE OF EUROPEAN FRESHWATER PEARL MUSSELS. (*MARGARITIFERA MARGARITIFERA* L.). Juergen P. Geist, Unit of Functional Aquatic Ecology and Fish Biology, Department of Animal Science, Technische Universität München-Weihenstephan, Mühlenweg 22, D-85354 Freising, Germany

Conservation approaches for freshwater mollusks can greatly benefit from integrating knowledge derived from molecular and macro-ecological tools, as demonstrated here for European freshwater pearl mussels (*Margaritifera margaritifera*). Non-destructive DNA sampling methods from shells and haemolymph, and a suite of genetic markers (microsatellites, mtDNA markers) were developed to study the genetic diversity and differentiation of European pearl mussel populations. The contribution of individual populations to total heterozygosity was computed to determine conservation prioritization and genetic diversity hotspots of the mussels and their host fishes. Pearl mussel population structure resembled a fragmented metapopulation model with high susceptibility to loss of genetic diversity and high extinction risk. Genetic diversity in brown trout was inversely related to pearl mussel, which can be explained by differences in the ecological niches and life histories of both species. Stable isotope records in tissue and shells of this long-lived species were used to reveal tropic niche, shell carbon source and the temporal dynamics of stable carbon signatures resulting from metabolic changes. The importance of critical habitat features at different stages of the life cycle were identified by comparing functional and non-functional pearl mussel populations in terms of host fish stocks and stream substratum properties. Stream substratum properties (texture, redox depth gradients, substratum penetration resistance) and the exchange rates between free-flowing water and interstitial zone were identified as the most important factors for recruitment in Europe whereas densities and biomass of host fish were only locally limiting. Pearl mussels can serve as key examples for the development of integrative conservation strategies.

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PL 41

CALCIUM MOVEMENTS ON THE SHELL FORMATION IN *ANODONTA CYGNEA:* AN OVERVIEW. Jorge Machado and Manuel Lima. ICBAS - Instituto de Ciências Biomédicas de Abel Salazar, Universidade do Porto, Portugal, CIIMAR - Centro Interdisciplinar de Investigação Marítima e Ambiental, Universidade do Porto.

Electrophysiological, histological and immunocytochemistry studies by light and transmission electron microscopy (TEM) with *Anodonta cygnea* on the outer mantle epithelium (OME), and further studies on the nacre composition and morphology, mantle mineral concretions, and compositional variations of the related biological fluids, allowed to establish a model for the deposition of calcium carbonate and organic matrix in the nacreous layers. Transcellular calcium transport in OME of *A. cygnea* coexists with paracellular diffusion of calcium from the haemolymph to the pallial fluid at a significant rate. In fact, an alternative model system for the shell calcification of *A. cygnea* may be suggested. The calcium peak in June and October depends probably on the microspherule dissolution in the haemolymph due to metabolic acidosis. The peak in June is associated with a peak in permeability and lower short-circuit current of the OME; this creates ideal conditions for calcium deposition on the mother shell while the October peak (gravid period), associated with lower permeability and higher short-circuit current on the OME , constitute ideal conditions for calcium deposition on the shells of larvae. Reversal behaviour occurs during autumn/winter with reduction of shell CaCO3 precipitation by a high proton pump activity and an increase of CaCO3 spherules in the mantle by respiratory alkalosis added by HCO^-_3 secretion from OME. Between March and August new nacre is formed with a preferential hydrophobicity order for organic compounds. In fact, the results indicate a relative increase for nacreous chitin in March, followed by a minimum in April. At the same time, an increase of a strongly basic soluble protein is observed, probably for establishing the connection between the previously deposited insoluble matrix and the acidic soluble fraction, which suggests initiating the biomineralization phenomenon. In parallel, the increase of proline and glycosaminoglycans, possibly indicating a proteoglycan, reached a peak in June, suggesting the presence of an effective calcium transporter in the mineralization front. This corresponds to an intense calcium deposition period. In this model, glycosaminoglycans may hence function as relevant agents for the calcium ion transport and local aggregation leading to nucleation.

PL 36

A PEARLMUSSEL'S (*MARGARITIFERA AURICULARIA*) VIEW OF ECOSYSTEM DYNAMICS – FROM SINGLE SHOAL TO WHOLE DRAINAGE, THROUGH PEOPLE AND OTHER ALIENS. Cristian R. Altaba, Laboratory of Human Systematics, University of the Balearic Islands, 07071 Palma, Balearic Islands (Spain).

The threats facing freshwater mussels are highlighted in the Ebro basin. This largest of Iberian drainages still harbors a remarkably rich freshwater mollusc fauna, resulting from its isolation, complexity, and relictual habitats. The last viable population of the giant pearlmussel (*Margaritifera auricularia*) survives in the lower reaches of this river, having lost its major host (the European sturgeon) and relying on the freshwater blenny –a small, rare, sedentary bottom-dweller. The Ebro remained relatively unspoiled until recent decades, but is now under pressure by unprecedented human demands –big dams, pollution, waterway works, diversion plans and exotic fishes. Analysis of the environmental long-term record encoded in *M. auricularia* shells reveals striking differences among the lower and middle reaches, the latter suffering profound transformations. Recently, this river has experienced invasion by zebra mussels and Asiatic clams. These invasive bivalves benefit from human alterations and originate drastic ecological changes progressing in cascade. Conservation efforts can only become fruitful if allied with unbiased scientific guidance, grassroot movements and drainage-wide management.

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PL 42

HEALTH AND STRESS ASSESSMENT IN FRESHWATER MUSSELS FOLLOWING TRANSLOCATION TO A CAPTIVE SETTING. Barbara A. Wolfe, DVM, PhD,[1] Mary Jo Burkhard, DVM, PhD,[2,3] Sarah Leavell,[2] Rachael B. Weiss, DVM,[1] Kody Kuehnl, PhD,[4] Hope Valentine, DVM, [1] and G. Thomas Watters, PhD[4] . [1]Department of Wildlife and Conservation Medicine, The Wilds, Cumberland, OH, USA; [2]Department of Veterinary Biosciences, College of Veterinary Medicine, The Ohio State University, Columbus, OH, USA; [3] Center for Microbial Interface Biology, The Ohio State University, Columbus, OH, USA; [4] Department of Ecology, Evolution, and Organismal Biology, The Ohio State University, Columbus, OH, USA

Freshwater mussels (Family Unionidae) are important in maintaining ecosystem functioning and species diversity, and serve as sentinels of environmental quality. Unfortunately, freshwater mussels are the most imperiled group of animals in North America. While relocation, translocation, and captive propagation of unionids are widely supported as appropriate conservation measures, a high proportion of these normally long-lived animals die within the first year following such activities, reducing the effectiveness of such conservation efforts. Furthermore, the ability to evaluate the health of freshwater mussels has historically been limited and has relied primarily on behavioral changes, mortality rates, histopathology and non-survival assays. Our objectives are to develop better biomarkers of health and disease in wild, captive and translocated freshwater mussels, specifically to: 1) develop techniques for identification of hemocyte cell types in freshwater mussel hemolymph; 2) identify hemolymph chemistries of value in health assessment; and 3) identify catecholamines and monoamines present in hemolymph and assess their response to stressors. Toward this aim, we have compared hemolymph collection and processing strategies in *Quadrula quadrula* and *Q. pustulosa*, assessing their effects on cell yield and morphology, and characterized key morphologic features for the development of a mussel hemogram. We have assessed hemolymph chemistries and hemocyte cell function in wild mussels (control) and those brought into captivity and monitored closely for an extended time. We are using pericardial catheters to allow direct access to the vascular system in order to assess stress effects without causing direct physical stress. Finally, we are evaluating hemolymph catecholamine and monoamine responses to emersion and other stressors in an attempt to identify the mechanisms of the captive stress response in these species.

PL 37

A CATCHMENT MANAGEMENT APPROACH TO THE CONSERVATION AND RESTORATION OF PROTECTED *MARGARITIFERA MARGARITIFERA* POPULATIONS IN THE REPUBLIC OF IRELAND. Evelyn A. Moorkens, 53 Charleville Square, Rathfarnham, Dublin 14, Ireland.

Pearl mussels are still widespread in Ireland, there are thought to be a total of 93 populations in 139 rivers. All are in unfavorable conservation status, and vary from very poor residual populations to large (1 million plus individuals) with some juvenile recruitment. A total of 27 populations have been designated for protection under the EU Habitat's Directive. A catchment management approach is being taken as a means of restoring protected populations to favorable condition. Information on the catchment status and pressures is taken from existing datasets (GIS data on overgrazing, drainage, landuse, abstractions, forestry, agriculture and discharges) and from targeted survey (pearl mussels, fish, macroinvertebrates, macrophytes). A programme of measures has been produced for each catchment landuse and future development in order to reduce negative levels of nutrient and silt, and legal habitat regulations will be used to ensure implementation. A draft set of these plans can be read at http://www.wfdireland.net/docs/5_FreshwaterPearlMusselPlans/. The draft habitat regulations can be read at http://www.environ.ie/en/Heritage/NationalParksandWildlife/Biodiversity/PublicConsultation/.

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CLEARANCE RATE AS A NON-LETHAL MEASURE OF CONDITION IN FRESHWATER MUSSELS HELD AT DIFFERENT STOCKING DENSITIES. Matthew A. Patterson[1], Catherine M. Gatenby[1], Rachel A. Mair[1], and Julie L. Devers[2] [1]White Sulphur Springs National Fish Hatchery, 400 E. Main Street, White Sulphur Springs, WV 24986. [2] Maryland Fisheries Resource Office, 177 Admiral Cochrane Dr., Annapolis, MD 21401.

Developing non-lethal measures of condition is critical to monitoring the health of freshwater mussels held in captivity. Declines in clearance rate have been documented for freshwater and marine bivalves under stress. Clearance rate was measured seasonally in the mucket (*Actinonaias ligamentina*) held at six different stocking densities (12, 18, 24, 36, 48 and 76 mussels $\cdot m^{-2}$) for one year in captivity. Immediately following clearance rate experiments, each mussel was sacrificed to measure condition index, a standard, lethal measure of condition in bivalves. All mussels were held in recirculating aquaculture systems and fed a tri-algal diet (*Bracteacoccus grandis, Phaeodactylum tricornutum,* and *Oocystis polymorpha*) at a constant rate (2 mg dry weight $\cdot L^{-1}$) using an automated feeding system. Mussels held at the three highest stocking densities showed significant reductions in survival, condition index and clearance rate over time compared to the three lowest stocking densities. This data indicate that clearance rate has the potential for use as a non-lethal indicator of condition in freshwater mussels. Clearance rate experiments both provide valuable baseline data on feeding physiology and optimal feeding rates in captivity and are relatively inexpensive and easy to conduct.

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PL 38

CONSERVATION AND RESTORATION OF A FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA)* POPULATION IN NORTHERN ENGLAND. Ian J. Killeen, Malacological Services, 53 Charleville Square, Rathfarnham, Dublin 14, Ireland.

There is only one large remaining population of *Margaritifera margaritifera* surviving in England. A major survey in 2006 (10 years after the previous survey) showed that whilst the river still had a population of over 350,000 individuals, the river was not in favourable condition and there was virtually no recruitment. There had been a shift of the entire population to a higher size/age class since the 1996 survey, with the adults now 10 years older. Mussels under 65 mm comprised less than 1.5 % of the overall population and juveniles <10mm (i.e. 4 years old) were rare and found only in the most highly oxygenated riffles. Redox potential measurements showed high levels of siltation in the gravel substrate and young mussels were present only at sites with high redox potential. Given the small catchment size and relatively few environmental pressures it was considered that the river and its mussel population had the potential to be recoverable to favourable condition. Since the 2006 survey, a restoration programme has been instigated. Most of the environmental threats to the mussels have been identified and addressed. In the last 2 years non-native conifer forestry has been sympathetically removed, sections of river have been fenced to prevent stock access, fallen trees have been removed, turbidity meters have been installed, and field drains are being blocked to prevent silt input. The water abstraction license is under review to permit a higher flow and there are plans to divert a mountain stream back to river to enhance the geomorphological regime. Early indications show that all the measures are having a positive effect and that the river and mussels are showing signs of recovery.

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PL 44

NON-LETHAL ESTIMATION OF PHSYIOLOGICALLY ACTIVE SOFT-TISSUE MASS IN FRESHWATER MUSSELS USING SHELL MORPHOMETRICS. Jeffrey J. Kovatch[1], David M. Sovic[1,2], and Thomas G. Jones[3] . [1]Marshall University, Department of Biological Sciences, [2]Ohio State University, Department of Entomology, [3]Marshall University, Department of Integrated Science and Technology

Freshwater mussels can greatly influence energy flow in aquatic ecosystems and may be useful as environmental sentinels. Understanding their capacities in both these roles requires estimation of their metabolic rates because metabolic rates influence rates of feeding and toxin ingestion. Metabolic rates of animals are mass-dependent, but direct estimation of the physiological active, soft-tissue mass in mussels requires specimen sacrifice. Sacrificing mussels is less than ideal because ~50% of North American species are either locally or globally threatened. An indirect method for estimating soft-tissue mass and density was developed using non-lethal and easily obtainable morphometric predictors for Unionid mussels. Naturally dead specimens are used to generate soft-tissue mass predictive models for live mussels of the same species from the same location. Tissue density is also derived and may serve as a potential metric of mussel condition: degree of starvation, sexual maturity, and harboring of young. Methodological validation is non-lethal and compares estimated and observed total animal volumes. Techniques are described and tested using *Pyganodon grandis*, and comparative volumetric error is <5%. The procedure offers a simple and non-lethal alternative to estimating the physiologically active biomass of individuals and populations, and provides a necessary tool to model energetic influence of populations on the ecosystem level and toxicity effects on individuals.

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PL 39

IMPACT OF TURBIDITY AND SEDIMENTATION ON RECRUITMENT, GROWTH AND HOST FISH OF *MARGARITIFERA MARGARITIFERA*. Martin Österling, Björn Arvidsson and Larry Greenberg. Department of Biology, Karlstad University, SE 651 88 Karlstad, Sweden.

The objective was to explore the cause of population declines of *Margaritifera margaritifera* by comparing the age distribution, density and growth of the mussels with turbidity, sedimentation rates and density of the mussel's host, trout (*Salmo trutta*), in Swedish streams. Age structure analysis of nine populations revealed a difference in maximum age of sixty years among populations, with five populations having low proportions of juvenile mussels. Growth of adult mussels during the past 10 years was lower in the five streams lacking recent recruitment than in the other four streams that had recent recruitment. A comparison among 24 populations indicated that turbidity and sedimentation may be responsible for recruitment failure in 58% of the populations. Turbidity and sedimentation of all inorganic material and the smallest size class of organic material was lower in streams with recent recruitment than in streams without recent recruitment. Age of the youngest mussel, a measure of the time elapsed since recruitment last succeeded, was positively related to turbidity and sedimentation. In contrast, trout density was positively related to turbidity, but was not related to sedimentation or to recruitment of mussels. Recruitment failure of *M. margaritifera* may therefore be more related to its own vulnerability to turbidity and sedimentation than to its host's response to the same habitat degradation. The mechanism may be changed chemo-physical and/or food conditions for juvenile mussels. Restoration activities should focus on reducing fine material transportation into streams to improve the mussels' environment.

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PL 45

HISTOLOGICAL EVALUATIONS OF ORGAN TISSUES FROM UNIONID MUSSELS. William F. Henley[1] and Richard J. Neves. [1]Freshwater Mollusk Conservation Center, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg VA 24061-0321.

Quantitative data generated from microscopical evaluations of histologically prepared unionid organ tissues using point-count volumetry can be analyzed to determine statistical differences among selected groups of mussels. Data represents fractions of organs containing investigator-specified cell or tissue types. Tissues from gills, digestive glands, kidneys, and gonads are sensitive indicators of impacts due to holding and water quality differences. Gill tissues are evaluated for fractions of filaments with cilia (FGFC) and fused filaments (FGFF); gonads are evaluated for fractions of gonads containing acinic tissue (FAT), acini containing mature and/or developing gametes (FAMD), and acini containing resorbing gametes (FAR); digestive glands are assessed for fractions containing diverticula (FDD) and diverticula containing necrotic cells (FDNC); and evaluations of kidney tissues include fractions of kidneys containing diverticula (FKD) and diverticula cells containing lipofuscin (FKDL). All organ tissues also can be evaluated for fractions containing trematodes (FTREM). Methods of data acquisition are presented, and data analyses are provided from various experiments and field studies.

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PL 40*

FRESHWATER MUSSELS (BIVALVIA: UNIONOIDA) OF THE UPPER KENNEBECASIS RIVER, NEW BRUNSWICK, CANADA WITH EMPHASIS ON *MARGARITIFERA MARGARITIFERA*. Mary C. Sollows*[1,2] and Kelly R Munkittrick[1] [1]University of New Brunswick, Department of Biology, Canadian Rivers Institute, Box 5050, Saint John, New Brunswick E2L 4L5 Canada. [2]New Brunswick Museum, Department of Natural Science, 277 Douglas Avenue, Saint John, New Brunswick E2K 1E5 Canada

Canadian populations of *Margaritifera margaritifera* occur in the provinces of New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Quebec. Reduced numbers of the fish host species, *Salmo salar* (Atlantic salmon), pose a threat to the recruitment of *M. margaritifera* in this region. Density, abundance and age structure data for *M. margaritifera* populations are required to determine the conservation issues for this species. In 2007 and 2008 we quantitatively sampled freshwater mussels in the Kennebecasis River, New Brunswick at 6 locations known to contain *M. margaritifera*. A total of 1010 individuals representing 5 species: *M. margaritifera*, *Alasmidonta undulata, Anodonta implicata, Elliptio complanata* and *Pyganodon cataracta* were found within 300 quadrats (0.25m^2 each). *M. margaritifera* was the only mussel species found at the 3 upstream sites, at mean densities ± SE (mussels/m^2) of 9.1 ± 1.7, 16.3 ± 4.2, and 9.9 ± 1.9. *M. margaritifera* densities at the three downstream sites were 1 ± 0.62, 5.9 ± 0.90 and 1.9 ± 0.42. Sixty-six percent of the 662 shells measured for length were greater than 70 mm and only 3% were less than 30 mm. Length-frequency distributions indicate low recent recruitment of *M. margaritifera* at all sites studied.

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PL 46

EFFECTS OF COAL MINING DISCHARGES ON JUVENILE MUSSELS AND COMMONLY TESTED ORGANISMS. Ning Wang, Chris Ingersoll, James Kunz, Chris Ivey, William Brumbaugh, USGS, Columbia, MO; Cindy Kane, USFWS, Gloucester, VA; Steve Alexander, USFWS, Cookeville, TN; Brian Evans, USFWS, Abingdon, VA; Richard Neves, Dan Hua, Virginia Tech, Blacksburg, VA; Craig Walker, OSM, Pittsburgh, PA; Jess Jones, USFWS, Blacksburg, VA; Rachel Mair, USFWS, White Sulphur Springs, WV; Nathan Eckert, VDGIF, Marion, VA; Steve Bakaletz, NPS, Oneida, TN

Acute or chronic effects of coal mining discharges on juvenile mussels (*Villosa iris*) and two commonly tested organisms (cladocerans, *Ceriodaphnia dubia*, and amphipods, *Hyalella azteca*) were evaluated in water or sediment toxicity tests using methods adapted from ASTM standards. Acute exposures with waters contaminated by an uncontrolled release of coal mining wastewaters collected from Powell River watershed in Virginia resulted in >60% mortality of amphipods (2-d exposure) but no mortality for cladocerans (2-d exposure) and mussels (4-d exposure). Acute exposure to a coal slurry sample collected from an impoundment associated with a coal preparation plant in Clinch River watershed in Virginia resulted in significant reduction in survival of amphipods and mussels relative to the controls. In chronic 28-d exposures with eight permitted coal effluents collected from coal preparation plants in Virginia and Tennessee, three effluents significantly reduced survival or growth of amphipods, and one effluent reduced mussel survival or growth. In a 28-d sediment toxicity test with two coal slurry particle samples and three coal-contaminated sediment samples collected from Virginia or Tennessee, no significant reduction in survival or growth of amphipods and mussels was observed. These results indicate that some samples of coal effluents and slurry were toxic to aquatic organisms, and amphipods were equal or more sensitive in these water or sediment exposures compared to mussels tested. Chemical analyses of test samples are ongoing.

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PL 47*

DEVELOPING PROTOCOLS FOR INTRODUCTIONS OF CAPTIVE-BRED *MARGARITIFERA MARGARITIFERA* (L.) INTO THE WILD. Conor D. Wilson[1], Dai Roberts[1], S. Jane Preston[1], Jim Provan[1] & Alan Keys[2]. [1]Quercus, School of Biological Sciences, Queen's University Belfast, Medical Biology Centre, Belfast, Northern Ireland, BT9 7BL. [2]Ballinderry Fish Hatchery, Orritor, Cookstown, Northern Ireland.

One of the most common forms of endangered species conservation is captive breeding. Here, we describe captive breeding of the endangered Freshwater Pearl Mussel *M. margaritifera* in Northern Ireland and a subsequent release study. To date around 700, 8 – 12 year old juvenile mussels have been reared at the Ballinderry Fish Hatchery (BFH), County Tyrone, Northern Ireland. These mussels are now being used as part of a restoration trial in the natal river of the parent stock. Release strategies will be developed within the framework of the IUCN guidelines for re-introductions of captive bred endangered species. Information including dispersal, survival of differing size classes and growth rates will be collected during the study. Gathering such information is dependent on recapturing the mussels post-release. Passive Integrated Transponder (PIT) tags give each mussel a unique identity and have been used elsewhere with 72-80% recovery success and are being used in the proposed trials.

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PL 53

DEVELOPMENT AND APPLICATION OF METHODS FOR CONDUCTING WHOLE-SEDIMENT TOXICITY TESTS WITH JUVENILE FRESHWATER MUSSELS. Chris Ingersoll, John Besser, William Brumbaugh, Nile Kemble, James Kunz, Ning Wang. US Geological Survey, Columbia Environmental Research Center, Columbia, MO.

Standard methods have been established for conducting whole-sediment toxicity tests with a variety of freshwater organisms including amphipods, midge, mayflies, and oligochaetes. However, limited studies have evaluated the bioavailability of contaminants in whole-sediment samples to freshwater mussels. The objective of this study was to develop and apply a method for conducting 28-day whole-sediment exposures with juvenile mussels (fatmucket, *Lampsilis siliquoidea*; rainbow mussels, *Villosa iris*, and Neosho mucket, *L. rafinesqueana*). The method was adapted from the ASTM standard E2455-06 for conducting water-only toxicity tests with early life stages of freshwater mussels and ASTM standard E1706-05 for conducting sediment toxicity tests with freshwater invertebrates. Two- to four-month-old mussels used in testing were obtained from the laboratory cultures. Sediments were wet sieved with a #60 U.S. standard stainless steel sieve (250-µm opening) before the start of the tests to facilitate isolation of mussels from sediment at the end of the exposures. Ten mussels were exposed in each of four 300-ml replicate beakers containing of 100 ml of sediment and 170 ml of overlying water and were fed a non-viable algal mixture twice daily. Tests were conducted for 28 days at 20°C with two volume additions/day of well water (hardness 100 to 300 mg/L as $CaCO_3$). Test endpoints were survival (foot movement) and growth (shell length, biomass). Survival of mussels in different control sediments ranged from 88 to 100% and increase in shell length ranged from 20 to 70%. Sensitivity of mussels exposed to metal-contaminated sediments collected from about 70 locations in Missouri was similar to the sensitivity of the commonly tested amphipod *Hyalella azteca.*

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PL 48

CONSERVATION AND PROPAGATION OF THE FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA* L.) IN THE LUXEMBOURG ARDENNES (EUROPE). F. Thielen[1], L. Masura[1], M. Molitor[1], A. Arendt[1], S. Terren[2], G. Motte[2], H. Selheim[3] and S. Miseré[3]. [1]Foundation: Hëllef fir d'Natur (LIFE 05 NAT /L/ 000116), Hauptstrooss 83, L-9753 Heinerscheid, Luxembourg. [2] Centre de Recherche Nature, Forêts et Bois, 23 Avenue Maréchal Juin, B-5030 Gembloux, Belgium. [3] Biologische Station im Kreis Aachen e.V., Zweifaller Str. 162, D-52224 Stolberg, Germany.

The freshwater pearl mussel (*Margaritifera margaritifera*), a formerly widespread and abundant species, is close to become extinct throughout Europe. In order to maintain and enhance the last remaining important populations in central Europe, located in the Luxembourgish/Belgian and German Ardennes, a European Life Nature Project started in autumn 2005. The aim of the project is to restore the habitat of the mussel and to raise young mussels in order to reinforce the local population. In 2007 and 2008 young mussels from 4 different rivers (Our (L), Rulle (B), Anlier (B), Perlenbach (D)) were obtained from experimentally infected 0+ brown trout (*Salmo trutta fario* L.) and kept at the rearing station in Luxembourg under different conditions. 1: Mussels from the river Rulle were kept in "pipe-gages" in an artificial stream supplied with water from the river Our. 2: Mussels from the rivers Rulle, Anlier and Perlenbach were kept in a bucket recirculating system and additionally fed with algae concentrates. 3: Mussels from the river Our were transferred to "hole gages" and kept in small tributaries of the same river. The survival rate and growth of the different groups were regularly checked. It was possible to grow young mussels in all three systems. The growth- and survival-rate between the different rearing methods are compared and advantages and disadvantages of the respective methods are presented and discussed. Furthermore, a short insight into the habitat restoration actions is given.

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PL 54

A CONTINUED IMPACT TO FRESHWATER MUSSEL POPULATIONS, INCLUDING THE FEDERALLY ENDANGERED CAROLINA HEELSPLITTER (*LASMIGONA DECORATA*), IN THE LYNCHES RIVER IN SOUTH CAROLINA FOLLOWING CONTAMINATION FROM GOLDMINE OPERATIONS. T. W. Savidge[1] and T. E. Dickinson[1]. [1]The Catena Group Inc., 410-B Millstone Drive, Hillsborough, NC 27278.

Mining activities associated with the Brewer Gold Mine (BGM) in Chesterfield County, South Carolina resulted in downstream contamination of portions of Little Fork Creek, Fork Creek and the Lynches River. In particular, a failure of an overflow storage pond at the mine in 1990 resulted in a release of a sodium-cyanide solution containing cyanide, copper, and mercury into Little Fork Creek. This release caused a fish kill along 49 miles of the Lynches River. The federally endangered Carolina heelsplitter (*Lasmigona decorata)* is known to occur in portions of the Lynches River. Sampling investigations conducted subsequent to the overflow pond failure have shown that releases of chromium, cobalt, nickel, and selenium also have occurred. Metals, including copper and mercury, have been detected in ground water underlying the former mining activities. The Catena Group Inc. (TCG) was contracted by the US Fish and Wildlife Service Charleston, SC Field Office in 2006 to conduct semi-quantitative mussel surveys in the watershed to assess likely impacts to freshwater mussel resources from the contamination. Analysis of the survey results indicate that freshwater mussel abundance is significantly lower in Little Fork Creek downstream of the BGM contamination source compared to upstream, and mussel abundance and diversity in the Lynches River are significantly lower below the Fork Creek confluence than above.

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PL 49

CAPTIVE BREEDING AND JUVENILE CULTURE OF THE FRESHWATER PEARL MUSSEL (*MAGARITIFERA MAGARITIFERA*) IN WALES, UK : RESTORATION OF A CRITICALLY ENDANGERED SPECIES. Taylor, J. V[1*]., Scriven, K. J[2]. 1 Environment Agency Wales, Cynrig Fish Culture Unit, Llanfrynach, Brecon, Powys, Wales, UK, LD3 7AX, 2 Environment Agency Wales, Mawddach Hatchery, Tywyn Road, Dolgellau, Gwynedd, LL40 1YA.

The Freshwater Pearl Mussel (FWPM) (*Magaritifera magaritifera*) is endangered and under serious threat of extinction throughout its European range. There are no self sustaining populations of MM in Wales, most are now functionally extinct. Captive breeding has been identified as the only management option that could save the species from extinction in the short term. The ultimate goal was to elucidate the optimum conditions for holding and spawning adult mussels and for successful culture of juveniles for re-introduction. Subsequently "living gene banks" of 8 populations of FWPM were established at 3 Environment Agency Wales Salmon Hatcheries. To date 7 of these populations have bred in captivity although frequency of spatting and glochidia quality have varied considerably. Host (juvenile salmonids) encystment rates have been as high as 3,500 glochidia per fish with an average of 50% "drop off". Brown trout (*Salmo trutta*) appear to be the favoured host and encystment rates increase significantly with size ($P<.05$). The encystment period appears to be relatively predictable at 2200-2600 degree days. Up to 100,000 juveniles have been collected from some populations. Juveniles have been reared under a variety of conditions with seminatural environments providing the best survival, 50% to age 1 year. However, survival to 2 years has been extremely low, approximately 0.14%. The future direction of the programme relies on improving juvenile survival to at least age 3 years when the mussels will be capable of filtering.

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PL 55*

ACUTE TOXICITY OF COPPER AND AMMONIA TO GLOCHIDIA OF TWO MUSSEL SPECIES INSIDE AND OUTSIDE OF CONGLUTINATES. M. J. Pillow[1], A. K. Crownhart[1], R. L. Brondel[1], M. C. Barnhart[1], and N. Wang[2]. [1]Department of Biology, Missouri State University, 901 S. National Ave., Springfield, MO 65897. [2]Columbia Environmental Research Center, U.S. Geological Survey, 4200 New Haven Rd., Columbia, MO 65203.

Mussel glochidia free in water have shown high sensitivity to dissolved copper and ammonia. However, glochidia of many species are released from the female while still within eggs, which are grouped into structures called conglutinates. Little is known about possible protective effects of conglutinates. We measured the toxicity of copper and ammonia to glochidia of *Ptychobranchus occidentalis* and *Pleurobema sintoxia* inside and outside of conglutinates, using ASTM standard methods. Copper toxicity was assessed as time to 50% loss of viability (ET50), when exposed to control water or to a 50-µg/L copper solution at 10°C and 20°C. Ammonia toxicity was assessed as the concentration causing 50% loss of viability (EC50) at 6, 24, 48, or 72 hours of exposure at pH 7.5 or pH 8.5. Both copper and ammonia were significantly less toxic when glochidia were inside conglutinates. Copper ET50s for *P. sintoxia* glochidia (inside:outside) were 108:29 h (10°C) and 72:25 h (20°C). Copper ET50s for *P. occidentalis* glochidia (inside:outside) were 347:62 h (10°C) and 116:56 h (20°C). Ammonia EC50s were higher when glochidia were inside conglutinates, and higher at lower pH. Ammonia EC50s (24 h) for *P. sintoxia* (inside:outside) were 15.6:11.9 mg/L (pH 7.5) and 9.2:4.0 mg/L (pH 8.5). EC50s (24 h) for *P. occidentalis* (inside:outside) were 21.1:11.9 mg/L (pH 7.5) and 9.5:7.7 mg/L (pH 8.5). Conglutinates might protect glochidia simply by providing a diffusion barrier to dissolved toxicants.

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PL 50

A KEYSTONE INTERACTION OF EUROPEAN RIVERS: FISH HOSTS OF THE GIANT PEARLMUSSEL *MARGARITIFERA AURICULARIA*, A REVIEW. M. A. López[1], E. Gisbert[2], and C. R. Altaba[3]. [1]Forestal Catalana, Environmental Agency, Generalitat de Catalunya, Sabino Arana 34 1r-1a, 08028 Barcelona, Spain. 2 IRTA, Aquaculture Center, Ctra Poblenou km 5.5, 43540 Sant Carles de la Ràpita, Spain. 3 Environmental Agency, Government of Balearic Islands, Gabriel Alomar 33, 07006 Palma, Spain.

We have performed a wide array of experimental trials for the determination of the fish hosts of the Giant Pearlmussel *Margaritifera auricularia*. Tests were carried on 32 fish species belonging to 12 families, virtually all species inhabiting the Ebro river. The results exclude as hosts all ciprinids, the most abundant and widespread fish family in European rivers. Only two native fishes, isolated phylogenetically and unique in their ecological traits, have been recognized as hosts: the European Sturgeon (*Acipenser sturio*), and the Freshwater Blenny (*Salaria fluviatilis*). In addition, two invasive exotic species (Siberian Sturgeon *Acipenser baeri*, and Mosquitofish *Gambusia holbrooki*) are able to support metamorphosis of glochidia larvae, rendering free-living juveniles. We suggest the existence of a double-sided reproductive strategy for the Giant Pearlmussel. A "macro-scale" interspecific interaction was played by the native sympatric sturgeons, today at extinction's edge. In this strategy, large numbers of juveniles would be dispersed over long distances but with little predictability of settling habitat. Alternatively, a "micro-scale" strategy involves the blenny, a small, sedentary resident that can carry just a few young mussels over a very short distance, but with a high probability of releasing them in a suitable microhabitat, thus ensuring successful recruitment. We hypothesize that across the range of this mollusk other fishes with similar ecological traits, such as the Bullhead *Cottus gobio*, may be suitable for a comparable microscale strategy. This could explain the survival of *M. auricularia* in Atlantic French drainages.

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PL 56*

BEATING THE HEAT: UPPER THERMAL TOLERANCES OF THE EARLY LIFE STAGES OF FRESHWATER MUSSELS. T. J. Pandolfo [1], W. G. Cope[1], R. B. Bringolf[2], M. C. Barnhart[3]. 1. Department of Molecular and Environmental Toxicology, North Carolina State University, Campus Box 7633, Raleigh, NC 27695. 2. Warnell School of Forestry & Natural Resources, University of Georgia, Athens, GA 30602. 3. Department of Biology, Missouri State University, 901 South National Avenue, Springfield, MO 65897.

Freshwater mussels fulfill an essential role in aquatic communities, but are also one of the most rapidly declining faunal groups in North America. Rising water temperatures, caused by global climate change, industrial discharges, or land development, can further challenge impaired unionid communities. In this study, upper thermal tolerances were determined for the early life stages of eight species of freshwater mussels: *Lampsilis siliquoidea*, *Potamilus alatus*, *Ligumia recta*, *Ellipsaria lineolata*, *Lasmigona complanata*, *Megalonaias nervosa*, *Alasmidonta varicosa*, and *Villosa delumbis*. Mussels were held at three acclimation temperatures (17°C, 22°C, 27°C) and exposed to a range of common and extreme water temperatures (20 - 42°C) in standard acute laboratory tests. The average median effective temperature (ET50) among species in 24 h tests with glochidia was 33.7°C, ranging from 29.1 to 37.5°C. The mean ET50 in 96 h juvenile tests was 34.8°C, and ranged from 32.9 to 36.7°C. As an indicator of sublethal thermal stress, heart rate patterns for seven species of juvenile mussels were assessed through direct observation; *L. recta* and *V. delumbis* displayed significant changes in heart rate associated with increasing temperature. Thermal tolerance data for freshwater mussels and their host fish were compared to determine if the community structure of these systems is at risk from rising environmental temperatures; relationships were complicated with mussels being both more and less thermally sensitive than certain host fish species.

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PL 51

MARGARITIFERA MARGARITIFERA RESTOCKING ACTIVITIES IN SAXONY/GERMANY. Michael J. Lange, PLD Vogtland/Anglerverband Südsachsen „Mulde/Elster" e.V. [Margaritifera restocking programm, Saxony]

Many of the central European M. margaritifera populations are damaged and close to extinction. In the Czech Republic, a way of semi-natural breeding was developed by HRUŠKA in the Šumava National Park area in the late 1980s. In Saxony, the local adaptation of this method was supported by European funds from 7/2001 up to 12/2007. During that period, we learnt many things about the ecology of different life stages after glochidial release. Growth rate and mortality are closely linked to the quality of the food provided within the first 1-3 months of the post-parasitic stage. Concerning the sources of that specific food we started understanding, that the catchment areas have been widely changed or destroyed by the common way of agro-industrial land use within the last 50 years. These results suggest that young mussels and especially mussel seed will have bad chances for their further development. Siltation on the one hand and low quality of artificial food on the other hand, as well as age-specific food requirements must be considered. Developing and using different methods of bioindication we became able to check food conditions in both living and extinct populations and its tributaries. For these investigations we use mussel-seed and young mussels with an age of one year. Rearing the older young mussels in sediment cages for few years before release, we collected many data concerning micro-habitat and temperature values which help us identify optimum places to build up new colonies and to develop ideas to change the bad or unfavorable situations in the catchment. In 2007 we have started comparing the Saxony-specific results (catchment of river Labe) with mussel stocks from three genetically distinct populations (Danube, Maas, Rhine).

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PL 57*

BIOACCUMULATION OF PLATINUM GROUP METALS IN THE FRESHWATER MUSSEL *ELLIPTIO COMPLANATA*. Jason W. Mays[1], W. Gregory Cope[2], Thomas J. Kwak[3], and Damian Shea[1]. [1]North Carolina State University, Department of Biology, Box 7617, Raleigh, NC 27695; [2]North Carolina State University, Department of Environmental and Molecular Toxicology, Box 7633 Raleigh, NC 27695; [3]U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, North Carolina State University, Box 7617, Raleigh, NC 27695.

The use of catalytic converters for automobile exhaust purification has led to the emission and environmental contamination by the platinum group metals (PGM) platinum (Pt), palladium (Pd), and rhodium (Rh). Tissue from *Elliptio complanata* adults and sediment samples were analyzed from 42 sites adjacent to highways throughout central North Carolina. At each site, samples were collected from upstream and downstream of bridges crossing inhabited streams. Additional stream, mussel, and watershed variables investigated included sediment total organic carbon, co-occurring metal contamination (Cd, Pb, Hg), water chemistry, and estimated traffic density at the bridge. Landscape variables included human population density, land use, and density of transportation infrastructure. Results suggest that PGM are accumulating in *E. complanata* tissue. Pt concentrations ranged from 0.09- 1.98 ng/g dry weight in mussel tissue and from 0.06-1.86 ng/g dry weight in sediment. A bioaccumulation factor for Pt, calculated as the median [tissue]/[soil], was 2.0, compared to 61.5 and 60.7 for Hg and Cd, respectively. PGM contamination of mussels and sediment at the highway crossing sites were not correlated with the amount of traffic crossing the structure. Best fit models indicate a significant relationship between PGM concentration and the population density of the watershed. A standard 28-d toxicity test with waterborne PGM and adult *E. complanata* mussels was performed to assess the environmental relevance of the measured environmental concentrations. Mussel survival, PGM accumulation in tissue and hemolymph, and hemolymph enzyme activity and ion levels were the measured endpoints. No significant changes in enzyme or ion levels were observed at environmentally relevant concentrations; however, significant effects were observed at higher exposure levels.

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PL 52

SUCCESSFULL SPECIES PROTECTION MEASURES FOR THE FRESHWATER PEARL MUSSEL (MARGARITIFERA MARGARITIFERA L.) IN LOWER SAXONY, IN THE NORTH OF GERMANY. LOWER SAXONY SPECIALIST AGENCY FOR NATURE CONSERVANCY. Reinhard Altmüller. Römerweg 11, D-29331 Lachendorf. Formally: Lower Saxony Water Management, Coastal Defence and Nature Conservation Agency, Division of Animal and plant species protection, Göttinger Chaussee 76A, D-30453 Hannover, Germany.

The Freshwater Pearlmussel *Margaritifera margaritifera* L. (FPM) was up to the 18th century almost abundant in five catchments of the Lüneburg Heath (Lower Saxony, North of Germany). Because of water management, drainage and using the once wet river valleys in the 19th century the most habitats of the FPM has been totally destroyed or damaged. Thus the size of population declined. In the 1930th only a remainder of about 50.000 specimens had survived in one catchment. About 1980 the amount of the FPM population has been melted down to about 3000 specimens, the species threatened to be extinct. To prevent this species protection measures are done since 1973 by artificially infection of brown trout with glochidia of Margaritifera. These measures at first were almost without success as far as we found unnaturally high bed load of fine material is the most harmful factor to Margaritifera. Since 1989 funds of a specific nature conservation fund of the German federal government has been used to minimise the high load of fine sediments in the river Lutter. Thus the interstitium between gravel and stones in the river bottom has become almost free. After this typically fish species reproduce themselves in an naturally amount and the population of Margaritifera has raised up to more than 12.000 specimens. In the meantime the next mussel generation has started to grow up without any artificially help.

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PL 58*

NA^+, K^+-ATPASE ACTIVITY AS A BIOMARKER OF LEAD EXPOSURE IN FRESHWATER MUSSELS. Shad Mosher, and W. Gregory Cope. North Carolina State University, Department of Environmental and Molecular Toxicology, Box 7633, Raleigh, NC 27695.

The objectives of this research were to evaluate potential biomarkers of lead (Pb) exposure and effect in freshwater mussels, as well as to assess current Pb concentrations in mussels (*Elliptio complanata*) and sediment sampled near highway bridge crossings in relation to traffic count. The endpoints examined included Na^+, K^+-ATPase activity in mussel gill tissue and the measurements of Pb and ion concentrations in mussel hemolymph. In laboratory exposed mussels, concentrations of Pb increased in hemolymph for all exposure concentrations except the greatest (245 µg/L) which, after an initial increase, decreased significantly by the end of the study, suggesting a threshold effect for Pb exposure. Mussel tissue Pb was strongly correlated with exposure concentration (R^2= 0.99). Na^+ ,K^+-ATPase activity was found to be a strong biomarker of Pb exposure in freshwater mussel gill tissue, being negatively correlated with average tissue Pb concentration (R^2 = 0.82). Pb only accumulated in mussel tissue during the first two weeks of the exposure, and because Pb was continually removed from the water throughout the test, we conclude that the mussels were approaching equilibrium with the aqueous environment and were eliminating Pb in lysosomes and granulocytes through pseudo-feces. From mussel samples taken at over 40 sites throughout North Carolina, present levels of Pb were not great enough to result in acute toxicity. Moreover, the sub-lethal effects of Pb on Na^+, K^+-ATPase activity, although a strong biomarker of exposure in laboratory tests, were not significantly affected at environmentally relevant concentrations.

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PL 59

STRATEGIES FOR CONSERVING AND PROTECTING MOLLUSK SPECIES AT RISK AND THEIR HABITATS IN ONTARIO, CANADA. Dr. Gerald L. Mackie, Department of Integrative Biology, University of Guelph, Guelph, ON, N1G 2W1 and Water Systems Analysts, 23 Avra Court, Guelph, ON, N1H 7B2

The conservation status (extinct, extirpated, endangered, threatened, special concern, not at risk, data deficient) of all species of mollusks (and other wildlife) in Canada is determined by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Assessments are based on the best available information in status reports. COSEWIC meets annually to deliberate and vote on the status of each species and report their assessment and reasons for designation to the Canadian Endangered Species Conservation Council (CESCC). CESCC discusses the assessment and its uncertainties with Canadian Wildlife Directors Committee (CWDC). Their decisions are made public and approved species at risk (SAR) are listed on Schedule 1 (official list of Canadian SAR). Recovery strategies must be established for all SAR. Updates or reassessments for all SAR (endangered, threatened, special concern) must be done every ten years. Each province in Canada has a committee that makes its own assessment of conservation status. The Committee on the Status of Species at Risk in Ontario (COSSARO) bases its assessments on the same criteria used by COSEWIC. Protection of a SAR and its habitat in Ontario begins as soon as COSEWIC makes its assessment. SARA also specifies that if a project area includes a listed species or its habitats, an environmental assessment must account for the project's effects on listed SAR and their habitats. The assessment must include recommendations for measures to avoid or reduce adverse effects, and plans to monitor the impact of the project if it goes ahead. The project plan must respect recovery strategies and action plans. To address these concerns a protocol has been developed to provide guidance on methods to detect, relocate and monitor mussel SAR in Ontario after their relocation and for determining the need for a SAR permit and the process for obtaining the permit.

NOTES: _____

PL 65*

DEVELOPMENT OF A SUITABLE DIET FOR ENDANGERED JUVENILE OYSTER MUSSELS, EPIOBLASMA CAPSAEFORMIS (BIVALVIA: UNIONIDAE), REARED IN A CAPTIVE ENVIRONMENT. M. E. Vincie[1], R. J. Neves[1], C. M. Gatenby[2], S. R. Craig[1], E. McLean[1]. [1]Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Mail Code 0321, Blacksburg, VA 24061. [2]White Sulphur Springs National Fish Hatchery, 400 East Main Street, White Sulphur Springs, WV 24986.

Epioblasma capsaeformis, commonly named the oyster mussel, once occupied thousands of miles of stream reaches, but has now been reduced in range to small, isolated populations in a few river reaches. Due to this significant decline in population numbers, a study was conducted to develop a diet for propagating this endangered species under captive conditions. Oyster mussel juveniles were collected from several sites on the Clinch River and sacrificed for gut content and biochemical composition analyses in summer. Feces and pseudofeces from live river-collected juveniles were examined seasonally for algae, detritus, and bacteria to qualitatively determine diet of specimens. Two feeding trials also were conducted in this study to evaluate effect of commercial and non-commercial diets on growth and survival of oyster mussel juveniles. From examination of gut contents, fecal and pseudofecal samples, it was apparent that algae and a significant amount of detritus (~90%) composed wild juvenile diets. *E. capsaeformis* juveniles (1-3 y of age) could have fed on particles up to 20 µm in size and seemed to mostly ingest particles within the 1.5-12 µm size range. Protein content of sacrificed juveniles ranged from 313 to 884 mg/g and was highly variable. Glycogen content ranged from 49-171 mg/g. Caloric content of four juveniles ranged from 2,935.10 to 4,287.94 cal/g, providing a preliminary baseline range for future energetic studies on freshwater mussels. Results of the feeding trials indicated that growth was significantly higher in those juveniles fed the triple concentration algae-mix (62,076 cells/ml) than all other diets tested in trial 1. Results of both feeding trials indicated that survival of juvenile oyster mussels was enhanced when fed an algal diet supplemented by bioflocs.

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PL 60*

RICHNESS AND CONSERVATION STATUS OF ARKANSAS FRESHWATER GASTROPODS. David M. Hayes[1], Alan D. Christian[1,2], William R. Posey II[3], Russell L. Minton[4]. [1]Arkansas State University, Environmental Science Graduate Program, P.O. Box 847, State University, AR 72467, [2]Department of Biology, University of Massachusetts Boston, 100 Morressey Boulevard, Boston, MA 02125, [3]Arkansas Game and Fish Commission, 7002 Hwy 67 East, Perrytown, AR 71801, [4]University of Louisiana at Monroe, Department of Biology, Monroe, LA 71209

Freshwater gastropods represent the most imperiled group of organisms in North America, however basic information regarding distribution and conservation status is lacking. Here, we present data from inventory surveys of freshwater gastropods from Arkansas. A total richness of 37-40 species was found. Our results show *Elimia potosiensis* (Pleuroceridae) to be the most common gastropod species within the Ozark and Ouachita mountain regions. *Leptoxis arkansensis*, once thought to be extirpated from the state, was found in large numbers at several sites within its historical range. Two locations within the Ozark region had *Marstonia* sp., which may represent a significant range expansion for *Marstonia ozarkensis* (S1), or undescribed taxa. Our results also suggest *Lioplax sulculosa* has been extirpated from Arkansas. Baseline distributional studies such as these provide much needed information for establishing conservation rankings.

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PL 66

A SUITABLE DIET, FEED CONCENTRATION, AND CULTURE SYSTEM FOR REARING JUVENILE NORTHERN RIFFLESHELL, *EPIOBLASMA TORULOSA RANGIANA*. R. A. Mair [1], C. M. Gatenby[1], and R. J. Neves[2],. [1]White Sulphur Springs National Fish Hatchery, 400 East Main St., WSS, WV 24986. [2]Department of Fisheries and Wildlife, Virginia Tech, Blacksburg, VA 24061.

Three 60 d. experiments were conducted to improve culture methods for juvenile northern riffleshell, *Epioblasma t. rangiana* at White Sulphur Springs National Fish Hatchery (WSSNFH), WV. The first experiment evaluated the effect of food concentration on growth (shell length, SL) and survival of juvenile (<1 mo.) *E.t. rangiana.* Juveniles were fed a live algae diet at three concentration treatments: 30,000, 90,000, and 150,000 cells mL^{-1}. Mean shell length and survival were significantly higher ($p<0.005$) for juveniles fed 30,000 cells mL^{-1} than other treatments. The effect of three diet treatments on growth and survival of *E. t. rangiana* juveniles (<1 mo.) was evaluated as well. Diet treatments included WSSNFH live algae mix and two preserved commercial diets from Reed Mariculture; 'Shellfish diet', and 'Phytofeast'. Juveniles reared on the WSSNFH live algal diet had significantly greater growth (Mean SL= 3.1mm, $p<0.0001$) and survival (85%, $p=0.009$) than the other 2 diet treatments (2.6 mm, 2.4 mm respectively, and 79%, 75% survival respectively). Growth and survival also were compared among larger juveniles (>5mm) reared in three different culture systems which included a newly designed upwelling culture system at WSSNFH. Growth ($p<0.0001$) and survival ($p<0.05$) were significantly higher in mussels reared in the WSSNFH upweller system (increase in mean SL = 1.9 mm, survival = 100%) than in other culture systems (1.3 mm, 1.0 mm, 91%, 90%). Following results from these tests, WSSNFH has had repeated success culturing *E. t. rangiana*. We believe other species of federally endangered mussels may be cultured successfully with these techniques.

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PL 61*

UNIONID MUSSELS AS BY-CATCH IN LARGE RIVER BENTHIC TRAWLS. Sean P. Reese, Sean Collins, Matt Kinsey, Casey Swecker, Dr. Thomas G. Jones. Marshall University: One John Marshall Dr. Huntington, WV 25755

Freshwater benthic trawling is a relatively new sampling method in large river habitats. Many of the fish species collected might be host fish for unionid mussels since they are small benthic fishes. From the summer of 2006 through the winter of 2008, over 900 trawls have been conducted along the entire 981 miles of the Ohio River in part of larger sampling studies. The purpose of these trawl studies was to effectively sample large river benthic fish however a pattern of juvenile unionid mussels caught in the trawl as by-catch amongst freshly fallen leaf packs was observed. Along with juveniles, adult unionids have also been sampled as by catch. Each site consisted of a 500 x 30 meter reach and four trawls were conducted inside this area. Trawls were distributed evenly throughout the study site, with two one minute trawls near the bank, one two minute trawl on the slope, and one two minute trawl in the channel. All adult unionids were weighed, measured, photographed and released to where they were sampled. All juvenile unionids were preserved and identified in lab under microscope. To date five species of juveniles have been conclusively identified including *P. alatus, L. fragilis, Q. quadrula, O. reflexa, A. plicata*. Trawls filled with leaf packs yielded most juvenile mussels while adults have been sampled throughout a wide habitat range. Fall and early winter yielded most juvenile unionids per trawl effort while adults are commonly sampled year round. Benthic trawling in large rivers is an effective sampling technique for juvenile unionids.

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PL 67*

PROPAGATION AND GROW-OUT OF LARGE-SIZED JUVENILES FOR RELEASE, AND ASSESSMENT OF RESTORATION IN THEIR NATAL RIVERS. D. Hua, Y. Jiao, R. J. Neves and N. King, Freshwater Mollusk Conservation Center, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

To augment natural populations of endangered freshwater mussels, the propagation and culture of juveniles have been recommended as important strategies. During the last 10 years, a great number of propagated juveniles has been released into their natal rivers. However, these stocking programs have had limited success due to unavailable culture methods to grow juveniles to larger sizes before release. New culture methods with indoor and outdoor culture systems, overwinter culture systems, flow-through tank systems, a concomitant pond fertilization regimen, and an algae distribution system using water circulation from the pond have been developed recently at the Freshwater Mollusk Conservation Center at Virginia Tech. The new techniques have doubled the survival rate and growth rate of propagated juveniles at the early life stage, and succeeded in rearing juveniles consistently through the vital 2-month stage. So far, we have cultured approximately 30,000 juveniles, up to 2 years in age, including *Epioblasma brevidens*, *E. capsaeformis*, *Villosa vanuxemensis*, *V. iris*, *Lampsilis ovata*, *L. fasciola*, and *Potamilus alatus*. In the past two years, 6,000 *V. iris* and 1,200 *L. ovata* have been released in the Clinch and Powell rivers after reaching 20 mm in averaged length, of which 1,500 individuals were tagged. The recapture rates using systematic surveys after 1 year averaged 20 %. Released mussels revealed positive growth at three release sites, though growth rate varied among them. Reproduction in *V. iris* juveniles was observed one year after release, indicating the success of releasing large-size juveniles at suitable habitats in the two rivers.

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PL 62*

PREDICTIVE MODELING OF FRESHWATER MUSSEL SPECIES *ELLIPTIO DILATATA* AND *ELLIPTIO COMPLANATA* IN THE APPALACHIANS. A. R. Mynsberge[1*], J. M. Strager[2], M. P. Strager[3], and P. M. Mazik[4]. [1]Division of Forestry and Natural Resources, 322 Percival Hall, West Virginia University. [2]Natural Resource Analysis Center, 2010 Agricultural Sciences Building, West Virginia University, Morgantown, WV 26506. [3]Division of Forestry and Natural Resources, 317D Percival Hall, West Virginia University, Morgantown, WV 26506. [4]U.S. Geological Survey, West Virginia Cooperative Fish and Wildlife Research Unit, 322 Percival Hall, West Virginia University, Morgantown, WV 26506.

Because detailed distribution maps are not available for many freshwater mussel species, the goal of this project was to develop predicted distribution maps at a scale appropriate for regional conservation projects. We obtained data on several mussel species to model their distributions within the Appalachians. We focused our models on two species represented most in the data, *Elliptio dilatata* and *Elliptio complanata*. A Geographic Information System (GIS) was used to assemble and analyze spatial information that could influence freshwater ecosystems, such as slope, elevation, acid deposition, soil buffering capacity, flow accumulation, density of dams, and density of roads. The density of zebra mussel occurrences was also included in the model. We created predicted species distribution maps using observed mussel locations and locations where mussels were not found. Model accuracy was tested using an independent dataset. The modeled output failed to predict many known locations of these species. We believe that the spatial distribution of the data affected the accuracy of the results. Additionally, the factors that can be described in a GIS may be poor proxies for factors that affect mussel locations, such as in-stream habitat or water quality. Collecting more data on nondetections of freshwater mussels and georeferencing more locations of mussel species may increase the reliability of predicted distribution models.

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PL 68*

DEXAMETHASONE TREATMENT OF NON-HOST FISH TO INDUCE TRANSFORMTATION OF JUVENILE MUSSELS. J. A. Johnson[1], J. Wisniewski[2], and R.B. Bringolf[1]. [1]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, Georgia, 30602. [2]Georgia Department of Natural Resources.

Identification of host fish is an essential component to managing freshwater mussel populations and advancing mussel propagation programs. However, there are instances when primary host fish species cannot be identified or are rare themselves so it is prudent to evaluate other options for propagation of freshwater mussel populations.

The innate immune system of potential host fish determines whether or not successful transformation from parasitic glochidia to independent juvenile mussel occurs. We hypothesized that suppressing the immune system of non-host fish will increase successful transformation rates for freshwater mussels. We compared transformation success from fish that were treated with an immunosuppressant drug, dexamethasone, to fish that were not treated. Dexamethasone was administered to a confirmed non host fish by two methods: intraperitoneal injection (200 µg/g) and an immersion bath (225 – 1000 µg/L). Fish were then exposed to glochidia for approximately one hour and placed into the holding system. Transformation success for each treatment group will be discussed. Use of immunosuppression to induce juvenile metamorphosis on non-host fish could prove to be a valuable tool for restoration of freshwater mussels, particularly for threatened and endangered populations for which host fish have not been identified.

NOTES: _____

PL 63

SURVEY OF THE MUSSELS OF THE MONONGAHELA RIVER IN PENNSYLVANIA. Sean Collins, Matt Kinsey, Sean Reese, Tom Jones. Marshall University, One John Marshall Drive, Huntington, WV 25755 USA.

Relatively little is known about the freshwater mussel communities of the Monongahela River in Pennsylvania. In August 2008, a group of researchers from Marshall University completed a river-wide mussel sampling project on the Monongahela River in Pennsylvania as part of a larger biological assessment of the river in PA by the US EPA and PA DCNR. The goal of the project was to determine the status and distribution of mussel species throughout the Monongahela in Pennsylvania. Thirty one sample sites were identified by the EPA. Using SCUBA, divers conducted 12 five-minute visual search transects at each sample site. Transects were performed upstream and parallel to flow. Divers recorded depth, substrate composition and zebra mussel score (based on abundance). All live mussels were brought to the surface, weighed, measured, photographed and immediately returned to the river. Dead shells were identified and recorded for presence/absence data only. In total, 148 live mussels of 7 different species were recovered. *Potamilus alatus* accounted for >90% of the live mussels collected. Live mussels were found only at 25% of searched transects. The average zebra mussel score was 0.32. The most dominant substrate was fines/silt (78%). The Monongahela River in Pennsylvania supports a very diffuse, species-poor Unionid community dominated by *P. alatus*. The Unionid community is also very sparse with few individuals collected from only 25% of searched transects.

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PL 69*

INVESTIGATIONS IN THE *IN VITRO* METAMORPHOSIS OF FRESHWATER MUSSELS. Christopher Owen[1], James Alexander [1] and Monte McGregor[2]. [1]Department of Biology, University of Louisville, Louisville, KY 40292. [2]Center for Mollusk Conservation, Kentucky Department of Fish and Wildlife Resources, Frankfort, KY 40601.

In vitro metamorphosis is a technique of culturing freshwater mussels without fish hosts. The method utilizes cell culture techniques to artificially create the physiological environment of a fish and allow normal development of mussel larvae. Upon completed development, mussels are transferred to freshwater where they begin growing as juvenile mussels. We investigated the prospects of metamorphosis of nineteen species and as well as various factors affecting their development *in vitro*. Factors investigated include antibiotic toxicology, control of microbial contamination, nutritional supplementation and dilution techniques. Twelve species were successfully metamorphosed, including the endangered species *Cyprogenia stegaria*, *Epioblasma capsaeformis* and *Lampsilis abrupta*. Control of microbial contamination was the most critical factor with mussels requiring more than 7-9 days to metamorphose. Increasing antibiotic concentrations generally resulted in cytotoxic effects on glochidia, especially with the antimycotic amphotericin B. Frequent media changes controlled microbial contamination more effectively than increased drug concentrations, and allowed for antibiotic concentrations to be reduced. Sources of protein serum were investigated, including fetal bovine, rabbit and fish. While most sera were effective with host-generalists (*Utterbackia imbecillis, Pyganodon grandis*), host-specifists (*Cyprogenia stegaria*) developed best with fish serum. Lipid augmentation with cod liver oil or defined lipid supplements increased total lipid reserves thereby improving the physiological condition in newly metamorphosed juveniles. The *in vitro* method demonstrates successful metamorphosis, even with sensitive and host-specific species. Juveniles produced are generally as active and viable as juveniles produced *in vivo*. This method serves as a valuable tool for producing juvenile mussels for physiological research, toxicity testing and propagation with species for which no host is known.

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PL 64*

RANGE EXTENTION OF ANODONTA SUBORBICULATA TO INCLUDE POPULATIONS WITHIN WEST VIRGINIA. Matthew E. Kinsey, Sean Collins, Sean Reese, Ralph Taylor. Marshall University, One John Marshall Dr., Huntington, WV 25755.

Anodonta suborbiculata is a unionid that inhabits backwater areas of rivers that have low velocity and fine sediment. It is a secure species (G5) that has an expanding range. It utilizes a variety hosts that are common in northeastern river systems. The aim of this study was to begin examining the range of this species in West Virginia, specifically in the connected backwaters of the Ohio River. During the fall of 2008, 16 embayments with connections to the Ohio River within West Virginia were identified. Haphazard searches in wadeable water were conducted to determine presence. Shell material was collected from middens within each embayment. *A. suborbiculata* was considered to be present when identifiable shell material was recovered. In all, 8 of the 16 sites had *A. suborbiculata* present. Four of the 8 where it was not detected appeared to be marginal habitat due to substrate characteristics or fluvial/ channel character. Based on these findings it appears that this is an area where *A. suborbiculata* has expanded its range. Since it was present at the most upstream and downstream of the chosen sites further investigation is needed to determine the extent of its range.

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PL 70

RECOVERING THE RIFFLESHELL: THE PROPAGATION AND TRANSLOCATION OF A FEDERALLY ENDANGERED FRESHWATER MUSSEL TO OHIO. G.T. Watters[1], T. Gibson[1], C. B. Kelly[1], K. Kuehnl[1], M. Kibbey[1], K. Harraman[1], J. Cramer[1] & H. Albin[2]. [1]Department of Evolution, Ecology, and Organismal Biology, Ohio State University, and Columbus Zoo and Aquarium Freshwater Mollusc Conservation and Research Facility. [2]Columbus Metro Parks.

The Northern Riffleshell, *Epioblasma torulosa rangiana*, is a federally endangered freshwater mussel. Once common in the Darby Creek system of Ohio, the population experienced a decline in the 1980-1990's. However, based on the current abundance of other mussels exhibiting recruitment it is believed that the creek has recovered sufficiently to support the Riffleshell again. In August 2007 two trial populations of 23 and 21 individuals were moved from the Allegheny River of Pennsylvania to Big Darby Creek and fitted with passive integrated transponders (PIT) tags. These populations were recovered in October 2007 and July 2008 with only 4% mortality. Based on this trial success, in June and July 2008 1,737 Riffleshells were collected from the Allegheny River, fitted with PIT tags, and moved to Big Darby Creek. Eight individuals died in transit or before release (0.5% mortality). Nine experimental populations were established at six sites within Battelle-Darby Metro Park: two of 500, two of 200, two of 100, two of 50, and one of 69. The 69 individuals had been used for propagation work that resulted in ~700 juveniles that were released as well. The hosts for this propagation (rainbow darters) were raised from eggs specifically for the project. Future monitoring will measure the reproductive success of the various-sized populations. It is hoped that these releases will reestablish this unique mussel in Ohio.

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PL 71

FRESHWATER MUSSEL STUDIES IN THE NAVIGATIONAL POOLS OF THE ALLEGHENY RIVER, PENNSYLVANIA. Tamara A. Smith[1*] and Elizabeth S. Meyer[2], [1] Western Pennsylvania Conservancy, Northwest Field Station, Union City, Pennsylvania, 16438; [2] Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania, 15222, U.S.A. ([*] Current Address - 12131 Richmond Rd, Twin Lakes, WI, 53181, U.S.A.

The main-stem Allegheny River is nationally recognized for its freshwater mussel (Unionidae: Bivalvia) diversity; however habitat disturbance and degradation have triggered the decline and loss of mussel communities in the lower river, where lock and dam structures restrict the free-flow of water and create deep navigational pools. Seventy-five transects were surveyed for freshwater mussels in the navigational pools of the lower Allegheny River. Transects 100-meters long were placed perpendicular to river flow and surveyed using SCUBA. We recorded 22 live native mussel species, including *Pleurobema clava* (Lamarck, 1819) (clubshell) and *Epioblasma torulosa rangiana* (I. Lea, 1838) (northern riffleshell). Two additional species were found only as dead shells. No live mussels were found in depths greater than 9.8 meters, and over 95% of all live mussels were found in depths less than 6 meters. Multiple regression analysis indicates that sand, gravel and boulder had positive partial effects on species richness, and depth, silt and organic debris had negative partial effects (multiple $r^2 = 0.2648$, $F = 33.14$, $d.f. = 6$ and 552, $P < 0.0001$). Similar analyses indicate that sand and boulder had positive partial effects on mussel abundance, and depth, silt and organic debris had negative partial effects (multiple $r^2 = 0.1988$, $F = 27.45$, $d.f. = 5$ and 553, $P < 0.0001$). Percent riverine species significantly increased with increasing river kilometer ($F = 6.337$, $d.f. = 73$, $P = 0.014$). Sand and boulder had positive partial effects on riverine mussel abundance, and depth, silt and organic debris had negative partial effects (multiple $r^2 = 0.1952$, $F = 26.82$, $d.f. = 5$ and 553, $P < 0.0001$). We hope these data will help aid the restoration and protection of endangered mussels in this watershed.

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PL 76

CHARACTERIZING IN-STREAM HABITAT OF DWARF WEDGEMUSSEL IN THE DELAWARE RIVER WATERSHED. Jeffrey C. Cole and William A. Lellis, USGS Leetown Science Center, Northern Appalachian Research Branch, 176 Straight Run Road, Wellsboro, PA 16901.

The federally endangered dwarf wedgemussel (DWM), *Alasmidonta heterodon*, requires certain habitat conditions for survival, which may include specific temperature and flow regimes. We evaluated discharge and temperature at each of three known DWM sites in the upper Delaware River mainstem (NY/PA) in order to identify any unique characteristics at these sites that might be favorable for DWM. We also developed bathymetric profiles of the stream channel to assess potential impacts of dewatering and scouring on mussels. Our results show that specific areas within each site that support mussels were less likely to be dewatered in times of low flows, and also less susceptible to scouring during periods of high water. We measured temperatures in mussel areas to be cooler (-4°C) during periods of extremely warm mainstem temperatures and warmer (+6°C) during periods of extremely cold mainstem temperatures, indicating sites may serve as a thermal refuge for DWM. In ongoing work, we are examining stream gradient in smaller tributaries to the Delaware River mainstem that contain DWM. We are also employing new techniques to develop more accurate site maps as well as sediment transport and deposition models for both mainstem and tributary sites.

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PL 72

GASTROPODS IN TIGUA RIVER, SAN FERNANDO, BUKIDNON, PHILIPPINES. Gloria Galan and Michelle Pepito, Biology Department, CAS, Central Mindanao University, Musuan, Bukidnon, Philippines.

A study was conducted in Tigua River, San Fernando, Bukidnon, Philippines from November 2003 to January 2004. The study aimed to: 1) determine species of gastropods; 2) determine species abundance of gastropods using sieve and handpicking method; and 3) determine some physical and chemical parameter such as temperature, depth, pH, and water current affecting the distribution of gastropods. Three (3) stations were established with 2x5 meter square plots. Two methods were employed: sieving and hand picking. The statistical tool utilized the Analysis of Variance (ANOVA). There were eight (8) identified species of gastropods, five (5) Genera and four (4) Families. The families include Viviparidea, Thiaridae, Physidea; while the genera include *Melania, Melanoides, Vivipara, Tarebia, Physa* and one (1) *Sp.1*. Results revealed that Station 1 obtained the highest species abundance with eight (8) species, followed by Station with 2 with seven (7) species and station 3 with five (5) when sieve method was employed. During handpicking method, Station 1 and 2 obtained the highest species abundance with seven (7) species and Station 3 with three species data analysis showed that species mean value of station 3 was found to be significantly difference (P=0.0001). No significant differences were found in both methods. Based from finding of the study, an inventory of gastropods should be further studied as well as the ecological factors affecting the gastropods.

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PL 77

DETERMINING TENNESSEE HEELSPLITTER (*LASMIGONA HOLSTONIA*) PRESENCE/ABSENCE THROUGH PREDICTIVE MODELING. B. T. Watson[1] and K. J. Ryan[2]. [1]VA Department of Game & Inland Fisheries, 1132 Thomas Jefferson Road, Forest, VA 24551. [2]VA Department of Game & Inland Fisheries, P.O. Box 11104, Richmond, VA 23230.

The Tennessee heelsplitter is a state endangered freshwater mussel that predominantly occupies small, shallow streams and headwater creeks, which has resulted in the lack of a comprehensive understanding of the species' distribution in Virginia since surveys in such streams have been relatively infrequent. This has lead to conflicts with projects where the T&E species review results in no "hits" for the TN heelsplitter but visual assessment of the site identifies suitable habitat. A more thorough survey of small tributaries and headwater creeks throughout the species' range would reduce these conflicts by not only identifying species presence/absence, but also by identifying habitats where the species is likely or not likely to occur. To this extent, the VA Department of Game & Inland Fisheries has developed an aquatic habitat classification system to evaluate the potential for an area to support aquatic species. The model is hierarchical and uses landscape-scale parameters such as ecoregional drainage units, stream reach order, connectivity (downstream reach order) gradient, reach elevation, and dominant geology overlain with known species records to determine stream reaches where a species may occur. The model was ground truthed for the TN heelsplitter by surveying 72 sites – 61 that were identified as potential habitat and 11 that were not. TN heelsplitter was found at six of the 61 potential sites and one of the 11 non-potential sites. The TN heelsplitter also was found at three sites post project, making the current effectiveness of the model 14%. Incorporation of additional parameters, such as water chemistry data, may increase the model's effectiveness.

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PL 73

TESTING HABITAT SUITABILITY MODELS WITH MUSSEL TRANSLOCATIONS. B. J. K. Ostby and R. J. Neves. Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA, 24061.

Many freshwater mussel species demonstrate non-random distributions within reaches of the Clinch River, and some are strongly associated with environmental gradients. In a previous study we quantified habitats occupied by mussel species and developed habitat suitability criteria (HSC) models to describe the range of flow and substrate conditions inhabited by species. In the current project, we tested whether those criteria were applicable beyond the Clinch River and whether observed relationships were related to survival and condition of individuals. We placed 30 individuals of *Actinonaias pectorosa* in each of 2 replicate plots of 3 habitat treatments in the Douglas Dam tailwater, French Broad River. Habitat treatments were optimal, suitable, and unsuitable according to HSC. We found evidence that individuals in optimal and suitable habitats maintained better physiological condition than those in unsuitable habitats. Additionally, individuals consistently abandoned one of the unsuitable plots while remaining in all optimal and suitable treatments. Quality of habitat as described by HSC may be related to an individual's condition and most likely to its reproductive potential and survival. Our HSC may be an important tool to guide flow releases at dams and select suitable habitats for mussel translocations for some species of the Upper Tennessee River Basin.

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PL 78

SEASONAL POPULATION DYNAMICS OF *LAMPSILIS FASCIOLA* IN TWO SOUTHERN ONTARIO RIVERS. Todd J. Morris. Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, 867 Lakeshore Rd., Burlington, Ontario, Canada, L7R 4A6.

The wavy-rayed lampmussel (*Lampsilis fasciola*) is considered federally Endangered in Canada and efforts are underway to facilitate its recovery. One identified knowledge gap is an understanding of the temporal nature of the species' reproductive behaviours. In an attempt to address this gap two populations (Thames and Grand rivers) were examined in 2008. One site was selected in each watershed and a 400 m^2 area was sampled weekly from May through September. During each sampling event the substrate surface was searched visually for individuals and all detected individuals were tagged, sexed, measured, assessed for gravidity and returned to their original position. In addition, all individual females exhibiting a luring behaviour were photographed *in situ* and the lure type was recorded. Gravid females were recorded continuously from May 15 through September 24 however two peak periods were detected. The initial peak occurred during the first week of June while the second occurred towards the middle of July. The majority of females (70-80% by site) were only present at the surface during one peak event. Males were typically found in very low numbers however they reached peak abundance during the first week of July preceding the second female peak.

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PL 74

GROWTH OF CAGED RAINBOW MUSSELS IN TWO UPPER TENNESSEE RIVER BASIN STREAMS DRAINING DIFFERENT LAND USES. Brian Evans, USFWS, Abingdon, VA; Cindy Kane, USFWS, Gloucester, VA; Nathan Eckert and Amanda Wood, VDGIF, Marion, VA; David Garst and Rachel Mair, USFWS, White Sulphur Springs NFH, WV.

During an ongoing body burden study to monitor and evaluate effects of water quality and habitat conditions on freshwater mussels, groups of "Barnhart" silos containing 20 native rainbow mussels (*Villosa iris*) each were placed in two streams of the Upper Tennessee River Basin, Virginia. In October 2007, three silos each containing 9 month-old mussels were deployed at five sites in Indian Creek (IC), a tributary of the Clinch River. On July 1, 2008, four silos each containing 18 month-old mussels were deployed at three sites in the North Fork Holston River (NFHR). Predominant land uses in IC are gas well development, coal mining, and timbering. NFHR land use is predominantly agriculture. Separate controls for IC and NFHR mussels, subsets of which were assessed for contaminant levels before deploying, are maintained at the Virginia Department of Game and Inland Fisheries' mussel propagation facility. Mussel growth is measured bimonthly and temperature is measured hourly at all sites. Water column food (organic content as ash-free dry weight) adjacent to IC silos was collected bimonthly April through October. At three of five sites in IC, mussels grew beginning in April and ceased growing in early July, although available food increased through October. Mussels held at the IC site with poorest physical habitat quality continued to grow through September and had the greatest percent increase in length among all sites. At the IC site with coldest average daily temperature, mussel growth was lowest. In the NFHR, mussels grew through September and there was little difference in growth among sites.

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PL 79

AGE, GROWTH, AND POPULATION DEMOGRAPHY OF THREE FRESHWATER MUSSEL SPECIES (BIVALVIA: UNIONIDAE) IN THE CLINCH RIVER, TN, U.S.A. Jess W. Jones[1,2], and Richard J. Neves[2]. [1]U.S. Fish and Wildlife Service, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321; [2]Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321.

Age, shell growth, and population demography of two endangered mussel species *Epioblasma brevidens* and *E. capsaeformis* and a third non-listed species *Lampsilis fasciola*, were studied from 2004-2007 in a 32-km reach of the Clinch River, TN. Observed maximum age and length of *E. brevidens* was 28 y and 71.55 mm for males and 11 y and 56.6 mm for females; of *E. capsaeformis*, 12 y and 54.6 mm for males and 9 y and 48.6 mm for females; and of *L. fasciola*, 45 y and 91.3 mm for males and 13 y and 62.6 mm for females. For all three species, observed maximum age and length was greater in males than females. Estimated population size in this river reach for *E. brevidens* was 43,426 individuals, 579,141 individuals for *E. capsaeformis*, and 29,532 individuals for *L. fasciola*. Mean recruitment y^{-1} of 1 y-old *E. brevidens* ranged from 7.1% to 20%, of *E. capsaeformis* from 4.0% to 32.4%, and of *L. fasciola* from 5.8% to 25.6%. Population growth rate was 24.9% for *E. brevidens*, 34.6% for *E. capsaeformis*, and -22.4% for *L. fasciola*. Mortality rates of females were higher than for males of *E. capsaeformis* and *L. fasciola*, but not *E. brevidens*. Juvenile mussels were detectable but temporally and spatially variable in occurrence, and a significant component of the age-class structure of all three species. Recruitment was very high during 2006-2007 for *E. capsaeformis* and other species, and likely due to low river discharges in the spring-summer of 2005-2007. Surplus individuals of *E. brevidens* and *E. capsaeformis* are currently available to conduct translocations for restoration purposes.

NOTES: _____

PL 75

WHAT CAN BIOCHRONOLOGY OF MUSSEL SHELL RINGS REVEAL ABOUT HEALTHY MOLLUSKS AND HEALTHY RIVERS? A. L. Rypel [1,2], W. R. Haag [2]. [1]Biology Department, University of Mississippi, Box 1848, University, MS., 38677. [2]US Forest Service, Center for Bottomland Hardwoods Research, 1000 Front Street, Oxford, MS 38655

For over a century, dendrochronology (the study of tree rings) has provided insight into the ecology of trees and forest ecosystems. We present shell growth increment data on multiple mussel species to show how analogous approaches (biochronology) can be applied to mussel ecology and aquatic ecosystems. First, biochronology can be used as a supporting, or in some cases, stand-alone method to validate the assumption of annual ring formation and to detect errors in interpretation of rings. At unregulated sites, mussel growth varied among years but was synchronous among individuals and species, and in some cases among rivers, and was negatively correlated to mean annual streamflow. Predictable patterns of mussel growth and the relationship to strong, annual environmental signals supports annual formation of shell rings. Second, patterns of annual variation in increment width can be used to study mussel growth mechanisms and life histories. In addition to mean annual streamflow, we found correlations of growth with other hydrologic (e.g., timing and number of flood pulses) and climatic variables (El Nino Southern Oscillation, Arctic Oscillation), and a 50+ year chronology for *Elliptio crassidens* showed regular oscillations in growth on about a 10-year cycle. At regulated sites, growth was decoupled from otherwise pervasive relationships with streamflow. In addition, increment data can be used to develop growth models and to estimate longevity and potentially age at maturity. Finally, shell ring chronologies can provide long-term records of mussel growth and environmental conditions allowing assessment of anthropogenic impacts to streams, including nutrient enrichment, streamflow regulation, and global climate change.

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PL 80

LONG-TERM PATTERNS OF RECRUITMENT IN FRESHWATER MUSSEL POPULATIONS. Wendell R. Haag and Melvin L. Warren, Jr. US Forest Service, Center for Bottomland Hardwoods Research, 1000 Front Street, Oxford, MS 38655.

We monitored annual recruitment at two sites in the Sipsey River, Alabama, and one site in the Little Tallahatchie River, Mississippi, for 10 years (1999-2008). Abundance of most species was stable during the study and rate of population increase ( ) • 1 for most populations, but recruitment varied among species and years. In the unregulated Sipsey River, two recruitment strategies were evident: 1) boom or bust and 2) low and constant. Boom or bust species (*Elliptio arca, Medionidus acutissimus, Obovaria unicolor*) had highly variable recruitment in which percentage of recruits varied annually from 0 to >50%, averaging 14-25%. Recruitment of these species was synchronized among sites and species and was strongly negatively correlated with mean August streamflow; highest recruitment occurred in drought years 2000 and 2006. Recruitment of low and constant species (*Fusconaia cerina, Pleurobema decisum, Quadrula asperata*) was lower and less variable (mean = 3-8 %, range = 0-22%), and was not correlated with streamflow. In the regulated Little Tallahatchie River, recruitment was high but variable among years and species (mean annual recruitment, range: *Amblema plicata* = 53%, 0-72%; *Obliquaria reflexa* = 24%, 0-53%, *Quadrula pustulosa* = 13%, 0-21%). Although low recruitment occurred during the 2000 drought, responses to hydrologic variables were less pronounced in the Little Tallahatchie River. The existence of two distinct recruitment strategies shows life history traits have strong bearing on the level of recruitment necessary to sustain populations, but hydrologic alteration can disrupt these associations. Furthermore, frequent and often high recruitment is a regular feature of healthy mussel populations. The low and sporadic recruitment seen in many other populations is likely unsustainable over the long-term.

NOTES: _____

PL 81

ESTABLISHMENT OF THE CLINCH POWELL CLEAN RIVERS INITIATIVE. Braven Beaty, The Nature Conservancy, 146 East Main Street, Abingdon, VA 24210

The Clinch and Powell rivers in northeast Tennessee and southwest Virginia are among the most biologically significant temperate rivers from a global perspective. While the organizations working in the watershed have achieved many conservation successes, there are some shortcomings in the coordination of conservation work. Therefore, cases of piecemeal data gathering/analysis, disconnected regulatory oversight, opportunistic rather than targeted conservation efforts, and lack of cooperation among stakeholders occur. In response to this reality, The Nature Conservancy is collaborating with a diverse array of stakeholders in the watershed including federal and state agencies, private industry, non-governmental organizations, local government representatives and academia to address these shortcomings. The process began by convening a symposium in September 2007 to discuss the current state of knowledge about coal mining impacts on aquatic animals of the Clinch, Powell, and Big South Fork Cumberland rivers. The meeting goal was to foster an open and non-confrontational dialogue among diverse stakeholders and search for solutions to aquatic biodiversity conservation issues. The establishment of an organized initiative to better coordinate conservation efforts in the watershed is a key outcome of the symposium. A broad array of stakeholders active in the watershed created the Clinch Powell Clean Rivers Initiative as a bi-state, bi-EPA region forum for discussion, cooperation, information and data sharing, and priority setting. To date, the group has developed a cooperative agreement among regulatory agencies crossing state and federal regional borders, a draft science research plan, a data and information sharing effort among Clean Water Act regulatory agencies, and an effort to improve outreach to additional stakeholders. The presentation focuses on the formation and structure of the initiative, the range of participating organizations, accomplishments to date, and future efforts.

NOTES: _____

PL 87

HISTORICAL DEMOGRAPHY AND GENE FLOW OF THREE FRESHWATER MUSSEL SPECIES (BIVALVIA: UNIONIDAE) IN THE CLINCH RIVER, TN, U.S.A.: GENETIC EVIDENCE FOR POPULATION EXPANSION AND CONTRACTION DURING THE HOLOCENE. Jess W. Jones[1,2], Richard J. Neves[2] and Eric M. Hallerman[2]. [1]U.S. Fish and Wildlife Service, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321; [2]Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321.

Patterns of intraspecific genetic variation are shaped by contemporary population processes and historical events that have occurred over millennial time-scales. In particular, vicariance biogeography and palaeo-climate change control long-term population trends, historical isolation and incidence of secondary contact throughout a species range, whereas life history traits interact with environmental variables to affect current dispersal rates and fluctuations in population size. Genetic variation was examined in two cognate endangered mussel species, *Epioblasma brevidens* and *E. capsaeformis*, and a common species *Lampsilis fasciola*, in the Clinch River, TN, U.S.A, by screening mitochondrial DNA (mtDNA) sequences and nuclear DNA microsatellites. These species use specific primary fish hosts with varying dispersal capabilities, ranging from low, moderate, and high, respectively. Patterns of mtDNA polymorphism exhibited different trends for long-term population sizes for each species during the Holocene (~10,000 ya to present); namely, *E. brevidens* has declined over time, while *E. capsaeformis* has remained stable and *L. fasciola* has expanded. Long-term effective population size (N_e) was smallest in *E. brevidens*, intermediate in *E. capsaeformis*, and highest in *L. fasciola*. Moderately diverged mtDNA lineages, perhaps indicative of secondary contact, were observed in *E. brevidens* and *E. capsaeformis*. High levels of gene flow (*Nm*) were measured among demes of *L. fasciola* using traditional *F*-statistics and likelihood estimates of *Nm*, whereas such metrics were lower in *E. brevidens* and *E. capsaeformis*. Data are consistent with known population dynamics and life history traits of these species and their fish hosts.

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PL 82

DEVELOPING A MODEL FOR ASSESSING THE SUITABILITY OF POTENTIAL SITES FOR THE RESTORATION OF FRESHWATER PEARL MUSSEL POPULATIONS. Dr. Lee Hastie, University of Aberdeen, School of Biological Sciences, Aberdeen AB24 2TZ, Scotland UK.

A major aim of European conservation agencies, for ensuring the survival of the endangered freshwater pearl mussel (*Margaritifera margaritifera*), is to seek ways of restoring populations within its historic holarctic range. Pilot studies have been undertaken, covering a range of experimental techniques, including habitat restorations, mussel transfers (re-introductions), captive-rearing, and infecting native fish. However, it is recognised that evaluating the success of such experiments will be a medium- to long-term task, owing to the length of the pearl mussel life cycle and the time taken for establishment and growth to maturity. There is an urgent need, therefore, to develop a method of assessing suitable sites before restoration work begins, in order to ensure that the best available sites are selected, thereby increasing the likelihood of success. In Scotland, a simple model was designed for assessing the suitability of historic (extinct and depleted) sites for restoration work, based on conservation (population) status, host fish density, riverbed habitat condition, site security and logistics. It is planned to develop the model further, for use in other areas where water quality may be an issue, by incorporating critical water chemistry parameters in the overall scoring system. The aim is to establish an international project to design a basic, flexible, transferrable model for assessing potential sites for restoration work and to evaluate the model in a range of pearl mussel rivers.

NOTES: _____

PL 88

SPECIES RICHNESS AND CONSERVATION STATUS OF ARKANSAS' UNIONOID BIVALVES. John L. Harris[1], Walter R. Hoeh[2], William R. Posey II[3], Chris L. Davidson[4], Susan Rogers Oetker[5], Jerry L. Farris[1], Jeanne M. Serb[6], Kentaro Inoue[1], David L. Hayes[1], Mark E. Gordon[7], and Alan D. Christian[1,8] [1]Department of Biological Sciences, Arkansas State University, Jonesboro, AR 72467; [2]Department of Biological Sciences, Kent State University, Kent, OH 44242; [3]Southwest Regional Office, Arkansas Game and Fish Commission, Perrytown, AR 71801; [4]Arkansas Ecological Services Field Office, U.S. Fish and Wildlife Service, Conway, AR 72032; [5]Twin Cities Field Office, U.S. Fish and Wildlife Service, Bloomington, MN 55425; [6]Department of Ecology, Evolution, and Organismal Biology, Iowa State University, Ames, IA 50011; [7]New Mexico Museum of Natural History and Science, 1801 Mountain Road NW, Albuquerque, NM 87104; [8]Department of Biology, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA 02125

Since Call's 1895 monograph, various authors have provided estimates of the unionoid bivalve species richness in Arkansas. The most recent synopsis listed 72 species for the state. However, that tally now appears to underestimate the actual unionoid bivalve species richness in Arkansas. Relatively recent phylogenetic studies of the evolutionary relationships and geographic distributions of *Cyprogenia*, *Quadrula*, and *Ptychobranchus* revealed additional phylogenetic species within the state. Our DNA sequence-based phylogeographic studies conducted over the past five years, primarily of taxa currently assigned to *Fusconaia*, *Lampsilis*, *Pleurobema*, and *Villosa,* have revealed at least seven additional phylogenetic species in Arkansas. Geometric morphometric and anatomic data sets have been developed to facilitate identification of these species. Thus, we conclude that the unionoid species richness in Arkansas now exceeds 90 species. In addition to documenting our recent discoveries, we discuss the conservation status of these newly recognized species within the context of revised taxonomic classifications, geographic distributions, and relative abundances.

NOTES: _____

PL 83

DO SMALL DAMS ENHANCE FRESHWATER MOLLUSK HABITATS? Michael M. Gangloff, Appalachian State University, Biology Department, 572 Rivers Street, Boone, NC 28608, Emily E. Hartfield, Auburn University, Department of Biological Sciences, 331 Funchess Hall, Auburn, AL 36849-5407, Jack W. Feminella, Auburn University, Department of Biological Sciences, 101 Rouse Life Sciences, Auburn, AL 36849-5407.

Impoundments are widely recognized as having dramatic impacts on freshwater biota. However, our understanding of how large dams affect mollusks greatly surpasses our understanding of the effects of smaller structures. From 2006-2008 we assessed the impacts of low-head dams (i.e., those <10 m height) on lotic habitats and mollusks in 22 Alabama streams. We measured bivalve and gastropod abundance using a combination of quadrats and timed searches. We surveyed three reaches immediately downstream of each dam and in reference reaches located both up-and-downstream. Streams with intact small dams supported significantly larger mussel populations than did streams with breached (>50% of channel impeded) or relict (<50% channel impeded) dams. Further, mussel species richness was low in streams with breached dams but was much greater in streams with relict dams. In contrast, *Elimia* spp. densities were higher in streams with breached dams. We speculate that long-term streambed stability associated with some intact small dams may benefit mussel populations. In contrast, *Elimia* spp. and other gastropods appear more sensitive to local-scale physicochemical conditions, including flow velocity and substrate composition. Although removal of breached dams should take priority over removing intact structures, a case-by-case approach is necessary to evaluate impacts to sensitive mollusk taxa.

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PL 89

***PHYSA NATRICINA* AND TAXONOMY IN THE FRESHWATER SNAIL FAMILY PHYSIDAE.** J. B. Burch[1], J. Keebaugh[2] and T. Lee[1]. [1]Museum of Zoology, University of Michigan, Ann Arbor, MI 48109. [2]Orma J. Smith Museum of Natural History, The College of Idaho, Caldwell, ID 83605.

Various species of freshwater mollusks have been designated as "Rare and Endangered," and such species are protected to prevent their extinction. For species that have been judged as "Rare and Endangered," it is imperative that their taxonomic credentials are accurate, i.e., that they are valid species, they have been adequately described, and they are not synonyms of previously named species. One of the most speciose and widely distributed families of freshwater snails in continental North America is the Physidae. Here physid snails are distinctive and easily recognizable from other families of freshwater snails: physid shells are left-coiled, non-planate, and inoperculate. Ecologically, most species live in lentic habitats. Among the many nominal species of Physidae, only one is "Red Book" listed, *Physa natricina* (Taylor 1988). *Physa natricina* is a riverine species, whose Recent populations seem to be confined to the Snake River in southern and western Idaho, a river with stretches significantly impounded by hydroelectric dams and whose managed levels are responsive to the demands of agriculture. *Physa natricina* has been recently "synonymized" with the invasive European physid, *Physa acuta* (Draparnoud, 1805). However, morphological, ecological, and molecular evidence indicates that *Physa natricina* is a distinct species, not closely aligned with *Physa acuta*. This controversy illustrates a major taxonomic problem with this family. Most of the species were named largely on geographic location and shell characteristics. However, within the family, there is not a significant amount of variation in the purported diagnostic shell characteristics, which—in light of the plethora of nominal species—frequently makes species identifications very challenging.

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PL 84

EVALUATION OF A FISH LADDER'S CONSERVATION BENEFIT TO MUSSELS IN THE BROAD AND CONGAREE RIVERS, SOUTH CAROLINA, USA. J. E. Price[1], C. B. Eads[2], M. E. Raley[3], [1]Belle W. Baruch Institute for Marine and Coastal Research, University of South Carolina, Columbia, SC 29208, College of Veterinary Medicine, North Carolina State University, 4700 Hillsborough Street, Raleigh, NC 27606, [3]North Carolina Museum of Natural Sciences, Research Lab, MSC 1626., Raleigh, NC 27699-1626.

The South Carolina section of the Broad River is impounded by seven dams, and fish passage has become a conservation priority. In 2007, a fish ladder was opened at the Columbia dam, the dam the farthest downstream, giving fish, and any mussels parasitizing them, the ability to travel to an additional 23 river miles upstream. Inventories revealed 10 mussel species in the 4 mile stretch of the Broad and Congaree immediately downstream of the Columbia dam, but only 4 species upstream. It is unknown if any of the six species found only below the dam historically occurred above it. To evaluate the effectiveness of the fish ladder in transporting mussels, we conducted fish host trials, monitored the seasonality of reproduction of mussels below the dam, and collected glochidia in drift nets to determine when they could be transported upstream. At least one known host species was observed moving through the fish ladder for 5 out of 6 mussel species found only below the dam. No successful hosts are currently known for the sixth species. Although numbers of released glochidia were highest in April and May, some mussel species released most of their glochidia in June and July. Though the fish ladder originally closed in mid to late May each year, we recommended it be left open through August. These recommendations have been accepted pending sufficiently high flow rates for successful operations.

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PL 90

PHYLOGEOGRAPHY OF *ELLIPTIO COMPLANATA* ALONG A PORTION OF THE ATLANTIC SLOPE. C. L. Elderkin. Department of Biology, The College of New Jersey, Ewing, NJ 08638.

The Atlantic slope fauna is unique, although mussel diversity (especially in northern areas) is relatively low. The rivers that drain land east of the Appalachian mountains are separated into distinct drainages that drain directly into the Atlantic ocean; which serves as a barrier to dispersal. Mussels in these areas are thought to spread from one drainage to the other by river capture during severe flooding. Also, fish (and mussels) may have spread back into these areas from one or more coastal refugia following the Pleistocene glacier. One common mussel taxa that is widespread throughout the area is the Eastern Elliptio mussel (*Elliptio complanata*). *E. complanata* is common and occurs in large numbers, and most likely has genetic diversity that is still relatively intact compared to co-distributed taxa that are endangered and/or threatened. Mitochondrial DNA from the COI gene was amplified, sequenced, and compared, among *E. complanata* populations from the Connecticut, Hudson, Delaware, Susquehanna, Po, Meherrin, Nottoway, and Roanoke rivers. Results thus far indicate that genetic structure was the greatest among drainages with little structure within rivers. A notable exception is the Susquehanna River which appears to have genetically divergent populations between the Juniata and other tributaries. Overall, there were two distinct mitochondrial lineages in *E. complanata*. It appears from preliminary analysis that the Delmarva peninsula served as a dispersal barrier from the south. Where a lineage common in the south did not occur in large numbers northeast of the Susquehanna drainage, however both lineages co-occur in rivers southwest of the peninsula. Future data may include samples from drainages in Maine and North Carolina, and include preliminary data from Microsatellite loci.

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PL 85

A TEXAS TREASURE: NATIVE AQUATIC PLANT RESTORATION IN A SPRING-FED RIVER. Sara E. Seagraves[1], Melissa Mullins[1], Dr. Mara Alexander[2], and Dr. Robert Doyle[1]. [1]Baylor University Center for Reservoir and Aquatic System Research, One Bear Place 97178, Waco, TX 76798. [2]US Fish and Wildlife Service, San Marcos, TX.

The second largest spring ecosystem in Texas, the San Marcos Springs rise from the Edwards Aquifer giving life to the San Marcos River and providing habitat for a number of threatened and endangered species. Like most spring-fed systems the stable temperature, relatively reliable flow and consistent water chemistry make the San Marcos River an ideal place for aquatic organisms. A refuge to six federally threatened and endangered species, including the Texas blind salamander, San Marcos salamander, San Marcos fountain darter and Texas Wild Rice, the U.S. Fish and Wildlife Service has declared the San Marcos River a "Critical Habitat". Threats to this system and its endemic species include decreased spring flow, increased urbanization, recreation and introduction of non-native species. Non-native plant species in the San Marcos River include *Cryptocoryne becketti, Hydrilla verticillata* and *Hygrophila polysperma.* In 1998, the U.S. Fish and Wildlife Service began surveying the river for *C. becketti* and found that approximately 200m^2 of the survey area was covered; by 2003 the area had increased to almost 1500m^2 so they joined Baylor University in small scale dredging efforts to remove *C. becketti.* In 2006 a large scale dredging effort occurred and test plantings of three native species, *Sagittaria platyphylla, Heteranthera dubia* and *Ludwigia repens*, were established. After three months 40% and 25% for *S. platyphylla* and *H. dubia*, respectively, were relocated. In 2008, 138 *H. dubia* and 258 *S. platyphylla* were planted and after 4 months 22% and 49% were relocated. Survey efforts will be repeated at one year.

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PL 91

A NEW SPECIES OF FRESHWATER MUSSEL, GENUS *ANODONTA* (BIVALVIA: UNIONIDAE), FROM THE COASTAL PLAIN DRAINAGES OF ALABAMA, FLORIDA, AND MISSISSIPPI, USA. J. D. Williams[1], A. E. Bogan[2] and J. T. Garner[3]. [1]Florida Museum of Natural History, University of Florida, Museum Road and Newell Drive, Gainesville, Florida 32611. [2]North Carolina State Museum of Natural Sciences, MSC 1626, Raleigh, North Carolina 27699-1626. [3]Alabama Division of Wildlife and Freshwater Fisheries, 350 County Road 275, Florence, Alabama 35633

A new species of unionid mussel, Genus *Anodonta*, is described from Coastal Plain streams of the eastern Gulf of Mexico drainages. It occurs in the Pearl and Pascagoula River drainages in Mississippi, Tombigbee River in Mississippi, Tensaw River in Alabama and the Escambia River drainage in Alabama and Florida. Based on shell morphology and color pattern it belongs to a species group within the genus *Anodonta* which includes *Anodonta couperiana, A. heardi A. implicata* and *A. suborbiculata*. Of the four species in this group it appears to be most closely related to *A. suborbiculata* which is widespread in the Mississippi Basin and has been widely introduced outside its native range. *Anodonta* sp. differs from *A. suborbiculata* in having a more inflated umbo which extends above the hinge line and being more elongate. *Anodonta* sp. occurs in floodplain sloughs and oxbow lakes in silty sand to mud sediments. Its conservation status is unknown as its typical habitat has not been included in most mussel sampling programs.

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PL 86

RESTORATION OF FOUR RARE AND ENDANGERED MUSSELS IN THE BIG SOUTH FORK CUMBERLAND RIVER. Monte A. McGregor[1], J. J. Culp[1], A.C. Shepard[1], F. Vorisek[1], S. Ahlstedt[2], S. Bakalytz[3]., and L. Koch[4]. [1] KDFWR, Center for Mollusk Conservation, Frankfort, KY 40601. [2] retired USGS, Knoxville, TN. [3] BSF National River and Recreational Area, 4564 Leatherwood Rd, Oneida, TN 37841. [4] USFWS, Frankfort, Kentucky 40601.

Seventy-one species of freshwater mussels have been reported in the Big South Fork (BSF) Cumberland River in Kentucky and Tennessee: only 25 are found today. In an effort to restore the mussel diversity, we reintroduced four species that historically occurred in the BSF (the endangered *Dromus dromas*, endangered *Epioblasma capsaeformis*, and two candidate species, *Ptychobranchus subtentum*, and *Cumberlandia monodonta*). During the spring 2008, approximately 300 individuals were collected from the Clinch River, TN and translocated to BSF in KY. Prior to release, all mussels were measured, weighed, and tagged. The target survey area (22m x 20 m) selected for release was sampled with 24 randomly placed m^2 quadrats to determine pre-release species assemblages and densities. Twelve species and 2.17 mussels/m^2 (mean) were identified, with one endangered (*Epioblasma brevidens*, 0.25/m^2). None of the target species were found. In June 2008, all individuals were released in a 6 x 12 m area at pre-determined densities and locations within the grid to facilitate monitoring. The spectaclecase was released under large boulders near the grid. In late September 2008, a post release quantitative survey was conducted in a 12 x 15 m area surrounding the release grid. Sixteen species and 2.77 mussels/m^2 were identified along with the three translocated species (which ranged in densities from 0.17 to 0.46/m^2). Two endangered mussels were also found (*E. brevidens*, 0.12/m^2 and *Villosa trabilis*, 0.04/m^2). Additional qualitative efforts revealed 29 spectaclecase.

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PL 92

PHYLOGENETIC ANALYSES AND CLASSIFICATION: PROBLEMS IN PARADISE. A.E. Bogan[1], J.L. Harris[2], J.D. Williams[3], and W.R. Hoeh[4]. [1]North Carolina Museum Natural History, 11 West Jones St., Raleigh, NC 27601. [2]Dept. Biological Sciences, Arkansas State University, Jonesboro, AR 72467. [3]Florida Museum of Natural History, Gainesville, FL 32611. [4]Dept. Biological Sciences, Kent State University, Kent, OH 44242.

Recent research on the phylogeny of various freshwater molluscan groups has illustrated some serious problems in the application of Linnaean classification and the basic rules of nomenclature. Problems often begin with a lack of appreciation for the importance of the type specimen/locality of a species and the type species of a genus. The type locality of a species is published with the original description or is subsequently fixed, and it is restricted to published literature. Thorough review of the published literature, synonymies, and type specimens should precede the start of phylogenetic studies at any taxonomic level. The use of type specimens (which is often impractical for molecular systematic work) or topotypic specimens which phenotypically match the original description, enhances the value of phylogenetic analyses by minimizing potential identification-based ambiguities. Including generic type species in phylogenetic analyses is very important to correctly name species-level clades in Linnaean classifications. Analyses of random collections of specimens attributed to a species or genus without including types/topotypes and generic type species for comparison severely limits the utility of any phylogenetic study.

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PL 93

DAMS AND ZEBRAS: THE HISTORICAL LOSS OF FRESHWATER MUSSELS IN THE OHIO RIVER MAINSTEM. G. T. Watters[1], and C. J. Myers Flaute[2]. [1]Department of Evolution, Ecology, and Organismal Biology, Ohio State University, and Columbus Zoo and Aquarium Freshwater Mollusc Conservation and Research Facility. [2]College of Environment and Design, University of Georgia.

The decline of the freshwater mussel fauna of the Ohio River mainstem is compared to the dates of service of the existing dams and the arrival of the exotic zebra mussel. Based upon historical records we know that most pools supported 20-50 species of mussels; today many have less than ten. The results presented here show a mixed effect of these dams on the mussel fauna ranging from marked deleterious effects in Hannibal, McAlpine, and Smithland pools to comparatively little effect in pools such as Dashields, Greenup, and Markland. In nearly all cases the most dramatic declines in mussels are associated with the arrival of zebra mussels in the Ohio River in 1991.

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PL 98

MOLLUSC CULTIVATION AND RECOVERY AT VIRGINIA'S AQUATIC WILDLIFE CONSERVATION CENTER. Nathan L. Eckert[1], Joseph J. Ferraro[1], Amanda E. Wood[1], Jonathan Orr[1] and Michael J. Pinder[2]. Virginia Department of Game and Inland Fisheries, [1]1724 Buller Hatchery Rd, Marion, Virginia 24354, [2]2206 South Main Street, Blacksburg, Virginia, 24060.

The Virginia Department of Game and Inland Fisheries established the Aquatic Wildlife Conservation Center (AWCC) in 1998 to recover the high number of endangered freshwater mussels in the Upper Tennessee River System of Virginia. The facility is located along the South Fork Holston River (SFHR) near Marion, Virginia. The AWCC draws water from the SFHR that passes through a 5-acre pond to increase temperature and algal productivity. Adult mussels are held in circular fiberglass tanks that can provide optimal habitat conditions for each species. Thirty-eight species of freshwater mussels have been held at AWCC with 30 spawning in captivity. Twenty-four species have been propagated producing over 2,618,000 juveniles since 2003. A portion of juveniles are held for grow-out in flow-through and recirculating systems supplied with filtered river water, eight species have been raised to over one year of age in these system, two species have become sexually mature. To date, we have released over 635,000 mussels ranging in age from one day to nine years. In addition to mussels, the state endangered spiny riversnail, *Io fluvialis*, is raised at AWCC with over 10,750 released ranging from three months to two year old. These animals are released into six designated mussel restoration reaches in the Powell, Clinch, and North Fork Holston rivers of the upper Tennessee River System of Virginia.

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PL 94

EFFECTS OF DAM FAILURE ON UNIONIDS IN WINTER: CLAMSICLES OF 2005. J. L. Clayton[1] and P. A. Morrison[2]. [1]West Virginia Division of Natural Resources, PO Box 67, Elkins, WV 26241. [2]USFWS, Ohio River Islands National Wildlife Refuge, 3982 Waverly Road, Williamstown, WV 26187.

On January 6, 2005 a towboat lost nine of 12 coal barges while maneuvering upstream into floodwaters out of the Belleville Lock and Dam (RM 203.8) on the Ohio River. Four barges sank and impeded operation of the dam gates, resulting in a lowering of the water level between Belleville and Willow Island Dams. The pool was eventually closed to navigation. Pool levels dropped 16 feet at the dam before refilling on January 31. The loss of pool left resident mussel populations stranded causing significant mortality due to extremely cold temperatures and wind. A mussel kill investigation was conducted by the West Virginia Division of Natural Resources and others (ORSANCO, OHDNR, USFWS, and WVDEP). Three transects were placed from top of bank to water's edge on all banks at approximately two mile intervals over the 26 mile affected river reach. Known mussel beds at the head of islands were assessed separately. Over 84,000 mussels of 18 species died as a result of this incident. Using the AFS guidelines, the estimated replacement cost of the mussels was nearly $490,000, not including assessment costs. In addition to the efforts required to conduct the assessment, numerous volunteers assisted in salvage efforts to relocate stranded individuals at known mussel beds. As the mussels were exposed, many were moved to deeper water while some individuals were taken to Ohio State University Mussel Conservation and Research Center in order to monitor mortality. The greatest mortality was observed in *Amblema plicata* with nearly 75% of the individuals dying following salvage.

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PL 99

SPAWNING, PROPAGATION AND CULTURE OF GREEN RIVER MUSSELS. K R. Moles[1], and J. B. Layzer[2]. [1]Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, P.O. Box 5114, Cookeville TN 38505. [2] U.S. Geological Survey, Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, P.O. Box 5114, Cookeville TN 38505.

At least 51 mussel species once occurred in the Green River within the boundaries of Mammoth Cave National Park (MACA). For decades, little or no recruitment occurred for most species in the upper Green River. Recently, recruitment of $\geq$39 species has occurred in response to a few years of favorable flow conditions. Recruitment of the endangered clubshell has occurred about 120 km upstream of MACA but neither adults nor young have been found recently within the park. Without intervention (propagation and stocking), it might take decades of favorable flow conditions and successful reproduction for the upstream population to expand downstream into the park. Tennessee Tech University (TTU) and MACA entered into a joint propagation-culture effort with the goal of restoring mussel biodiversity and ecological function to the Green River within MACA. Seven species, including the federally endangered *Pleurobema clava* and *Lampsilis abrupta*, were propagated at TTU and the juveniles transferred to the MACA culture facility located within Western Kentucky's Upper Green River Biopreserve. The MACA culture facility is a streamside flow-through facility utilizing water and natural food pumped directly from the Green River. In the fall, juveniles were released into the Green River within MACA. *Lampsilis abrupta* broodstock originated from individuals TTU propagated in 2002 and cultured them until they became sexually mature in a hatchery raceway where they spawned and produced viable glochidia. We collected broodstock of other species from the Green River. We collected non-gravid *P. clava* and *T. lividus* and held them in the MACA culture facility where spawning occurred.

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PL 95

SAMPLING MUSSEL COMMUNITY IN CONJUNCTION WITH A LOCK ADDITION AT KENTUCKY LOCK AND DAM: DETECTING COMMUNITY CHANGE. J. B. Sickel[1], C. E. Lewis[2], A. T. Miller[3], J. E. Peck[4], and R. N. Tippit[5]. [1]24 Richmond Dr., Savannah, GA 31406. [2]Lewis Environmental Consulting, LLC., Murray, KY 42071. [3] Third Rock Consultants, LLC, Lexington, KY 40503. [4]Pennsylvania State University, University Park, PA 16802. [5]Nashville District U.S. Army Corps of Engineers, Nashville, TN 37202.

In conjunction with construction of the new 366 meter lock at Kentucky Lock and Dam on the Tennessee River, mussels were randomly sampled at four sites in 2003, 2005, and 2007. Statistical precision is critical for detecting community change with minimal sampling. In an attempt to improve precision, in 2007 supplementary samples were collected adjacent to locations in 2005 which had the lowest variation in mussel density (lowest coefficient of variation for five 0.25 m^2 quadrats per sample unit). Results were not as expected: variation was just as high as for randomly selected samples. Data were analyzed as univariate mussel density, and as multivariate community data using PC-ORD. Statistical precision, especially univariate density, was confounded by a large juvenile recruitment from the 2006 reproductive season apparently influenced by low dam discharge during and following reproduction that year. High discharge in 2002 and 2004 resulted in low recruitment detected the following years. Canonical Correspondence Analysis revealed that mussel density was positively correlated with occurrence of fine gravel (compared to other grain sizes) and negatively correlated with discharge (especially discharge above 150,000 cfs). A multivariate, calibration ordination model was developed which we believe will be useful in detecting future change in community structure if it occurs. Deciding which characteristics and species to use for evaluating community change remains refractory.

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PL 100

INSIGHTS ON FRESHWATER BIVALVES "IN VITRO" CULTURE. Jorge Machado[1,2], Paula Lima[1,2], Manuel Lopes Lima[1,2]; Uthaiwan Kovitvadhi[3], Satit Kovitvadhi[4], [1] ICBAS - Instituto de Ciências Biomédicas de Abel Salazar, Departamento de Produção Aquática, Univ. do Porto, 4099 – 003, Portugal. [2] CIIMAR - Centro Interdisciplinar de Investigação Marítima e Ambiental, Univ. Porto, 4050 – 123, Portugal. [3] Department of Zoology, Faculty of Science, Kasetsart University, Bangkok 10900, Thailand. [4] Department of Agriculture, Faculty of Science and Technology, Rajabhat Bansomdejchaopraya University, Bangkok 10600, Thailand.

Generally, mussel culture tends to mimic natural conditions, but results are far from successful for glochidia and juvenile survival due to several limiting factors; namely larvae release from gravid female, host fish infestation and natural contamination with pathogenic agents in the water. The more traditional method of glochidia culture is carried out by artificial fish infestation and its success depends on several factors such as the condition of the glochidia, temperature and host's acquired immunity to the glochidia. It is now possible to culture glochidia in vitro under controlled conditions and reach a glochidia survival rate of 94% for *Hyriopsis myersiana* and a posterior juvenile survival rate of 84% at the 120th day. Based on our results obtained with the tropical species *Hyriopsis myersiana* cultured under *in vitro* conditions, the successful survival of glochidia requires a mixture of an adequate artificial medium (M199) with a fish plasma fraction in a culture disc (60X15 mm) under 5% CO_2 atmosphere and room temperature and humidity. The survival rate of the cultured glochidia was improved from a low of 32.42% with stripped catfish to a high of 94% with common carp. It suggests a close correlation between the specificity of fish plasma and glochidia survival. The CIT-ALA group of amino acids are particularly determinant for successful development. The high growth and survival rates of these *in vitro* juvenile freshwater pearl mussels *H. myersiana* was accomplished in closed recirculating aquacultural systems composed of 5 cabinets: a particulate filter cabinet, a macrophyte (*Limnophila heterophylla*) filter cabinet, a biological filter cabinet, a water resting cabinet and plastic culture units. Water flowed through the juvenile culture units at 20 ml/min in both systems. This enhanced system allowed low free carbon dioxide, total ammonia nitrogen, nitrate, phosphate and silica. The juveniles were fed twice a day on a 1:1 mixture of *Chlorella* sp. and *Kirchneriella incurvata*.

PL 96

NOVEL COST EFFECTIVE TECHNIQUES TO MAP SUBSTRATE AND DEPTH OVER LARGE AREAS. C. D. Swecker [1], S. Collins [2], and T. G. Jones [2]. [1] Environmental Solutions & Innovations, Inc., 781 Neeb Rd., Cincinnati, OH 45233. [2] Marshall University, Department of Integrated Science and Technology, 1 John Marshall Dr. Huntington, WV 25755.

Substrate is a critical component to the survival and well being of freshwater unionid mussels. Methods of mapping and modeling substrates in large rivers are laborious, costly, time intensive, and when completed are usually on a small scale. Using a standard ¾ inch diameter section of copper pipe and an inexpensive global positioning depth sounder (Garmin GPSMAP 498C) one can accurately measure substrate trends over a wide expanse of stream or river. Methods were modified from the Ohio River Valley Water Sanitation Commission's (ORSANCO) protocol to assess substrate and depth at their electro fishing sites. Recent work associated with habitat restoration in a small stream has shown the technique capable of tracking changes in depth and streambed composition over time. This method incorporates Global Positioning System (GPS) and spatial analyst tools to create a variety of maps depicting depth, substrate composition, and other biotic/abiotic variables. This method can be used as a powerful tool to provide incite in locating upstream relocation habitat for mussel surveys, locating suitable substrate for the translocation of threatened and endangered species, tracking shifting substrates at long term mussel monitoring sites, estimating impacts of dredging on streambed movements, and/or determining the extent of sedimentation influx due to drilling frac-outs. This simple technique can assist in further quantifying mussel habitat and may be a valuable tool to Malacologists over a broad geographic range.

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PL 101

FLOATING UPWELLER SYSTEMS FOR POND CULTURE OF FRESHWATER MUSSELS. Chris Barnhart[1], Andy Roberts[2], Steve McMurray[3], and Scott Faiman[3]. [1]Biology Department, Missouri State University, 901 S National Ave., Springfield, MO 65897. [2]U.S. Fish and Wildlife Service, 101 Park DeVille Place, Columbia, MO 65203, [3]Missouri Dept of Conservation, 1110 S College Ave, Columbia , MO 65201

Efforts to culture freshwater mussels are hampered by the difficulty of providing suitable food. Laboratory culture is labor intensive and artificial foods present difficulties. Caging mussels in rivers provides access to a natural food supply but is impractical at most sites. Increasingly, mussel culturists are turning to ponds as an alternative source of natural particulate food. In some operations pond water is piped to the mussels in substrate trays in indoor facilities. Alternatively, mussels can be brought to the pond, if suitable flow can be provided. We are developing floating upweller systems ("flupsys") for mussel culture in ponds. Flupsys are used extensively for bivalve mariculture and several large-scale designs are available. Basically, the animals are held without substrate in screen-bottom containers that are suspended from a floating platform, and water is drawn through the containers by a pump. We developed small systems suitable for experimental use, and a larger system (16*14 feet) with 16 20-gallon bins for mussel grow-out, recently installed at the Kansas City Zoo. We tested growth of 4 mussel species in 3 different water bodies over 5 months. Juveniles were lab-cultured to 5 mm before placing in the flupsys. Survivorship ranged among species from 30 to 100%, with most mortality in the first month. Mean growth varied among species and among water bodies, and ranged from 5-10 fold in shell length and from 300-1000 fold in mass. These systems can be combined with lab production of juveniles for rapid grow-out to "taggable" size.

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PL 97

MITIGATION RULE 2008: OPPORTUNITIES FOR DEVELOPMENT OF A FRESHWATER MUSSEL HABITAT IN-LIEU-FEE PROGRAM. James B. Spence, Department of Integrated Science & Technology, Marshall University, 1 John Marshall Dr, Huntington, WV 25755

The U.S. Army Corps of Engineers has regulated impacts to waters of the U.S. under Section 10 of the Rivers and Harbors Act since 1899 and under Section 404 of the Clean Water Act since 1972. Projects involving unavoidable impacts to these waters are required to provide compensatory mitigation to offset these impacts. Most of the early mitigation rules focused on impacts to wetlands, with little emphasis on streams or rivers. Since 2002, the Corps and the US EPA have provided clarification that mitigation should be developed as functional replacement of the physical, chemical and biological characteristics of the impacted water body. The publishing of revised regulations at 33 CFR 332 and 40 CFR 230 (effective June 9, 2008) further clarified these requirements, and indicated a preference for mitigation banks and in-lieu-fee (ILF) programs due to the frequent failures of individual mitigation projects. The flexibility of the ILF and rules governing functional replacement have introduced a unique opportunity to develop a freshwater mussel habitat ILF program, particularly for large river projects such as dredging and fleeting facilities.

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PL 102

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PL 103

THE CHRONICLES OF GASTROPODA: THREE SHORT STORIES ABOUT AQUATIC SNAILS IN ILLINOIS. Jeremy S. Tiemann and Kevin S. Cummings, Illinois Natural History Survey, 1816 South Oak Street, Champaign, IL 61820

There are several mollusk-related projects occurring in Illinois, including the following three on freshwater gastropods: 1) *Illinois pleurocerids* – Pleurocerids are typically found in high quality streams on rocky substrates. As with many freshwater mollusks, pleurocerids are experiencing declines in their distributions. We are working on determining the status of Illinois pleurocerids by gathering data on historical distributions from museum collections and conducting field surveys to assess if those populations are still extant. Work from this study has thus far resulted in the listing of *Lithasia obovata* on the Illinois endangered species list, and adding *Lithasia geniculata* to the state species list. 2) *Effects of lowhead dams on pleurocerids* – A plethora of data exist on the effects of dams on aquatic insects, fishes, and freshwater mussels; however, little has been published on their effects on aquatic snails. In the summers of 2007-2008, we examined the effects of lowhead dams on pleurocerids by comparing data from reference sites to areas immediately upstream and downstream from impoundments. The results were similar to those reported for other taxa in that densities of pleurocerids were significantly lower in areas immediately upstream and downstream from impoundments. 3) *Misc. comments on Illinois viviparids* – While conducting surveys for pleurocerids, we have gathered data on the status of *Bellamya chinensis* in Illinois, and have found remnants of an unique sinistral population of *Campeloma decisum* from the Fox River.

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PL 107

DONATION OF HISTORIC FRESHWATER MUSSEL SHELLS TO THE PAUL W. PARMALEE MALACOLGICAL COLLECTION: A RARE EARLY TEACHING COLLECTION? G. R. Dinkins. Frank H. McClung Museum, University of Tennessee, 1327 Circle Park Dr., Knoxville, TN 37996.

In 2008, a small collection of apparently random marine shells was donated to the Frank H. McClung Museum at the University of Tennessee by a local resident. The shells were of low quality and of no scientific value, but included with the marine material were 56 freshwater mussel specimens representing 51 taxa, nearly all of which had been collected by A. E. Ortmann or H. H. Smith between May 1913 and August 1924. Each freshwater mussel specimen had been carefully wrapped in newsprint from the Detroit Evening Times (February 29, 1924) or the Cleveland Plain Dealer (October 24, 1920 and June 12, 1921) and was accompanied by a small, hand-written label indicating species, collection locality, and specimen number. Some specimens were identified as to gender and sexual condition when collected (e.g., gravid). All were individually numbered and were from the Tennessee River system in southwest Virginia, east and middle Tennessee, or north Alabama. Based on the number of specimens, collectors, and dates of collection, it appears this was a rare and entirely intact teaching collection as described by H. H. Smith in his article entitled Cui Bono written around 1910. In Alabama, these teaching collections were distributed to schools and colleges and were considered to be gifts to that particular academic institution. The origin of this particular teaching collection and the circumstances that led it to the McClung Museum are still unclear, but at least a few of the specimens had at one time been catalogued at the Carnegie Museum of Natural History, Section of Mollusks, where Smith served as curator prior to his relocation to Alabama where he was employed by various individuals and institutions.

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PL 104

ADDITIONS TO THE KNOWN FINGERNAIL CLAM (SPHAERIIDAE-PISIIDAE) FAUNA OF WEST VIRGINIA WITH ADDITIONAL COMMENTS ON NEW RECORDS OF AQUATIC SNAILS FOR THE STATE. Ralph W. Taylor, Professor Emeritus, Marshall University, Huntington WV 25755.

The aquatic mollusk fauna of West Virginia continues to be poorly known. In recent years many different investigators have added much to our knowledge of the state's freshwater mussels but the other groups remain essentially a mystery. I will present data on additional records of fingernail clams as well as comments on additional records of aquatic snails of WV. Nature Serve shows no records for WV Sphaeriids, Mackie lists *Corbicula fluminea*, *Sphaerium fabale*, *Musculium transversum*, and *Pisidium casertanum*. I will document additional records for these and also add *Sphearium striatinum*, *Sphaerium simile*, *Musculium partumium*, *Musculium securis*, *Pisidium dubium*, and *Pisidium compressum* to the list. Previously unpublished records for West Virginia for the following aquatic snails will also be presented: *Leptoxis praerosa*, *Leptoxis carinata*, *Elimia livescens*, *Elimia simplex*, Elimia semicarinata, *Elimia virginica*, *Planorbula armigera*, *Campeloma decisum*, *Amnicola limosus*, *Birgella subglobosa*, *Lithasia verrucosa*, *Lithasia obovata*, *Probythinella emarginata*, and *Fossaria humilis*

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PL 108

MUSSEL AND MUSSEL-HOST ASSOCIATIONS IN MARYLAND. C. A. Campbell[1], R.H. Hilderbrand[2], and W.A. Lellis[1]. [1]US Geological Survey, Northern Appalachian Research Laboratory, 176 Straight Run Rd., Wellsboro, PA 16901. [2]University of Maryland Center for Environmental Science, Appalachian Laboratory, 301 Braddock Rd., Frostburg, MD 21532.

Unionids are declining, yet their complex life history hampers species assessment and conservation. Examining both mussel and mussel-host associations could provide information to improve the knowledge base and enhance conservation efforts. We conducted community analyses within Maryland streams to identify associations among: 1) freshwater mussel species and 2) freshwater mussel and fish species. Biological assemblage data was obtained from the Maryland Natural Heritage Program freshwater mussel database and the Maryland Biological Stream Survey fish database. The fish sampling site nearest each mussel site was identified and the occurrence data for species from both taxa was converted to presence-absence. We tested for differences in mussel and fish species composition between the presence-absence of each mussel species. Once differences were established, indicator species analysis was performed to identify the mussel and fish species most closely associated with the presence-absence of each mussel species. Results identified groups of mussels that could indicate the presence of other mussel species. Similarly, specific sets of fish species were associated with the presence of groups of mussels. The findings support current knowledge regarding fish hosts for these mussels and highlight potential hosts for further study.

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PL 105

STATUS AND DISTRIBUTION OF MARYLAND'S FRESHWATER MUSSELS. J. M. McCann[1], D. J. Feller[1], and D. F. Brinker[2]. Maryland Department of Natural Resources, Natural Heritage Program, 301 Braddock Road, Frostburg, MD 21532; Maryland Department of Natural Resources, Natural Heritage Program, 1200 Frederick Road, Catonsville, MD 21228.

During 1988-2008, the Maryland Natural Heritage Program conducted approximately 1,300 freshwater mussel surveys in streams, rivers and impoundments throughout Maryland. Using these survey data along with museum records, published literature, and unpublished accounts, we report on the status and distribution of the state's unionid fauna. Historically, 16 native species occurred in Maryland. Although all remain extant, most species show evidence of decline and 56% (9 of 16 species) are rare (state rank of S1 or S2). Six species are state listed including the federally endangered dwarf wedgemussel (*Alasmidonta heterodon*, G1G2/S1), triangle floater (*A. undulata*, state endangered G5/S1), Atlantic spike (*Elliptio producta*, In Need of Conservation [INC], G2G3Q/S2) and creeper (*Strophitus undulatus*, INC, G5/S2). Among the most imperiled species are the state endangered brook floater (*A. varicosa*, G3/S1) and green floater (*Lasmigona subviridis*, G3/S1). The most common and widespread species is, by far, the eastern elliptio (*Elliptio complanata*, G5/S5) followed by eastern floater (*Pyganodon cataracta*, G5/S5). Taxonomic questions persist regarding the dark, lanceolate forms of *Elliptio* and potential hybridization with the non-native plain pocketbook (*Lampsilis cardium*, G5/SE) has confounded efforts to assess the status of the globally rare yellow lampmussel (*L. cariosa*, G3/SU). The greatest remaining centers of unionid biodiversity lie in the western Ridge and Valley section of the Potomac River and several tributaries (Sideling Hill Creek, Licking Creek, Town Creek); the upper fresh tidal portion of the Potomac and several nontidal tributaries (Nanjemoy Creek, McIntosh Run, Zekiah Swamp Run); and sections of the Chester and Choptank watersheds on the Lower Coastal Plain. Suburban sprawl, chronic agricultural impacts, sea-level rise, and non-native species (e.g., zebra mussel [*Dreissena polymorpha*], Asiatic clam [*Corbicula fluminea*], rusty crayfish [*Orconectes rusticus*]) pose the most significant threats to Maryland's freshwater mussels and their habitats.

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PL 109

MUSSELS ABOVE THE FALLS. John J. Jenkinson, 305 Revere Avenue, Clinton, Tennessee, 37716.

For more than 100 years, biologists studying freshwater mussels have recognized that the approximately 300 North American species typically occur in a few, geographically-distinct faunal zones. Some of these mussel faunal zones coincide with present continental or regional stream drainage basins but others clearly do not. As early as 1913, Ortmann concluded that these mussel faunal zones represent pre-glacial associations and separations of the river systems in which the various species arose. Within each faunal zone, species number is typically associated with stream size: the most species occur in the largest river segments, trailing off to just a few species in the smallest creeks. Three major rivers, however, -- each in a different faunal zone -- do not follow this stream size-species number relationship. The New, Cumberland, and Tallapoosa rivers each contain one or more falls that, apparently, have prevented most mussel species from gaining access to the upstream part of the watershed. This presentation will examine the mussel faunas in each of these isolated watersheds and compare them to each other. The results of this evaluation suggest that some of the populations now found above these sets of falls represent extremely old and, perhaps, truly ancient roots of the North American mussel fauna.

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PL 106

STATUS EVALUATION OF FOUR MUSSEL SPECIES BY THE FISH AND WILDLIFE SERVICE. S. R. Oetker[1], A. Boyer[2], K. McPeek[3], R. Butler,[4] and L. Ragan[5]. [1]Twin Cities Field Office, 4101 American Blvd E, Bloomington, MN 55425. [2]Reynoldsburg Field Office, 6950 Americana Parkway, Suite H, Reynoldsburg, OH 43068. [3]Rock Island Field Office, 1511 47th Ave, Moline, IL 61265. [4]Asheville Field Office, 160 Zillicoa St, Asheville, NC 28801. [5]Midwest Regional Office, BHW Federal Building, 1 Federal Drive, Fort Snelling, MN 55111.

The US Fish and Wildlife Service is further evaluating whether to develop proposed rules to list three Federal candidate species under the Endangered Species Act: the sheepnose (*Plethobasus cyphyus*), spectaclecase (*Cumberlandia monodonta*), and rayed bean (*Villosa fabalis*). Furthermore, the Service is evaluating whether the there is enough information to indicate that the snuffbox (*Epioblasma triquetra*) warrants listing under the Act. Despite the seemingly large ranges of each of these mussels, each has experienced significant range restriction in recent years. Their remaining populations tend to be small, isolated, and under continuing threats. The sheepnose has been extirpated from over 50 streams, and it is uncommon at best in the vast majority of extant populations. The spectaclecase has been extirpated from three-fifths of its historical distribution and is only thought to have potentially sustainable populations in four of the rivers in which it is extant. It imperilment is further confounded by the lack of knowledge of its host species. The snuffbox has been extirpated from over 65 percent of its historical range, with only five stronghold populations. The rayed bean has been extirpated from over 80 streams and other water bodies, and relatively few populations are thought to be sustainable. Although these species had large historical ranges and still are found in a number of rivers, they each have very few sustainable populations and are susceptible to further habitat loss.

NOTES: _____

PL 110

LONG TERM QUALITATIVE MONITORING OF FRESHWATER MUSSELS IN THE CONASAUGA RIVER, MURRAY/WHITFIELD COUNTIES, GEORGIA. G. R. Dinkins[1], P. D. Johnson[2], and S. A. Ahlstedt[3]. [1]Frank H. McClung Museum, University of Tennessee, 1327 Circle Park Dr., Knoxville, TN 37996. [2]Alabama Aquatic Biodiversity Center, Route 3, Box 86, Marion, AL 36756. [3]P.O. Box 460, Norris, TN 37828.

The Conasauga River is a small river in the headwaters of the Mobile River Basin in extreme southeastern Tennessee and northwest Georgia. Historically the river supported 36 species of mussels, and survey efforts in 1998-99 found 24 species extant. However, the river still supports reproducing populations of 7 federally listed mussels along with 3 listed fishes. Thus, the Conasauga River hosts more federally listed species than any other location in Georgia. In 1992 an off-stream pump storage facility was constructed in the river floodplain to move water into and out of the reservoir in times of high and low flows, respectively. When operational, 20 cfs of water is discharged into the river, and is withdrawn at a water treatment plant 11 miles downstream. As part of the Section 404 Permit agreement for the reservoir operation, annual monitoring of fishes and mussels in an 18-mile river reach is required by the USFWS. After a dozen years of monitoring, operation of the pump storage reservoir does not appear to have affected fish or mussel diversity. However, severe habitat degradation ongoing in the Conasauga River basin unrelated to the reservoir operations is adversely impacting the mussel community, and extensive survey efforts since 2005 have found only 18 species extant in the basin.

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Poster # * Student Poster	**POSTER SESSION**
	Monday, April 20th, 6:30 - 8:30 pm ---- Ballroom C
	Moderator: Patricia A. Morrison, U.S. Fish and Wildlife Service, Williamstown, WV
	Evolution and Systematics
PO 01	**THE REMARKABLE NAIAD FAUNA OF THE USUMACINTA RIVER (MEXICO AND GUATEMALA): ANCIENT VICARIANCE AND MORPHOLOGICAL DIVERSIFICATION.** Cristian R. Altaba and Ariel Ruiz i Altaba
PO 02	***TOXOLASMA* IN ALABAMA: UPDATE.** D. C. Campbell
PO 03*	**MOLECULAR SYSTEMATICS OF INTERIOR HIGHLAND PLEUROCERIDAE (GASTROPODA).** David M. Hayes, Kentaro Inoue, Russell L. Minton, Alan D. Christian
PO 04*	**PHYLOGEOGRAPHY REVEALS PLEISTOCENE ISOLATION FOLLOWED BY HIGH GENE FLOW IN A WIDE-RANGING IMPERILED MUSSEL: THE SPECTACLECASE, *CUMBERLANDIA MONODONTA*.** E. M. Monroe, C. L. Elderkin, and D. J. Berg
PO 05	**IN SITU STUDY OF NON-LETHAL DNA COLLECTION TECHNIQUES FOR FRESHWATER MUSSELS: AN EXAMINATION OF SURVIVAL AND SWAB EFFECTIVENESS.** Sandra Pursifull, Nathan A. Johnson, James D. Williams, Allison Fritts-Penniman, and Gregory R. Moyer
PO 06	**THE HERBERT D. ATHEARN COLLECTION, FRUIT OF A LIFETIME OF COLLECTING.** J. M. Smith and A. E. Bogan
	Water Quality and Ecotoxicology
PO 07*	**SUBCHONIC EFFECTS OF ATRAZINE EXPOSURE ON PHYSIOLOGICAL AND REPRODUCTIVE CONDITIONS AND ON DNA ADDUCT FORMATION IN UNIONID MUSSELS.** J. L. Barkley, R. J. Neves, E. M. Hallerman, C. M. Gatenby, W. F. Henley, and W. Hopkins.
PO 08*	**VARIATION IN POPULATION SEX RATIOS OF PLEUROCERID SNAILS: EVIDENCE OF AN ENVIRONMENTAL INFLUENCE?** Serena Ciparis and J. Reese Voshell
PO 09*	**BIOACCUMULATION OF CADMIUM BY THE MUSSEL *LASMIGONA COMPLANATA*.** A. J. Hager, L. M. Wieland, A. W. DeLorme
PO 10*	**EVALUATING THE EFFECTS OF EMERGING CONTAMINANTS ON REPRODUCTION IN FATMUCKET (*LAMPSILIS SILIQUOIDEA*).** Hazelton, P. D. , W. G. Cope, M. C. Barnhart, and R. B. Bringolf
PO 11	**APPLICATION OF ASTM MUSSEL TOXICITY TESTING GUIDANCE TO CONDUCTING A USEPA TOXICITY IDENTIFICATION OR REDUCTION EVALUATION.** R. Lockwood and R. L. Garibay
PO 12	**COMPARATIVE STUDY OF THE PHYSIOLOGICAL RESPONSES OF FRESHWATER BIVALVES TO POINT SOURCE POLLUTION IN THE EBRO RIVER (NE SPAIN): A NATIVE NAIAD (*Psilunio littoralis*) VS INTRODUCED SPECIES (*Dreissena polymorpha* and *Corbicula fluminea*)**. M. Faria, M. A. López, and C. Barata
PO 13*	**REVIEW OF GENE EXPRESSION BIOMARKERS IN BIVALVE TOXICOLOGY.** Jingjing Miao and M. Christopher Barnhart.

	World Atlas of Freshwater Mollusks
PO 14	**TWO PUZZLING NAIADS FROM THE MARAGARAZI RIVER (BURUNDI AND TANZANIA).** Cristian R. Altaba
PO 15	**DIVERSITY, ENDEMISM AND CONSERVATION STATUS OF THE FRESHWATER MUSSEL FAUNA OF THE IBERIAN PENINSULA.** Cristian R. Altaba
PO 16	**ONLINE MUSSEL ATLASES AT THE OHIO STATE UNIVERSITY.** J. Cramer and G. T. Watters
	Advances in Propagation of Mollusks
PO 17*	**INCREASED SURVIVAL OF ENDANGERED JUVENILE OYSTER MUSSELS, *EPIOBLASMA CAPSAEFORMIS* (I. LEA, 1834), FOLLOWING FEEDING WITH BIOFLOCS.** M. E. Vincie, R. J. Neves, S. R. Craig, E. McLean.
PO 18*	**DESIGN AND MAINTENANCE OF A SYSTEM FOR LONG-TERM HOLDING OF FRESHWATER MUSSEL, *ANODONTITES TRAPESIALIS* (LAMARCK 1819) (BIVALVIA: MYCETOPODIDAE).** Lima, Ricardo C., Paes, Angela T. and Avelar Wagner E.P.
PO 19*	**MONITORING FITNESS OF CAGED FRESHWATER MUSSELS TO PRIORITIZE STREAMS FOR RESTORATION IN SOUTHEASTERN PENNSYLVANIA.** Matthew Gray, Danielle Kreeger and Angela Padeletti
PO 20	**SMALL SCALE AQUACULTURE SYSTEMS FOR PROPAGATION OF JUVENILE RARE AND ENDANGERED MUSSELS.** Monte A. McGregor, A.C. Shepard, F. Vorisek, J. J. Culp, and J. Hinkle
PO 21	**A NEW FRESHWATER NONGAME AQUACULTURE FACILITY IN NORTH CAROLINA.** Brena Jones, Steve Fraley, Chris Eads, Kyle Briggs, David Deaton, T.R. Russ
PO 22	**PRELIMINARY TRIAL TO REPRODUCE *Acostaea rivoli* DESHAYES, 1827 (MOLUSCA: BIVALVIA: ETHERIIDAE) IN LABORATORY CONDITIONS.** O. Repizo, D. M. Gualtero, F. Pinzón, L.A. Velasco
PO 23	**RESTORING RARE AND ENDANGERED FAUNA AT THE AQUATIC WILDLIFE CONSERVATION CENTER.** Nathan L. Eckert, Joseph J. Ferraro, Amanda E. Wood, Jonathan Orr and Michael J. Pinder
	Habitat and Community Restoration
PO 24	**USING MUSSELS SILOS AS A TOOL FOR ASSESSING POTENTIAL FRESHWATER MUSSEL RESTORATION SITES.** Nathan L. Eckert, Joseph J. Ferraro, Jonathan E. Orr, Amanda E. Wood and Michael J. Pinder
PO 25	**THE SLOW PATH TO NEAR-EXTINCTION AND RECOVERY OF A RESTRICTED-RANGE FRESHWATER MUSSEL - *UNIO ALERONI* IN THE EASTERN PYRENEES FOOTHILLS.** Cristian R. Altaba, Carme Rosell), Santiago Giráldez, Marc Fernández), Emili Bassols
PO 26	**ASSISTING IN RECOVERY EFFORTS FOR MUSSEL SPECIES AT RISK IN CANADA.** K. A. McNichols, G. L. Mackie, and J. D. Ackerman.
PO 27	**HEALTHY MUSSELS = HEALTHY RIVERS: RESTORATION OF THE DELAWARE ESTUARY WITH THE LIGHTFOOT MUSSEL (*ELLIPTIO COMPLANATA*).** Angela T Padeletti, Danielle A. Kreeger, Catherine M. Gatenby, Steven G. Hughes, Roger L. Thomas, Rosemary Malfi, Heidi Tucker-Wood, William Ellis, and Mathew Gray

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PO 57	**A STUDY OF THE REPRODUCTIVE BIOLOGY FOR ANODONTA SP. AND *GONIDEA ANGULATA* IN THE MIDDLE FORK JOHN DAY RIVER, OREGON.** Christine O'Brien, Donna Nez, David Wolf, and Melisa Van Pelt
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PO 63	**EVALUATION OF FISH HOST SUITABILITY FOR THE DWARF WEDGEMUSSEL (*ALASMIDONTA HETERODON*).** Barbara St. John White, C. Paola Ferreri, and William A. Lellis
PO 64*	**FILTRATION RATE OF GRAVID, NON-GRAVID FEMALE AND MALE MUSSELS, CRISTARIA PLICATA, AND OBSERVATION OF MICROSTRUCTURE AND ULTRASTRUCTURE OF THEIR GILLS.** H. B. Wen, R. B. Gu, G. C. Xu, D. Hua, P. Xu
PO 65	**TRANSLOCATION AND MONITORING OF THE BROOK FLOATER, *ALASMIDONTA VARICOSA*, AFTER THE 2006 AVULSION IN THE SUNCOOK RIVER, NEW HAMPSHIRE.** B. J. Wicklow, D. R. Smith, K Flanery, S. von Oettingen
PO 66	**STATUS OF THE BROOK FLOATER (ALASMIDONTA VARICOSA) IN THE NORTHEAST.** B. J. Wicklow and E. J. Nedeau
PO 67	**SEXUAL DIMORPHISM IN THE FEDERALLY ENDANGERED DWARF WEDGEMUSSEL, *ALASMIDONTA HETERODON*.** N. E. Baginski, K. M. O'Brion, K. L. Richardson, P. M. Larson, and B. J. Wicklow

PO 01

THE REMARKABLE NAIAD FAUNA OF THE USUMACINTA RIVER (MEXICO AND GUATEMALA): ANCIENT VICARIANCE AND MORPHOLOGICAL DIVERSIFICATION. Cristian R. Altaba [1] and Ariel Ruiz i Altaba[2] [1]Laboratory of Human Systematics, University of the Balearic Islands, 07071 Palma, Balearic Islands (Spain), [2] University of Geneva Medical School, Dept. Gen. Med. Dev., 8242 C.M.U., 1 rue Michel Servet, CH-1211, Geneva 4 (Switzerland).

The Usumacinta river at the Mexico-Guatemala border is a tropical drainage located between the Nearctic and the Neotropical regions. Although it is largely unexplored, it has recently been shown to harbor a unique fish fauna including ancient relics. The naiads of the Usumacinta appear to be a monophyletic group on the basis of mtDNA. Their closest relatives are *Microcondylaea* from southeastern Europe and *Gonidea* from northwestern North America, suggesting vicariance at a continental scale. The Usumacinta naiads show an explosive diversification of shell shape and sculpture. It is hypothesized that shell traits in freshwater mussels, being highly homoplasious characters, are largely antipredatory devices, their geographic and stratigraphic distribution tracking that of molluscivorous fishes.

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PO 02

***TOXOLASMA* IN ALABAMA: UPDATE.** D. C. Campbell, Department of Biological Sciences, University of Alabama, Box 870345, Tuscaloosa AL 35487-0345.

The number of species recognized in *Toxolasma* in recent treatments ranges from 3 to about 8. However, morphological variation and molecular data from *cox1, nad1,* and ITS support the recognition of at least 9 species in drainages in Alabama (two of which have not been sampled recently in the state), and additional differences in species from other areas. *Toxolasma lividum* (Tennessee and Cumberland drainage) is distinct from *T. glans* (Ohio and Mississippi drainage). Three species occur in the Apalachicola basin (*T. paulum, T. cromwelli, T. sp. nov.* 2) and three others in the Mobile basin (*T. germanum, T. granulatis, T. parvum* –the last may be introduced). An undescribed species occurs between them in the Escambia, Yellow, and Choctawhatchee. Additional populations, particularly in the eastern Gulf Coast and the Mississippi drainage, deserve scrutiny. *Toxolasma* is near the base of the Lampsilini and may be polyphyletic. *"Villosa" fabalis* is a very close relative of at least some *Toxolasma*.

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PO 03*

MOLECULAR SYSTEMATICS OF INTERIOR HIGHLAND PLEUROCERIDAE (GASTROPODA). David M. Hayes[1], Kentaro Inoue[1], Russell L. Minton[2], Alan D. Christian[1,3]. [1]Arkansas State University, Environmental Sciences Graduate Program, P.O. Box 847, State University, AR 72467, [2]University of Louisiana at Monroe, Department of Biology, Monroe, LA 71209, [3]University of Massachusetts Boston, Department of Biology, 100 Morressey Boulevard, Boston, MA 02125

The Interior Highlands are a biogeographically unique region west of the Mississippi River. We examined genetic diversity of three freshwater gastropods, *Elimia potosiensis*, *Leptoxis arkansensis* and *Pleurocera cf. actua* (Pleuroceridae) using mitochondrial (16s) and nuclear (28s) markers. Our data indicate high levels of within-population genetic diversity in all three species, with genetic divergences up to 13%. All phylogenetic analyses indicate a mixture of haplotypes from *E. potosiensis*, *L. arkansensis,* and *P. acuta*. Our results are similar to those of previous studies of pleurocerid genetic diversity in the Appalachian Mountains, indicating this pattern may be common among the highland regions not impacted by glacial activity or ocean inundation. Possible explanations for the unresolved Interior Highland pleurocerid relationships, including a combination of mitochondrial introgression and retention of ancestral polymorphisms, are discussed.

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PO 04*

PHYLOGEOGRAPHY REVEALS PLEISTOCENE ISOLATION FOLLOWED BY HIGH GENE FLOW IN A WIDE-RANGING IMPERILED MUSSEL: THE SPECTACLECASE, CUMBERLANDIA MONODONTA. E. M. Monroe[1], C. L. Elderkin[2], and D. J. Berg[3]. Department of Zoology, Miami University, [1]Oxford, OH 450313 and [3]Hamilton, OH 45011. [2] Department of Biology, The College of New Jersey, PO Box 7718, Ewing, NJ 08628.

Freshwater organisms of North America have had their population genetic structure shaped by past events, such as Pleistocene glaciations. Life history traits that promote dispersal and gene flow have since continued to shape population genetic structure. Freshwater mussel larvae are obligate parasites of fish hosts, and thus, fish movement is the major mode of dispersal for mussels. *Cumberlandia monodonta*, an imperiled mussel with a widespread distribution was examined to determine genetic diversity and population genetic structure range-wide. Two different classes of molecular markers, allozymes and cytochrome oxidase I (COI) partial gene sequences were used to measure genetic diversity. COI data were analyzed with statistical phylogeography to explicitly test hypotheses if this species spread northward from two specific glacial refugia: 1) areas south of the glaciers and, 2) the Driftless Area of WI, IA, MN, and IL, or only one refuge. There was not any geographic structure detected with allozyme or COI data. A phylogeny of COI sequences indicated past isolation which created divergence of two lineages estimated to occur during the Pleistocene. However, isolation did not occur within the Driftless Area. Up until recent times, gene flow within this species has maintained high levels of genetic diversity. Extirpation of this species from its entire central range likely has isolated remaining populations due to the distances among them.

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PO 05

IN SITU STUDY OF NON-LETHAL DNA COLLECTION TECHNIQUES FOR FRESHWATER MUSSELS: AN EXAMINATION OF SURVIVAL AND SWAB EFFECTIVENESS. Sandra Pursifull[1], Nathan A. Johnson[2], James D. Williams[3], Allison Fritts-Penniman[4], and Gregory R. Moyer[4]. [1]US Fish and Wildlife Service, Panama City, Florida; [2]University of Florida, Gainesville, Florida, [3]Florida Fish and Wildlife Conservation Commission, Gainesville, Florida, [4]US Fish and Wildlife Service, Warm Springs Fish Technology Center, Warm Springs, Georgia.

With the invention of polymerase chain reaction (PCR) amplification techniques, mussel DNA can be obtained by passing a buccal swab over mantle and/or foot tissue. The use of swabs to obtain genetic material is an option to be considered when the target species is imperiled; however, this technique is fairly new and little information is presently available on mussel survival following this type of collection method. We conducted a stream side study using two common species, *Elliptio crassidens* (n = 40) and *Elliptio pullata* (n = 20), to examine 1) the efficacy of clove oil as an anesthetic, 2) survival after the use of a buccal swab, and 3) the ability of the two swab types to yield an adequate amount of genetic material for PCR analysis. The mussels were tagged, relaxed in a mild solution of pure clove oil (2 ml/L stream water), swabbed with either a round nylon brush or a flat cotton swab, and returned to the stream. The clove oil solution worked well as a mussel anesthetic (relaxing 90%), and all eventually recovered once returned to a container of stream water. The mussels were checked for survival on day 30 (group 1, n = 40) or day 35 (group 2, n = 20). Combined survival of both species was high, and 92% of the swabbed mussels were recovered alive (87% of the control), 3% were recovered dead (0% control), and 5% were not recovered (13% control). The mean DNA concentration extracted using the round brush (n = 20) was 492.5 ng/ul, and the flat swab (n = 18) was 234.6 ng/ul. This difference between the two is significant (t stat 2.77, $p < 0.05$). However, PCR was more successful with the flat swab samples (67% success) than with the round brush samples (20% success). Although the round brush yielded higher concentrations of DNA, the flat swab samples were higher quality for amplification. This study shows that buccal swabs can be used, as an alternative to sacrificing whole mussels, to successfully obtain genetic material.

PO 06

THE HERBERT D. ATHEARN COLLECTION, FRUIT OF A LIFETIME OF COLLECTING. J. M. Smith and A. E. Bogan, North Carolina State Museum of Natural Sciences, Research Lab, MSC 1626, Raleigh, NC, 27699-1626.

The North Carolina State Museum of Natural Sciences (NCSM) acquired the private Museum of Fluviatile Mollusks collection of Herbert D. Athearn in July 2007. This addition has greatly enriched the mollusk collection at NCSM. Athearn's collection efforts spanned the 1940's through 2006, generating 23,344 catalogued lots. Athearn's collection focused mainly on freshwater gastropods and bivalves, with a small sample of terrestrial gastropods. The collection is equally rich in North American freshwater mussels and gastropods, including extinct and endangered bivalves and gastropods not previously contained in the NCSM collection. The cataloged collection contains about 11,000 lots of unionoid bivalves, 2,500 lots of sphaeriid bivalves, 9,000 lots of freshwater gastropods. This collection is of tremendous scientific and historical value because of the information on the geographic range (range expansions and range contractions) of a given species. All collection materials from the Museum of Fluviatile Mollusks (MFM) are dried specimens. Currently, over 3,500 localities have been computerized, all of his duplicate collection has been rehoused, and over 50 percent of his catalogued material has been rehoused in archival trays. Efforts are currently underway to re-house and catalog all donated materials.

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PO 07*

SUBCHONIC EFFECTS OF ATRAZINE EXPOSURE ON PHYSIOLOGICAL AND REPRODUCTIVE CONDITIONS AND ON DNA ADDUCT FORMATION IN UNIONID MUSSELS. J. L. Barkley[1], R. J. Neves[1], E. M. Hallerman[1], C. M. Gatenby[2], W. F. Henley[1], and W. Hopkins[1]. [1]Virginia Tech, Department of Fisheries & Wildlife, Blacksburg, VA 24061; [2]U. S. Fish and Wildlife Service, White Sulphur Springs NFH, WV 24986

This research project will determine the subchronic effects of atrazine on physiological and reproductive conditions and on DNA adduct formation in eastern elliptios, *Elliptio complanata*, and rainbow mussels, *Villosa iris* (Unionidae). Similar studies have looked at the effects of atrazine on glochidia and juveniles, but not on adults. In one study, comparisons were made among glochidia and juvenile sensitivities to atrazine exposure, finding an atrazine concentration of 30 mg/L for 48 h was not acutely toxic to glochidia or juveniles, but that a concentration of 4.3 mg/L in a 21-day, chronic exposure resulted in diminished growth. Atrazine is one of the most widely-used agricultural herbicides, with an estimated production of 76 million pounds annually, and its presence in streams and lakes is detected regularly throughout the United States. In the soil, atrazine breaks down over a period of days to months, yet takes months and sometimes years to break down in streams and groundwater. It has been shown to bioaccumulate in bivalve mantle, visceral mass, and foot with continuous exposures. Atrazine is known to impact organisms through at least two pathways: interference in dopamine synthesis and the formation of atrazine-DNA adducts. In bivalves, gills function in respiratory and feeding roles by means of dopamine-mediated cilia, generating water flows to regulate the intake of oxygen and food. Disruption of dopamine synthesis results in altered respiration and feeding. Exposure of cells to atrazine can also result in the formation of atrazine-DNA adducts. Atrazine-DNA adduct levels potentially can be correlated with atrazine exposure of freshwater mussels leading to the use of chemical-DNA adducts as a non-lethal biomarker of contaminant exposure in freshwater environments.

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PO 08*

VARIATION IN POPULATION SEX RATIOS OF PLEUROCERID SNAILS: EVIDENCE OF AN ENVIRONMENTAL INFLUENCE? Serena Ciparis and J. Reese Voshell. Department of Entomology, Virginia Tech, Blacksburg, VA 24061.

Estrogenic compounds have been shown to interact with molluscan reproductive systems; observed effects include increased egg and embryo production and female-biased sex ratios. The pleurocerid snail, *Leptoxis carinata*, is widespread in the Shenandoah River watershed (Virginia, USA), where studies of fish have indicated that estrogenic compounds are stressors of interest. We conducted a study of population sex ratios of *L. carinata* in this watershed in order to (1) document deviations from the expected ratio of 1:1 over a broad spatial scale and (2) investigate the possibility of a relationship between female-biased sex ratios and land use and/or measured concentrations of estrogenic compounds. In May and October 2008, replicate quadrat samples of *L. carinata* were taken from 7 Shenandoah River sites and 19 tributary sites. For comparison, samples of *Leptoxis sp.* were also collected from 5 other rivers in Virginia. Upstream land use was quantified for each sampling site, and water samples were analyzed for estrogenic activity. The proportion of female snails ranged from 0.36-0.89 in Shenandoah River tributaries, 0.5-0.69 in the Shenandoah River, and 0.37-0.81 in other Virginia rivers. Female-biased sex ratios were significant (Chi-square test, =0.05) at 12/19 tributary sites, 3/7 Shenandoah River sites, and 1/5 sites in other Virginia rivers. Although estrogenic activity was significantly correlated with agricultural land use, we did not find statistically significant correlations between either of these variables and the proportion of females. However, the variation in sex ratios between sites, coupled with longitudinal shifts in sex ratios in tributaries and the Shenandoah River, suggest that site-specific environmental conditions may affect either sex determination or sexual differentiation of juveniles. Potential mechanisms and opportunities for further study will be discussed.

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PO 09*

BIOACCUMULATION OF CADMIUM BY THE MUSSEL *LASMIGONA COMPLANATA*. A. J. Hager, L. M. Wieland, A. W. DeLorme. Department of Biology, Valley City State University, Valley City, ND 58072.

In eastern North Dakota (ND), it is known that Cadmium (Cd) and other heavy metals are naturally present within the soil. We are examining the levels of Cd and other trace metals in river sediments and mussel tissues from ND Rivers. In a pilot project we collected 52 mussels that encompassed 8 native species from the Sheyenne River of eastern ND. Mussel tissues were dried to a constant weight and digested according to EPA method 3052. Blanks and controls were prepared. Samples were analyzed by inductively coupled plasma mass spectrometry (ICP-MS). Fourteen river sediment samples were collected from 6 sites on the Sheyenne River and were analyzed. The White Heelsplitter, *Lasmigona complanata,* had higher Cd levels at a degree between 8 to 13 times greater than all other species. The average Cd levels for the White Heelsplitter was 124.2 ppb (n=5). The average for all species other than the White Heelsplitter was 11.4 ppb (n=52). The average Cd levels in river sediment samples was 250 ppb (range 50 – 520ppb). The White Heelsplitter had much higher levels of cadmium in it's tissues than the other species of mussels. The populations of this mussel are healthy within the Sheyenne River so this level of Cd does not seem to be having a negative effect on the White Heelsplitter. We have recently expanded this investigation to include White Heelsplitters from throughout the state. It will be interesting to see if we have the same degree of bioaccumulation in other populations. This work is supported by NIH grant P20RR016741 from the NCRR.

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PO 10*

EVALUATING THE EFFECTS OF EMERGING CONTAMINANTS ON REPRODUCTION IN FATMUCKET (*LAMPSILIS SILIQUOIDEA*). Hazelton, P. D. [1], W. G. Cope [2], M. C. Barnhart [3], & R. B. Bringolf [1]. [1]Warnell School of Forestry & Natural Resources, University of Georgia, Athens, GA 30602-2152. [2]Department of Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC 27695-7633. [3]Missouri State University, 901 South National Ave. Springfield, MO 65897

The term "emerging contaminants" refers to a group of organic compounds with either recent occurrence in the environment, or little is known about their environmental impact. Many of these compounds have been associated with municipal wastewater, and origins range from industrial compounds (e.g. perfluorinated chemicals & surfactants), to pharmaceuticals (e.g. antidepressants), and estrogenic compounds (e.g. birth control). Evaluation of how contaminants affect freshwater mussels has been largely focused on acute lethal toxicity. While these tests are important, environmental exposures are likely to be at relatively low concentrations which may not cause overt toxicity but may interfere with behavior and physiological processes such as reproduction, glochidia development, glochidia-juvenile transformation, and growth and fitness of transformed juveniles. We propose an investigation targeting rates of transformation of fatmucket (*Lamsilis siliquoidea*) exposed to environmentally relevant concentrations of: (1) perfluoroctane sulfonate (PFOS); (2) perfluoroctanoic acid (PFOA); (3) 4-nonylphenol; (4) fluoxetine; (5) 17 - ethynylestradiol. All of these compounds are known to have at least some endocrine disruption properties in fish and other organisms. We will assess biomarkers of exposure and effect to these contaminants in adult mussels, glochidia viability, host fish transformation success and juvenile growth and fitness. Results from our research will be useful in identifying challenges to freshwater mussel conservation and restoration efforts, as well as document continued patterns of contamination on freshwater ecosystems.

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PO 11

APPLICATION OF ASTM MUSSEL TOXICITY TESTING GUIDANCE TO CONDUCTING A USEPA TOXICITY IDENTIFICATION OR REDUCTION EVALUATION. Richard Lockwood and Robin L. Garibay, ENVIRON International Corporation, Brentwood, TN and Arlington, VA.

In summer of 2005 a mussel die off occurred downstream of a new NPDES discharge in Oklahoma. This event prompted an investigation that included a Toxicity Identification Evaluation and Toxicity Reduction Evaluation (TIE/TRE) to identify and control freshwater mussel toxicants in the effluent. The TIE/TRE began in January 2007, with mussel testing methods taken from the recently approved ASTM Method E2455 – 06 *Standard Guide for Conducting Laboratory Toxicity Tests with Freshwater Mussels*. The fatmucket (*Lampsilis siliquoidea*) was selected as the test organiism and the mussel testing methods were applied to elements of USEPA protocols for conducting a TIE/TRE. The TIE/TRE methods were taken from:

EPA/600/6-91/003. *Methods for Aquatic Toxicity Identification Evaluations Phase I Toxicity Characterization Procedures.*

EPA/600/R-92/080. *Methods for Aquatic Toxicity Identification Evaluations Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity*.

EPA/600/R-92/081. *Methods for Aquatic Toxicity Identification Evaluations Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity*.

EPA/600/2-88/062. *Toxicity Reduction Evaluation Protocol for Municipal Wastewater Treatment Plants*.

Due to the high levels of Total Dissolved Solids (TDS) in the effluent, conventional TIE "fractionation" methods were not applicable, and a "mock effluent" and effluent-spiking approach were the primary methods employed. Results of the TIE/TRE investigation revealed that potassium was the primary toxicant with elevated alkalinity levels causing secondary effects. It was also determined that the levels of ammonia typically observed in the effluent were not a concern for the mussels. Choice of test vessel size, dilution water chemistry, reference toxicant tests, and mortality endpoints were components of the mussel test methods that were refined for application to the TIE/TRE.

PO 12

COMPARATIVE STUDY OF THE PHYSIOLOGICAL RESPONSES OF FRESHWATER BIVALVES TO POINT SOURCE POLLUTION IN THE EBRO RIVER (NE Spain): A NATIVE NAIAD (*Psilunio littoralis*) vs INTRODUCED SPECIES (*Dreissena polymorpha* and *Corbicula fluminea*). M. Faria [1], M. A. López[2], and C. Barata[1]. [1]Department of Environmental Chemistry, Institute of Environmental Diagnosis and Water Studies (IDAEA, CSIC), Jordi Girona 18-26, 08034 Barcelona, Spain. [2]Forestal Catalana, Environmental Agency, Generalitat de Catalunya, Sabino Arana 34 1r-1a, 08028 Barcelona, Spain.

In the Lower Ebro river exists the paradoxical convergence of relatively well preserved river dynamics and fauna composition (water discharge, river bed morphology, reduced anthropogenic pressures) with the historical presence of a chlor-alcali point-source industry with a long history of waste discharges. Here we present data of a comparative in-situ study performed on these two alien bivalves, and one protected species of naiads, *Psilunio littoralis,* which is the most common freshwater mussel species in this river (ca. 95% of species composition). Individuals of the three species were transplanted to three sites that included clean and polluted lenthic conditions at Riba-roja (up-river from the factory) and Flix (inside polluted sediments) reservoirs respectively, and a riparian polluted site down-river of the factory at Ascó. The study focused on digestive gland oxidative stress and biotransformation related markers such as antioxidant enzyme activities, glutathione S-transferase, metallothionein proteins, lipid peroxidation and DNA damage to allow determination of responses to environmental stress. Results evidenced different responses for each of the studied bivalves with *P. littoralis* showing the greatest and lowest biotransformation activities and antioxidant enzyme activities respectively, and increased levels of DNA damage in the most polluted sites. Our findings discuss the differential specific effects of pollution on these species and with the future aim to translate some results to the conservation-specific efforts to the critically endangered Giant Pearlmussel, *M. auricularia* which has in this river one it´s last European strongholds. This work was founded by the Spanish Ministry of Environment projects 041/SGTB/2007/1, and the Water Agency (ACA) of the Generalitat de Catalunya.

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PO 13*

REVIEW OF GENE EXPRESSION BIOMARKERS IN BIVALVE TOXICOLOGY.

Jingjing Miao[1,2] and M. Christopher Barnhart[2]. [1]Ocean University of China, Yushan 5, Qingdao, China, 266003. [2]Missouri State University, 901 S. National Avenue, Springfield, MO 65897.

Biomarkers in bivalves are commonly used to study site impacts in both freshwater and marine ecosystems, using either transplanted or endogenous animals. Biomarkers can present an early warning as they may be predictive of other biological effects and they are generally specific to a contaminant or class of contaminants. Currently, biomarker studies are advancing towards the use of molecular tools, such as changes in gene expression, which also enable an integrated view of molecular mechanisms of pollution effects. Our knowledge of bivalve genomes, especially freshwater bivalves, is still less extensive when compared with other invertebrate taxa such as gastropods or flatworms. A search of the GenBank protein database for "Bivalvia" returned about 2,700 entries not including mitochondrial proteins (~7,000 entries) with about 1.7% of them from Unionoida. Expressed sequence tag (EST) search showed more than 129,000 entries with about 5,137 from Unionoida (*Hyriopsis cumingii*). Genes related to biotransformation enzymes, multixenobiotic resistance proteins, antioxidant enzymes, metallothionein, and heat shock proteins were sequenced and used in bivalve biomarker studies which resulted primarily from classical single-gene studies. Recently transcriptomics and proteomics methods such as suppression subtractive hybridization (SSH), microarray and two-dimensional electrophoresis are being carried out to study the genetic and molecular bases of biomarkers. Here we review present research of molecular biomarker studies of bivalves and introduce the new approaches that are ongoing or has not been applied on freshwater bivalves yet but could be particularly useful.

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PO 14

TWO PUZZLING NAIADS FROM THE MARAGARAZI RIVER (BURUNDI AND TANZANIA).

Cristian R. Altaba. Laboratory of Human Systematics, University of the Balearic Islands, 07071 Palma, Balearic Islands (Spain)

Two species of freshwater mussels are reported from the upper Maragarazi (Malagarasi) river along the border between Burundi and Tanzania. No freshwater bivalves have been hitherto reported from this drainage, tributary to lake Tanganyika and considered itself a distinct freshwater ecoregion. One of the species found belongs to *Aspatharia*. It differs from *A. subreniformis* living in drainages further south, and is similar to *A. pfeifferiana* from the Congo basin. The other one belongs to *Chambardia*. It differs from two species found further east in Tanzania, *C. bourguignati* and *C. wahlbergi hartmanni*; it is similar to *C. flava* from the Congo. The probable close relationship of the Maragarazi naiads with species living in the Congo River coincides with a pattern found among several fishes, pointing to a vicariant speciation through the formation of lake Tanganyika. This deep lake effectively isolated the headwaters of the pre-rift Congo since the latest Miocene, causing parallel divergence between the unionoid bivalves and their putative fish hosts.

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PO 15

DIVERSITY, ENDEMISM AND CONSERVATION STATUS OF THE FRESHWATER MUSSEL FAUNA OF THE IBERIAN PENINSULA. Cristian R. Altaba, Laboratory of Human Systematics, University of the Balearic Islands, 07071 Palma, Balearic Islands (Spain).

Throughout most of the 20th century it was generally assumed that the Iberian freshwater mussels included only a few widespread species. The combination of comparative anatomy, molecular genetics and ecology yields a novel perspective - a diverse assemblage encompassing a wide variety of ecological adaptations and exhibiting high levels of endemism. In northwestern Iberia, differentiation among drainages shows that Quaternary cladogenesis of *M. margaritifera* in relation to fish hosts may be grossly underestimated. In the northeast there are a few European taxa at the edge of their range. Along the eastern Mediterranean drainages, the genera *Unio*, *Psilunio* and *Anodonta* have experienced uneven diversification among isolated rivers. However, this pattern is not a simple one, suggesting instead repeated invasions. Endemism in southwestern Iberia may be traced to vicariance caused by large inland saline lakes in the Miocene, followed by isolation in separate drainages. Most of these endemic naiads are endangered, and some are presumed to be already extinct.

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PO 16

ONLINE MUSSEL ATLASES AT THE OHIO STATE UNIVERSITY. J. Cramer, and G. T. Watters. Department of Evolution, Ecology, and Organismal Biology, The Ohio State University.

Spatial representation of data is a powerful tool for understanding conservation issues. The objective of the Online Ohio Mussel Atlas mapping program is to disseminate geographic information about mussel records contained in The Ohio State University Museum of Biological Diversity Division of Molluscs collections. The Online Ohio Atlas allows users to quickly and efficiently obtain information by means of custom built queries. Queries can be basic, such as a search for any and all Ohio records for the "species = *Amblema plicata*". Users may also search for a smaller subset of records using a more detailed search. For instance, by creating the query string "**SPECIES = "plicata" AND YEAR > 1950 AND LIVE_FRESH = "X"**", the user would see all records for *Amblema plicata* found after 1950 that were live or fresh dead when sampled. The Atlas includes a number of map layers as well, including water bodies, dams, counties, and land use among others. This poster exhibits some applications of mapping technology in examining changes in geographic distribution of native Ohio mussel species as they have altered over time. Since the successful completion of the Ohio Atlas, work has begun and continues on a much more extensive North American Online Mussel Atlas.

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PO 17*

INCREASED SURVIVAL OF ENDANGERED JUVENILE OYSTER MUSSELS, EPIOBLASMA CAPSAEFORMIS (I. LEA, 1834), FOLLOWING FEEDING WITH BIOFLOCS. M. E. Vincie, R. J. Neves, S. R. Craig, E. McLean. Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Mail Code 0321, Blacksburg, VA 24061.

In an effort to develop artificial feeds for propagation purposes, two feeding trials were conducted to evaluate effect of commercial and non-commercial diets on growth and survival of oyster mussel *Epioblasma capsaeformis* juveniles. Juvenile mussels were placed in each of 24 separate culture vessels in a recirculating aquaculture system at the Freshwater Mollusk Conservation Center (FMCC), Blacksburg, Virginia, and randomly assigned a dietary treatment. Dietary treatments included the standard algae mix diet utilized in FMCC supplemented with bioflocs, algae mix supplemented with a probiotic, algae mix without any supplements, a triple concentration algae mix, and water from a pond source. Each diet was fed three times daily for a period of 51 d (trial 1) and 40 d (trial 2). Mussels were individually measured every ten to twelve days for shell length, and survival was measured at the end of each trial. In trial 1, growth was significantly higher in those juveniles fed the triple concentration algae mix (62,076 cells/ml) than all other diets tested in this trial, with juveniles achieving a mean length of 813 µm. The other dietary treatments tested in this trial were not significantly different from one another. Survival was significantly higher in those juveniles fed the algae mix supplemented with bioflocs with a survival rate of 9.92%. In trial 2, growth was significantly better in those juveniles fed algae mix supplemented with bioflocs than all other diets tested in this trial, with juveniles achieving a mean length of 685 µm. Survival was again significantly higher in those juveniles fed algae mix supplemented with bioflocs, with a two-fold increase in survival at a rate of 19.67%. Results of all feeding trials indicated that bioflocs enhanced survival of juvenile oyster mussels. An algae mix diet fed at a higher concentration supplemented with bioflocs could improve growth and survival of juvenile oyster mussels and should be tested.

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PO 18*

DESIGN AND MAINTENANCE OF A SYSTEM FOR LONG-TERM HOLDING OF FRESHWATER MUSSEL, *ANODONTITES TRAPESIALIS* (LAMARCK 1819) (BIVALVIA: MYCETOPODIDAE). Lima, Ricardo C.[1,3]; Paes, Angela T.[2]; Avelar Wagner E.P.[3]. [1] PPG Biologia Comparada, FFCLRP, Universidade de São Paulo.[2] UNIFESP, Setor de Estatística Aplicada.[3] Laboratório de Malacologia, Depto. Biologia, FFCLRP, Universidade de São Paulo.

Artificial culture of endangered and threatened mussel species has been strongly recommended in recovery plans as a strategy to enhance declining population numbers, as well as for the reintroduction of species to sites within their historic ranges. However, standard protocols for cultivating freshwater mussels are not completely developed, even though many populations of threatened and endangered mussel species would benefit from release of cultured juveniles. Our project compares two methods of adult's management, buried, within 15 cm layer of sediment (<600 µm) or suspended, in 32x28 cm nylon bags, focusing on growth and survival of these mussels in a captive environment. The animals were fed daily with a monospecific microalgae diet of *Chlamydomonas* sp. Comparing the percentage values between the measured weights it was observed a mean increase of 2.1% in the suspend group and a mean loss of 1.4% in the buried group. The suspended animals showed higher survival than the buried ones (p=0.007), with only two death (4%) over 120 days. The buried mussels ended the experimental period with 22% of mortality. We demonstrated that growth and survival of *A. trapesialis* in a captive environment for long-term holding is possible and easiest when they are kept suspend, and this could promote healthiest animals to propagation programs.

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PO 19*

MONITORING FITNESS OF CAGED FRESHWATER MUSSELS TO PRIORITIZE STREAMS FOR RESTORATION IN SOUTHEASTERN PENNSYLVANIA. Matthew Gray[1], Danielle Kreeger[2] and Angela Padeletti[2], [1] Drexel University 3141 Chestnut Street, Philadelphia, PA 19104., [2] Partnership for the Delaware Estuary One Riverwalk Plaza 110 South Poplar Street, Suite 202, Wilmington, DE 19801.

Freshwater mussels were once abundant and diverse throughout the Delaware Estuary where they provided numerous ecological benefits. Declines in both species diversity and abundance have been precipitous, like elsewhere in North America. Accompanying their decline is a loss of important functional services. Unionids dominate the ecology of streams where they are abundant through their filter feeding, redistribution of nutrients, and stabilization of substrates. Since they are sessile and long-lived, they are useful indicators of environmental conditions. Their success depends on high water and habitat quality, as well as fish hosts, and so the revitalization of these animals can serve as a driver for ecosystem restoration. A key prerequisite for restoration is to determine which streams can sustain viable populations. Mussels (*Elliptio complanata*) were collected from source streams, caged, and deployed into seven restoration candidate streams in southeastern Pennsylvania. Caged mussels from candidate streams, and caged and uncaged mussels from source streams (controls), were sampled 5 times over a 1 year period and analyzed for survivorship and condition index. Survivorship was high throughout the study and no caging effects were observed. While survivorship was not significantly different among all but one stream, condition index varied significantly among candidates (mean = 31-56). Future biochemical and water quality studies in these streams are planned and may yield more information on differences in stream quality for mussels. These preliminary data suggest that some candidate streams, which currently contain few or no native mussel populations, are capable of supporting mussel life and are ready for restoration.

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PO 20

SMALL SCALE AQUACULTURE SYSTEMS FOR PROPAGATION OF JUVENILE RARE AND ENDANGERED MUSSELS. Monte A. McGregor, A.C. Shepard, F. Vorisek, J. J. Culp, and J. Hinkle. KDFWR, Center for Mollusk Conservation, 3761 Georgetown Road, Frankfort, KY 40601.

We developed several small aquaculture systems for use in research and propagation of juvenile mussels. Starter systems (nursery stage I) include air lift downwellers consisting of 3.18 cm pvc vessels with mesh screening (100 to 250 µm) and a 1.27 cm cpvc air lift pipe to deliver up to 1 L/minute flow. Systems are maintained by replacing screens as juveniles grow. Once juveniles reach 2-3 mm, they are transferred to mini-riffle systems (nursery stage II) for the next several months. Mini-riffle systems are made from small 19 L square buckets retrofitted with a small section of 5 cm pvc pipe on the top to make a pvc bridge with a stainless steel screen bottom. Water is circulated by a small pump (600-1200 L hour). The final nursery (stage III) consists of variable sized upwelling tanks (19, 95, and 150L) that may be recirculating or open design. Several hundred juveniles (> 5 mm in length) can be held in each system for long-term grow-out using natural river water. In the closed systems, cultured algae/river sediment are continually mixed in a second 19 L bucket and delivered 3 to 4 times/hour (600 to 1000 ml of concentrated food per hour) to the downwellers or mini-riffle system with a small pump controlled by a repeat cycle timer. We have experimented with several species, including *Simponsias ambigua*, *Alasmidonta viridis*, *Lampsilis siliquoidea*, *L. cardium*, *L. abrupta*, *Epioblasma triquetra*, *E. capsaeformis*, and *Villosa trabilis*. Growth for most species has been up to 15-20mm in less than 9 months, regardless of time of year.

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PO 21

A NEW FRESHWATER NONGAME AQUACULTURE FACILITY IN NORTH CAROLINA. Brena Jones[1], Steve Fraley[2], Chris Eads[3], Kyle Briggs[4], David Deaton[4], T.R. Russ[4]. [1]NC Wildlife Resources Commission, 1142 I-85 Service Rd, Creedmoor, NC, 27522. [2]NC Wildlife Resources Commission, 50 Trillium Way, Clyde, NC, 28721. [3]North Carolina State University College of Veterinary Medicine , 4700 Hillsborough St, Raleigh, NC, 27606. [4]NC Wildlife Resources Commission, 645 Fish Hatchery Rd, Marion, NC 28752.

The North Carolina Wildlife Resources Commission (WRC) and North Carolina State University (NCSU) are working together to propagate native freshwater mussel species in need of conservation throughout the state. Two WRC state hatchery facilities and a third at the NCSU College of Veterinary Medicine are currently supporting spawning, host fish infestation, and growout of a total of 13 species, including state and federally listed imperiled species such as the Carolina Heelsplitter (*Lasmigona decorata*) and the Tar River Spinymussel (*Elliptio steinstansana*). Groundbreaking discoveries such as host species identification and successful propagation techniques for the latter two federally endangered species have been accomplished through this cooperative work. The new facility in Marion, NC is a 15 x 7.5 meter converted storage building with a flow-through system that pumps water from an onsite pond through multiple growout and holding tanks. Seven mussel species are held there presently, including juvenile Carolina Heelsplitters. Goals for mussels produced from this increased culture capacity include endangered species recovery, toxicological studies, life history research, and river ecosystem restoration.

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PO 22

PRELIMINARY TRIAL TO REPRODUCE *Acostaea rivoli* DESHAYES, 1827 (MOLUSCA: BIVALVIA: ETHERIIDAE) IN LABORATORY CONDITIONS. O. Repizo[1], D. M. Gualtero[1], F. Pinzón[2], L.A. Velasco[3].[1]Department of Environment Engineer, Corhuila University, Street 21 No. 6-01, Neiva-Huila, Colombia. [2]Corporation Morrosquillo, Street 4A No. 58-85, Bogotá, Colombia. [3]University of Magdalena, Street 32 No. 22-08, Santa Marta, Magdalena, Colombia.

Acostaea rivoli Deshayes, 1827, is a bivalve mollusk endemic to Colombia, of which there are few reports of its biology and ecology. Moreover, this species is threatened by the deterioration of rivers, and the extensive collection for food and for sale. This led to the attempt to reproduce this species in laboratory conditions. Specimens of *A. rivoli* (8 cm long) were captured in the Rio Opia (Tolima), and transported to the laboratory. Thirty-five specimens were kept in 100-liter tanks of filtered water at a temperature of 25 °C, and were fed with the algae *Selenastrum* sp. at densities of 20,000 cells ml^{-1}. Spawning occurred from June to July 2008, with a larval density of 86,943 larvae ml^{-1}. The mean larval length was 130 um long and 60 um wide on average, and were kept in 40-liter containers at densities of 1 larva ml^{-1}), and fed with *Selenastrum* sp. at a density of 10,000 cells ml^{-1}. *Tilapia rendalli* was employed as an intermediate host fish for the larvae, but so far, there has been no larval survival.

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PO 23

RESTORING RARE AND ENDANGERED FAUNA AT THE AQUATIC WILDLIFE CONSERVATION CENTER. Nathan L. Eckert[1], Joseph J. Ferraro[1], Amanda E. Wood[1], Jonathan Orr[1] and Michael J. Pinder[2]. Virginia Department of Game and Inland Fisheries, [1]1724 Buller Hatchery Rd, Marion, Virginia 24354, [2]2206 South Main Street, Blacksburg, Virginia, 24060.

The Virginia Department of Game and Inland Fisheries established the Aquatic Wildlife Conservation Center (AWCC) in 1998 to recover the high number of endangered freshwater mussels in the Upper Tennessee River System of Virginia. The facility is located along the South Fork Holston River (SFHR) near Marion, Virginia. The AWCC draws water from the SFHR that passes through a 5-acre pond to increase temperature and algal productivity. Adult mussels are held in circular fiberglass tanks that can provide specific habitat for niche specialists. Thirty-eight species of freshwater mollusks have been held at AWCC with 30 spawning in captivity. Twenty-four species have been propagated since 2003. A portion of juveniles are held for grow-out in flow-through and recirculating systems supplied with filtered river water, eight species have been raised to over one year of age in these system, two species have become sexually mature. In addition to mussels, the state endangered spiny riversnail, *Io fluvialis*, and eastern hellbender, *Cryptobranchus alleganiensis*, is raised at AWCC. These animals are released into six designated mussel restoration reaches in the Powell, Clinch, and North Fork Holston rivers of the upper Tennessee River System of Virginia.

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PO 24

USING MUSSELS SILOS AS A TOOL FOR ASSESSING POTENTIAL FRESHWATER MUSSEL RESTORATION SITES. Nathan L. Eckert[1], Joseph J. Ferraro[1], Jonathan E. Orr[1], Amanda E. Wood[1] and Michael J. Pinder[2] Virginia Department of Game and Inland Fisheries, [1]1724 Buller Hatchery Rd, Marion, Virginia 24354, [2]2206 South Main Street, Blacksburg, Virginia, 24060.

A two year study was conducted using Barnhart mussel silos to assess the quality of current freshwater mussel restoration sites in the Upper Tennessee River System of Virginia and Tennessee. A total of six sites were studied in 2007 while eight sites were studied in 2008. Among these 8 sites, four were duplicates and four where new sites. Sites varied from headwater tributaries to large mainstem sections. Each study site received three silos stocked with 10 subadult hatchery-raised *L. ovata* (2005 cohort). Controls were kept at the Aquatic Wildlife Conservation Center, near Marion to compare captive to wild growth. Mussels were measured monthly from March until November. Growth was recorded and expressed as percent growth to standardize differences among initial size. Sites with poor growth were excluded from the second year of the study. Growth in silos the initial year ranged from 26.0% to 56.6%. Second year of the study growth ranged from 10.0% to 80.1%. We found the silos to be a useful tool in assessing quality mussel habitat prior to implementing mussel restoration activities. Further analysis would be needed to the causal factors that explain differences in mussel growth among sites.

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PO 25

THE SLOW PATH TO NEAR-EXTINCTION AND RECOVERY OF A RESTRICTED-RANGE FRESHWATER MUSSEL -*UNIO ALERONI* IN THE EASTERN PYRENEES FOOTHILLS. Cristian R. Altaba[1], Carme Rosell [2], Santiago Giráldez [2], Marc Fernández [2], Emili Bassols[3] [1] Laboratory of Human Systematics, University of the Balearic Islands, 07071 Palma, Balearic Islands (Spain). [2] Minuartia Estudis Ambientals, Passatge Domènech 3, 08470 Sant Celoni, Catalonia (Spain). [3] Parc natural de la Zona Volcànica de la Garrotxa, Casal dels Volcans, Av. Santa Coloma s/n, 17800 Olot, Catalonia (Spain).

Unio aleroni Companyo & Massot, 1845 (Bivalvia: Unionidae) is a species endemic to the foothills of the eastern Pyrenees in north-eastern Catalonia, with an original range extending through several small river systems. Now it is critically endangered, due to pollution, destruction of river beds and margins, and decimation of native fish. A project aimed at the study and recovery of the last known population, located near the limits of the Garrotxa Volcanic Zone Natural Park, has been carried on during the last 16 years. Less than 5000 individuals were censed, living mainly in the submerged counterforts of the riparian forest. They exhibit a strongly disturbed demographic structure, with negligible recruitment, progressive ageing, reduced fertility, and resource allocation into individual growth. Predation by introduced American vison and reintroduced otter is a serious new conflict. The fight against the species' extinction is being done along four fronts: protection and recovery of the population's habitat; successful translocation to new sites; captive breeding and infestation of wild fish (using the natural hosts, barbel and chub); and environmental education. The detection of young individuals, together with the public attention received by the species, are encouraging signals for the naiad's return. In addition, other surviving populations have been located, even extending the species' known range, although they are very small and highly vulnerable.

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PO 26

ASSISTING IN RECOVERY EFFORTS FOR MUSSEL SPECIES AT RISK IN CANADA. K. A. McNichols, G. L. Mackie, and J. D. Ackerman. Department of Integrative Biology, University of Guelph, Guelph, ON, Canada, N1G 2W1

Currently eight of the 55 species of mussels in Canada are federally protected under the Canadian Species at Risk Act (SARA). Our immediate goal was to identify and/or confirm host fish, an urgent priority for all mussel SAR in Canada, for three endangered species of mussels: *Ligumia nasuta*, *Villosa fabalis*, and *Epioblasma torulosa rangiana*. In addition, we infested the endangered *Lampsilis fasciola* using a known host to obtain large numbers of juvenile mussels for laboratory experiments. *Ligumia nasuta* juveniles developed on yellow perch (91%), pumpkinseed sunfish (8%), and Brook stickleback (1%). Host fishes for *Villosa fabalis* were confirmed as greenside darter (8%), rainbow darter (44%), and mottled sculpin (40%) and Johnny darters (7%) were newly identified as marginal hosts. *Epioblasma torulosa rangiana* juveniles developed on Iowa (99%) and blackside (1%) darters. Over 3,000 *Lampsilis fasciola* were produced using 16 smallmouth bass. Mean survival (± standard error) for two cohorts of juveniles involved in dietary experiments (3 different algal treatments) were 7 ± 1 % and 19 ± 3 % since the inception of the experiments. The mean length of the first cohort of juveniles is 1143 ± 132 µm. Both survival and growth have increased substantially since the addition of a juvenile mussel AHAB system and the introduction of live algal cultures into dietary treatments. The identification and confirmation of the host fishes for mussel SAR is vital to their recovery, especially with respect to breeding programs. This type of information will lead to the protection, augmentation of existing populations, and reintroduction of extirpated populations in Canada.

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PO 27

HEALTHY MUSSELS = HEALTHY RIVERS: RESTORATION OF THE DELAWARE ESTUARY WITH THE LIGHTFOOT MUSSEL (*ELLIPTIO COMPLANATA*). Angela T Padeletti[1], Danielle A. Kreeger[1], Catherine M. Gatenby[2], Steven G. Hughes[3], Roger L. Thomas[4], Rosemary Malfi[4], Heidi Tucker-Wood[3], William Ellis, and Mathew Gray.. [1]Partnership for the Delaware Estuary Wilmington, DE 19801; [2]US. Fish and Wildlife Service White Sulphur Springs, WV 24986; [3]Cheyney University Cheyney, PA 19319; [4]The Academy of Natural Sciences Philadelphia, PA 19103

The health of freshwater mussel assemblages, endangered in biodiversity and population abundance, represents an ideal indicator of watershed health. Freshwater mussels require a complex suite of suitable conditions, including healthy habitats, water quality and flow, and free passage of host fish. For these reasons, freshwater mussels represent ideal targets for ecosystem restoration. Freshwater mussels once thrived across the Delaware Estuary, but only one of our native species can now be readily found. The Freshwater Mussel Recovery Program was implemented to restore diversity, population biomass, and resilience of native mussel communities using conservation, reintroduction, and range expansion. Reintroduction will be achieved by seeding targeted streams (Gray, Poster) with hatchery reared juvenile mussels and transplanted reproductively active adults. Initial phases of the project have commenced in Southeastern Pennsylvania, where broodstock of the lightfoot mussel (*Elliptio complanata*) as well as pumpkinseed (*Lempomis gibbosus*), white suckers (*Catostomus commersonii*), and banded killfish (*Fundulus diaphanous* & *F. heteroclitus*) were collected from study sites. At Cheyney University's hatchery, approximately 165 of 508 fish were successfully infested with glochidia in 2008. The successful production of seed mussels is scheduled for 2009 using American eels (*Anguilla rostrata),* which were deemed the preferred fish hosts of this species. Enhancing ecosystem services, boosting population resilience, and filling open niches are only some of the objectives we hope to achieve by reintroducing freshwater mussels not only into Southeastern Pennsylvania but through out the Delaware Estuary.

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PO 28

***UNIO ELONGATULUS ALERONI* IN THE LLOBREGAT RIVER (NE SPAIN). FROM DISCOVERY TO RESCUE. A HOPEFUL CASE FOR SUCCESSFUL CONSERVATION MEASURES.** N. Valls [1], O. Comas[1], N. Gázquez[2] and M. A. López[3]. [1]Association for the protection of the native flora and fauna (ADEFFA), Masia Camadoca s/n, 08517 Santa Maria de Merlès, Barcelona, Spain. [2]Environmental Agency, Generalitat de Catalunya, Dr. Roux 80, 08017 Barcelona, Spain. [3]Forestal Catalana, Environmental Agency, Generalitat de Catalunya, Sabino Arana 34 1r-1a, 08028 Barcelona, Spain.

Naiad populations have been extensively eradicated in highly impacted rivers. The Llobregat river (5000 km^2 surface, 170 km. length and 10-30 m^3/s flows) provides the majority of water for industrial uses and personal consumption in Catalonia, which includes Barcelona metropolitan area (3.5 million people). Despite this situation, and the lack of previous records for naiads in this river, since ca. 1998 living individuals of the species *Unio elongatulus aleroni* (Companyó & Massot, 1845) was discovered. Several surveys have found the presence of *U. elongatulus* in at least four of the less polluted smaller tributaries, all of which contain permanent water. More recently, during 2 years of severe drought most of these recently discovered wild populations have become extinct due to river dessication. A rescue program, begun with 7 founder individuals, based on ex-situ maintainance using the same river water together with natural host fish interactions was initiated in 2003. During 5 years ca. 500 juveniles of the species have been produced, growth and survival has been studied, and propagation measures for re-introduction to the river have been carried out. Life cycles have been completed in captivity, and in the wild, where some juveniles have been found (F2 generation) indicating that the enhancement of propagation measures, should they attain the proper scale, will enable the return of naiad populations to near the previous population numbers in the drought-affected locations. In addition, we have made some advances in identification of the fish-host range, and growth and survival parameters which can be used as a reference for growth validation in this species.

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PO 29*

ACTION PLAN FOR THE FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA)* IN THE CZECH REPUBLIC. Ond ej Spisar[1], Tereza Mináriková[2].[1]Institut of fishery, Agriculture faculty, University of South Bohemia, Kn žská 8, 370 01, eské Bud jovice, Czech Republic. [2]The Agency for Nature Conservation and Landscape Protection (ANCLP) of the Czech Republic, Nuselská 34, 140 00 Praha 4, Czech Republic.

The freshwater pearl mussel *Margaritifera margaritifera* (L.), once common bivalve in rivers all around the world, is now a seriously endangered species. It is protected under the EU and the Czech legislature. In the Czech Republic (CR), it is a Specially Protected Animal Species, listed in the category of Critically Endangered Species. Therefore, the ANCLP was encharged by the Ministry of the Environment (MoE) of the CR with the coordination, preparation and realization of an Action plan for the freshwater pearl mussel. The Action plan was approved by the MoE in 2000 and its main aim is to preserve viable populations of the species, with successful reproduction. In the CR, the main causes of population decline are eutrophication and decreasing water quality, erosion, unnatural river modifications and changes in landuse. Therefore, the Action plan focuses on conservation of entire oligotrophic ecosystems. It is being implemented in eight sites of occurence of the freshwater pearl mussel in the CR within the National Natural Monument (NNM) Blanice (River), which constitutes a pilot area with the most significant surviving Central European population of the species (approx. 20 000 ex.). In the pilot area, different methods of biotope and species management are being tested, including semi-natural breeding of juvenile freshwater pearl mussels and special revitalization adjustments of river systems. Consequential phases of the project will be directed towards renewal of biotopes and concurrent repatriation of the freshwater pearl mussel to selected sites while using the semi-natural breeding units.

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PO 30

DISTRIBUTION, ABUNDANCE AND CONSERVATION STATUS OF THE CRITICALLY ENDANGERED FRESHWATER PEARL MUSSEL (MARGARITIFERA MARGARITIFERA) AND THE THICK SHELLED RIVER MUSSEL (UNIO CRASSUS) IN BAVARIA, GERMANY. Bernhard Gum & Juergen P. Geist, Unit of Functional Aquatic Ecology and Fish Biology, Department Animal Science, Technische Universität München-Weihenstephan, Muehlenweg 22, D-85354 Freising, Germany.

The overall objective of this work is to design sustainable conservation strategies for two highly endangered bivalve species: *Margaritifera margaritifera,* the European freshwater pearl mussel and *Unio crassus,* the European thick shelled river mussel. Both species differ in their life history strategy, longevity, population density and demography. While *M. margaritifera* is a stenoecious and long-lived freshwater mussel that is strictly adapted to oligotrophic conditions and which obligatorily depends on salmonid hosts, by contrast, the short-lived *Unio crassus* represents a more euryoecious species which uses a broader host fish spectrum and colonizes a wider range of suitable habitats. Based on a comprehensive data collection, ongoing surveys and field mapping, we aim to develop both immediate rescue actions (e.g. host infection, culturing, and stocking of juvenile mussels) and long-term habitat restoration measures that take into account the different life histories of both species. The conservation management approach of this project integrates joint efforts of university and government organizations, most notably the Bavarian Environmental Protection Agency ("LfU Bayern"), and has a geographical focus on the state of Bavaria, Germany. In this area both large populations of *U. crassus* and *M. margaritifera* still occur, despite of strong decline and lack of recruitment. We suggest that restoration of mussel populations and stream ecosystems requires a holistic catchment conservation approach which includes all stakeholders such as fisheries managers, land owners and representatives of nature protection and landscape conservation.

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PO 31

AN EXPERIMENTAL TEST OF HOST SPECIFICITY IN THE FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA).* G. R. Thomas[1], J. Taylor[2] & C. Garcia de Leaniz[1]. [1]Swansea University, SOTEAS, Institute of Environmental Sustainability, Singleton Park SA2 8PP, Swansea, UK. [2]Environment Agency Wales, Cynrig Fish Culture Unit, LD3 7AX Brecon, Powys, UK.

The endangered freshwater pearl mussel (*Margaritifera margaritifera*) is closely linked to the distribution of salmonids but the extent of host specificity is poorly known. We employed a 'common-garden' approach to examine host specificity in *M. margaritifera* following cohabitation for 96 hours with equal numbers of juvenile (0+) brown trout (*Salmo trutta*), Atlantic salmon (*Salmo salar*) and arctic charr (*Salvelinus alpinus*). Glochidia prevalence differed significantly betwen salmonid hosts one week after encystment ($P<0.001$), being much higher for brown trout (100%) and artic charr (100%) than for Atlantic salmon (12.5%). Mean glochidia loads (m) differed significantly between hosts ($P<0.001$) when statistically controlling for differences in body size, and were highest for brown trout ($m = 100.70$, SE = 11.74), intermediate for artic charr ($m = 55.87$, SE = 11.74) and lowest for Atlantic salmon ($m = 0.208$, SE = 0.120). Thus our results indicate that there may be important differences in suceptibility among salmonid hosts, and that variation in host specificity should be taken into acount when designing captive breeding and reintroduction programmes.

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PO 33

TALE OF TWO RIVERS IN NORTHEASTERN OREGON: UMATILLA AND MIDDLE FORK JOHN DAY RIVERS. Donna Nez, Jayne Brim-Box, Jeanette Howard, Christine O' Brien, Andrew Wildbill, and David Wolf, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fish & Wildlife Programs, PO Box 638, Pendleton, Oregon 97801.

Up until the early 1900's freshwater mussels were an important food staple during the harsh winter months for Native Americans tribes. In 2003 The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) conducted a presence absence survey to determine the current status of freshwater mussel populations on tribal ceded land. The Middle Fork John Day (MFJD) and Umatilla rivers were selected for the study. In the MFJD basin the CTUIR found all three mussel genera: Margaritifera, Gonidea, and Anodonta. However, on the Umatilla River Anodonta and Gonidea were only found on the lower section and its tributaries. No live *Margaritifera falcata* were found. Extirpation of *M. falcata* on the Umatilla River was most likely a result of the following: habitat degradation, active channel change, water diversion, flood water control dams in agriculture areas, and the decline of host fish such as the Chinook salmon. Nationwide many populations of freshwater mussels are still in decline. The conclusion of the status survey leads to the drafting of a recovery plan for the Umatilla River. Genetic mapping, mussel reproductive biology, and relocation projects are currently in progress on the MFJD River.Data obtained from these projects will provide the information and tools necessary for the recovery of the Umatilla River ecosystem.

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PO 34

REACH AND CATCHMENT LEVEL CONDITIONS OF FRESHWATER MUSSEL ASSEMBALGES (BIVALVIA: UNOINIDAE) ON MARYLAND'S COASTAL PLAIN. Matthew J. Ashton, Scott A. Stranko, and Michael T. Kashiwagi. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, 580 Taylor Ave. C-2, Annapolis, MD 21401.

We investigated the relationship between environmental and landscape conditions on freshwater mussel distribution in Coastal Plain streams of Maryland. Visual searches (≥15 min) for mussels were conducted within 157, 75-m stream reaches sampled from 2007-2008. Water chemistry, habitat, and fishes were collected along with mussels at sites using standardized methods. We used GIS to quantify land use types within upstream catchments. Imperiled species and diverse mussel (ID) assemblages were encountered at 28 sites. At the remaining sites, common species or no mussels (CA) were collected. Principal component analysis identified seven components accounting for 65% of the variation in environmental conditions across Coastal Plain sites. While spatial patterns of conditions could be discerned, examination of PCA plots revealed that *a priori* assemblages may not be appropriate. Stepwise multiple linear regression models were created for species richness and mussel assemblages to evaluate variables that may explain their distribution. Models predicting mussel richness and CA mussel assemblages with a combination of reach and catchment variables preformed poorly (R^2=0.31-35). A model containing instream habitat, eroded area, % shade, riparian width, total nitrogen, and % urban land cover best explained ID mussel assemblages (R^2=0.72). Increasing urbanization and poor agricultural practices can result in stream degradation through loss of riparian function, habitat degradation, increased nutrients, and siltation. Reach- and catchment-level variables that typically relate to stream condition were commonly identified in regression models. Consequently, landscape alterations that adversely affect water quality may structure the apparent distribution and assemblage composition of Maryland mussels.

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PO 35

A QUALITATIVE SURVEY OF FRESHWATER MUSSELS IN CUB RUN, FAIRFAX COUNTY, VA. C. D. Bishop [1], R. A. Connelly [1,] J. Matkowski [1], G. Wilson [2.] [1]EA Engineering Science and Technology, Inc.,15 Loveton Circle, Sparks, MD 21152. [2] Whitman, Requardt & Associates, LLP, 3701 Pender Drive, Fairfax, VA 22030.

A freshwater mussel survey was performed at all proposed utility crossings of Cub Run and Flatlick Branch in Northern Virginia for a sanitary sewer line upgrade project in order to assess potential impacts to listed mussel species, particularly *Elliptio lanceolata*. Eight stations were qualitatively surveyed 100 m upstream and 400 m downstream distance from the utility crossings for the presence of live unionids in the project area during the fall of 2008. All live individuals were identified to species and aged. Additional environmental data were collected at each upstream and downstream reach including substrate composition, stream habitat, and water quality. No federal or state listed species were collected in the project area. Approximately 1,700 mussels comprising four species were collected from the eight stations. *Elliptio complanata* dominated the collection comprising 96% of the mussel fauna, followed by *Alasmidonta undulata*, *E. producta*, and *Pyganodon cataracta*. While mussel diversity is limited, substrate and water quality appears to support a viable *E. complanata* population, despite extreme stormwater runoff conditions that often occur in Cub Run. All mussel species collected during this survey are known to prefer a variety of substrates and water velocities. Substrate characterization, water quality, and habitat analysis reported during this survey indicated that these preferred habitats were not limited and therefore did not appear to be the primary cause of low mussel diversity in this reach of Cub Run and Flatlick Branch.

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PO 36*

ASSESSING THE INFLUENCE OF MUSSEL BEDS ON STREAM ECOSYSTEM STRUCTURE AND FUNCTION. N. G. Jeremiah[1], E. F. Benfield[1], H. M. Valett[1], J. R. Webster[1] and C. M. Gatenby[2]. [1]Virginia Polytechnic Institute and State University, Mail Code 0321, Blacksburg Va. 24061. [2]White Sulphur Springs National Fish Hatchery, 400 East Main St., White Sulphur Springs, WV 24986.

Freshwater mussels are a diverse group of animals consisting of approximately 1000 species found worldwide. However, despite their diversity and range, freshwater mussels are imperiled disproportionately to other animal groups. Mussels serve critical biological, chemical and physical roles and their extirpation will likely alter the structure and function of the freshwater systems they inhabit. We are currently working in Copper Creek, Russell County Virginia, a stream known to be high in mussel biomass, to explore how mussel beds contribute to the structure and function of stream ecosystems. We are investigating the influence mussels have on suspended organic matter, their contribution to benthic organic matter, and their potential influence on nutrient cycling and stream metabolism. We are also investigating mussel beds as loci of macroinvertebrate and fish diversity. Through experimentally changing mussel density, we will attempt to identify ecosystem services that may be compromised or potentially altered due to the continued decline in native freshwater mussel abundance and richness. By understanding the potential loss in ecosystem services due to mussel decline, more aggressive and effective legislation, management, and conservation techniques can be employed to maintain critical mussel habitat.

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PO 37

FRESHWATER MUSSEL (BIVALVIA: UNIONIDAE) SURVEY OF THE SALT RIVER, MISSOURI. S. E. McMurray and J. S. Faiman. Missouri Department of Conservation, Resource Science Division, 1110 S. College Ave., Columbia, MO 65201.

From 2005 – 2007 freshwater mussels (Bivalvia: Unionidae) were qualitatively surveyed with timed, visual searches (average time/site = 1.25 hrs) at 36 locations in the Salt River basin, a Mississippi River tributary in northeast Missouri; 20 of these locations were also surveyed before closure of Clarence Cannon Dam. A total of 2180 live individuals from 28 species and shells of 3 additional taxa, including 3 Species of Conservation Concern (*Ligumia recta, Quadrula nodulata, and Plethobasus cyphyus*), were observed. Catch per unit effort (CPUE, live individuals/hr) ranged from 0 to 332 (average = 50.4). *Amblema plicata* was the most dominant taxa encountered (530 individuals at 21 sites), representing 24% of the mussels collected. Live taxa richness and number of individuals (pre-impoundment = 31 and 4288, respectively; average time/site = 2.7 hrs.) decreased from pre- to post-impoundment, but average CPUE increased (pre-impoundment 27.5). However, post-impoundment CPUE values decreased at 12 locations below and above the impoundment and were similar at one location. Seven stations had higher post-impoundment CPUE values, but only one of those was downstream of the impoundment. With 37 species known to occur there, the Salt River basin is a diverse system, similar to rivers in the Ozark region.

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PO 38*

THE DISTRIBUTION OF UNIONID MUSSELS IN NORTH DAKOTA RIVERS. J. T. Mertes[1], L. M. Wieland[1], G. L. Van Amburg[2], A .W. DeLorme[1]; [1]Department of Biology, Valley City State University, Valley City, ND 58072; [2]Department of Biology, Concordia College, Moorhead MN, 56562.

Two major drainages can be found in North Dakota; the Missouri River drainage and the Red River drainage. Historically 14 species of Unionid mussels (Superfamily *Unionacea*) have been reported in the aforementioned drainages. We conducted a qualitative rapid assessment protocol, the purpose of which was to provide: 1) updated species lists for each site and species distribution throughout the state and 2) information which will allow us to design and effect a more rigorous quantitative survey in the summer of 2009. Timed searches were performed at 153 sites on 28 rivers; 7,780 mussels were identified and measured with the vast majority being returned to their site of collection. Most of the sites were chosen to mirror the surveys done by Dr. Alan Cvancara between 1960 and 1983, the last major surveys of North Dakota mussels. Our inspection of these locations confirmed the presence of each of the species of Unionid mussels that had been documented in earlier investigations, together with the discovery of a species (*Truncilla truncata* - Deertoe) previously unknown within North Dakota river systems. Some of the species have expanded their range (*Lampsilis cardium* - Plain pocketbook, *Quadrula quadrula* - Maple leaf, and *Ligumia recta*- Black sandshell) while others (*Strophitus undulates* - Creeper and *Potamilus ohiensis* - Pink papershell) look to have been locally extirpated from some areas they used to inhabit. Overall current mussel populations in the state appear to be analogous to those of 30 years ago however, a more structured, quantitative survey must be carried out in order to make an accurate assessment of their population dynamics.

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PO 39

FRESHWATER MUSSEL, FISH, AND MACROINVERTEBRATE SURVEYS IN THE MAJOR TRIBUTARIES OF FRENCH CREEK, PENNSYLVANIA. Tamara A. Smith[1*] and Elizabeth S. Meyer[2] [1] Western Pennsylvania Conservancy, Northwest Field Station, 11881 Valley Rd., Union City, PA; 16438, U.S.A., [2] Western Pennsylvania Conservancy, 800 Waterfront Dr., Pittsburgh, PA, 15222, U.S.A.; [*] Current Address, 12131 Richmond Rd., Twin Lakes, WI, 53181, U.S.A.

The French Creek Watershed, located at the headwaters of the Ohio River drainage, is nationally recognized for its high aquatic species diversity. Twenty-five timed search mussel surveys were conducted throughout the ten major tributaries of French Creek, and fish and macroinvertebrate surveys were conducted at most sites. We recorded 22 live native mussel species, including federally endangered *Pleurobema clava* (Lamarck, 1819) (clubshell) and several other Pennsylvania State species of concern. In addition, we documented 48 fish species and determined that most mussels had at least one host fish species present at each mussel site. Macroinvertebrate surveys indicate good water quality throughout the tributaries. Fish species richness, mussel species richness, and macroinvertebrate genus richness had no significant correlations. We hope these data will help aid the restoration and protection of endangered mussels in this watershed.

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PO 40*

A UNIQUE APPROACH: UNIONID FILTRATION OF THE PHYTOPLANKTON COMMUNITY. Carrie J. Miller and Caryn C. Vaughn, Oklahoma Biological Survey, Ecology and Evolutionary Biology Graduate Program and Department of Zoology; University of Oklahoma; 111 E. Chesapeake St. Norman, OK 73019, U.S.A.

Cultural eutrophication and an increasing prevalence of harmful algal blooms (HABs) are worldwide phenomena. One potential biological solution for the reduction and prevention of algal blooms is the use of natural filter feeding organisms, such as freshwater mussels, to reduce phytoplankton abundance in the water column. However, prior to implementation, we need more information on how freshwater mussel filtration affects phytoplankton community composition, lest the addition of mussels to a system promote rather than mitigate harmful algal species. The central goal of my proposed Ph.D. research is to increase our understanding of how freshwater mussel filtration affects phytoplankton abundance and community composition. My planned approach is twofold, combining long-term field monitoring with laboratory experiments. I will include natural complexity by sampling abiotic (temperature, pH, nutrients, DO, flow) and biotic (phytoplankton, zooplankton, bacteria) parameters over and adjacent to several mussel beds on a monthly basis. This also allows for detection of seasonal, hydrographic, and mussel bed effects on the phytoplankton community. I will also test for filtering differences among various mussel species under standardized conditions in several laboratory experiments using natural plankton assemblages. By collecting and culturing mussel feces and pseudofeces during these feeding experiments, I plan to test the viability of filtered and ingested phytoplankton. Together, these studies will increase our understanding of how mussels impact the phytoplankton community and may provide a viable bioremediation solution that would also promote conservation and restoration of an important aquatic group dangerously close to extirpation.

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PO 41

STATUS AND CONSERVATION OF FRESHWATER MUSSELS IN COASTAL PONDS OF SOUTHEASTERN MASSACHUSETTS. Ethan Nedeau, Steve Johnson, and Paul Low. Biodrawversity LLC, 441 West Street, Amherst, MA; Marea Gabriel. Massachusetts Natural Heritage and Endangered Species Program, Westborough, MA

Coastal ponds of southeastern Massachusetts support seven species of freshwater mussels, including three state-listed species: tidewater mucket (*Leptodea ochracea*), eastern pondmussel (*Ligumia nasuta*), and triangle floater (*Alasmidonta undulata*). These glacially derived kettlehole ponds are revered for their clear water and sandy beaches, however, their proximity to intensifying urban development is putting enormous strain on these ecosystems in the form of shoreline development, recreational use, eutrophication, and introductions of invasive plants and animals. The Massachusetts Natural Heritage and Endangered Species Program has funded research on these ponds to understand the status and habitat of freshwater mussels, specific effects of docks, and to develop long-term conservation strategies. We present results of semi-quantitative and quantitative studies conducted from 2007-2008 on nine ponds, including diversity patterns, abundance, demographics, habitat, and the effects of docks, motorboat use, and trampling. Implications of these studies for environmental permitting and conservation planning are discussed.

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PO 42

CAN RAPID BIOASSESSMENT PROTOCOLS BE USED AS INDICATORS OF MUSSEL COMMUNITIES? Nathan J. Wentz[1], Alan D. Christian[2,3], John L. Harris[1], and Jerry L. Farris[2]. [1]Department of Biological Sciences, PO Box 599, State University, AR, 72467. [2]Environmental Sciences Graduate Program, Arkansas State University, P.O. Box 847, State University, AR 27467. [3]Department of Biology, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA 02125

Fish, aquatic macroinvertebrate, and mussel are highly affected by habitat degradation and alteration and are often used in rapid bioassessment protocols (RBP) as indicators of stream integrity and water quality. The goal of this study was to determine whether fish, macroinvertebrates, and habitat RBP indices are suitable indicators of mussel habitat and community structure in the Tyronza River, Arkansas. We investigated 9 sites in the Tyronza River and 2 reference sites for fish, mussels, other macro-invertebrates, and physical habitat using RBPs and Principal Component Analysis (PCA). A total of 1611 fish was collected comprising 42 species. Richness ranged from 4-15 species per site with a mean of 10 ± 4.4 (SD). Fish Community Structure Index values ranged from 4 to 20 with a mean of 12; a "Somewhat Similar" condition. From 627 macro-invertebrate individuals, 23 taxa were recorded. Mean taxa richness per site was 10 ± 4.2 (SD), ranging from 3-14. Macro-invertebrate Index-Small Watershed values ranged from 16-28, with a mean of 23; a "Good" condition. Both fish and macroinvertebrate communities showed little correlation with mussel communities, however, mussel diversity was significantly correlated with U.S. EPA habitat scores. PCA results suggest that mussels were driven by the fish community. These results indicate that fish and macroinvertebrate RBPs are not suitable indicators of mussel communities in deltaic systems. However, further research is needed to determine if U.S. EPA habitat RBPs could be used to predict the locations of increased mussel diversity.

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PO 43

PATTERNS IN COMMUNITY STRUCTURE OF NATIVE MUSSELS IN THE UPPER MISSISSIPPI RIVER. S. Zigler[1], T. Newton[1], J. Rogala[1], and M. Davis[2]. [1]USGS Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603. [2]MN Department of Natural Resources, 1801 South Oak Street, Lake City, MN 55041.

In the past century about 20 mussel species have been functionally lost from the Upper Mississippi River (UMR) basin, and at least 28 species are state or federally listed. Anecdotally, community composition appears to have changed considerably from pre-European settlement times toward communities dominated by pollution-tolerant, habitat generalists (e.g., *Amblema plicata*, *Fusconaia flava*), but rigorous studies are lacking. To evaluate patterns in mussel communities in the UMR, we analyzed data from surveys of native mussels that were conducted in three reaches (Navigation Pools 5, 6, and 18). These surveys resulted in >560 quadrat samples taken systematically at >280 sites (two samples/site) in each reach. Although study reaches contained similar densities of mussels, differences in mussel communities were evident from exploratory nonmetric multidimensional scaling analyses. Permutation tests (ANOSIM) indicated that communities differed (global Rank Similarity statistic, *RS*=0.376; P<0.01) among reaches. Pairwise tests of rank similarities showed that the mussel community in Navigation Pool 18 was substantially different from the community in Navigation Pool 5 (*RS*=0.52) and moderately different from the community in Navigation Pool 6 (*RS*=0.28), whereas communities in Navigation Pools 5 and 6 were similar (*RS*=0.182). The dissimilarity between the mussel community in Navigation Pool 18 and the other two Navigation Pools was primarily the result of higher abundances of *Quadrula quadrula* and *Obliquaria reflexa*, and lower abundances of *Amblema plicata* and *Q. pustulosa*. The results of our study suggest that management goals and actions in the UMR may need to account for important differences in mussel communities that occur among reaches.

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PO 44*

GENETIC DIVERSITY OF THE RAINBOW SHELL (*VILLOSA IRIS* (LEA 1829)) IN THE SOUTH FORK OF THE SPRING AND SPRING RIVERS, ARKANSAS.

Allison M. Asher[1]* and Alan D. Christian[1,2]. [1]Environmental Sciences Graduate Program, Arkansas State University, P.O. Box 847, State University, AR 72467. [2]Department of Biology, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA 02125

The genetic structuring of the freshwater mussel *Villosa iris* was investigated at four populations in the Spring River drainage [Spring River (SR) and the South Fork Spring River(SFR)] in north central Arkansas. For freshwater mussels, gene flow occurs through migration of glochidia via host fish and genetic distance corresponds geographic distance, increasing as distance between populations increase. We sampled two populations (n= 11 and 56) in the SR and two populations (n= 17 and 82) from the SFR. We used 7 polymorphic microsatellite primers previously designed for *L*ampsilis *abrupta*. Number of alleles per locus ranged from 9 to 32, with an average of 23 alleles per locus. Population structuring was low between all populations (F_{st}= 0.028). We observed lower genetic diversity in the SF (F_{st}=0.012) than in the SR (F_{st}= 0.022). Four of the 7 loci were not in of Hardy-Weinberg equilibrium in at least 1 population, while 2 loci were not in equilibrium in any population. Genetic diversity did not increase with geographic distance. Low overall diversity values and variable and low sample size in two of the populations could explain the lack of increased diversity with geographic distance. The high gene flow observed in this study could be explained by *V. iris* being known to use host fish (e.g. large and smallmouth bass) that are highly mobile fishes.

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PO 45

AUGMENTATION OF THE FATMUCKET, *LAMPSILIS SILIQUOiDEA* IN ELKHORN CREEK, KY: A PILOT STUDY.

J. Jacob Culp, Monte A. McGregor, Adam C. Shepard, and Fritz Vorisek. Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY 40601.

We released 100 captive-reared *Lampsilis siliquoidea* in Elkhorn Creek in September 2007. Released individuals were 21-23 months old and were the product of multiple infestations of largemouth bass with glochidia taken from adults originally collected in Elkhorn Creek. Before the release all juvenile *L. siliquoidea* were tagged and measured: mean length was 20.83 mm. One month prior to the release, we completed a quantitative survey of the site. We randomly sampled 60 m^2 quads and determined mean densities of 1.35 per m^2 for all 9 mussel species collected and 0.03 per m^2 for *L. siliquoidea*. A 5m x 5m release site was chosen based on the criteria of habitat stability and high mussel density. Approximately one year after initial release, we surveyed the site a second time to monitor the released *L. siliquoidea*. In an area of 7m x 20m, 32 m^2 quads were randomly sampled. Both total densities (9 species) and *L. siliquoidea* densities were higher, with a mean of 4.31 per m^2 and 0.34 per m^2 respectively. We located 12 released *L. siliquoidea* during sampling and mean length for these individuals was 47.62 mm, an increase of 129% from the mean length at release. No released individuals were found gravid, but yearly surveys of this site will continue to monitor growth, survival, and gravidity of the released *L. siliquoidea*, as well as changes in the entire mussel community at the release site.

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PO 46*

OBSERVATIONS ON SHELL MICROSTRUCTURE AND SCULPTURE IN JUVENILE FRESHWATER MUSSELS (UNIONOIDA) USING SEM. A. Zieritz[1], E. M. Harper[2] and D. C. Aldridge[1]. [1]Department of Zoology, University of Cambridge, Downing Street, CB2 3EJ Cambridge, UK. [2]Department of Earth Sciences, University of Cambridge, Downing Street, CB2 3EQ Cambridge, UK.

Little is known about the ecology and behaviour of juvenile freshwater mussels, not to mention functional morphologies of their shells. Given the disparate life habits of juvenile and adult unionoids (eg. juveniles are interstitial deposit feeders while adults are filter feeders) juvenile shell characters such as their microstructure might differ considerably from those of adults, and identification and understanding of the functional morphology of such features could give vital insights on ecological aspects of this crucial life stage. We analysed juvenile specimens of six unionoid species using SEM and identified various differences to their adults: (1) The prismatic layer present in adult individuals, at the umbonal region is substituted by a layer of homogeneous shell material. Being more resistant to abrasion than prismatic structure, this might be a more suitable material for the interstitially living juvenile unionoids than prismatic microstructure. (2) Up to a certain life stage, a fairly regular pattern resembling honeycombs, resulting from 'hanging' periostracum above early prisms, can commonly be observed. (3) Periostracal spikes were found in young shells of at least two of the species and these probably have functional significance such as helping in orientation or increasing frictional force to promote stable life position within the sediment. Finally, a new hypothesis of the possible function of protruding microsculptures (rugae) commonly displayed in juvenile unionoids is discussed.

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PO 47

DETERMINING LENGTH AT AGE FOR YOUNG MUSSELS IN THE GREEN RIVER, KENTUCKY. B. F. Davis[1], J. B. Layzer[2], and K R. Moles[1]. [1]Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, P.O. Box 5114, Cookeville TN 38505. [2] U.S. Geological Survey, Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, P.O. Box 5114, Cookeville TN 38505.

Identifying the location of early annuli, particularly the 1st annulus, externally or in thin-sections can be problematic because of shell erosion even on young individuals. We determined ages of mussels ($\leq$5 yr old) from thin-sections, examination of external growth arrests and length frequency distributions of individuals collected in quadrat samples and from muskrat middens. Judging ages from length-frequency distributions can be difficult because of overlap among age groups; however, the history of recruitment in the Green River was conducive to determining ages of young mussels. Following more than a decade of minimal recruitment, a strong year class (YC) of most species occurred in 1999. Subsequently, the degree of recruitment has varied among years from minimal to strong. The length range and mode of the 1999 YC of *Actinonaias ligamentina* were well defined through age 3. The 1st annulus was identifiable externally and in thin sections of *A. ligamentina* shells on all individuals during their 2nd growing season and for most individuals during their 3rd growing season. In contrast, the 1st annulus in shells of most tachytictic species was rarely evident beyond age 3. Length at first annulus varied within and among species.

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PO 48*

IMPORTANCE OF THE HOST FISH LOCATION AT THE TIME OF JUVENILE DROP OFF ON DISPERSAL OF JUVENILE MUSSELS IN THE UPPER MISSISSIPPI RIVER. Joseph A. Daraio[1], Larry J. Weber[1], Teresa J. Newton[2] and Steven J. Zigler[2]. [1]IIHR—Hydroscience and Engineering, Iowa City, IA 52242; [2]USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.

Host fish distribution contributes to mussel community structure, but after release from the host fish, the fluid environment likely determines the spatial pattern of settling juveniles. If host fish are present in habitats characterized by high gradients in velocity, small changes in vertical and lateral locations when juveniles are released may affect the settling distribution of juveniles. We tested the hypothesis that variation in juvenile dispersal distance is dependent upon the degree of local lateral and vertical velocity gradients using a 3-D computational fluid dynamics model in a reach of the Upper Mississippi River. Juvenile mussels were modeled as passive particles using stochastic Lagrangian particle tracking. Results suggest that juveniles released in close proximity to the main channel become entrained in flow and were dispersed long distances (> 1 km) relative to juveniles that were released in shallower water, where dispersal distances were considerably less (< 200 m). Variance in juvenile dispersal distance generally increased as juveniles were released from host fish located higher in the water column, but the rate of change in variance with change in release depth was greatest near the river bed where velocity gradients were high. Collectively, this suggests that juveniles that use host fish that inhabit areas with high velocity gradients were likely to have greater and more variable dispersal distances than juveniles that use host fish that inhabit areas of shallow tranquil water.

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PO 49

MUSSEL DENSITY AT INTERSTATE PARK, ST. CROIX RIVER, MN AND WI: A NEW EQUILIBRIUM? Daniel J. Hornbach, Mark C. Hove and Kelly R. MacGregor. Departments of Biology, Environmental Studies and Geology, Macalester College. St. Paul, MN 55105.

Interstate Park on the St. Croix River contains a dense and diverse mussel assemblage. We have quantitatively sampled the mussel assemblage and habitat every 2-3 years since 1992. The density of adult mussels was fairly constant between 1992-2000 (approximately 20 mussels/m^2). From 2002-2008 adult density was about 25% lower; this difference was not statistically significant. There were significant changes in juvenile mussel density between 1992-2008. Juvenile density was 4.8 mussels/m^2 in 1992 but dropped to 0.07-1.7 mussels/m^2 from 2002-2008. The change in juvenile mussel density varies among species. *Truncilla truncata* (•50% of the community) and *Fusconaia flava* had significant decreases in juvenile density. *Quadrula pustulosa* and *Actinonaias ligamentina* showed no significant change. Substrate was coarsest in 1992 (average size 3.6 mm – very fine gravel) and became finer through 2002 (1.2 mm – very coarse sand). Starting in 2005 the substrate became coarser (~ 1.6 mm). From 1986 to 1995 the annual peak water discharge was < 30,000 cfs. This was the longest period in the last 50 years with peak flows < 30,000 cfs. We hypothesize that changes in peak flow may be responsible for changes in substrate composition, which could affect juvenile recruitment. Future modeling of flow dynamics, along with estimates of sediment trapping in a dam above the area, will allow us to consider this hypothesis more quantitatively. With the possible return of "normal" flow conditions and finer sediment, it is possible that the lower adult and juvenile densities found since 1995 are actually more "typical" of this are and the high densities in 1992 are actually an anomaly.

NOTES: _____

PO 50*

THE ECOLOGICAL EFFECT OF THE INVASIVE GASTROPODS, *THIARA GRANIFERA* (LAMARCK, 1822) AND *MELANOIDES TUBERCULATA* (MULLER, 1774), ON THE DISTRIBUTION AND ABUNDANCE OF THE ENDEMIC *HEMISINUS LINEOLATUS* (WOOD, 1828) IN JAMAICA. A. B. Fender-Longman and E. J. Hyslop. Department of Life Sciences, University of the West Indies, Mona, Jamaica, West Indies, Kingston 7.

Thiara granifera and *Melanoides tuberculata* (Family Thiaridae) are invasive tropical prosobranch snails that have been introduced into Jamaica's freshwater systems. Their exact time of introduction is unknown. Both species are now widespread and have densely occupied many types of freshwater habitats. Their ecological effect on the endemic thiarid, *Hemisinus lineolatus* is unknown. Very little is also known about *H. lineolatus* population ecology, however, the snail appeared to have once been widespread and abundant. This study forms part of a research program with the general aim to determine whether the invasive abilities of *M. tuberculata* and *T. granifera* are affecting the distribution and abundance of the endemic snail. An island wide survey determined *H. lineolatus* distribution to be predominantly concentrated in the south western portion of the island, the snail is now absent from several areas where it was formerly found. Longitudinal surveys of a short coastal stream, in Bluefields (Westmoreland) where all three species coexist, indicate that *T. granifera* is significantly more abundant than the other thiarid snails. *M. tuberculata* and *H. lineolatus* species are occurring only in marginal numbers. *T. granifera* and *M. tuberculata* could possibly be responsible for the absence or decline of *H. lineolatus* in the freshwater systems of Jamaica.

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PO 51

EARLY LIFE HISTORY AND DISTRIBUTION OF PISTOLGRIP (*TRITOGONIA VERRUCOSA*) IN MINNESOTA AND WISCONSIN. Mark Hove[1, 2], Josh Bakelaar[3], Bernard Sietman[3], Jennifer Bury[2, 3], Dave Heath[4], Vanessa Pepi[2], Jennifer Kurth[2], Mike Davis[3], Daniel Hornbach[1] and Anne Kapuscinski[2]. [1] Macalester College, Biology Department, 1600 Grand Avenue, Saint Paul, MN 551051. [2] University of Minnesota, 1980 Folwell Avenue, Saint Paul, MN 55108. [3] Minnesota Department of Natural Resources (DNR), 500 Lafayette Road, Saint Paul, MN 55155. [4] Wisconsin DNR, 3550 Mormon Coulee Road, La Crosse, WI 54601

Pistolgrip (*Tritogonia verrucosa*) are rare in several central and southeast states and information is needed to improve conservation efforts. We conducted a series of studies to improve our understanding of pistolgrip life history. In the St. Croix River, where this species is relatively abundant, we studied animals biweekly from May-November 1997, April-October 1998 and nearly biweekly during May-July 2004 and observed females brooding glochidia between late April-July at water temperatures 13-25 °C. Females brooding mature glochidia exhibited a distinctly, inflated mantle magazine that was significantly more inflated at night. Fifty-seven pistolgrip glochidia measured using scanning electron microscopy had an average height and length (±1 SD) of 119 $\pm$ 6 µ and 102 $\pm$ 4 µ, respectively. Of 65 fish species (18 families) exposed to pistolgrip glochidia only select catfishes (brown and yellow bullheads, and flathead catfish) were suitable hosts and glochidia grew approximately 400% during encystment. The range of pistolgrip has decreased in Minnesota and Wisconsin. It is extirpated from the Minnesota River and nearly so in the Mississippi River. The best remaining populations are in the lower St. Croix (MN, WI) and lower Chippewa, lower Black, Wolf and Wisconsin rivers (WI). We plan to use this information to improve our ability to find brooding pistolgrip and culture juvenile mussels for use in conservation efforts.

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PO 52*

AN UNATTEMPTED CHALLENGE: DISPERSAL OF JUVENILE UNIONIDS. Pascal Irmscher and Caryn C. Vaughn, Department of Zoology, Ecology & Evolutionary Biology / Oklahoma Biological Survey, The University of Oklahoma, Norman OK 73019, U.S.A.

Research on unionid mussels has, for the most part, focused on adult animals in the past, and although their complex life history has been acknowledged for a long time, only little is known about juvenile mussels in general, and the reproductive cycle specifically. This is especially true for the time phase after juvenile detachment from the fish host until they settle permanently in the bottom substrate. I plan to address the following questions for my Ph.D. research at the University of Oklahoma: (1) Which mechanisms and processes are important for the dispersal and subsequent spatial distribution of juvenile (and thus, adult) mussels? (2) After accounting for hydraulic factors, morphological adaptations and behavioral patterns, how does the spatial distribution of host fishes within a stream reach affect mussel dispersal and distribution? As detecting the actual, minute juveniles in the field will be hard to accomplish, I will conduct an experimental field study using fluorescent dye to simulate juvenile downstream drift. In another approach, I will assess the spatial distribution of host fish and mussel populations in a stream by using GPS and GIS techniques. In addition, hydraulic, morphologic and behavioral experiments will be conducted in mesocosm and flumes in the laboratory that will reveal the importance of individual components within this part of the reproductive cycle. As an ultimate goal, I hope to merge the respective findings into a greater concept of unionid juvenile dispersal in streams that will enhance the understanding of suitable (adult) mussel habitat. Besides promoting our scientific knowledge, my research will support management strategies that aim for detecting and protecting suitable freshwater mussel habitat worldwide.

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PO 53

FISH HOST IDENTIFICATION FOR EASTERN ELLIPTIO (*ELLIPTIO COMPLANATA*) FROM THE UPPER SUSQUEHANNA RIVER BASIN, TIOGA COUNTY, PENNSYLVANIA. William A. Lellis[1], Barbara St. John White[1], Jeffrey C. Cole[1], Connie S. Johnson[1] and Julie L. Devers[2]. [1]USGS Leetown Science Center, Northern Appalachian Research Branch, 176 Straight Run Road, Wellsboro, PA 16901. [2]Maryland Fishery Resources Office, USFWS, 177 Admiral Cochrane Dr., Annapolis, MD 21401.

The eastern elliptio (*Elliptio complanata*) is a common, abundant and ecologically important mussel species in the Atlantic slope drainage from Canada to northern Florida, in the upper portion of the Interior basin and in the Hudson Bay drainage. Past fish host identification studies conducted in Michigan, Missouri, New York, Nova Scotia, Ohio and Ontario have shown *E. complanata* to be a host generalist, parasitizing yellow perch (*Perca flavescens*), banded killifish (*Fundulus diaphanus*), banded sculpin (*Cottus carolinae*), and seven centrarchid fish species. During several years (1999-2008), we tested host suitability of 42 fish species in the laboratory. Fish collected from the Delaware River, Susquehanna River and Chesapeake Bay drainages were exposed to glochidia of *E. complanata* from Pine Creek, a tributary to the upper Susquehanna River in north central Pennsylvania. Glochidia successfully transformed into juvenile mussels on five fish species: American eel (*Anguilla rostrata*), brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*), mottled sculpin (*Cottus bairdi*), and slimy sculpin (*Cottus cognatus*). American eels served as particularly good hosts, yielding high transformation success values (percent of attached glochidia that transformed into juvenile mussels) of 82-100% in repeated infestation trials. No transformed juvenile *E. complanata* were observed on 37 infested fish species, including yellow perch (tested repeatedly), banded killifish, and eight centrarchid fishes known to occur in the Susquehanna watershed.

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PO 54*

FRESHWATER MUSSEL DISTRIBUTION IN MICHIGAN UPPER PENINSULA WATERSHEDS. Kathryn M. Harriger[1], Jennifer A. Johnson[1], Peter J. Badra[2], and Ashley H. Moerke[1]; [1]Department of Biological Sciences, Lake Superior State University, Sault Sainte Marie, MI 49783; [2] Michigan Natural Features Inventory, Lansing, MI.

Information on the status, distribution and habitat preferences of freshwater mussels in the Upper Peninsula of Michigan is minimal. The objectives of this study were to determine the distribution of freshwater mussels in watersheds of the Upper Peninsula of Michigan and identify relationships between mussel populations and in-stream habitat parameters. Eighty-two wadeable sites in the eastern Upper Peninsula (EUP) and 39 sites in the central Upper Peninsula (CUP) were surveyed for freshwater mussels using glass bottomed buckets and the transect method. Mussels found were identified, measured, and placed back into the substrate. Locations were imported into GIS. Regression analyses were performed to determine possible relationships between freshwater mussel populations (presence/absence, density, and species richness) and instream habitat parameters (e.g., current velocity, sediment size, water quality). Of the surveyed sites, 33% in the EUP and 39% in the CUP had mussels present. A total of 12 species were identified throughout the study, with the number of species at each site ranging from 0-7. No threatened or endangered species were found, although two species of special concern were identified. Significant positive relationships were observed between mussel species richness and temperature, mussel density and temperature, and mussel density and conductivity. The findings from this study will be useful for regional freshwater mussel population management and future habitat restoration.

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PO 55

PHOTO DOCUMENTATION OF A NATURAL FISH HOST INFESTATION BY THE FEDERALLY ENDANGERED OYSTER MUSSEL (*EPIOBLASMA CAPSAEFORMIS*). Nicholas A. King, Richard J. Neves, Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061

Burrowed into the riverbeds and lake-bottoms of the United States is the largest diversity of freshwater mussels in the world. Of the approximately 300 species of mussels, 68% are considered to be at risk and 12% are extinct. Most freshwater mussels must infest a fish host with their larvae (glochidia) to complete the life cycle; however, only a few natural infestations have been documented. Laboratory experiments and field observations indicate that individuals of riffleshells (genus: *Epioblasma*) capture their host fish to ensure that glochidia become attached to the fish. It was hypothesized that the oyster mussel (*Epioblasma capsaeformis*) employs the strategy of host fish capture in nature. In May 2007, photographs were taken of two individuals of *E. capsaeformis* capturing and infesting darters (family: Percidae) in the Clinch River. This is the first known photo-documentation of mussels capturing fish in the wild. These photographs confirm the hypothesis of host fish capture by this species.

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PO 56*

STATUS OF THE FRESHWATER MUSSEL FAUNA IN THE POWELL RIVER, VIRGINIA AND TENNESSEE. M. Johnson[1], R. J. Neves[1], W. Henley[1], J. W. Jones[1]. [1]Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Mail Code 0321, Blacksburg VA 24061.

Thirty-five of the historically documented 41 species of freshwater mussels remain in the Powell River, including 7 federally endangered species, the dromedary pearlymussel (*Dromus dromas*), Cumberlandian combshell (*Epioblasma brevidens*), shiny pigtoe (*Fusconaia cor*), fine-rayed pigtoe (*F. cuneolus*), birdwing pearlymussel (*Lemiox rimosus*), Cumberland monkeyface (*Quadrula intermedia*), and Appalachian monkeyface (*Q. sparsa*). A survey was initiated during the 2008 summer to document the presence, relative abundance, and size-class structures of the mussel fauna at selected sites. This survey placed a particular emphasis on locating live *Q. sparsa* and *Q. intermedia*. Each site was surface sampled by qualitatively sampling the entire stream bed at each site using parallel transects. Each mussel located during the qualitative search was marked by a fluorescent flag, identified, measured and immediately returned to where they were collected. Systematic quadrat sampling will also be conducted at these sites during the 2009 summer. To date, 7 sites have been surface sampled over 504 person-hours and there are plans to survey an additional 10 sites during the 2009 summer. At the seven completed sites, 21 species were represented by 2039 mussels. Fifty-five of these individuals represented 5 of the 8 federally endangered species found in the Powell River. Fourteen live *Q. intermedia* and 3 live *Q. sparsa* were identified during this portion of the survey, including young individuals of each species. Data from this survey will be used to document the current species richness, density, relative abundance, and size-class structure at these selected sites and aid the assessment of the Powell River mussel fauna in the future.

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PO 57

A STUDY OF THE REPRODUCTIVE BIOLOGY FOR ANODONTA SP. AND *GONIDEA ANGULATA* IN THE MIDDLE FORK JOHN DAY RIVER, OREGON. Christine O'Brien, Donna Nez, David Wolf, and Melisa Van Pelt, Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fish & Wildlife Programs, P. O. Box 896, Pendleton, OR 98704.

Results from a freshwater mussel status survey, conducted in 2003, indicated *Margaritifera falcata* had been extirpated from the Umatilla River and *Gonidea angulata* and Anodonta sp. were only found in the lower Umatilla River. In contrast, all three mussel genera were found in the Middle Fork of the John Day River. Knowledge of the reproductive biology is currently lacking for *G. angulata* and Anodonta sp. In an effort to implement a recovery plan for the mussel population of the Umatilla River the reproductive biology of Anodonta sp. and *Gonidea angulata* was studied from the summer of 2005 to 2007. Anodonta sp. and *G. angulata* released their glochidia when the average daily water temperatures remained above 10°C. Wild caught fish were inspected for encysted glochidia from early June to late July 2005. Anodonta sp. glochidia were found encysted on a variety of fish species, but speckled dace had the highest infestation. Seventy-five percent of the speckled dace collected in early June had encysted Anodonta sp. glochidia, followed by 63% in late June and 85% in late July. None of the fish collected during the month June had encysted *G. angulata* glochidia. However 100% of the mottled sculpin collected in late July had encysted *G. angulata* glochidia. Mottled sculpin were the only fish species collected with encysted *G. angulata* glochidia. Laboratory host fish experiments identified the longnose dace as a host for Anodonta sp. and the torrent sculpin as a host for *G. angulata*.

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PO 58*

SALINITY TOLERANCE OF THREE FRESHWATER MUSSEL SPECIES (BIVALVIA: UNIONIDAE): A COASTAL PLAIN SPECIES SHOWS TOLERANCE. N. A. Johnson[1], I .J. McLean[2], J. D .Williams[3], and P. J .Schofield[4]. [1]Department of Fisheries and Aquatic Sciences, University of Florida, Gainesville, FL 32653. [2]Advanced Placement/Cambridge Advanced International Certificate of Education (AICE) Biology Program, Gainesville High School, Gainesville, FL 32607. [3]Florida Museum of Natural History, Gainesville, FL 32611. [4]U.S. Geological Survey, Florida Integrated Science Center, Gainesville, FL 32653.

Successful management and restoration of mussel populations requires understanding how physical and chemical habitat variables shape species boundaries. To better understand ecophysiological boundaries of mussels inhabiting coastal plain rivers, we tested salinity tolerance of three freshwater mussel species (*Elliptio buckleyi*, *Utterbackia imbecillis,* and *Glebula rotundata*). Adult mussels were acutely shifted from fresh water to a specific salinity condition (0, 6, 12, 18 or 24 ppt) and survival was monitored daily for nine days. Survival at the control salinity (0 ppt) was 100% for all individuals. Results indicate significant differences among species, with *G. rotundata* showing highest salinity tolerance. Mean survival time for *G. rotundata* was 9 days at 6 and 12 ppt, 6.6 days at 18 ppt and 7.8 days at 24 ppt. Mean survival times were lower for *E. buckleyi* (4.25 at 6 ppt; 3.75 at 12 ppt; 3.5 at 18 ppt; 2.75 at 24 ppt) and *U. imbecillis* (2 at 6, 18 and 24 ppt; 2.5 at 12 ppt). Unlike most freshwater mussel species, *G. rotundata* is more abundant in lower reaches of coastal rivers, where it is commonly found syntopic with euryhaline bivalves. Adaptations to survive fluctuations in salinity conditions are essential in lower river reaches due to tidal cycles, variability in freshwater inflows, and marine transgression during interglacial periods.

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PO 59

SEASONALITY OF GLOCHIDIAL INFECTION IN WILD-CAUGHT FISH FROM THE MUSKINGUM RIVER, OHIO. C. B. Smith, and G. T. Watters. Department of Evolution, Ecology, and Organismal Biology, Ohio State University, and Columbus Zoo and Aquarium Freshwater Mollusc Conservation and Research Facility.

There are relatively few records of wild-caught fish bearing glochidia and studies have rarely examined wild-caught fish in one location for an extended period of time. Over the course of one year, starting in July 2006 and ending in June 2007, 2,097 fish were collected from the vicinity of the Muskingum River Plant in Ohio. Twenty-two species were examined. These fish were collected, on average, weekly. The gills and fins of each fish were inspected under a dissecting microscope using polarized light. Of the 22 species, six fish species were found to be infected with glochidia. These species included channel catfish, freshwater drum, gizzard shad, orange-spotted sunfish, bluegill, and hybrid *Morone*. Freshwater drum had the highest percentage of infection with an average of 21.3% infected over the year. Gizzard shad had the lowest percentage of these six species with 0.6%. The highest number of glochidia found on one fish was 140 on the gill filaments of a freshwater drum collected in April. The average amount of glochidia found on infected fish was 15. Glochidial infections were found to occur from March through August. No fish were found to be infected between September and February.

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PO 60*

EXPLORING PATCH-OCCUPANCY MODELS TO ESTIMATE SITE OCCUPANCY RATES USING PRESENCE ABSENCE DATA FOR RARE FRESHWATER MUSSEL SPECIES IN A LARGE RIVER. R. Glenn Nelson and Rita F. Villella. Aquatic Ecology Branch, Leetown Science Center, U.S. Geological Survey, Leetown Science Center, Kearneysville, WV 25430.

Often the objective of freshwater mussel surveys is to determine the presence of mussels, especially of rare populations. Detecting the presence of rare mussel populations in large rivers and the area they occupy can be difficult and require considerable resources. Patch occupancy models are relatively new and have been used in terrestrial systems to estimate the probability a patch, or habitat unit, is occupied by the species of interest. Application of these models in aquatic systems is limited. The methods are based on repeated visits to selected sampling units requiring only information on species detection or nondetection. Freshwater mussels are long-lived and basically immobile, relative to more mobile organisms, making them ideal candidates for modeling occupancy rates. Because occupancy surveys are less expensive than surveys to collect data to estimate population abundance, estimating the area or habitat occupied may be very useful in monitoring rare mussel species. We describe the sample design to qualitatively survey mussels along 756 transects at 63 sites within a 122 kilometer stretch of the Allegheny River. The resulting data is summarized as a detection history of the target species, *Pleurobema clava* and *Epioblasma torulosa rangiana*. Since nondetection does not mean a species is absent we use a model and likelihood-based method to estimate site occupancy rates for these species when probability of detection is <1.

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PO 61

PREDOMINANT BACTERIA ISOLATED FROM MORIBUND *FUSCONAIA EBENA* EXPERIENCING DIEOFFS IN THE TENNESSEE RIVER, MUSCLE SHOALS, AL. Clifford Starliper[1], Jeff Powell[2], and Jeff Garner[3]. [1]USGS, Kearneysville, WV 25430; [2]USFWS, Daphne, AL, 36526; [3]Alabama DCNR, Florence, AL 35633.

Pickwick Reservoir, Tennessee River, AL harbors a diverse large-river mussel fauna. Notable mussel dieoffs were observed in the Reservoir in 2002, 2004, 2006, and 2008. Efforts to understand the cause(s) yielded observations pointing towards the involvement of an etiological agent, e.g. bacterial pathogen. Dieoffs generally occurred within a similar timeframe in different years and coincided with lower basin inflows and warmer water temperatures favoring bacterial growth. Ebonyshells *Fusconaia ebena* were the primary affected host. Many of the moribund and fresh dead specimens were female *F. ebena*, perhaps related to post-spawning stress predisposing the animals to infection and disease. We examined affected mussels from the 2006 and 2008 outbreaks. Diseased ebonyshells (gaping valves, weak closure to stimuli), and healthy cohorts were assayed for bacteria from paired fluids and soft tissues. Bacteria from healthy *F. ebena* were typical of what we anticipated- there was a variety of bacterial species (flora) and total bacterial loads were about 1×10^5 to 1×10^6 cfu/mL of fluid or g of tissues. Bacterial profiles from diseased *F. ebena* were often 100- to 1,000-fold greater. Primary cultures were often pure or nearly pure, and with the same bacterium from all of the specimens from that year. However, the predominant bacteria from 2006 (enteric) and 2008 (motile *Aeromonas* sp.) were different. Both of these bacteria are common in aquatic environments and may be isolated from healthy mussels. One scenario we surmise is that diseased *F. ebena* were compromised by a combination of factors and their bacterial profile criteria indicated opportunistic pathogen involvements, or secondary pathogens to another etiology.

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PO 62*

MILL DAMS ENHANCE MUSSEL GROWTH RATES IN ALABAMA STREAMS. Erin E. Singer and Michael M. Gangloff, Department of Biology, Appalachian State University, 572 Rivers St., Boone, NC 28608.

Although the effects of large dams on stream ecosystems are well-known, the effects of more ubiquitous smaller dams on stream biota remain understudied. We investigated differences in *Elliptio* spp. density and body size near mill dams in 3 East-central Alabama Piedmont streams. *Elliptio arca* populations in Sandy Creek (Tallapoosa River Drainage) immediately downstream of the mill dam (mill reach) occurred at significantly higher densities (ANOVA $F_{2,262}$=12.45, P<0.0001) and were significantly larger than individuals collected up-or downstream (ANOVA, $F_{2, 391}$=26.02, P< 0.0001). We observed similar length difference patterns in *E. arctata* in Loblockee Creek (Tallapoosa River Drainage) (ANOVA $F_{2,335}$=18.74, P<0.0001). *Elliptio pullata* in Halawakee Creek (Chattahoochee Drainage) were significantly larger in the mill reach than individuals upstream (ANOVA $F_{2,125}$=6.56, P<0.02). We thin sectioned *E. arca* shells from Sandy Creek, obtained internal age estimates, and observed significant growth rate differences between mill, up- and downstream reaches (ANOVA $F_{2,24}$=7.14, P<0.004). Moreover, LSD Post hoc analysis showed that mussel growth rates in the mill reach are significantly greater than both up-and downstream reaches (P<0.0001 and P=0.05, respectively). We are conducting annual ring validation studies to verify that mussels are producing a growth band every year in Sandy Creek. We hypothesize that shell growth rates may be greater below mill dams because impoundments increase downstream temperatures and possibly mussel food quality and/or abundance.

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PO 63

EVALUATION OF FISH HOST SUITABILITY FOR THE DWARF WEDGEMUSSEL (*ALASMIDONTA HETERODON*). Barbara St. John White[1, 2], C. Paola Ferreri[1], and William A. Lellis[2]. [1]The Pennsylvania State University, School of Forest Resources, Forest Resources Building, University Park, PA 16802. [2]USGS Leetown Science Center, Northern Appalachian Research Branch, 176 Straight Run Road, Wellsboro, PA 16901.

Fish hosts for the dwarf wedgemussel *Alasmidonta heterodon* (DWM) have been identified at the southern and northern extents of its Atlantic slope range, but this study is the first to examine hosts for DWM in the Delaware River basin (PA/NY/NJ), in the mid-Atlantic region. In spring and summer of 2006 and 2007, we tested suitability of potential fish hosts using glochidia of mussels from Flat Brook (NJ), a tributary to the upper Delaware River. We also examined local variation in suitability of a known fish host, the tessellated darter, by comparing suitability of darters from locations in the Connecticut, Delaware and Susquehanna River basins, using glochidia of DWM from the upper Connecticut River (NH). In screenings of potential hosts for DWM from the Flat Brook, four previously identified hosts for DWM were confirmed: the slimy sculpin (*Cottus cognatus*), mottled sculpin (*Cottus bairdi*), Atlantic salmon (*Salmo salar*) and tessellated darter (*Etheostoma olmstedi*). In addition, four new potential hosts were identified: the shield darter (*Percina peltata*), striped bass (*Morone saxitilis*), banded killifish (*Fundulus diaphanus*) and brown trout (*Salmo trutta*). Variation in host suitability of tessellated darters varied minimally among fish sources, but in general, numbers of juvenile DWM produced tended to decrease as distance between the mussel source and each fish source increased. Overall, our findings confirm the suitability of known fish hosts for DWM in the Delaware River basin, but also indicate that evaluation of regional variation in host suitability may be important in fish host studies.

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PO 64*

FILTRATION RATE OF GRAVID, NON-GRAVID FEMALE AND MALE MUSSELS, *CRISTARIA PLICATA,* AND OBSERVATION OF MICROSTRUCTURE AND ULTRASTRUCTURE OF THEIR GILLS. H. B. Wen[1], R. B. Gu[1], G. C. Xu[1], D. Hua[2], P. Xu[1], Key Laboratory of Genetic Breeding and Aquaculture Biology of Freshwater Fishes, Freshwater Fisheries Research Center, Chinese Academy of Fishery Sciences, Wuxi, 214081, China•2. Virginia Polytechnic Institute and State University, VA 24061, USA.

The filtration rate of gravid mussels, cockscomb mussel (*C. plicata*) was significantly less than the non-gravid females and males. However the filtration rates weren't significantly different in non-gravid females and males. Mussels were anatomized and found that two pairs of laminae composed of the inner and outer lamellae which met at the posterior. The microstructure and the ultrastructure of the inner and outer lamina of *C. plicata* were observed. Generally, histological analysis showed that each lamella consisted of a number of longitudinal-arranged branchial filaments which were connected by interfilamentary junctions. Some branchial filaments formed a gill, and the gill unit of the inner lamellae of the female mussels was about 2 to 3 times larger than those of the outer lamellae. The outer lamellae of gravid *C. plicata* were observably broader than those in non-gravid female and male mussels. There were no significant differences in the distribution of the frontal cilia•laterofrontal cilia and lateral cilia on the surface of the branchial filament among gravid mussels, non-gravid females and males. Rows of holes with the size of 58 ~ 85um in diameter distributed among the interfilamentary junctions, likely to be the entrances and exits of the water channel. The ultrastructure of the mammillae and microvilli of the gill epidermal cells were observed through TEM. Ultimately, the changes in the structure of the middle zone of the gravid mussels' outer lamina fundamentally affected their filtration rate.

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PO 65

TRANSLOCATION AND MONITORING OF THE BROOK FLOATER, *ALASMIDONTA VARICOSA*, AFTER THE 2006 AVULSION IN THE SUNCOOK RIVER, NEW HAMPSHIRE. B. J. Wicklow 1, D. R. Smith 2, K Flanery 3, S. von Oettingen 4. 1 Department of Biology, Saint Anselm College, 100 Saint Anselm Drive, Manchester, NH 03102. 2 USGS Leetown Science Center, Aquatic Ecology Lab, 11649 Leetown Road, Kearneysville, West Virginia 25430. 3 Nashua National Fish Hatchery, 151 Broad Street, Nashua, NH 03063. 4 US Fish and Wildlife Service, 70 Commercial Street, Concord, NH 03301

During extensive flooding in May of 2006, the Suncook River in Epsom, NH breeched a glacial ridge, cut a new channel, and dewatered 3.2 km stretch inhabited by brook floater mussels. Approximately 1100 brook floaters were rescued and held at the National Fish Hatchery, Nashua NH. The mussels were tagged measured and translocated to an upstream section of the Suncook River in North Chichester, NH after up to 60 days in the hatchery. At the translocation site we discovered one of the largest known brook floater populations range-wide. Resident brook floaters were marked and measured, and both resident and translocated mussels were mapped in 2 experimental plots (Sites 1 and 2). In a control site (Site 3), only resident mussels were marked and measured. Translocated mussels were less likely to be recaptured than resident mussels at site 1 while recapture rates for resident mussels at site 1 and site 3, were comparable. Translocated and resident mussels had similar but low recapture rates at site 2. Assuming that capture probability of resident and translocated mussels was equal then the difference in recapture rates would be due to lower survival or higher emigration for translocated mussels. Between site differences in recapture rate could be due to variation in capture probability rather than survival. However, a 100–year flood in April 2007 washed out many mussels, increasing mortality, and affecting each site differently. Moreover, low water following a prolonged summer drought exposed mussels to intense opportunistic predation at site 3.

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PO 66

STATUS OF THE BROOK FLOATER (ALASMIDONTA VARICOSA) IN THE NORTHEAST. B. J. Wicklow 1 and E. J. Nedeau 2, 1 Department of Biology, Saint Anselm College, 100 Saint Anselm Drive, Manchester, NH 03102. 2 Biodrawversity, 441 West Street, Amherst, MA 01002

The brook floater (*Alasmidonta varicosa*) may have once been widely distributed in Atlantic coastal watersheds from South Carolina to Nova Scotia. It is listed as endangered or extirpated by most states in its native range and it was a candidate for federal protection. Our understanding of its status is mostly based on infrequently collected presence-absence data and scant historic data, but long-term quantitative monitoring have revealed startling population declines in the West River in Vermont and Piscataquog River in New Hampshire. Large populations exist in the Merrimack River watershed in New Hampshire and the Penobscot River watershed in Maine; in these watersheds, the brook floater inhabits a wide range of stream sizes and is often co-dominant with other species. Elsewhere in New York and New England, the brook floater is considered extirpated from 16 of its native rivers and it is critically endangered in others due to insular and low-density populations. Populations in Connecticut (six rivers), Massachusetts (four rivers), the Connecticut River watershed in Vermont and New Hampshire (two rivers), and small coastal watersheds of New Hampshire and Maine are generally confined to isolated reaches of small to medium-sized rivers that have fair to excellent water quality and relatively intact upland areas. However, insular and low-density populations are very difficult to detect—recent surveys in Connecticut have rediscovered individual animals or relict "populations" in five rivers where they had not been seen for periods of time approaching or exceeding the expected life span of these animals, providing hope that source populations persist in these watersheds. It is critical to locate source populations, identify factors responsible for declining populations, and seek ways to protect or restore habitats and populations throughout the species' native range.

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PO 67

SEXUAL DIMORPHISM IN THE FEDERALLY ENDANGERED DWARF WEDGEMUSSEL, *ALASMIDONTA HETERODON*. N. E. Baginski, K. M. O'Brion, K. L. Richardson, P. M. Larson, and B. J. Wicklow. Department of Biology, Saint Anselm College, 100 Saint Anselm Drive, Manchester, NH 03102.

Although the dwarf wedgemussel is considered stable in the northern extent of its range (with large populations in the Connecticut and Delaware River Watersheds), is believed extirpated from or has declined to small insular populations in much of the southern part of its range and is extinct in Canada. Small and declining populations are at risk of stochastic events that lead to reduced recruitment and local extinction. Knowledge of sex ratio is fundamental in determining the potential for small or declining populations to persist. Although sexual dimorphism was noted in early descriptions of the dwarf wedgemussel, there are no validated studies that define the characters that can be used to differentiate sex in the field. We used geometric morphometric methods to analyze shell shape of gravid and nongravid dwarf wedgemussels collected from the Connecticut River in Lancaster, New Hampshire. We extracted gonadal fluid to determine the sex of non-gravid individuals. Our preliminary results show that mature male and female mussels can be differentiated on the basis of animal dimensions and shell shape characteristics. The use of key measurements or the analysis of photographs of mussel shells taken in the field can be an effective, non-invasive way of determining individual sex. Sex ratios in dwarf wegdemussel populations can be assessed, providing critical information for management decisions.

NOTES: _____

International Symposium of the Freshwater Mollusk Conservation Society

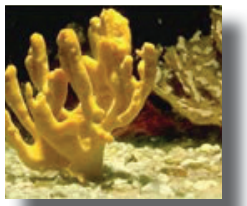
Tour and Field Trip Information

Thursday, April 23

Visit the Smithsonian National Museum Of Natural History and the Smithsonian National Museum Of The American Indian

The National Museum of Natural History (NMNH) is part of the Smithsonian Institution, the world's preeminent museum and research complex. The museum is dedicated to inspiring curiosity, discovery, and learning about the natural world through its unparalleled research, collections, exhibitions, and education outreach programs. The Smithsonian National Museum of the American Indian on the National Mall galleries and display spaces house both permanent and temporary exhibitions. The museum's permanent exhibitions, Our Universes, Our Peoples, and Our Lives, represent important ideas and experiences in Native life and history.

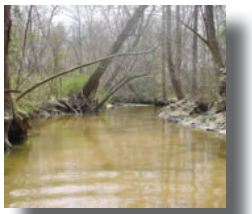
Tour Schedule: Leave Baltimore Marriott at 9am; First stop: National Museum of Natural History; Leave the NMNH at 12:30 pm (You are welcome to remain at the NMNH or visit other sites in the area.); Second Stop: National Museum of the American Indian; Bus departs the NMAI at 3:45pm; Bus departs the NMNH at 4:15 pm; Arrive at the Baltimore Marriott by 5:00 pm.



Or Visit the Smithsonian National Zoological Park

The National Zoo is a 163-acre zoological park set amid Rock Creek Park in the heart of Washington, D.C. Open to the public 364 days a year, it is home to 2,000 individual animals of nearly 400 different species. The best known residents are the giant pandas, Tian Tian, Mei Xiang, and their cub, Tai Shan.

Tour Schedule: Leave Baltimore Marriott at 9am; Bus departs National Zoo at 2pm.



Or Freshwater Mussel Field Trip

Come out and join us in viewing some of the eastern United States' Atlantic slope freshwater mussels. We'll visit two distinctly different aquatic systems including an area along the Maryland shoreline of the upper fresh tidal section of the Potomac River and Nanjemoy Creek, a small, nontidal, forested coastal plain stream with one of the region's best remaining populations of the federally endangered Alasmidonta heterodon.

Field Trip Schedule: Depart the Baltimore Marriott Hotel at 8:30am and return around 5pm

Hatchery Field Trips Information

Friday, April 24

Visit the White Sulphur Springs National Fish Hatchery

White Sulphur Springs National Fish Hatchery (WSSNFH) is one of the oldest national fish hatcheries in the U.S. Originally established in 1900 to produce fish for the American Public, WSSNFH began research into freshwater mussel conservation in 1995. Today, hatchery biologists use state-of-the-art technology to propagate federally endangered freshwater mussels to prevent extinction and common freshwater mussels to restore the natural filtration capacity of mussel beds, a critical ecosystem service in rivers. Hatchery staff will provide guided tours of the mussel propagation facility as well as the trout raceways and egg incubation facilities.

Field trip Schedule: Leave Baltimore Marriott 8:30am; Lunch upon arrival; Tour WSSNFH : 2:00-4:30pm

Saturday, April 25

Visit the Virginia Department of Game and Inland Fisheries AWCC

The Aquatic Wildlife Conservation Center (AWCC) operated by the Virginia Department of Game and Inland fisheries (VDGIF) is located along the banks of the scenic South Fork Holston River near Marion, Virginia. Established in 1998, the AWCC is a nongame production facility that specializes in the cultivation of freshwater mussels and snails. Over 30 adult mussel species, several of which are threatened and endangered, make their home at AWCC. Over one million juveniles of 23 species have been propagated with many held for grow-out beyond a year of age. AWCC staff will be on hand to give a guided tour of the facility, explain the mussel propagation process, and show juvenile mussels reared at the facility.

Field trip Schedule: Depart General Lewis Inn 8:30am; Arrive AWCC 11:30am; Tour AWCC 12:30 pm-3pm

Sunday, April 26

Visit the Virginia Tech Freshwater Mollusk Conservation Center (FMCC)

In 1978, the nation's first cooperative research and propagation facility was established to restore and recover endangered freshwater mollusks in Virginia and adjacent states. Numerous graduate students over a 20+-year period provided the knowledge and expertise to implement the propagation program. In 1997, the first propagated juveniles of a federally endangered species were released. The facility now produces roughly 250,000 juveniles of about 10 species each year. The VT Mussel Lab has been at the forefront of mussel research and advises both national and international efforts focused on mussel biology and conservation.

Field trip Schedule: Tour FMCC 9-11:30am; Depart for Baltimore at 1pm; Arrive Baltimore at 6:30pm

Acknowledgements and Thanks

I would like to thank everyone for your contribution to the success of the 6th Biennial, International Symposium of the Freshwater Mollusk Conservation Society. I am grateful to the Symposium Committee members for the team work and spirit you provided me throughout the past two years – I couldn't have done this without you! Thank you, thank you: Dick, Patty, Julie, Cristi, Matt, Janet, Barb, Cindy, Brian, Rachel.

Thanks as well to past and future presidents, Steve Ahlstedt and Greg Cope for your encouragement and sage advice. I wish to extend my gratitude to Dr. Juergen Geist and Dr. Cristian Altaba for coordinating the session on the Margaritiferidae, and recruiting colleagues from outside of the United States. You made this Symposium international and for that I am very grateful. A big thank you to Joyce Barkley and Hua Dan for coordinating the sessions on Pearls and Mollusks on Tribal Lands. Thank you field trip coordinators: Cindy Kane, Brian Watson, Julie Devers, Rachel Mair, Mike Pinder and Jess Jones. Thank you Cindy for working out the details for limousine service in such a timely basis! Thank you Brian and Julie and folks in Maryland DNR for working out the details for the river field trip. Thank you Rachel for taking on the Hatchery Field Trip logistics.

THANK YOU Matthew Patterson for working tirelessly on the program; it is beautiful. And thank you, Matthew, for your assistance in coordinating the Plenary Session. Thank you again, Matthew, for coordinating a special outreach event with the Baltimore Aquarium. Thank you to Janet Clayton and Barb Douglas for taking care of the 2009 t-shirts. Thank you to Sam Norris for the generous donation of the cartoon graphic we used on the t-shirts and conference bags. Thank you to Mike Pinder for the beautiful artwork on the cover of the program. Thank you to Cristi Bishop, Teresa Newton, and Lisie Kitchel for taking charge of the Auction. You made my job so much easier! Thank you to Steve Ahlstedt your hard work obtaining sponsorships.

I would like to thank Sara Guerry and staff at the VA Tech Continuing and Professional Education Services for their excellent service assisting me in planning this meeting, negotiating all the contracts, and advising on everything from website design to to program printing. Thank you Sara for making decisions that I could not make by myself. Thank you Dick Neves for sitting with me at every step of the planning process, and thank you, Dick, for recruiting folks from overseas to attend the 2009 Symposium.

I also wish to thank the Plenary Session speakers for giving FMCS their valuable time and agreeing to set the tone for the meeting. Thank you for providing us global and national perspectives on biodiversity, riverine health, and restoration of freshwater ecosystems.

Thanks to everyone that acquired financial sponsorships from their respective agencies, institutions, and companies. Thanks are due the U. S. Fish and Wildlife Service for allowing me the opportunity to serve as Chair for this Symposium.

Finally….last but not least…. THANK YOU TO PATTY MORRISON! Patty agreed early on to serve as program chair. Patty attended to everyone's concerns and changes with such calm and kindness. She was exceptional! Without Patty I don't think I could have accomplished all that was necessary in planning this Symposium. I OWE YOU BIG TIME. . .

Again, I would like to thank you all for your contribution to the 6th Biennial, International Symposium of the Freshwater Mollusk Conservation Society. If I forgot to mention you personally, please know that I truly appreciate every contribution and suggestion you provided. I could not have done it without you!

Sincerely,

Catherine Gatenby, Chair, 2009 FMCS Symposium
Hatchery Manager, White Sulphur Springs National Fish Hatchery

International Symposium of the Freshwater Mollusk Conservation Society

19-24 April 2009 * The Marriot Waterfront * Baltimore, Maryland

Healthy Mollusks = Healthy Rivers = Healthy People

Meeting at a Glance

Monday, 20 April 2009

7am – 5pm: Registration – Harborside Foyer

8am – 10am: Plenary Session – Harborside Ballroom C

10am – 10:20 am: Break

10:20am – 11:50 am: Plenary Session – Harborside Ballroom C

11:50 am – 1 pm: Lunch on your own and Committee Meetings

12pm – 1pm: Environmental Quality and Affairs Committee Meeting – Harborside Ballroom A

1pm – 3pm: Session 1A **-** Status of Mollusks on Tribal Lands – Harborside Ballroom A
Session 1B – Evolution and Systematics I – Harborside Ballroom B

3pm – 3:20 pm: Break

3:20 pm – 5:20 pm: Session 2A – Systems and Community Ecology I – Harborside Ballroom A
Session 2B – Pearls – Harborside Ballroom B

5pm - 6:30pm: Guidelines and Techniques Committee Meeting - James

5:20 pm - Dinner on your own; Committee Meetings

6:30 pm – 8:30 pm: Poster Session – Harborside Ballroom C

7:30pm – 10:30pm: Social – Harborside Ballroom C/Foyer

Tuesday, 21 April 2009

8am – 9:40 am: Session 3A – Systems and Community Ecology II – Harborside Ballroom A
Session 3B – Physiology, Life History and Population Ecology I – Harborside Ballroom B

9:40 am – 10am: Break

10:00 am – 12:00 pm: Session 4A **-** Conservation of Margaritiferidae I – Harborside Ballroom A
Session 4B – Physiology, Life History and Population Ecology II – Harborside Ballroom B

12pm – 1pm: Lunch on your own and Committee Meetings – Harborside Ballrooms A & B

1pm – 3pm: Session 5A – Conservation of Margaritiferidae II – Harborside Ballroom A
Session 5B – Water Quality and Ecotoxicology II – Harborside Ballroom B

3pm – 3:20 pm: Break

3:20 pm – 5:20 pm: Session 6A – Status, Distribution and Sampling I – Harborside Ballroom A
Session 6B - Advances in Propagation I – Harborside Ballroom B

4pm – 7pm: Awards Committee Meeting - Iron

5:30pm - Dinner on your own

5:30pm - 6:30pm: Committee Meetings; Guidelines and Techniques – James; Propagation – Ballroom A

7pm – 11pm: Social and Auction – Ballroom C

Wednesday, 22 April 2009

8am – 9:40 am: Session 7A – Systems and Community Ecology III – Harborside Ballroom A
Session 7B – Physiology, Life History and Population Ecology III – Harborside Ballroom B

9:40 am – 10am: Break

10:00 am – 12:00 pm: Session 8A **-** Habitat and Community Restoration – Harborside Ballroom A
Session 8B – Evolution and Systematics II – Harborside Ballroom B

12pm – 1:30 pm: Business Luncheon

1:40 pm – 3:20 pm: Session 9A – Maritime, Roads and Rails – Harborside Ballroom A
Session 9B – Advances in Propagation II – Harborside Ballroom B

3:20 pm – 3:40 pm: Break

3:40 pm – 5:20 pm: Session 10A – Status, Distribution and Sampling II - Harborside Ballroom A
Session 10B - Physiology, Life History and Population Ecology IV – Harborside Ballroom B

5:20 pm – 7pm: Dinner on your own
Committee Meetings