March 22-26, 2015

St. Charles Convention Center, St. Charles, MO

The 9th Biennial FMCS Symposium and the 71st Annual UMRCC Meeting

Conserving Aquatic Ecosystems – At the Confluence of the Past and Future

2015 JOINT MEETING OF THE FRESHWATER MOLLUSK CONSERVATION SOCIETY AND THE UPPER MISSISSIPPI RIVER CONSERVATION COMMITTEE ORGANIZING COMMITTEE		
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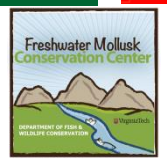
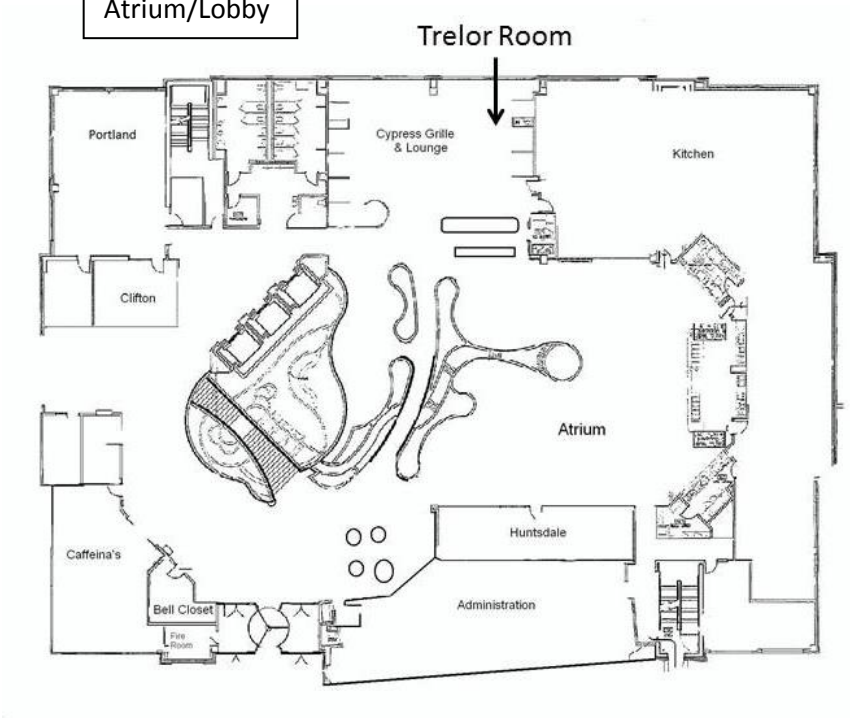


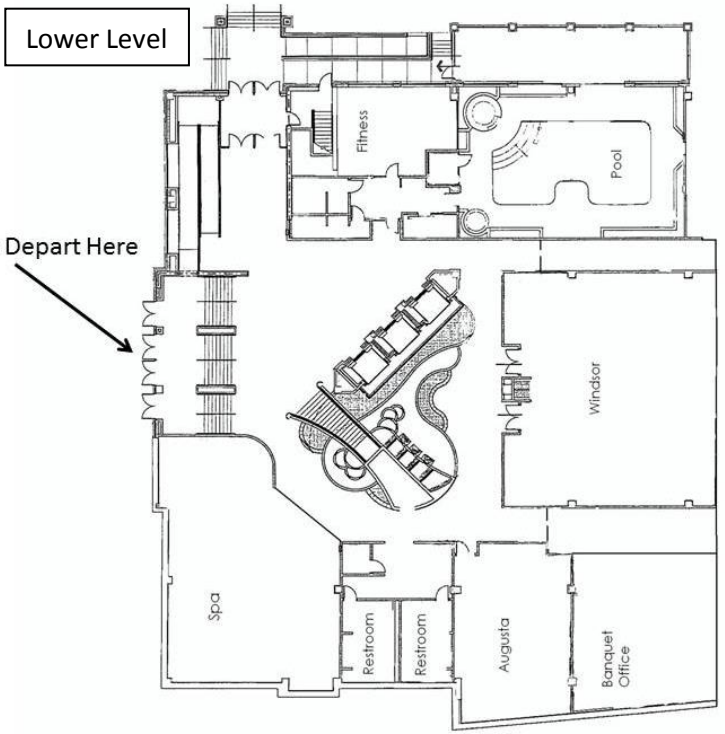
EMBASSY SUITES HOTEL & SPA

Atrium/Lobby

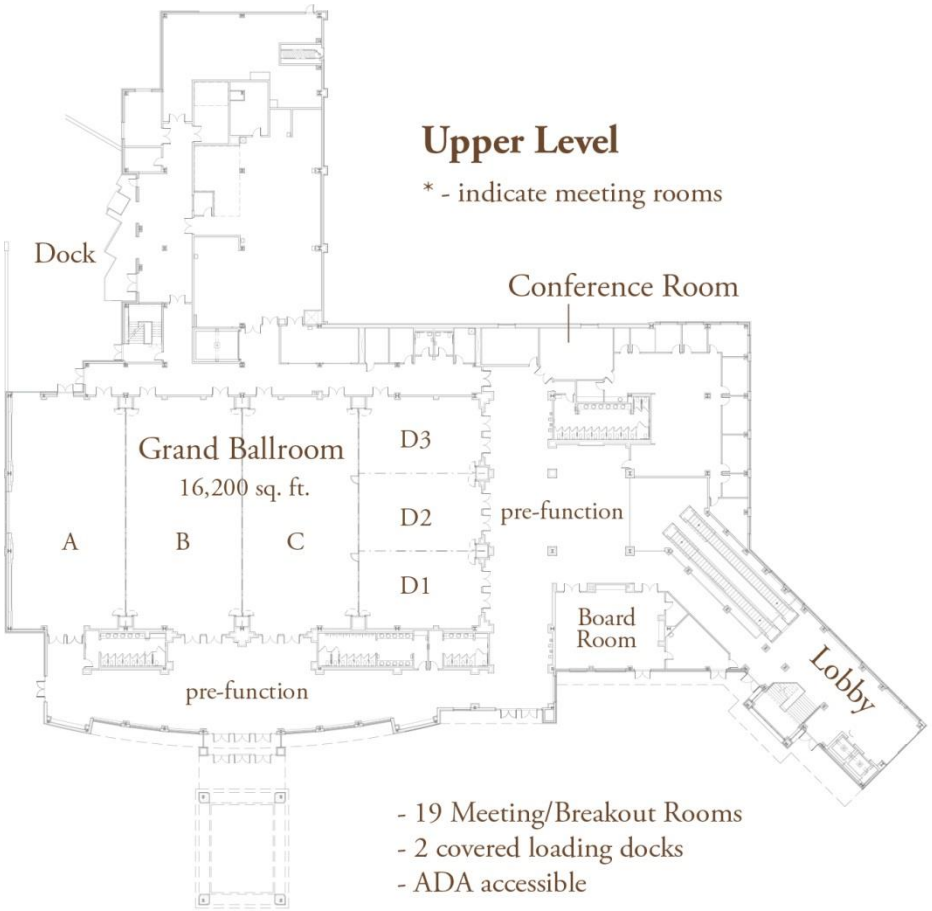


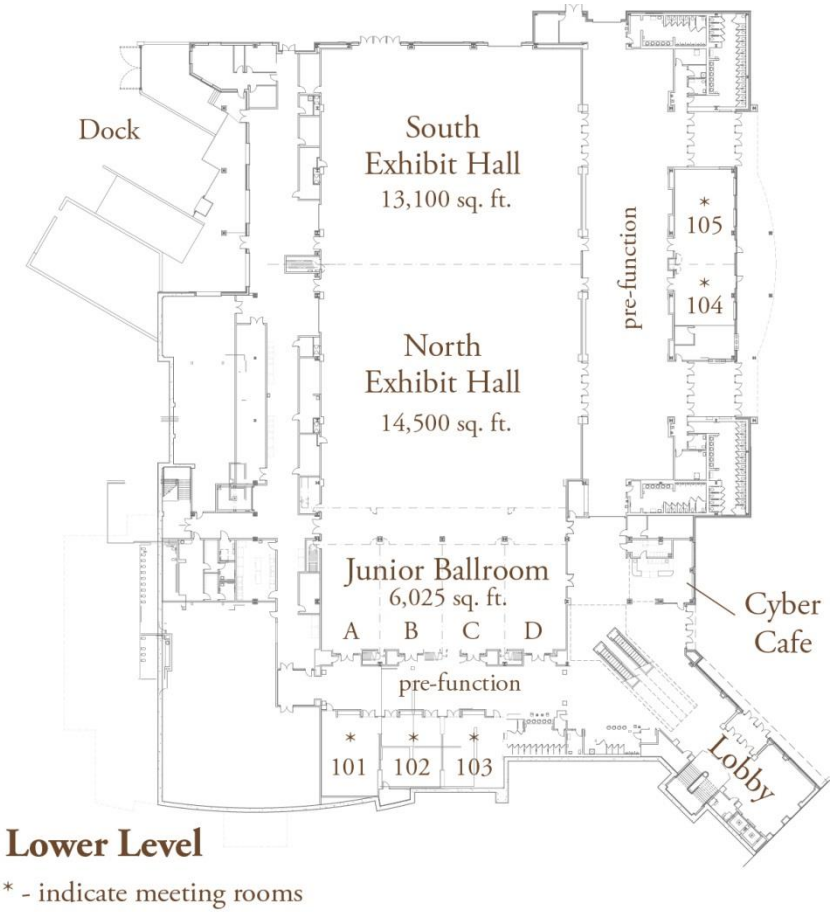
Lower Level

Field Trips Depart Here



SAINT CHARLES CONVENTION CENTER





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

This is the 9th Biennial FMCS Symposium

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The Upper Mississippi River Conservation Committee (UMRCC) consists of natural resource managers from Illinois, Iowa, Minnesota, Missouri, and Wisconsin. It was created in 1943 to promote a continuing cooperation between conservation agencies on the Upper Mississippi River.

This is the 71st Annual UMRCC Meeting

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2015 JOINT MEETING PROGRAM INDEX	

Session/Abstracts	PLATFORM SESSIONS – QUICK REFERENCE	Session/Abstracts	PLATFORM SESSIONS – QUICK REFERENCE
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Pages 8 / 22	SESSION 2: CONTAMINANTS & ECOTOXICOLOGY I Monday, March 23, 2015 | 8:00 a.m. – Grand Ballroom B	Pages 14 / 49	SESSION 13: LIFE HISTORY & ECOLOGY I Tuesday, March 24, 2015 | 1:40 p.m. – Grand Ballroom A
Pages 9 / 25	SESSION 3: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES II Monday, March 23, 2015 | 10:20 a.m. – Grand Ballroom A	Pages 14 / 51	SESSION 14: CONSERVATION II Tuesday, March 24, 2015 | 1:40 p.m. – Grand Ballroom B
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Pages 10 / 30	SESSION 5: RELOCATION & REINTRODUCTION Monday, March 23, 2015 | 1:40 p.m. – Grand Ballroom A	Pages 15 / 55	SESSION 16: LIFE HISTORY & ECOLOGY II Tuesday, March 24, 2015 | 3:40 p.m. – Grand Ballroom B
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Pages 12 / 41	SESSION 10: CONSERVATION I Tuesday, March 24, 2015 | 8:00 a.m. – Grand Ballroom B	Pages 18 / 66	SESSION 19: OUTREACH IN NATURAL RESOURCES Wednesday, March 25, 2015 | 3:40 p.m. – Grand Ballroom A
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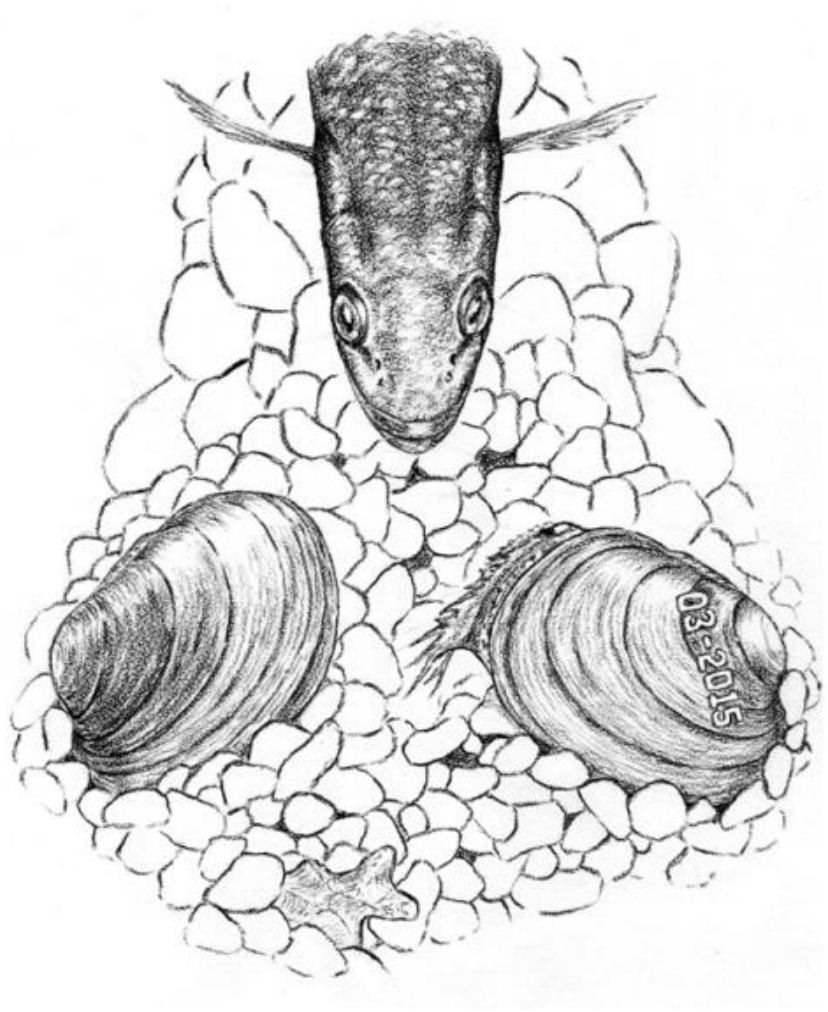
FMCS & UMRCC ST. CHARLES JOINT MEETING GENERAL SCHEDULE – MARCH 22 – 26, 2015

Conserving Aquatic Ecosystems – At the Confluence of the Past and Future

SUNDAY MARCH 22, 2015	MONDAY MARCH 23, 2015	TUESDAY MARCH 24, 2015	WEDNESDAY MARCH 25, 2015	THURSDAY MARCH 26, 2015
7:30 a.m. – 6:00 p.m. PRE-FUNCTION AREA *Registration* *Presentation Loading*				DAY TRIPS (Optional)
				6:30 a.m. – 8:15 a.m. TRELOR ROOM (EMBASSY SUITES) *UMRCC Executive Board Meeting*
8:00 a.m. – 5:00 p.m. MEETING ROOM 104/105 *Mussel Propagation Workshop* *(Lunch Provided)*	8:00-10:00 a.m. GRAND BALLROOM A *Status, Trends, and Monitoring of Molluscan Resources I* GRAND BALLROOM B *Contaminants & Ecotoxicology I*	8:00-10:00 a.m. GRAND BALLROOM A *Genetics & Phylogeny I* GRAND BALLROOM B *Conservation I*	8:15-10:00 a.m. GRAND BALLROOM A/B *Joint Plenary Session I*	8:00-10:15 a.m. BALLROOM D1 *UMRCC Technical Sections* *Mussel*
8:00 a.m. – 5:00 p.m. MEETING ROOM 104/105 *Mussel Propagation Workshop* *(Lunch Provided)*	10:20-12:00 p.m. GRAND BALLROOM A *Status, Trends, and Monitoring of Molluscan Resources II* GRAND BALLROOM B *Contaminants & Ecotoxicology II*	10:20-12:00 p.m. GRAND BALLROOM A *Genetics & Phylogeny II* GRAND BALLROOM B *Threats*	10:20-12:00 p.m. GRAND BALLROOM A/B *Joint Plenary Session II*	10:30-12:00 p.m. *Water Quality* – Conf. Room *Fisheries* – D1 *Wildlife* – D2 *Law Enforcement* – D3 *OREIT* – PFP BOARDROOM
2:00 p.m. – 5:00 p.m. PFP BOARDROOM *Mollusk Names Subcommittees Joint Meeting*	12:00-1:40 p.m. GRAND BALLROOM C/D *Boxed Lunch* *FMCS Committee Meetings*	12:00-1:40 p.m. GRAND BALLROOM C/D *Boxed Lunch* *FMCS Committee Meetings*	12:00-1:40 p.m. GRAND BALLROOM C/D *Buffet Lunch* *FMCS Committee Meetings*	12:00-1:00 p.m. GRAND BALLROOM C *Boxed Lunch*
5:00 p.m. – 5:30 p.m. REGISTRATION DESK *Student Worker Training*	1:40-3:20 p.m. GRAND BALLROOM A *Relocation & Reintroduction* GRAND BALLROOM B *Propagation I*	1:40-3:20 p.m. GRAND BALLROOM A *Life History & Ecology I* GRAND BALLROOM B *Conservation II*	1:40-3:20 p.m. GRAND BALLROOM A *Large River Management Issues* GRAND BALLROOM B *Conservation III*	1:00-3:30 p.m. *Water Quality* – Conf. Room *Fisheries* – D1 *Wildlife* – D2 *Law Enforcement* – D3 *OREIT* – PFP BOARDROOM
5:00-7:00 p.m. PFP BOARDROOM *FMCS Executive Board Meeting*	3:40-5:00 p.m. GRAND BALLROOM A *Status, Trends, and Monitoring of Molluscan Resources III* GRAND BALLROOM B *Propagation II*	3:40-5:00 p.m. GRAND BALLROOM A *Status, Trends, and Monitoring of Molluscan Resources IV* GRAND BALLROOM B *Life History & Ecology II*	3:40-5:00 p.m. GRAND BALLROOM A *Outreach in Natural Resources* GRAND BALLROOM B *Back to the Future: Using Archaeological Resources for Conservation of Freshwater Mollusks*	3:45-5:30 p.m. GRAND BALLROOM D1 *UMRCC Business Meeting*
7:00 p.m. – 11:00 p.m. BALLROOM C/D *Joint Meeting Welcome Reception*	7:00 p.m. – 11:00 p.m. GRAND BALLROOM C/D *Joint Mixer/Poster Session*	6:00 p.m. – 8:00 p.m. GRAND BALLROOM C/D *FMCS Banquet, Bus. Mtg., Awards* 8:00 p.m. – 11:00 p.m. *Joint Mixer* *Music by THE DIVA & THE DUDE*	7:00 p.m. – 11:00 p.m. GRAND BALLROOM C/D *Joint Mixer/Auction*	6:00 p.m. – 8:00 p.m. GRAND BALLROOM C *UMRCC Banquet, Awards* 8:00 p.m. – 11:00 p.m. *Joint Mixer*

SUNDAY, March 22, 2015| 8:00 a.m. – 5:00 p.m.	
JOINT MEETING REGISTRATION 7:30 a.m. – 6:00 p.m.	**SAINT CHARLES CONVENTION CENTER GRAND BALLROOM D PRE-FUNCTION AREA**
MEETING ROOM 105 8:00 a.m. – 5:00 p.m.	**MUSSEL PROPAGATION WORKSHOP**
REGISTRATION DESK 1:00 p.m. – 5:00 p.m.	**PRESENTATION LOADING**
PFP BOARDROOM 2:00 p.m. – 5:00 p.m.	**MOLLUSK NAMES SUBCOMMITTEES JOINT MEETING**
REGISTRATION DESK 5:00 p.m. – 5:30 p.m.	**STUDENT WORKER TRAINING**
PFP BOARDROOM 5:00 p.m. – 7:00 p.m.	**FMCS EXECUTIVE BOARD MEETING**
JOINT MEETING WELCOME RECEPTION 7:00 p.m. – GRAND BALLROOM C/D	



SESSION 1: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES I **Monday, March 23, 2015 | 8:00 a.m. – 10:00 a.m.** **Grand Ballroom A** *Moderator: Paul Johnson, Alabama Aquatic Biodiversity Center, Alabama Department of Conservation and Natural Resources, Marion, AL*		**SESSION 2: CONTAMINANTS & ECOTOXICOLOGY I** **Monday, March 23, 2015 | 8:00a.m. – 10:00 a.m.** **Grand Ballroom B** *Moderator: W. Gregory Cope, North Carolina State University, Department of Applied Ecology, Raleigh, NC*	
Platform 1 **8:00 a.m.**	**CONSERVATION STATUS OF NORTH AMERICAN FRESHWATER MUSSELS.** James D. Williams[1], Arthur E. Bogan[2], Jayne Brim Box[3], Noel M. Burkhead[4], Robert S. Butler[5], Alberto Contreras-Arquieta[6], Kevin S. Cummings[7], Jeffrey T. Garner[8], John L. Harris[9], Robert G. Howells[10], Sarina J. Jepsen[11], Nathan A. Johnson[12], Todd J. Morris[13], Terry L. Myers[14], and Jason M. Wisniewski[15] *INVITED SPEAKER*	**Platform 7** **8:00 a.m.**	**ADVANCES IN MOLLUSCAN TOXICOLOGY OVER THE PAST 25 YEARS: THE IMPORTANCE OF PEOPLE, PLACES, AND PERSPECTIVES**. W. Gregory Cope[1], Tom Augspurger[2], Robert B. Bringolf[3], Ed Hammer[4], Christopher G. Ingersoll[5], Teresa J. Newton[6], and Ning Wang[5] *INVITED SPEAKER*
Platform 2 **8:20 a.m.**	**UPDATE TO THE CONSERVATION STATUS OF FRESHWATER GASTROPODS OF CANADA AND THE UNITED STATES.** Paul Johnson[1], Arthur Bogan[2], Kenneth Brown[3], Noel Burkhead[4], James Cordeiro[5], Jeffrey Garner[6], Paul Hartfield[7], Dwayne Lepitzki[8], Gerry Mackie[9], Eva Pip[10], Thomas Tarpley[1], Jeremy Tiemann[11], Nathan Whelan[12], and Ellen Strong[13] *INVITED SPEAKER*	**Platform 8** **8:20 a.m.**	**DEVELOPMENT OF METHODS FOR CONDUCTING LABORATORY SEDIMENT TOXICITY TESTS WITH JUVENILE FRESHWATER MUSSELS.** Chris G Ingersoll[1], M. Chris Barnhart[2], John M Besser[1], Chris D Ivey[1], Nile E Kemble[1], James L Kunz[1], and Ning Wang[1]
Platform 3 **8:40 a.m.**	**IMPLEMENTATION OF A FIVE-YEAR MUSSEL MONITORING PLAN WITHIN THE WALLKILL RIVER NATIONAL WILDLIFE REFUGE, NEW JERSEY, USA.** Kyle McGill[1], Casey D. Swecker[1], John P. Spaeth[1], and Thomas G. Jones[2]	**Platform 9** **8:40 a.m.**	**ACUTE AND CHRONIC SENSITIVITY OF FRESHWATER MOLLUSKS TO SELECT CHEMICALS.** Ning Wang[1], Chris G. Ingersoll[1], Chris D. Ivey[1], James L. Kunz[1], Rebecca A. Dorman[1], John M. Besser[1], William G. Brumbaugh[1], Ed Hammer[2], Candice Bauer[2], Tom Augspurger[3], M Chris Barnhart[4]
Platform 4 **9:00 a.m.**	**LONG-TERM MONITORING OF FRESHWATER MUSSELS IN WEST VIRGINIA, TEN YEARS OF DATA SHOWING THE GOOD, THE BAD, AND THE UGLY.** Janet L. Clayton and Michael E. Everhart	**Platform 10** **9:00 a.m.**	**DO FRESHWATER MUSSELS AFFECT MERCURY CONTAMINATION OF AQUATIC FOOD WEBS?** Brent N. Tweedy and Caryn C. Vaughn *STUDENT PRESENTATION*
Platform 5 **9:20 a.m.**	**COMMUNITY CHANGES IN A FRESHWATER MUSSEL BED FROM 2004 TO 2014 IN THE GREEN RIVER, KENTUCKY.** Monte A. McGregor, Adam C. Shepard, Christopher Owen, Travis Bailey, Andy McDonald, Fritz Vorisek, and David Cravens	**Platform 11** **9:20 a.m.**	**ASSESSING THE TOXICITY OF RECENTLY-DEPOSITED SEDIMENTS OF THE CLINCH RIVER WATERSHED TO JUVENILE FRESHWATER MUSSELS.** Jennifer M. Archambault[1], Christine M. Bergeron[1], W. Gregory Cope[1], Peter R. Lazaro[2], Jeremy A. Leonard[1], and Damian Shea[2]
Platform 6 **9:40 a.m.**	**A LARGE-SCALE APPLICATION OF STANDARDIZED PROTOCOLS IN THE NAVIGATIONAL PORTION OF THE ALLEGHENY RIVER, PENNSYLVANIA FOR THE DETECTION OF RAYED BEAN (*VILLOSA FABALIS*) AND SALAMANDER MUSSEL (*SIMPSONAIAS AMBIGUA*).** Casey D. Swecker[1], John P. Spaeth[1], Kyle McGill[1], and Thomas G. Jones[2]	**Platform 12** **9:40 a.m.** *CANCELLED*	**SUBLETHAL EFFECTS OF CAGED FRESHWATER MUSSELS IN THE OIL SAND DEVELOPMENT AREA.** Francois Gagné, C. Andréa, A. Bruneau, E. Lacaze, C. Gagnon, M. Fournier, J. Parrott and J. Sherry
MORNING BREAK 10:00-10:20 a.m. – GRAND BALLROOM C/D			

SESSION 3: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES II Monday, March 23, 2015 | 10:20 a.m. – 12:00 p.m. Grand Ballroom A *Moderator: Kevin S. Cummings, Illinois Natural History Survey, University of Illinois, Champaign, IL*		SESSION 4: CONTAMINANTS & ECOTOXICOLOGY II Monday, March 23, 2015 | 10:20 a.m. – 12:00 p.m. Grand Ballroom B *Moderator: Jennifer M. Archambault, NC Cooperative Fish & Wildlife Research Unit, Dept. of Applied Ecology, NC State University, Raleigh, NC*	
Platform 13 10:20 a.m.	**CURRENT STATUS OF FRESHWATER MUSSEL POPULATIONS IN THE LITTLE SOUTH FORK CUMBERLAND RIVER DRAINAGE, MCCREARY AND WAYNE COUNTIES, KENTUCKY (2013): CONTINUING COLLAPSE OF A ONCE FABULOUS FAUNA.** Steven A. Ahlstedt[1], Robert Butler[2], Zachary Couch[3], Sue Bruenderman[3], Michael Compton[4], and Evelyn Brett[4]	**Platform 18 10:20 a.m.**	**EFFECTS OF ROUNDUP ON MUSSEL RECRUITMENT AND GLOCHIDIAL PERFORMANCE UNDER NATURAL CONDITIONS.** James A. Stoeckel[1], Wendell R. Haag[2], Robert B. Bringolf[3], Michael Hart[1], and Sayed M. Hassan[4]
Platform 14 10:40 a.m.	**QUANTITATIVE ASSESSMENT OF FRESHWATER MUSSEL POPULATIONS IN THE CLINCH RIVER, TENNESSEE AND VIRGINIA FROM 2004-2014 AND COLLAPSE OF THE FAUNA AT PENDLETON ISLAND SINCE 1979.** Jess W. Jones[1], S.A. Ahlstedt[2], T. Lane[3], B.J.K. Ostby[3], B. Beaty[4], M. Pinder[5], N. Eckert[6], R.S. Butler[7], D. Hubbs[8], C. Walker[9], S. Hanlon[10], J. Schmerfeld[11] and R.J. Neves[12]	**Platform 19 10:40 a.m.**	**CONSIDERATION OF THE EFFECTS OF HERBICIDES ON NON-TARGET SPECIES IN MANAGEMENT OF INVASIVE AQUATIC WEEDS.** Jennifer M. Archambault[1], Christine M. Bergeron[1], W. Gregory Cope[1], Rob Richardson[2], Mark Heilman[3], J. Edward Corey[4], Michael D. Netherland[5], and Ryan J. Heise[6]
Platform 15 11:00 a.m.	**MUSSEL ASSEMBLAGE AND DISTRIBUTIONS ALONG 10.3 MILES OF UNDERWATER TRANSECTS IN THE MAINSTEM OHIO RIVER NEAR CINCINNATI, OHIO, USA**. John P. Spaeth[1], Casey D. Swecker[1], Kyle McGill[1], and Thomas G. Jones[2]	**Platform 20 11:00 a.m.**	**EVALUATION OF THE LETHAL AND SUB-LETHAL EFFECTS OF BAYLUSCIDE®, A SEA LAMPREY LARVICIDE, ON NATIVE FRESHWATER MUSSELS.** Teresa Newton[1], Michael Boogaard[1], Terrance D. Hubert[1], and Cheryl Kaye[2]
Platform 16 11:20 a.m.	**PREDICTING STATEWIDE HABITAT SUITABILITY FOR 11 OF MICHIGAN'S LISTED UNIONIDS**. Wesley M. Daniel[1], Arthur Cooper[1], Pete Badra[2], Dana Infante[1]	**Platform 21 11:20 a.m. *CANCELLED***	**THE INFLUENCE OF ZINC CHLORIDE AND NANOPARTICLES ON AIR-TIME SURVIVAL IN FRESHWATER MUSSELS.** Francois Gagné[1], J. Auclair[1], C. Peyrot[2], K. Wilkinson[2]
Platform 17 11:40 a.m.	**THE FRESHWATER MUSSELS (BIVALVIA: UNIONOIDA) OF THE RIO AMAZON DRAINAGE WITH AN EMPHASIS ON THE RIO XINGU BASIN.** Kevin S. Cummings[1], Jeremy Tiemann[1], Daniel L. Graf[2], Maria Cristina Dreher Mansur[3], and Mark H. Sabaj-Perez[4]	**Platform 22 11:40 a.m.**	**TURBIDITY CONTROL IN AQUATIC SYSTEMS WITH POLYACRYLAMIDE: ASSESSING DIFFERENCES IN FORMULATION AND RESULTING TOXICITY TO NATIVE FRESHWATER MUSSELS.** Sean B. Buczek[1], W. Gregory Cope[1], Richard A. McLaughlin[2], and Thomas J. Kwak[3] *STUDENT PRESENTATION*
BOXED LUNCHES – GRAND BALLROOM C/D FMCS COMMITTEE MEETINGS CONCURRENT 12:00–1:40 p.m.			
Information Exchange* *Genetics* *Environmental Quality and Affairs* *Outreach* *Mussel Status and Distribution			

SESSION 5: RELOCATION & REINTRODUCTION **Monday, March 23, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom A** *Moderator: W. Gregory Cope, North Carolina State University, Department of Applied Ecology, Raleigh, NC*		**SESSION 6: PROPAGATION I** **Monday, March 23, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom B** *Moderator: Chris Barnhart, Missouri State University, Springfield, MO*	
Platform 23 **1:40 p.m.**	**AN EVALUATION OF MUSSEL RELOCATION AS A CONSERVATION STRATEGY: 25 YEARS REVISITED**. W. Gregory Cope[1], Heidi L. Dunn[2], and Diane L. Waller[3]. [1]North Carolina State University, Department of Applied Ecology, Raleigh, NC; [2]Ecological Specialists, Inc., O'Fallon, MO; [3]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. *INVITED SPEAKER*	**Platform 28** **1:40 p.m.**	**100 YEARS OF MUSSEL PROPAGATION: WHAT HAVE WE LEARNED AND WHERE ARE WE GOING?** Chris Barnhart[1] and Monte McGregor[2] *INVITED SPEAKER*
Platform 24 **2:00 p.m.**	**COOPERATIVE RECOVERY ON A LANDSCAPE SCALE: THE RE-INTRODUCTION OF NORTHERN RIFFLESHELL (*EPIOBLASMA TORULOSA RANGIANA*) AND CLUBSHELL (*PLEUROBEMA CLAVA*) TO SITES IN SIX STATES WITHIN THEIR HISTORIC RANGE.** Robert Anderson[1], Nevin Welte[2], Jordan Allison[2], Janet Clayton[3], Barbara Douglas[4], Patricia Morrison[5], G. Thomas Watters[6], Angela Boyer[7], Leroy Koch[8], Monte McGregor[9], Brant Fisher[10], and Jeremy Tiemann[11]	**Platform 29** **2:00 p.m.** *CANCELLED*	**OPTIMIZING HOMESTASIS IN MEDIA MUSSEL (IN VITRO) CULTURE.** Christopher Owen and Monte McGregor
Platform 25 **2:20 p.m.**	**EVALUATION OF SYSTEMATIC QUADRAT AND MARK-RECAPTURE SAMPLING DESIGNS: MONITORING A REINTRODUCED POPULATION OF OYSTER MUSSELS (*EPIOBLASMA CAPSAEFORMIS*) IN THE UPPER CLINCH RIVER, VIRGINIA**. Caitlin S. Carey[1,2], Jess W. Jones[2,3], Robert Butler[4], Eric M. Hallerman[2], and Marcella J. Kelly[2]	**Platform 30** **2:20 p.m.**	**RECENT CHANGES AND IMPROVEMENTS IN FRESHWATER MUSSEL CAGE CULTURE AT GENOA NATIONAL FISH HATCHERY (NFH).** Nathan Eckert and Jorge Buening
Platform 26 **2:40 p.m.**	**USE OF PIT TAGS TO ASSESS SURVIVAL, PERIODIC GROWTH AND GROWTH CESSATIONS OF LABORATORY-REARED ENDANGERED CUMBERLANDIAN COMBSHELL (*EPIOBLASMA BREVIDENS*) BASED ON A HIERARCHICAL BAYESIAN APPROACH INCORPORATING INDIVIDUAL HETEROGENEITY.** Dan Hua[1, 2], Yan Jiao[1], Richard Neves[1], and Jess Jones[1, 3]	**Platform 31** **2:40 p.m.**	**COMMUNITY LEVEL LOOK AT GLOCHIDIAL INFESTATIONS AND FISH CHARACTERISTICS THAT PROMOTE INFESTATION.** Katherine D. Bockrath and John P. Wares
Platform 27 **3:00 p.m.**	**HEALTH ASSESSMENT OF RELOCATED FRESHWATER MUSSEL *AMBLEMA PLICATA* USING METABOLOMICS**, Ieva Roznere, G. Thomas Watters, Barbara A. Wolfe, and Marymegan Daly *STUDENT PRESENTATION*	**Platform 32** **3:00 p.m.**	**LOCAL ADAPTATION STUDIES AND CONSERVATION: THE RELATIONSHIP OF A FRESHWATER MUSSEL SPECIES WITH TWO OF ITS SYMPATRIC AND ALLOPATRIC HOST FISH SPECIES.** Lea D. Schneider[1], P. Anders Nilsson[1,2], and Martin E. Österling[1] *STUDENT PRESENTATION*
AFTERNOON BREAK 3:20-3:40 p.m. – GRAND BALLROOM C/D			

SESSION 7: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES III **Monday, March 23, 2015 | 3:40 p.m. – 5:00 p.m.** **Grand Ballroom A** *Moderator: Daelyn A. Woolnough, Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mt. Pleasant, MI*		**SESSION 8: PROPAGATION II** **Monday, March 23, 2015 | 3:40 p.m. – 5:00 p.m.** **Grand Ballroom B** *Moderator: Monte A. McGregor, Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY*	
Platform 33 **3:40 p.m.**	**THE IMPORTANCE OF COMPLETE WATERSHED POPULATION DATA FOR FRESHWATER MUSSEL NICHE MODELS**. Daniel E. Symonds, Joshua A. Banta, and Neil B. Ford *STUDENT PRESENTATION*	**Platform 37** **3:40 p.m.**	***IN VITRO* CULTURED FATMUCKET, *LAMPSILIS SILIQUOIDEA* (BARNES, 1823) SUCCESSFULLY REPRODUCED AND GLOCHIDIA INOCULATED ONTO HOST LARGEMOUTH BASS FOLLOWING LABORATORY REARING AND HATCHERY GROW OUT.** Monte A. McGregor, Christopher Owen, Adam C. Shepard, Travis Bailey, Andy McDonald, Fritz Vorisek, and David Cravens
Platform 34 **4:00 p.m.**	**SURVEY FOR THE THREATENED PURPLE BANKCLIMBER (*ELLIPTOIDEUS SLOATIANUS*) TO ASSESS FLOW ENHANCEMENTS OF A HYDROELECTRIC PROJECT ON THE FLINT RIVER, GEORGIA.** Mary T. McCann	**Platform 38** **4:00 p.m.**	**DETERMINING VIABLE HOST-FISH SPECIES FOR *FUSCONAIA ASKEWI*, *POTAMILUS AMPHICHAENUS*, AND *PLEUROBEMA RIDDELLII* IN EAST TEXAS.** Erin Bertram[1], John S. Placyk, Jr.[1], and Lance R. Williams[1] *STUDENT PRESENTATION*
Platform 35 **4:20 p.m.**	**DISTRIBUTION AND STATUS OF *ANODONTOIDES DENIGRATA* (LEA 1852), CUMBERLAND PAPERSHELL, IN KENTUCKY.** Michael C. Compton and Evelyn G. Brett	**Platform 39** **4:20 p.m.**	**EVALUATION OF A FLUORESCENT DYE ASSAY TO ASSESS GLOCHIDIAL HEALTH**. Kathryn Mitchell[1], William Wayman[2], Jaclyn Zelko[2], Robert B. Bringolf[3] and James A. Stoeckel[1] *STUDENT PRESENTATION*
Platform 36 **4:40 p.m.**	**DETECTION, QUANTIFICATION, AND CONSERVATION OF RARE UNIONIDS: SNUFFBOX OF MICHIGAN.** Daelyn A. Woolnough, Mandi Caldwell, and Shaughn Barnett	**Platform 40** **4:40 p.m.**	**THE EFFECTS OF GLOCHIDIA INFECTION INTENSITY AND STRESS LEVELS ON THE METAMORPHIC SUCCESS OF *LAMPSILIS SILIQUOIDEA*.** Karel Douda[1], Michael Martin[2], Elizabeth Glidewell[2], Chris Barnhart[2]
JOINT MIXER/POSTER SESSION – 7:00 – 11:00 p.m. - GRAND BALLROOM C/D ***Hors D'oeurvres served***			
Poster Authors to remove displays at the end of the session			

SESSION 9: GENETICS & PHYLOGENY I **Tuesday, March 24, 2015 | 8:00 a.m. – 10:00 a.m.** **Grand Ballroom A** *Moderator: David M. Hayes. Department of Biological Sciences, Eastern Kentucky University, Richmond, KY*		**SESSION 10: CONSERVATION I** **Tuesday, March 24, 2015 | 8:00 a.m. – 10:00 a.m.** **Grand Ballroom B** *Moderator: Braven Beaty, The Nature Conservancy, Clinch Valley Program, 146 East Main St., Abingdon, VA*	
Platform 41 **8:00 a.m.**	**NICHE DIFFERENTIATION IN EVOLUTIONARY LINEAGES OF A FRESHWATER MUSSEL SPECIES COMPLEX**. Ashley D. Walters[1], Kentaro Inoue[1], John L. Harris[2], & David J. Berg[3] *STUDENT PRESENTATION*	**Platform 47** **8:00 a.m.**	**WORKING TOWARDS A LARGE-SCALE ASSESSMENT OF MOLLUSKS: IMPROVING CONSERVATION OF FRESHWATER SNAILS AND MUSSELS NATIONALLY.** Wesley M. Daniel[1], Kay McGraw[2], Dana M. Infante[1], Gary Whelan[3]
Platform 42 **8:20 a.m.**	**RAPID GENETIC BARCODE-BASED SPECIES IDENTIFICATION OF FRESHWATER MUSSEL GLOCHIDIA RECOVERED FROM NATURALLY-INFESTED FISH HOSTS**. Katherine D. Bockrath[1], Nathan A. Johnson[2], John P. Wares[1] *STUDENT PRESENTATION*	**Platform 48** **8:20 a.m.**	**BIOTIC AND ABIOTIC INFLUENCES ON THE OCCURRENCE AND DETECTION OF FRESHWATER MUSSELS AT MULTIPLE SCALES**. Tamara J. Pandolfo[1], Thomas J. Kwak[2], W. Gregory Cope[3], Ryan J. Heise[4], Rob B. Nichols[5], and Krishna Pacifici[3] *STUDENT PRESENTATION*
Platform 43 **8:40 a.m.**	**IDENTIFICATION OF FRESHWATER MUSSEL COMMUNITY COMPOSITION USING ENVIRONMENTAL DNA AND NEXT-GENERATION SEQUENCING.** David M. Hayes	**Platform 49** **8:40 a.m.**	**USING OCCUPANCY APPROACHES TO MONITOR RARE FRESHWATER MUSSELS IN VIRGINIA AND TENNESSEE.** Brett J. K. Ostby[1], Tim W. Lane[2], Shane Hanlon[3], Megan Bradley[4], Braven B. Beaty[1]
Platform 44 **9:00 a.m.**	**THE TREE OF BROKEN DREAMS: A MOLECULAR ANALYSIS OF *ELLIPTIO*.** Raquel Fagundo[1], Michael Perkins[1], David Campbell[2], Andrew Mahon[3], Lynn Siefferman[1], Ken Halanych[4] and Michael Gangloff[1] *STUDENT PRESENTATION*	**Platform 50** **9:00 a.m.**	**IDENTIFICATION OF IMPACT AVOIDANCE AREAS FOR AQUATIC SYSTEMS IN THE APPALACHIAN LCC.** Braven Beaty and Freshwater Team, The Nature Conservancy Central Appalachian Whole System
Platform 45 **9:20 a.m.**	**PHYLOGEOGRAPHY AND GENETIC STRUCTURE OF TWO FRESHWATER MUSSEL SPECIES (BIVALVIA: UNIONIDAE) ALONG HYPOTHESIZED POST-GLACIAL DISPERSAL ROUTES INTO THE GREAT LAKES.** Trevor L. Hewitt and David T. Zanatta *STUDENT PRESENTATION*	**Platform 51** **9:20 a.m.**	**LINKS BETWEEN LANDUSE, STREAM PHYSICOCHEMICAL PARAMETERS AND APPALACHIAN ELKTOE (*ALASMIDONTA RAVENELIANA*) POPULATIONS IN WESTERN NORTH CAROLINA.** Gary S. Pandolfi and Michael M. Gangloff *STUDENT PRESENTATION*
Platform 46 **9:40 a.m.**	**PHYLOGENY OF THE CRITICALLY ENDANGERED NORTH AMERICAN SPINYMUSSELS (UNIONIDAE: *ELLIPTIO* AND *PLEUROBEMA*).** Michael A. Perkins and Michael M. Gangloff *STUDENT PRESENTATION*	**Platform 52** **9:40 a.m.**	**DEMOLITION OF WEST MILTON DAM AND THE INFLUENCE OF FRESHWATER MUSSELS ON DESIGN AND IMPLEMENTATION.** W. Cody Fleece[1], E. Bocksiegel[1], J.D. Kiser[2], T. White[3], and J. Scheibly[1]
MORNING BREAK 10:00-10:20 a.m. – GRAND BALLROOM C/D			

SESSION 11: GENETICS & PHYLOGENY II Tuesday, March 24, 2015 | 10:20 a.m. – 12:00 p.m. Grand Ballroom A *Moderator: Kevin J. Roe. Department of Natural Resource Ecology and Management, Iowa State University, Ames, IA*		SESSION 12: THREATS Tuesday, March 24, 2015 | 10:20 a.m. – 12:00 p.m. Grand Ballroom B *Moderator: David J. Berg, Department of Biology, Miami University, Hamilton, OH*	
Platform 53 10:20 a.m.	**USING GENETIC STRUCTURE OF A COMMON FRESHWATER MUSSEL SPECIES (*LEPTODEA FRAGILIS*) TO EXAMINE THE IMPACT OF HOST FISH DISPERSAL ON AN ENDANGERED MUSSEL SPECIES (*LEPTODEA LEPTODON*).** Jer Pin Chong and Kevin J. Roe *STUDENT PRESENTATION*	**Platform 58 10:20 a.m.**	**PREDICTING THE EFFECT OF CLIMATE CHANGE ON POPULATION CONNECTIVITY AND GENETIC DIVERSITY IN RIVERINE SYSTEMS: A CASE STUDY OF *CUMBERLANDIA MONODONTA* (BIVALVIA: MARGARITIFERIDAE).** Kentaro Inoue[1] and David J. Berg[2] *STUDENT PRESENTATION*
Platform 54 10:40 a.m.	**MOLECULAR PHYLOGENETIC EVALUATION OF EXTANT POPULATIONS OF ENDANGERED *VILLOSA PERPURPUREA* (LEA 1861) AND *VILLOSA TRABALIS* (CONRAD 1834).** Tim W. Lane[1], Eric M. Hallerman[1], Jess W. Jones[2]	**Platform 59 10:40 a.m.**	**ASSEMBLAGE RESPONSE OF FRESHWATER MUSSELS TO LOW-HEAD DAMS AND LOW-HEAD DAM REMOVALS IN MICHIGAN, USA.** Shaughn Barnett and Daelyn Woolnough *STUDENT PRESENTATION*
Platform 55 11:00 a.m.	**DNA BARCODING REVEALS A CRYPTIC NEW GENUS OF ZEBRA MUSSELS (MOLLUSCA: BIVALVIA: DREISSENIDAE) IN SOUTH AMERICA.** Michael Gangloff[1], Michael Perkins[1], Susan Geda[1], Erin Abernethy[1,2], Nathan Lujan[3], Mark Sabaj Pérez[4], Maria Cristina Dreher Mansur[5], and Lynn Siefferman[1]	**Platform 60 11:00 a.m.**	**A COMPARISON OF FILTER FEEDING AND DEPOSIT FEEDING IN THE INVASIVE ASIAN CLAM, *CORBICULA FLUMINEA*, AND THE FATMUCKET, *LAMPSILIS SILIQUOIDEA*.** Caitlin Wilhelm and Chris Barnhart *STUDENT PRESENTATION*
Platform 56 11:20 a.m.	**PLEUROCERID POPULATION STRUCTURE ASSESSED WITH ISSRS**. Bethany L. McGregor[1] and Russell L. Minton[2]	**Platform 61 11:20 a.m.**	**ZEBRA MUSSEL DISTRIBUTION: TRACKING AN INVASION IN THE MARAIS DES CYGNES RIVER, KANSAS.** Judith S. Bilyea[1], David R. Edds[1], Scott S. Crupper[1], Jason M. Goeckler[2] *STUDENT PRESENTATION*
Platform 57 11:40 a.m.	**DRAFT GENOME ASSEMBLY *LEPTOXIS AMPLA* (GASTROPODA: PLEUROCERIDAE): A RESOURCE FOR CONSERVATION STUDIES**. Nathan V. Whelan[1], Paul D. Johnson[2], Ellen E. Strong[3]	**Platform 62 11:40 a.m.**	**ASSESSING THE EFFECTS OF WASTEWATER TREATMENT PLANT EFFLUENTS ON FRESHWATER MUSSELS.** Serena Ciparis[1], Susan Lingenfelser[2], and Luke Iwanowicz[3]
BOXED LUNCHES – GRAND BALLROOM C/D FMCS COMMITTEE MEETINGS CONCURRENT 12:00–1:40 p.m.			
Awards (Conference Room) Guidelines and Techniques Gastropod Distribution and Status (PFP Boardroom) Propagation, Restoration and Introductions			

SESSION 13: LIFE HISTORY & ECOLOGY I **Tuesday, March 24, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom A** *Moderator: Jeremy S. Tiemann, Illinois Natural History Survey, University of Illinois, Urbana-Champaign, Illinois*		**SESSION 14: CONSERVATION II** **Tuesday, March 24, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom B** *Moderator: Dan Hua, Department of Fish and Wildlife Conservation, College of Natural Resources, Virginia Polytechnic Institute and State University, Blacksburg, VA*	
Platform 63 **1:40 p.m.**	**VARIATION IN MUSSEL GROWTH ACROSS TIME AND SPACE.** Wendell R. Haag[1], Andrew L. Rypel[2], Zanethia Choice[1], and Martin Daufresne[3]	**Platform 68** **1:40 p.m.**	**ASSESSMENT OF SITE SUITABILITY FOR RESTORING LABORATORY-REARED JUVENILE MUSSELS TO HISTORICAL RIVER REACHES IN VIRGINIA AND TENNESSEE**. Dan Hua[1,2], Yan Jiao[1], Richard Neves[1], and Jess Jones[1,3]
Platform 64 **2:00 p.m.**	**SUICIDAL TENDENCIES? EVIDENCE FOR "SUICIDAL REPRODUCTION" IN FEMALE SCALESHELL MUSSEL. (*LEPTODEA LEPTODON*) BIVALVIA: UNIONIDAE.** Kevin J. Roe	**Platform 69** **2:00 p.m.**	**METAGENOMIC PROFILES OF WATER, SEDIMENT, AND APPALACHIAN ELKTOE (*ALASMIDONTA RAVENELIANA*) AND WAVY-RAYED LAMPMUSSEL (*LAMPSILIS FASCIOLA*) GUT CONTENTS IN THE LITTLE TENNESSEE AND TUCKASEGEE RIVERS, NC.** Scott Salger[1], Jay F. Levine[1], Chris Ellis[2], Steve Fraley[3], Mike Gangloff[4], Mac Law[1], Luke Borst[1], Chris Osburn[5]
Platform 65 **2:20 p.m.**	**INVESTIGATING THE EFFECTS OF CORTISOL ON LARVAL *LIGUMIA SUBROSTRATA*.** Jace Nelson and Robert Bringolf	**Platform 70** **2:20 p.m.**	**WATER AND SEDIMENT QUALITY STRESSORS AND UNEXPLAINED DECLINES OF FRESHWATER MUSSELS IN THE CLINCH RIVER**. Christine M. Bergeron[1], Jennifer M. Archambault[1], W. Gregory Cope[1], Peter R. Lazaro[2], Jess W. Jones[3], Braven Beaty[4], Damian Shea[2], Thomas J. Kwak[5], Brian Evans[6], and Steven Alexander[7]
Platform 66 **2:40 p.m.**	**FACTORS AFFECTING GROWTH OF *ANODONTA ANATINA* (UNIONIDAE) IN 14 BOREAL LAKES.** Jouni Taskinen *CANCELLED*	**Platform 71** **2:40 p.m.**	**METABONOMIC STUDY OF THE APPALACHIAN ELKTOE (*ALASMIDONTA RAVENELIANA*) AND WAVY-RAYED LAMPMUSSEL (*LAMPSILIS FASCIOLA*) IN THE LITTLE TENNESSEE RIVER AND TUCKASEGEE RIVERS, NC.** Scott A. Salger[1], Suraj Dhungana[2], Steve Fraley[3], Mike Gangloff[4], Mac Law[1], Susan Sumner[2], and Jay F. Levine[1]
Platform 67 **3:00 p.m.**	**ASSESSMENT OF NUTRITIONAL SUBSIDIES TO FRESHWATER MUSSELS USING A MULTIPLE NATURAL ABUNDANCE ISOTOPE APPROACH.** Amy M. Weber, James E. Bauer, and G. Thomas Watters	**Platform 72** **3:00 p.m.**	**TIMING, GROWTH AND PROPORTION OF SPAWNERS OF THE THREATENED UNIONOID MUSSEL *MARGARITIFERA MARGARITIFERA*: INFLUENCE OF WATER TEMPERATURE, TURBIDITY AND MUSSEL DENSITY.** E. Martin Österling
AFTERNOON BREAK 3:20-3:40 p.m. – GRAND BALLROOM C/D			

SESSION 15: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES IV Tuesday, March 24, 2015 | 3:40 p.m. – 5:00 p.m. Grand Ballroom A *Moderator: Stephen E. McMurray, Missouri Department of Conservation, Resource Science Division, Columbia, MO*		SESSION 16: LIFE HISTORY & ECOLOGY II Tuesday, March 24, 2015 | 3:40 p.m. – 5:00 p.m. Grand Ballroom B *Moderator: Carla L. Atkinson, Department of Biological Sciences, University of Alabama, Tuscaloosa, AL*	
Platform 73 3:40 p.m.	**TOWARDS A STRATEGIC AND SPATIALLY-EXPLICIT FRESHWATER MUSSEL CONSERVATION ASSESSMENT AND MONITORING PROGRAM IN MISSOURI – OUR VISION.** Amanda Rosenberger[1] and Stephen E. McMurray[2]	**Platform 77 3:40 p.m.**	**DO NATIVE UNIONID MUSSELS CREATE COUPLED DENITRIFICATION-NITRIFICATION HOTSPOTS?** Carla L. Atkinson[1,2], Matt Trentman[3], and John Brant[3]
Platform 74 4:00 p.m.	**DEVELOPING A BIOTIC INDEX FOR FRESHWATER MUSSELS IN IOWA.** Jennifer Kurth	**Platform 78 4:00 p.m.**	**BIOGEOCHEMICAL HOTSPOTS: TEMPORAL AND SPATIAL SCALING OF THE IMPACT OF FRESHWATER MUSSELS ON ECOSYSTEM FUNCTION.** Caryn C. Vaughn[1] and Carla L. Atkinson[1,2]
Platform 75 4:20 p.m.	**CURRENT AND HISTORIC AREA OF OCCURRENCE FOR SPECIES IN THE GENUS *MEDIONIDUS* IN FLORIDA RIVER BASINS.** Matthew Rowe[1], Jordan Holcomb[1], Jim Williams[1], and Sandra Pursifull[2]	**Platform 79 4:20 p.m.**	**IMPACT OF STREAM SIZE ON THE MUSSEL COMMUNITIES IN THE UPPER NECHES RIVER BASIN OF TEXAS.** David F. Ford[1], Ashley D. Walters[2], Lance R. William[3] and Neil B. Ford[3]
Platform 76 4:40 p.m.	**MONITORING OF MARKED MUSSELS IN ZERO VISIBILITY ENVIRONMENTS**. Krista McDermid and Brian Cowan	**Platform 80 4:40 p.m.**	**OVERVIEW OF USEPA AQUATIC LIFE CRITERIA FOR AMMONIA AND HIGHLIGHTS OF STAKEHOLDER'S MEETING REGARDING CRITERIA IMPLEMENTATION.** Scott Hall *INVITED SPEAKER*
FMCS BANQUET, BUSINESS MEETING, AWARDS PRESENTATIONS 6:00 – 8:00 p.m. GRAND BALLROOM C/D			
JOINT MIXER MUSIC BY THE DIVA AND THE DUDE 8:00 – 11:00 p.m. GRAND BALLROOM C/D			

WEDNESDAY, March 25, 2015| 8:15 a.m. – 12:00 p.m. Grand Ballroom A/B	
JOINT PLENARY SESSION I: CONSERVING AQUATIC ECOSYSTEMS – AT THE CONFLUENCE OF THE PAST AND FUTURE *Moderator: Stephen E. McMurray, Missouri Department of Conservation, Resource Science Division, Columbia, MO*	
8:15 a.m.	**WELCOME/INTRODUCTION.** Missouri Department of Conservation, Jefferson City, MO.
Plenary 1 8:30 a.m.	**THE ORIGINAL RIVER PARTNERSHIP - THE UPPER MISSISSIPPI RIVER CONSERVATION COMMITTEE.** Pam Thiel[1] and Janet Sternburg[2]. [1]U.S. Fish and Wildlife Service (retired), La Crosse, WI; [2]Missouri Department of Conservation, Jefferson City, MO. *INVITED SPEAKER*
Plenary 2 8:50 a.m.	**THE FRESHWATER MOLLUSK CONSERVATION SOCIETY: PERSPECTIVES ON ITS BEGINNING, NEAR-TERM, AND FUTURE.** Teresa J. Newton[1] and W. Gregory Cope[2]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI and [2]North Carolina State University, Department of Applied Ecology, Raleigh, NC. *INVITED SPEAKER*
Plenary 3 9:10 a.m.	**SCIENCE AND DECISION-MAKING ON LARGE RIVERS – THE LOWER MISSOURI RIVER EXAMPLE.** Robert B. Jacobson. Columbia Environmental Research Center, US Geological Survey, Columbia, MO. *INVITED SPEAKER*
Plenary 4 9:30 a.m.	**WHOLE SYSTEM CONSERVATION THE UPPER MISSISSIPPI RIVER BASIN: AN NGO PERSPECTIVE.** Steven J. Herrington. The Nature Conservancy, Missouri Chapter, St. Louis, MO. *INVITED SPEAKER*
MORNING BREAK 10:00-10:20 a.m. – GRAND BALLROOM C/D	
JOINT PLENARY SESSION II: BIG RIVER/LANDSCAPE ECOLOGY *Moderator: Janet Sternburg, Missouri Department of Conservation, Policy Coordination Unit, Jefferson City, MO*	
Plenary 5 10:30 a.m.	**MOVING FROM SITE-BASED MANAGEMENT TO PROCESS-BASED MANAGEMENT ON THE UPPER MISSISSIPPI RIVER SYSTEM.** Charles H. Theiling, Great River IWRM, Davenport, IA. *INVITED SPEAKER*
Plenary 6 10:45 a.m.	**LANDSCAPE CONSERVATION COOPERATIVES (LCC): MEETING LARGE-SCALE MISSISSIPPI BASIN CHALLENGES FROM DUCKS AND PALLID STURGEON TO GULF COAST SHRIMP.** Andrew Stephenson[1], Gwen White[2], Glen Salmon[2], Rick Nelson[3], John Rogner[4], Nicole Athearn[5], Bill Bartush[6], and Greg Wathen[7]. [1]University of Northern Iowa, Cedar Falls, IA; [2]Eastern Tallgrass Prairie & Big Rivers LCC, US Fish and Wildlife Service, Bloomington, IN; [3]Plains & Prairie Potholes LCC, Bismarck, ND; [4]Upper Midwest & Great Lakes LCC, East Lansing, MI; [5]Great Plains LCC, Norman OK; [6]Gulf Coast Prairie LCC, Lafayette, LA; [7]Gulf Coast Plains & Ozarks LCC, Hermitage, TN. *INVITED SPEAKER*
Plenary 7 11:00 a.m.	**ENVIRONMENTAL DNA TO AID CONSERVATION: USING eDNA TO LOCATE SPECIES OF CONSERVATION CONCERN**. Emy M. Monroe. Whitney Genetics Laboratory, US Fish and Wildlife Service, Onalaska, WI. *INVITED SPEAKER*
Plenary 8 11:15 a.m.	**ECOHYDRAULICS AND HABITAT: USING HYDRODYNAMIC TOOLS FOR MUSSELS IN THE UPPER MISSISSIPPI RIVER.** Steven J. Zigler and Teresa J. Newton. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. *INVITED SPEAKER*
Plenary 9 11:30 a.m.	**SUB-LETHAL EFFECTS OF CONTAMINANTS AS AN ADDED POPULATION STRESSOR.** James S. Candrl and Donald E. Tillitt. United States Geological Survey, Columbia Environmental Research Center, Columbia, MO. *INVITED SPEAKER*
Plenary 10 11:45 a.m.	**BABY STEPS AND HURDLES ALONG THE PATH TO UNDERSTANDING AND VALUING OUR GOLDEN GEESE (I.E. RIVER ECOSYSTEM SERVICES).** Ken Lubinski, U.S.Geological Survey, retired, Brownsville, MN. *INVITED SPEAKER*
BUFFET LUNCH 12:00–1:40 p.m. – GRAND BALLROOM C/D	
FMCS COMMITTEE MEETINGS: *Symposium (12:00-1:00) Webpage (1:00-3:00)*	

SESSION 17: LARGE RIVER MANAGEMENT ISSUES **Wednesday, March 25, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom A** *Moderator: Nathan Eckert, U.S. Fish and Wildlife Service, Genoa National Fish Hatchery, Genoa, WI*		**SESSION 18: CONSERVATION III** **Wednesday, March 25, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom B** *Moderator: Jason M. Wisniewski, Wildlife Resources Division, Georgia Department of Natural Resources, Social Circle, GA*	
Platform 81 **1:40 p.m.**	**EFFICIENCY AND EFFICACY OF USING SIDE SCAN SONAR AND GROUND TRUTHING TO ASSIST IN LARGE SCALE MUSSEL SURVEYS.** Donald Craig Fortenbery and Charles Albert Morgan III	**Platform 86** **1:40 p.m.**	**EVALUATION OF FLOW AUGMENTATION AS A SHORT-TERM MUSSEL CONSERVATION ACTION IN A SOUTHEASTERN STREAM.** Jason M. Wisniewski[1], Sandy Abbott[2], and Andrew Gascho Landis[1]
Platform 82 **2:00 p.m.**	**EFFECTS OF UNDERWATER BLASTING PRESSURES ON THE FRESHWATER MUSSEL, *AMBLEMA PLICATA*.** Gregory N. Anderson[1], Thomas M. Keevin[2], Gregory L. Hempen[2], and David J. Schaeffer[3]	**Platform 87** **2:00 p.m.**	**A GUILD APPROACH TO DEVELOP ENVIRONMENTAL FLOW RECOMMENDATIONS FOR FRESHWATER MUSSELS USING SPECIES TRAITS**. Kiza K. Gates[1], Caryn C. Vaughn[1], and Jason P. Julian[2]
Platform 83 **2:20 p.m.**	**PRE-RESTORATION SURVEY GUIDES RECOVERY EFFORTS AT MISSISSIPPI RIVER TRAIN DERAILMENT SITE.** Jorge Buening and Nathan Eckert	**Platform 88** **2:20 p.m.**	**MEASURING ECOSYSTEM SERVICES FOR OKLAHOMA FRESHWATER SYSTEMS: A SOCIAL-ECOLOGICAL APPROACH**. Antonio J. Castro and Caryn C. Vaughn
Platform 84 **2:40 p.m.**	**PATTERNS IN RECRUITMENT OF FRESHWATER MUSSELS AS A FUNCTION OF RIVER DISCHARGE.** Patricia Ries[1], Teresa Newton[1], Steve Zigler[1], Roger Haro[2], and Mike Davis[3]	**Platform 89** **2:40 p.m.**	**ADVANCED AGRICULTURAL WATER CONSERVATION MEASURES AND THEIR EFFECT ON FRESHWATER MUSSEL COMMUNITIES OF THE LOWER FLINT RIVER BASIN.** Nathalie Smith, Stephen Golladay, Brian Clayton and David Hicks
Platform 85 **3:00 p.m.**	**SURVIVAL ESTIMATES AND THE LONG TERM DECLINE IN NATIVE MUSSEL POPULATIONS IN LAKE PEPIN, MISSISSIPPI RIVER – THE ROLE OF AN INVASIVE SPECIES.** Rick A. Hart[1], Mike Davis[2], James W. Grier[3], Andrew C. Miller[4], and Zebulin Secrist[2]	**Platform 90** **3:00 p.m.**	**INVESTIGATION OF FRESHWATER MUSSEL GLOCHIDIA PRESENCE ON ASIAN CARP AND NATIVE FISHES OF THE ILLINOIS RIVER.** Sarah A. Douglass[1], Alison P. Stodola[1], Andrea K. Fritts[2], and Rachel M. Vinsel[1]
AFTERNOON BREAK 3:20-3:40 p.m. – GRAND BALLROOM C/D			

SESSION 19: OUTREACH IN NATURAL RESOURCES Wednesday, March 25, 2015 | 3:40 p.m. – 5:00 p.m. Grand Ballroom A *Moderator: Megan Bradley, Virginia Department of Game and Inland Fisheries, Aquatic Wildlife Conservation Center, Marion, VA*		SESSION 20: BACK TO THE FUTURE: USING ARCHAEOLOGICAL RESOURCES FOR CONSERVATION OF FRESHWATER MOLLUSKS Wednesday, March 25, 2015 | 3:40 p.m. – 5:00 p.m. Grand Ballroom B *Moderator: Andrea K. Fritts, Illinois Natural History Survey, Illinois River Biological Station, Havana, IL*	
Platform 91 3:40 p.m.	**INTRODUCING THE MISSOURI STREAM TEAM ACADEMY: ENGAGING CITIZENS IN AQUATIC CONSERVATION THROUGH EDUCATION AND STEWARDSHIP.** Amy Meier	**Platform 95 3:40 p.m.**	**INTEGRATION OF CURRENT COLLECTIONS, HISTORIC FIELD NOTES, AND MUSEUM RECORDS TO ASSESS LAND USE EFFECTS ON FEDERALLY ENDANGERED OCHLOCKONEE MOCCASINSHELL (*MEDIONIDUS SIMPSONIANUS*).** Jordan Holcomb[1], Matthew Rowe[1], Jim Williams[1], and Sandra Pursifull[2]
Platform 92 4:00 p.m.	**IS THERE AN APP FOR THAT? DEVELOPMENT OF A FRESHWATER MUSSEL IDENTIFICATION WEBSITE AND MOBILE DEVICE APP.** Susan Rogers Oetker[1], Arthur E. Bogan[2], Stan Martin[3], Jon Sundin[3], John L. Harris[4], Nathan A. Johnson[5], and Charles Randklev[6]	**Platform 96 4:00 p.m.**	**HISTORIC MUSSEL SHELLS ILLUMINATE LEGACY CONTAMINANT PATTERNS OVER THE PAST 1000 YEARS.** Andrea K. Fritts[1], W. Aaron Shoults-Wilson[2], Jason Unrine[3], Mark W. Fritts[1], and Andrew F. Casper[1]
Platform 93 4:20 p.m.	**DEVELOPING AND IMPLEMENTING A FRESHWATER MUSSEL IDENTIFICATION AND SURVEY METHODOLOGY TRAINING PROGRAM FOR THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STAFF WITH THE GOAL OF THE TRAINEES RECEIVING SURVEY PERMITS BY THE END OF THE PROGRAM.** Timothy W. Savidge	**Platform 97 4:20 p.m.**	**FRESHWATER MOLLUSK SHELLS AS CHART RECORDERS: THE RECONSTRUCTION OF MODERN AND ANCIENT RIVERINE ENVIRONMENTS.** David L. Dettman
Platform 94 4:40 p.m.	**FRESHWATER MUSSEL OUTREACH PROGRAMS UTILIZED BY THE GENOA NATIONAL FISH HATCHERY.** Jorge Buening and Nathan Eckert	**Platform 98 4:40 p.m.**	**ARCHAEOLOGICAL AND RECENT FRESHWATER MUSSEL FAUNAS IN THE ILLINOIS RIVER BASIN: COMPOSITIONAL VARIATION AND CHANGE.** Robert E. Warren
FMCS – UMRCC JOINT MIXER/AUCTION 7:00 – 11:00 p.m. GRAND BALLROOM C/D			

Thursday, March 26, 2013| 8:00a .m. – 5:30 p.m.	
6:30 a.m. – 8:15 a.m.	**UMRCC Executive Board Meeting** *Trelor Room (Embassy Suites)*
8:00 a.m. – 5:00 p.m.	**Optional Day Trips** Buses depart from the Embassy Suites Atrium Lower Level Entrance at 8:30 a.m. ***Optional Trip I*** **Ron Goellner Center for Hellbender Conservation/Saint Louis Zoo** Trip Leader: Steve McMurray, Missouri Dept. of Conservation ***Optional Trip II*** **Cahokia Mounds State Historic Site** Trip Leader: Bryan Simmons, U.S. Fish and Wildlife Service ***Optional Trip III*** **National Great Rivers Museum & the Melvin Price Locks & Dam/National Great Rivers Research and Education Center** Trip Leader: Scott Faiman, Missouri Dept. of Conservation
8:oo a.m. – 10:15 a.m.	**UMRCC TECHNICAL SESSIONS** *Mussel – Ballroom D1*
10:15 a.m. – 10:30 a.m.	**MORNING BREAK – GRAND BALLROOM C**
10:30 a.m. – 3:30 p.m.	**UMRCC TECHNICAL SESSIONS (CONT'D.)** *Water Quality – Conference Room* *Fisheries – Ballroom D1* *Wildlife – Ballroom D2* *Law Enforcement – D3* *OREIT – PFP Boardroom*
12:00 p.m. – 1:00 p.m.	**UMRCC BOXED LUNCHES – GRAND BALLROOM C**
3:30 p.m. – 3:45 p.m.	**AFTERNOON BREAK – GRAND BALLROOM C**
3:45 p.m. – 5:30 p.m.	**UMRCC BUSINESS MEETING – GRAND BALLROOM D1**
6:00 p.m.	**UMRCC BANQUET, AWARDS PRESENTATIONS – GRAND BALLROOM C**
8:00 p.m.	**FMCS – UMRCC JOINT MIXER – GRAND BALLROOM C**

PLATFORM SESSION ABSTRACTS

SESSION 1	STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES I Monday, March 23, 2015 | 8:00 a.m. – 10:00 a.m. Grand Ballroom A
Platform 1 **8:00 a.m.** **March 23, 2015**	**CONSERVATION STATUS OF NORTH AMERICAN FRESHWATER MUSSELS.** James D. Williams[1], Arthur E. Bogan[2], Jayne Brim Box[3], Noel M. Burkhead[4], Robert S. Butler[5], Alberto Contreras-Arquieta[6], Kevin S. Cummings[7], Jeffrey T. Garner[8], John L. Harris[9], Robert G. Howells[10], Sarina J. Jepsen[11], Nathan A. Johnson[12], Todd J. Morris[13], Terry L. Myers[14], and Jason M. Wisniewski[15]. [1]Florida Museum of Natural History, Gainesville, FL; [2]North Carolina State Museum of Natural Sciences, Raleigh, NC; [3]Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR; [4]U.S. Geological Survey, Gainesville, FL; [5]U.S. Fish and Wildlife Service, Asheville, NC; [6]Pronatura Noreste, A.C., Monterrey, N.L., México; [7]Illinois Natural History Survey, University of Illinois, Urbana-Champaign, IL; [8]Alabama Department of Conservation and Natural Resources, Florence, AL; [9]Arkansas State University Museum of Zoology, Jonesboro, AR; [10]BioStudies, Kerrville, TX; [11]Xerces Society for Invertebrate Conservation, Portland, OR; [12]U.S. Geological Survey, Gainesville, FL; [13]Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, Ontario, Canada; [14]Eagar, AZ; [15]Georgia Department of Natural Resources, Social Circle, GA. *INVITED SPEAKER*
North America has the greatest diversity of freshwater mussels on Earth (360 taxa). The Mussel Subcommittee (AFS Endangered Species Committee) determined that 74% of the fauna is imperiled (vulnerable, threatened, or endangered) or extinct; only 26% of the fauna is considered currently stable. This assessment is the first to include the entire North American fauna (Canada, the United States, and Mexico), comprising 360 species and subspecies divided among three families: Margaritiferidae (5 taxa), Mycetopodidae (3), and Unionidae (352). The modern extinction rate of freshwater mussels is more than 6000 times greater than the background extinction rate, the second highest modern extinction rate reported for aquatic biotas. Mussels are vulnerable to multiple threats, most notably habitat alteration and loss, degraded water quality, and effects of nonindigenous species. Although discovery of new species is approaching an asymptote, documentation of the continental fauna is incomplete. Additional research utilizing anatomical, reproductive, and molecular-based data are urgently needed to document phylogenetic and phylogeographic relationships, detect cryptic taxa, document natural host relationships, and ultimately to provide enhanced conservation of these remarkable animals. fishwilliams@gmail.com	
Platform 2 **8:20 a.m.** **March 23,2015**	**UPDATE TO THE CONSERVATION STATUS OF FRESHWATER GASTROPODS OF CANADA AND THE UNITED STATES.** Paul Johnson[1], Arthur Bogan[2], Kenneth Brown[3], Noel Burkhead[4], James Cordeiro[5], Jeffrey Garner[6], Paul Hartfield[7], Dwayne Lepitzki[8], Gerry Mackie[9], Eva Pip[10], Thomas Tarpley[1], Jeremy Tiemann[11], Nathan Whelan[12], and Ellen Strong[13]. [1]Alabama Aquatic Biodiversity Center, Alabama Department of Conservation and Natural Resources, Marion, AL; [2]North Carolina State Museum of Natural Sciences Raleigh, NC. [3]Louisiana State University, Department of Biological Sciences, Baton Rouge, LA; [4]United States Geological Survey, Southeast Ecological Science Center, Gainesville, FL; [5]Biology Department, University of Massachusetts at Boston, Boston, MA; [6]ADCNR, Florence, AL; [7]US Fish and Wildlife Service, Jackson, MS; [8]Wildlife Systems Research, Banff, AB. [9]University of Guelph, Water Systems Analysts, Guelph, ON. [10]University of Winnipeg, MA; [1]AABC, Marion, AL; [11]Illinois Natural History Survey, Champaign, IL; [12]Department of Biological Sciences, Auburn University, Auburn, AL; [13]Smithsonian Institution, Department of Invertebrate Zoology, Washington DC. *INVITED SPEAKER*

An update of the recent American Fisheries Society (AFS) freshwater gastropod conservation assessment evaluated 709 species of freshwater gastropods representing 16 families and 93 genera. We found a total of 69 species as extinct or possibly extinct, 282 endangered, 102 threatened, 73 vulnerable, 157 currently stable, and 26 species have uncertain taxonomic status. Of the entire fauna, approximately 74% of freshwater gastropods are imperiled (vulnerable, threatened, endangered) or extinct, which exceeds imperilment levels reported for fishes (39%) and crayfishes (48%), but is identical to the current AFS mussel assessment (74%). Despite the high imperilment rate, the US Fish and Wildlife Service currently recognizes only 29 species as federally endangered, and 6 threatened, with another 6 as current candidates. However several environmental advocacy groups have filed petitions to list dozens more species across the United States. During the assessment process, conservation status reviews were hampered by a paucity of current distributional information and taxonomic uncertainties for many species. Nevertheless, successful recovery efforts have been developed for numerous species and a single Alabama gastropod has been down-listed by USFWS from endangered to threatened. This represents the first down listing of a freshwater mollusk under the Endangered Species Act due to recovery. Research on several fronts including basic biology, physiology, conservation best practices, life history, and ecology is needed, but systematics and digital curation of museum collections and databases, coupled with comprehensive status surveys (geographic limits, threat identification) should be prioritized to promote future conservation efforts. Paul.Johnson@dcnr.alabama.gov

Platform 3 **8:40 a.m.** **March 23, 2015**	**IMPLEMENTATION OF A FIVE-YEAR MUSSEL MONITORING PLAN WITHIN THE WALLKILL RIVER NATIONAL WILDLIFE REFUGE, NEW JERSEY, USA.** Kyle McGill[1], Casey D. Swecker[1], John P. Spaeth[1], and Thomas G. Jones[2]. [1]Environmental Solutions and Innovations, Inc., 4525 Este Avenue, Cincinnati, Ohio; [2]Marshall University, 1 John Marshall Drive, Huntington, West Virginia

A Marcellus Shale Gas development project occurred within the Wallkill River National Wildlife Refuge in Sussex County, New Jersey. In 2009 and 2010, a total of 977 live mussels of five species including 208 New Jersey state-threatened eastern lampmussel (*Lampsilis radiata*) were translocated to a suitable relocation area within the Wallkill River. A mussel monitoring plan was developed by New Jersey Department of Environmental Protection (NJDEP) and implemented by Environmental Solutions & Innovations, Inc. for three years, post-construction. Monitoring of the relocated mussel population was conducted monthly from October 2010 to September 2011. Monitoring methods varied throughout the monitoring time period to limit potential stress to relocated mussels during the winter months and reproductive season. Annual monitoring was conducted for three years (2012-2014) following the first year of monthly monitoring. Annual timed search cells yielded an average of 37.5 percent search efficiency and over the course of three years, 71.4 percent of the total tagged individuals were recaptured at least once. A total of 357 marked individuals were recaptured in 2014, having survived 3-4 years after initial capture. No major mortality events occurred during the monthly or annual monitoring survey efforts. Post-construction surveys were completed at the project crossing in 2014 to determine the status of mussel resources and extent of any recolonization in areas disturbed during construction. In August 2014, suitable mussel habitat was available and mussels had naturally recolonized the project crossing. A total of 151 live mussels of three species were collected from within the novel habitat. kmcgill@envsi.com

Platform 4 **9:00 a.m.** **March 23, 2015**	**LONG-TERM MONITORING OF FRESHWATER MUSSELS IN WEST VIRGINIA, TEN YEARS OF DATA SHOWING THE GOOD, THE BAD, AND THE UGLY.** Janet L. Clayton and Michael E. Everhart. West Virginia Division of Natural Resources, Elkins, WV.

In 2003 the WVDNR began establishing long-term monitoring sites for freshwater mussels throughout the state. By the end of the 2014 field season, 25 sites on 13 streams have been established. Two basic methods are used for monitoring, mark/recapture of an established area and quantitative quadrat sampling using the three random start systematic sampling design. Over half of these sites have some type of on-going mussel restoration activities associated with them. Sampling is conducted on a five year rotation although some sites with on-going restoration activities have been sampled yearly. A summary of the monitoring results throughout the state will be presented. Additional details will be provided on one site on the Elk River where the five year monitoring resulted in changes to dam release operations to address a lack of reproduction. The ten year monitoring continued to show a lack of reproduction. Another site on Hackers Creek continues to document the loss of the last remaining clubshell population within the Monongahela Watershed. Yearly monitoring of endangered species restoration will be discussed which shows the importance of multiple year sampling. Janet.L.Clayton@wv.gov

Platform 5 **9:20 a.m.** **March 23, 2015**	**COMMUNITY CHANGES IN A FRESHWATER MUSSEL BED FROM 2004 TO 2014 IN THE GREEN RIVER, KENTUCKY.** Monte A. McGregor, Adam C. Shepard, Christopher Owen, Travis Bailey, Andy McDonald, Fritz Vorisek, and David Cravens. Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY.

The Green River is a large tributary of the Ohio River located in South Central and Western Kentucky and portions of Tennessee. It has historically supported 71 species of freshwater mussels and is considered the most biologically rich branch remaining of the Ohio River system. We assessed the mussel population at one mussel bed in a 1,000 m^2 area with the use of 1m^2 quadrats in the summers of 2004, 2009, and 2014. We determined species presence, abundance, and distribution patterns for all species. We collected 33 species (4,053 individuals) for all three events. The most dominant species found in all three events was the mucket, *Actinonaias ligamentina* (Lamarck, 1819) (71%, 32%, and 36% of the total abundance). Mucket densities ranged from 5.483/m^2 in 2004 to 2.124/m^2 in 2009, and 2.923/m^2 in 2014. Other abundant species were the purple wartyback, *Cyclonaias tuberculata* (Rafinesque, 1820) (5-14%), threeridge, *Amblema plicata* (Say, 1817) (5-7%), washboard, *Megalonaias nervosa* (Rafinesque, 1820) (2-5%), pimpleback, *Quadrula pustulosa* (I. Lea, 1831)(1-7%), round pigtoe, *Pleurobema sintoxia* (Rafinesque, 1820) (1-5%), spike, *Elliptio dilatata* (Rafinesque, 1820) (1-13%), and the monkeyface, *Quadrula metanevra* (Rafinesque, 1820) (2-7%), which collectively accounted for 76-86% of the individuals. Mussels were considered rare if densities were less than 0.1/m^2. Mean densities by species ranged from 0.005 to 5.48/m^2. Thirteen species were rare in 2014 (2 T&E), 19 in 2009 (3 T&E), and 18 in 2004 (4 T&E). Average mussel density for all years ranged from 6.63 to 8.09/m^2 with maximum densities ranging from 30 to 40/m^2. The endangered fanshell, *Cyprogenia stegaria* (Rafinesque, 1820), varied in density from 0.072 in 2004 to 0.393 in 2009, and 0.286/m^2 in 2014. In 2005 only 1 species was present at densities > 0.5/m^2, compared to 3 species in 2009, and 5 species in 2014.
monte.mcgregor@ky.gov

Platform 6 **9:40 a.m.** **March 23, 2015**	**A LARGE-SCALE APPLICATION OF STANDARDIZED PROTOCOLS IN THE NAVIGATIONAL PORTION OF THE ALLEGHENY RIVER, PENNSYLVANIA FOR THE DETECTION OF RAYED BEAN (*VILLOSA FABALIS*) AND SALAMANDER MUSSEL (*SIMPSONAIAS AMBIGUA*)**. Casey D. Swecker[1], John P. Spaeth[1], Kyle McGill[1], and Thomas G. Jones[2]. [1]Environmental Solutions & Innovations, Inc., 4525 Este Avenue, Cincinnati, OH; [2]Marshall University, 1 John Marshall Drive, Huntington, WV.

Environmental Solutions & Innovations, Inc. conducted an intensive qualitative mussel survey within the navigable portion of the Allegheny River, Pennsylvania. A combination of three standardized sampling protocols was implemented to accommodate site-specific project needs and agency requests within Pool 5 of the Allegheny River. Timed search cells were conducted according to the "*Survey protocol for assessment of endangered freshwater mussels in the Allegheny River, Pennsylvania*" (Allegheny Protocol). During all timed search cells, a portion of the *Predredging Protocol for Sampling and Relocating Live Salamander Mussels*, version: July 2009 was adopted to target salamander mussel microhabitats. Additionally, independent survey efforts were conducted downstream via linear transect surveys following the West Virginia Mussel Survey Protocol (WVMSP). A total of 165 timed-search cells, covering an estimated area of 11.7 acres, were delineated underwater from bank to bank and searched via the Allegheny Protocol. Furthermore, three bank-to-bank linear transects totaling 2,890 feet in length were surveyed. Survey efforts yielded 2,937 live mussels of 19 species. Eight live, federally endangered rayed bean mussels were collected. Searches for salamander mussel microhabitat facilitated the collection of 32 live state-endangered salamander mussels.
CSwecker@envsi.com

SESSION 2	**CONTAMINANTS & ECOTOXICOLOGY I** **Monday, March 23, 2015 | 8:00 a.m. – 10:00 a.m.** **Grand Ballroom B**
Platform 7 **8:00 a.m.** **March 23, 2015**	**ADVANCES IN MOLLUSCAN TOXICOLOGY OVER THE PAST 25 YEARS: THE IMPORTANCE OF PEOPLE, PLACES, AND PERSPECTIVES**. W. Gregory Cope[1], Tom Augspurger[2], Robert B. Bringolf[3], Ed Hammer[4], Christopher G. Ingersoll[5], Teresa J. Newton[6], and Ning Wang[5]. [1]North Carolina State University, Department of Applied Ecology, Raleigh, NC. [2]U.S. Fish and Wildlife Service, Raleigh, NC. [3]University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA. [4]U.S. Environmental Protection Agency, Chicago, IL. [5]U.S. Geological Survey, Columbia Environmental Research Center, Columbia, MO. [6]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. *INVITED SPEAKER*

The study of environmental pollutants on freshwater mollusks has advanced substantially over the past 25 years and the Freshwater Mollusk Conservation Society and its members have contributed directly to the many accomplishments. Progress has been made on multiple topics including contaminant monitoring, in situ caging studies, assemblage surveys, laboratory toxicity testing, and the mechanistic understanding of physiological and biochemical effects of pollutants. Many of the early field studies were largely descriptive and monitored accumulation of contaminants in adult mussels and in their associated habitats, while current field studies often utilize captively-propagated juvenile and sub-adult mussels to conduct specific, in-situ assessments. Concurrent with advances in field studies have been those in laboratory toxicity testing. Early toxicity tests were often conducted in short-term exposures (i.e., 1-4 d) with glochidia or with in vitro cultured juveniles at relatively few laboratories. Today, the short-term and longer-term (e.g., 28 d) early life stage tests have been standardized and are routinely performed by many laboratories. The advances made in laboratory toxicity testing have been in large part through simultaneous advances in mussel propagation and culture that have provided an abundant and stable supply of test organisms. A major milestone in testing and the acceptance of mollusk toxicity data for a revision to the USEPA water quality criteria for ammonia and other regulatory purposes was made possible by the inter-laboratory development of an ASTM International *Standard Guide for Conducting Toxicity Tests with the Early Life Stages of Freshwater Mussels*. Freshwater mussels tend to be more sensitive to ammonia and some metals (e.g., copper, zinc, nickel) and some major ions (e.g., sulfate, chloride, potassium) compared to commonly tested species such as daphnids or trout. Recent refinements to the ASTM standard have led to fully accepted water-only tests for glochidia and juvenile mussels, and efforts are currently underway to advance the ASTM standard to describe methods for conducting toxicity tests with sediment, sediment pore water and longer chronic and partial life cycle tests. Toxicity testing with gastropods, although experiencing recent advances in North America, is relatively well-developed in Europe. This presentation will summarize the contribution of key individuals and recent scientific advances in molluscan toxicology as well as highlight future directions for the science and its application to conservation. greg_cope@ncsu.edu

Platform 8 **8:20 a.m.** **March 23, 2015**	**DEVELOPMENT OF METHODS FOR CONDUCTING LABORATORY SEDIMENT TOXICITY TESTS WITH JUVENILE FRESHWATER MUSSELS.** Chris G Ingersoll[1], M. Chris Barnhart[2], John M Besser[1], Chris D Ivey[1], Nile E Kemble[1], James L Kunz[1], Ning Wang[1]. [1]US Geological Survey, Columbia, MO; [2]Department of Biology; Missouri State University, Springfield MO.

Standard methods for conducting laboratory toxicity tests with freshwater sediments were initially developed in the 1980s and 1990s by ASTM and USEPA for various species of amphipods, midge, oligochaetes, and mayflies. In 2005, an ASTM standard was developed for conducting water-only toxicity tests with a variety of species and life stages of freshwater mussels. Water-only toxicity testing has demonstrated that mussels are sensitive to a variety of contaminants associated with sediment including metals, ammonia, and organic contaminants. Moreover, juvenile mussels are in direct contact with sediment, often burrowing into the upper 2 cm of sediment. Our laboratory has adapted the ASTM water-only toxicity methods for mussels to conduct 28-d whole-sediment toxicity tests with freshwater mussels. Average 28-d control survival was 91% and exceeded 80% in 31 of these 34 tests. Average increase in 28-d control weight was 3.7 fold. In the three studies where 28-d control survival was below 80% it was likely that the batches of mussels used for those studies were of lower quality (perhaps due to underfeeding of cultures). Recently, a 28- to 84-d study indicated that: (1) addition of sand, frequent beaker replacement and increased amount of food improved survival and growth in water-only treatments, and (2) increased amount of food improved growth of mussels in sediment treatments. Growth of mussels tends to be a more sensitive endpoint relative to survival in water or sediment toxicity tests. Mussels may avoid exposure to some contaminants by valve closure, but this avoidance may come at a cost of reducing feeding and growth. The sensitivity of mussels to contaminated sediments has typically been similar to or greater than the sensitivity of amphipods or midge. Data from studies will be used to help draft a planned ASTM standard method for conducting whole-sediment toxicity tests with juvenile mussels. cingersoll@usgs.gov

Platform 9 **8:40 a.m.** **March 23, 2015**	**ACUTE AND CHRONIC SENSITIVITY OF FRESHWATER MOLLUSKS TO SELECT CHEMICALS.** Ning Wang[1], Chris G. Ingersoll[1], Chris D. Ivey[1], James L. Kunz[1], Rebecca A. Dorman[1], John M. Besser[1], William G. Brumbaugh[1], Ed Hammer[2], Candice Bauer[2], Tom Augspurger[3], M Chris Barnhart[4]. [1]USGS, Columbia, MO; [2]USEPA, Chicago, IL; [3]USFWS, Raleigh, NC; [4]Missouri State University, Springfield, MO.

Freshwater mollusks are generally under-represented in toxicity databases. Studies are needed to generate and compile a more comprehensive toxicity database for mollusks, and to evaluate the degree to which existing or proposed USEPA water quality criteria (WQC), state water quality standards (WQS), and pollutant discharge permit limits are protective of mollusks. A series of acute (4-day) and chronic (28-day) water-only toxicity tests were conducted with mussel and snail species representing diverse tribes or families using up to 10 organic or inorganic chemicals representing different toxic modes of action. The chemicals were chosen based on the interest of USEPA or states in developing or updating WQC or WQS; the availability of toxicity data for non-mollusks; the sensitivity of freshwater mollusks to the chemicals; and toxic mode of action. The results indicate that (1) mussels representing different tribes or families generally have similar sensitivity (effect concentration differences within a factor of 2) to the tested chemicals across different toxic modes of action, and generally, the mussels are equally or more sensitive compared to snails; (2) mussels are sensitive to most of the 10 tested chemicals; (3) the current WQC or WQS may not be protective of mussels exposed to chloride or nickel; and (4) it may be necessary to derive or update WQC or WQS for chloride, potassium, sulfate, and nickel to reflect the sensitivity of mussels to these chemicals. The mollusk toxicity data generated from these studies following the standard methods and quality control are being used to develop and update WQC and WQS. Additional chronic toxicity tests with two organic chemicals are planned for 2015. nwang@usgs.gov

Platform 10 **9:00 a.m.** **March 23, 2015**	**DO FRESHWATER MUSSELS AFFECT MERCURY CONTAMINATION OF AQUATIC FOOD WEBS?** Brent N. Tweedy and Caryn C. Vaughn. Department of Biology, University of Oklahoma, Norman, OK. *STUDENT PRESENTATION*

Freshwater mussels are an important part of many freshwater ecosystems throughout North America. Mussels are known to drive many important ecosystem processes in the lakes and rivers where they occur. They play a particularly important role in linking processes that occur in the water column and sediments of lakes and rivers. One such process is the conversion of mercury (Hg) into highly toxic methylmercury (MeHg) in aquatic sediments and its release into aquatic food webs. Hg is a serious environmental problem given its global scope and toxic effects on both humans and wildlife. Because of mussels' important role in driving ecosystem function and impacting both the water column and sediments, we hypothesized that they likely play a role in regulating the production and/or release of MeHg from aquatic sediments. To test this hypothesis we conducted a field survey in the Kiamichi River (OK, USA) and a follow-up mesocosm study. The field survey was conducted June-July of 2013. We sampled fish, invertebrates, and habitat parameters at sites with and without mussels looking for a difference in Hg contamination. We found no difference in Hg contamination of fish between sites but were unable to adequately assess differences in invertebrates due to inadequate biomass for Hg analysis. We then conducted a mesocosm study from July to November of 2014 to address the question in a more controlled and detailed manner. We used eight replicates of low (4), medium (10), and high (16) mussel treatments and a control treatment of no mussels. We collected emergent insects and snails for Hg analysis as well as a number of abiotic parameters. Analysis of the samples is currently ongoing. brent.tweedy@ou.edu

Platform 11 **9:20 a.m.** **March 23, 2015**	**ASSESSING THE TOXICITY OF RECENTLY-DEPOSITED SEDIMENTS OF THE CLINCH RIVER WATERSHED TO JUVENILE FRESHWATER MUSSELS.** Jennifer M. Archambault[1], Christine M. Bergeron[1], W. Gregory Cope[1], Peter R. Lazaro[2], Jeremy A. Leonard[1], and Damian Shea[2]. [1]Department of Applied Ecology, North Carolina State University, Raleigh, NC; [2]Department of Biological Sciences, North Carolina State University, Raleigh, NC.

The Clinch River is well known for its diverse unionid mussel assemblage; however, notable declines in mussel populations in some segments of the river in recent decades have prompted much concern and subsequent research. We examined the toxicity of recently-deposited sediments – one possible source of contaminants – on juveniles of the freshwater mussel *Epioblasma brevidens*, a federally-endangered species native to the Clinch and other rivers in the Cumberland and Tennessee River systems. We collected time-integrated sediment samples from the water column in traps deployed over a period of five months from four tributaries and seven mainstem sites of the Clinch River in southwestern Virginia and northeastern Tennessee, including a 65-km reach deemed a 'mussel zone of decline'. Sediment samples from each site were characterized (e.g., particle size, organic carbon) and analyzed to identify presence and concentration of organic contaminants (e.g., current-use and legacy pesticides, PAHs, PCBs) and metals. Mussels were exposed to sediment collected from each of the 11 field sites and to three uncontaminated reference treatments for 28 d. Chemicals were measured in the sediment at the beginning and end of the exposure and in the dissolved phase of the overlying water (with passive sampling devices) to estimate exposure and indicate relative partitioning of organic constituents. Endpoints included mussel survival, shell length, and biomass, and were assessed at the end of the exposure. Sediment treatment (i.e., river location) had a significant effect on mussel survival ($p < 0.01$) and biomass ($p = 0.02$), but did not affect length ($p = 0.37$). Comparisons of mussel survival and biomass in reference sediments and pairwise comparisons among Clinch River Basin sediments indicate that those collected from two of the tributaries were the most toxic. The results of our study corroborate recent findings from similar sediment toxicity studies demonstrating that juvenile mussel biomass is a more sensitive endpoint than length. jmarcham@ncsu.edu

Platform 12 **9:40 a.m.** **March 23, 2015**	**SUBLETHAL EFFECTS OF CAGED FRESHWATER MUSSELS IN THE OIL SAND DEVELOPMENT AREA**. Francois Gagné, C. Andréa, A. Bruneau, E. Lacaze, C. Gagnon, M. Fournier, J. Parrott and J. Sherry. Emerging Methods, Aquatic Contaminants Research Division, Water Science and Technology, Environment Canada, 105 Mc Gill Street, Montreal, QC, H2Y 2E7, Canada

The purpose of this study was to examine the health status of freshwater mussels placed in cages upstream and downstream the oil sand development area in the Athabasca River (Alberta, Canada). Mussels were caged for 30 days (September-October in 2012) at sites upstream and downstream the oil sand area and a reference site outside the natural OS deposit sector located some 200 km upstream the Athabasca River. The mussels were then analyzed for possible impacts on the immune system, xenobiotic biotransformation and DNA damage. Preliminary results revealed that mussels placed at sites downstream showed increased DNA damage and increased phagocytosis activity. The data also showed that mussels located upstream the OS development area but downstream Fort McMurray were similar to the mussels located at the remote reference site outside the OS deposits area which suggests that the observed impacts were not attributed to the natural OS deposits in this sector. Further mussel exposures were done in the fall of 2013 with additional mussel caging activity at the Steepbank and Athabasca rivers to better understand the impacts of industrial extraction activities in respect to the natural background effects of an OS rich area. francois.gagne@ec.gc.ca *CANCELLED*

SESSION 3	**STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES II** **Monday, March 23, 2015 | 10:20 a.m. – 12:00 p.m.** **Grand Ballroom A**
Platform 13 **10:20 a.m.** **March 23, 2015**	**CURRENT STATUS OF FRESHWATER MUSSEL POPULATIONS IN THE LITTLE SOUTH FORK CUMBERLAND RIVER DRAINAGE, MCCREARY AND WAYNE COUNTIES, KENTUCKY (2013): CONTINUING COLLAPSE OF A ONCE FABULOUS FAUNA.** Steven A. Ahlstedt[1], Robert Butler[2], Zachary Couch[3], Sue Bruenderman[3], Michael Compton[4], and Evelyn Brett[4]. [1]P.O. Box 460, Norris, TN; [2]U.S. Fish and Wildlife Service, 160 Zillicoa St., Asheville, NC; [3]Kentucky Division of Water, 200 Fair Oaks Lane, Frankfort, KY; [4]Kentucky State Nature Preserves Commission, 801 Schenkel Lane, Frankfort, KY.

The Tennessee-Cumberland faunal province is renowned for its rich diversity and has more endemic mussels than any other similar-sized watershed on Earth. Historically, the Little South Fork Cumberland River (LSF), Kentucky, despite its relatively small size harbored 27 species. Fossil fuel resource extraction (i.e., coal, oil, and gas) is extensive in the watershed and the decline of the mussel fauna reported in the mid-1980s and into the mid-1990s has been attributed to these activities. Continued monitoring of the fauna is critical for any future restoration efforts. The LSF was last surveyed during 1997-1998, so this study was initiated to determine the current distribution, density, and age-class structure of three federally listed mussels (*Pegias fabula*, *Ptychobranchus subtentum*, and *Villosa trabalis*), and other imperiled species. Timed snorkel surveys (43 person hours) at 14 sites was conducted within the lower 30-km of river bordering the Daniel Boone National Forest. Sampling revealed an almost total elimination of the LSF mussel fauna with only 55 live older individuals of five species sampled and 13 additional species represented solely by relics. Three *P. subtentum* were the only listed species encountered live. Evidence of successful recruitment was minimal, at best. Live individuals measured were >40 mm, with the exception of small *Toxolasma lividum* and one *Villosa iris* (35 mm). An assessment of the available habitat indicated that the substrate was severely destabilized and in some places scoured down to bedrock. This may explain why most individuals encountered were found among boulder and cobble substrate along the margins of the stream channel. Presumed oil or gas pipelines previously buried in the stream were exposed and petroleum-like sheens were often evident. Overall, a precipitous decline in the mussel fauna has occurred within the last 40 years, with prior studies reporting 24 (1977-1981), 9 (1997-1998), and 5 species present (this study, 2013). The decline is a product of poorly regulated fossil fuel activities which demonstrates that past and current State and Federal water quality and imperiled species regulations are not stringent enough (or applied correctly) for protecting stream integrity or their faunal groups where resource extraction is permitted. bigshelldaddy@bellsouth.net

Platform 14 **10:40 a.m.** **March 23, 2015**	**QUANTITATIVE ASSESSMENT OF FRESHWATER MUSSEL POPULATIONS IN THE CLINCH RIVER, TENNESSEE AND VIRGINIA FROM 2004-2014 AND COLLAPSE OF THE FAUNA AT PENDLETON ISLAND SINCE 1979.** Jess W. Jones[1], S.A. Ahlstedt[2], T. Lane[3], B.J.K. Ostby[3], B. Beaty[4], M. Pinder[5], N. Eckert[6], R.S. Butler[7], D. Hubbs[8], C. Walker[9], S. Hanlon[10], J. Schmerfeld[11] and R.J. Neves[12]. [1]United States Fish and Wildlife Service, Department of Fish and Wildlife Conservation, Virginia Tech University, Blacksburg, VA; [2]U.S. Geological Survey (Retired), Norris, Tennessee; [3]Department of Fish and Wildlife Conservation, Virginia Tech University, Blacksburg, VA; [4]The Nature Conservancy, Clinch Valley Program, Abingdon, Virginia; [5]Virginia Department of Game and Inland Fisheries, Blacksburg, Virginia; [6]United States Fish and Wildlife Service, Genoa National Fish Hatchery, Genoa, WI; [7]U.S. Fish and Wildlife Service, Asheville, North Carolina 28801; [8]Tennessee Wildlife Resources Agency, Camden, Tennessee; [9]U.S. Office of Surface Mining and Reclamation, Pittsburgh, Pennsylvania; [10]U.S. Fish and Wildlife Service, Abingdon, Virginia; [11]U.S. Fish and Wildlife Service, Arlington, Virginia; [12]Research Scientist, U.S. Geological Survey (Retired), Department of Fish and Wildlife Conservation, Virginia Tech University, Blacksburg, Virginia.
The Clinch River is located in northeastern Tennessee (TN) and southwestern Virginia (VA) of the United States, and contains a diverse mussel assemblage of 46 extant species, including 20 species listed as federally endangered. To facilitate quantitative monitoring of the fauna, quadrat data were collected from 2004–2014 at 18 sites in the river, including 12 sites in TN and 6 sites in VA. Thirty-eight mussel species were collected alive in total from quadrat samples taken annually at sites in the TN section of the river. Over the 10-yr. study period, mussel density averaged 25.5 m^{-2} at all sites sampled in TN. In contrast, mussel density averaged only 3.1 m^{-2} at sites sampled in VA. The best historical site in VA was Pendleton Island in Scott County, where 46 species have been recorded and mussel density was estimated as high as 25 m^{-2} in 1979, comparable to current densities recorded in TN. Mussel density is now <1 m^{-2}, indicating a collapse of the fauna. A severe reduction in mussel abundance has occurred in a 68-kilometer section of the river from St. Paul, VA, downstream to approximately Clinchport, VA (river kilometers 411.5 to 343.3). While the environmental factors responsible for the faunal decline are largely unknown, they must have been severe and sustained to reduce such large populations to their current low levels. Long-term water and habitat quality monitoring is needed to determine whether environmental degradation is still occurring in the river. jess_jones@fws.gov	
Platform 15 **11:00 a.m.** **March 23, 2015**	**MUSSEL ASSEMBLAGE AND DISTRIBUTIONS ALONG 10.3 MILES OF UNDERWATER TRANSECTS IN THE MAINSTEM OHIO RIVER NEAR CINCINNATI, OHIO, USA**. John P. Spaeth[1], Casey D. Swecker[1], Kyle McGill[1], and Thomas G. Jones[2]. [1]Environmental Solutions & Innovations, Inc. 4525 Este Avenue, Cincinnati, OH; [2]Marshall University, 1 John Marshall Drive, Huntington, WV.
The Ohio River is known to harbor a diverse mussel assemblage however contemporary mussel survey information is limited. During the months of September and October 2014, Environmental Solutions & Innovations, Inc. conducted a large-scale, intensive mussel survey including 167 linear transects along a 16.6-kilometer section of Markland Pool in the Ohio River mainstem near Cincinnati, Ohio. The Ohio Mussel Survey Protocol (OMSP) was implemented and transects were spaced 100 meters apart along the Ohio shoreline and each extended 100 meters from shore. Each transect was sub-divided into 10-meter intervals. Biotic and abiotic data were recorded at each interval to provide laterally resolute information throughout the entire survey area. Numerous diverse mussel beds were encountered and surveys yielded approximately 20,000 live mussels including state and federally listed species. Mapping the distribution of mussels provided valuable inventorial information, continuity of mussel beds, and assemblage associations. jspaeth@envsi.com	
Platform 16 **11:20 a.m.** **March 23, 2015**	**PREDICTING STATEWIDE HABITAT SUITABILITY FOR 11 OF MICHIGAN'S LISTED UNIONIDS**. Wesley M. Daniel[1], Arthur Cooper[1], Pete Badra[2], Dana Infante[1]. [1]Department of Fisheries & Wildlife, Michigan State University, East Lansing, MI; [2]Michigan Natural Features Inventory, Michigan State University Extension, Michigan State University, East Lansing, MI.

In Michigan, 28 of the 45 unionid species are considered endangered, threatened, or of special concern. To aid in management of unionid assemblages, ten state listed/special concern species and one federally listed endangered species (*Epioblasma triquetra*) were modeled using ecological parameters necessary to characterize habitat suitability within the Upper and Lower Peninsulas of Michigan. Habitat suitability values were proportional to likelihood of occurrence. Mussel data came from a combination of recent site occurrences (1990-2012) from the Michigan Natural Features Inventory unionid assemblage surveys and Natural Heritage Database. We utilized Maximum Entropy Modeling (MaxEnt) that employed natural (n=13) and anthropogenic (n=11) landscape variables including dam metrics, streamflow variables, and water temperature. Since potential host fishes are important biological determinants of mussel distributions, host fish distributions were modeled with MaxEnt with the same set of landscape variables, and then the results were integrated into the mussel's models. The model predicted that between 1,274 to 11,205 km of habitat (1.7 to 15% of the state's lotic reaches) would be suitable for species occurrence. Highly suitable habitat (defined as a logistic value greater than .5; a very conservation value for this model parameter) included between 330 to 3,241 km (0.4 to 4.3%) of lotic reaches. Natural variables were the strongest indicators of suitable habitat for all species, but *E. triquetra* that had strong influences from dams and agricultural land uses. The top four variables determining suitable habitat for unionids include stream discharge (QA50), host richness distribution, urban land use, and upstream dam density. The integration of all eleven models of suitable habitats can provide information on best available habitat in the state for multiple listed species. The combination of modeled unionid distributions along with the statewide important ecological parameters can allow for more informed decisions in conservation planning and management of Michigan's listed unionids. danielwe@msu.edu

Platform 17 **11:40 a.m.** **March 23, 2015**	**THE FRESHWATER MUSSELS (BIVALVIA: UNIONOIDA) OF THE RIO AMAZON DRAINAGE WITH AN EMPHASIS ON THE RIO XINGU BASIN**. Kevin S. Cummings[1], Jeremy Tiemann[1], Daniel L. Graf[2], Maria Cristina Dreher Mansur[3], and Mark H. Sabaj-Perez[4]. [1]Illinois Natural History Survey, University of Illinois, Champaign, Illinois, USA;, [2]Biology Department, University of Wisconsin-Stevens Point, Stevens Point, Wisconsin, USA; [3]Universidade Federal do Rio Grande do Sul, Centro de Ecologia, Porto Alegre, RS, Brazil; [4]Academy of Natural Sciences of Drexel University

The Amazon basin of South America is inhabited by three families of freshwater mussels: Etheriidae, Hyriidae, and Mycetopodidae. We conducted a systematic re-evaluation of the species and genera of the drainage based on fieldwork, collections-based research in 17 major research collections, and a comprehensive literature review. Digital photographs of specimen lots and geo-referenced localities were integrated into a comprehensive database of freshwater mussel taxonomy, literature records, and museum specimens. To-date, we have captured nearly 6800 specimen lots from South America, including 1130 from the Amazon basin. These data are publicly available via the MUSSEL Project Web Site (http://www.mussel-project.net/). We currently recognize approximately 56 species in 15 genera in the Amazon basin, 16 of which are endemic. Three to four species are shared between northern South America and the Amazon through connections between the Orinoco and Amazon though the Casiquiare Canal and the Essequibo and Amazon via the upper Rio Branco. From 2012-2014 we conducted surveys of the rio Xingu, the second largest tributary to the Amazon. Twelve species are now known from the basin, including three that have not previously been reported. We will present our results on patterns of species richness and taxonomic diversity in the Amazon basin and summarize the known deficiencies in our understanding of the biogeography and evolution of these taxa. kscummin@illinois.edu

SESSION 4	**CONTAMINANTS & ECOTOXICOLOGY II** **Monday, March 23, 2015 | 10:20 a.m. – 12:00 p.m.** **Grand Ballroom B**
Platform 18 **10:20 a.m.** **March 23, 2015**	**EFFECTS OF ROUNDUP ON MUSSEL RECRUITMENT AND GLOCHIDIAL PERFORMANCE UNDER NATURAL CONDITIONS.** James A. Stoeckel[1], Wendell R. Haag[2], Robert B. Bringolf[3], Michael Hart[1], and Sayed M. Hassan[4]. [1]School of Fisheries, Aquaculture, and Aquatic Sciences, Auburn University, Auburn, AL; [2]US Forest Service, Center for Bottomland Hardwoods Research, Oxford, MS; [3]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA; [4]Department of Crop and Soil Sciences, University of Georgia, Athens, GA.

Roundup (active ingredient glyphosate) is a widely used herbicide. Surfactants in commercial formulations are toxic to glochidia and juvenile mussels under laboratory conditions, but their effects in the wild are poorly known. We experimentally examined effects of Roundup® exposure on mussel recruitment and viability in a series of 12 earthen ponds. We stocked 10 gravid *Ligumia subrostrata* and 200 bluegill hosts in each pond in winter, 2013, and allowed recruitment to proceed naturally. Treatment ponds were sprayed with commercially available Roundup® ~every 10 days from March through July to achieve glyphosate concentrations of 2 mg/L (4 ponds) or 0.2 mg/L (4 ponds), representing the range of glyphosate typically reported from streams; four control ponds were not sprayed. In fall, 2013, ponds were drained and brood stock females and young of year (YOY) mussels were collected. Many of the broodstock females were gravid, presumably fertilized by YOY males. Glochidia from these females were assessed for viability and then used to infest bluegill in the laboratory. The number of YOY mussels produced in ponds did not differ among treatments, providing no evidence for a direct, negative effect of Roundup on mussel recruitment. Similarly, the number and viability of glochidia produced by brood stock females did not differ among treatments. However, the number of juveniles produced per fish in the laboratory was lower from females exposed to Roundup than from unexposed females. This was due to a lower number of glochidia attaching per fish, rather than a reduction in transformation efficiency. These results suggest that environmentally relevant concentrations of Roundup do not have strong, negative effects on mussel recruitment within a single season, but negative effects may be manifested in subsequent generations. Long-term studies and studies with other species and environmental contexts are needed to more comprehensively assess the risk of Roundup exposure. jas0018@auburn.edu

Platform 19 **10:40 a.m.** **March 23, 2015**	**CONSIDERATION OF THE EFFECTS OF HERBICIDES ON NON-TARGET SPECIES IN MANAGEMENT OF INVASIVE AQUATIC WEEDS.** Jennifer M. Archambault[1], Christine M. Bergeron[1], W. Gregory Cope[1], Rob Richardson[2], Mark Heilman[3], J. Edward Corey[4], Michael D. Netherland[5], and Ryan J. Heise[6]. [1]Department of Applied Ecology, North Carolina State University, Raleigh, NC; [2]Department of Crop Science, North Carolina State University, Raleigh, NC; [3]SePRO Corporation, Carmel, IN; [4]North Carolina Division of Parks and Recreation, Raleigh, NC; [5] US Army ERDC, Gainesville, FL; [6]North Carolina Wildlife Resources Commission, Raleigh, NC.

Hydrilla (*Hydrilla verticillata*) is an invasive aquatic weed that has spread rapidly throughout the USA, especially in the southeast. A common control method is application of aquatic herbicides, such as fluridone and endothall. However, there is limited documentation on effects of herbicides commonly used to control hydrilla and other aquatic weeds on many non-target freshwater species, and no published information exists on the toxicity of these herbicides to freshwater mollusks. We exposed juveniles (96 h) and glochidia (48 h) of the unionid mussel *Lampsilis siliquoidea*, and adults (28 d) of *Lampsilis fullerkati* to a formulation of fluridone (Sonar – PR®) in laboratory toxicity tests. The early life stages of *L. siliquoidea* were also exposed to a formulation of the dipotassium salt of endothall (Aquathol – K®) in separate tests. Juveniles of the freshwater gastropod snail, *Somatogyrus viriginicus* (Lithoglyphidae), were exposed (96 h) to the Sonar – Genesis® fluridone formulation. Endpoints were survival (all species and life stages), and siphoning behavior and foot protrusion (adult mussels). Median lethal fluridone concentrations (LC50s) were 865 µg/L (95% CI, 729 – 1026 µg/L) for glochidia (24 h), 511 µg/L (309 – 843 µg/L) for juvenile *L. siliquoidea* (96 h), and 500 µg/L (452 – 553 µg/L) for juvenile *S. viriginicus* (96 h). No mortality occurred in the 28-d exposure of adult *L. fullerkati*, and we found no statistically significant effect of fluridone concentration on foot protrusion ($p = 0.06$) or siphoning behavior ($p = 0.08$). The 24-h LC50 for glochidia exposed to the dipotassium salt of endothall was 31.2 mg/L (30.3 – 32.2 mg/L) and the 96-h LC50 for juvenile mussels was 34.4 mg/L (29.3 – 40.5 mg/L). Freshwater mollusks were more sensitive to fluridone and endothall than most other species previously tested. Fluridone and endothall concentrations typically recommended for hydrilla treatment (5 to 15 µg/L and 1 to 5 mg/L, respectively) were not acutely toxic to the mollusks we tested, and a 28-d exposure to fluridone was not lethal to adult mussels even at the highest concentration (300 µg/L), indicating minimal risk of short-term exposure effects. jmarcham@ncsu.edu

Platform 20 **11:00 a.m.** **March 23, 2015**	**EVALUATION OF THE LETHAL AND SUB-LETHAL EFFECTS OF BAYLUSCIDE®, A SEA LAMPREY LARVICIDE, ON NATIVE FRESHWATER MUSSELS.** Teresa Newton[1], Michael Boogaard[1], Terrance D. Hubert[1], and Cheryl Kaye[2]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI; [2]U.S. Fish and Wildlife Service, Marquette, MI

The sea lamprey (*Petromyzon marinus*) was first reported in the Great Lakes in 1921 and has caused substantial damage to native fish populations. In recent years, there has been growing concern over the potential for adverse effects of lampricide applications to non-target fauna, especially at-risk freshwater mussels. Granular Bayluscide® has been used since the 1990's as a bottom-release formulation to control larval sea lampreys in lentic habitats and to survey areas too deep to be electrofished. To date, there are no data on the effects of Bayluscide® treatments on native mussels. We evaluated the lethal and sub-lethal effects of Bayluscide® among 8 mussel species, including sub-adult and adult life stages. Mussels were exposed to environmentally relevant concentrations and exposure durations in static exposures. Bayluscide® was applied to aquaria containing mussels and mussels were randomly removed at 12 intervals between 0 and 8 hrs, after which mussels were followed for a 21-d recovery period. Mean mortality of sub-adults of 4 species was 42% and ranged from 23-51%. Mean mortality of adults of 6 species was 21% and ranged from 3-45%. The median time to death ranged from 53 min in *Ptychobranchus fasciolaris* to 105 min in *Obovaria subrotunda*. The median time to elicit a sub-lethal response (defined as gaped valves, foot extension, and/or mucus production) ranged from 107 (*Lampsilis fasciola*) to 252 min (*P. fasciolaris*) in 4 species of sub-adults and from 271 (*Villosa iris*) to 423 min (*Obovaria olivaria*) in 4 species of adults. The percent of mussels that recovered after displaying a sub-lethal response averaged 36% in sub-adults and 50% in adults, but was highly variable among species. Collectively, these data suggest that Bayluscide® may cause adverse lethal and sub-lethal responses in freshwater mussels but that the magnitude of these effects are variable among species and life stage.
tnewton@usgs.gov

Platform 21 **11:20 a.m.** **March 23, 2015**	**THE INFLUENCE OF ZINC CHLORIDE AND NANOPARTICLES ON AIR-TIME SURVIVAL IN FRESHWATER MUSSELS.** Francois Gagné[1], J. Auclair[1], C. Peyrot[2], K. Wilkinson[2]. [1]Emerging Methods Aquatic Contaminants Research Division, Water Science and Technology, Environment Canada, 105 McGill, Montréal QC H2Y 2E7; [2]Département de chimie, Université de Montréal, Montréal QC H2V 2B8

The purpose of this study was to determine the cumulative effects of exposure to either dissolved zinc or nanozinc oxide and air-time survival in freshwater mussels. Mussels were exposed to each form of zinc for 96 hours, then placed in air to determine the air-time survival. A sub-group of mussels before and after 7 days of exposure to air were kept aside for the determination of the following biomarkers: arachidonate-dependent cyclooxygenase (COX) and peroxidase (inflammation and oxidative stress), lipid metabolism (total lipids, esterases activity, HO-glycerol, acetyl CoA and phospholipase A2) and lipid damage (lipid peroxidation [LPO]). In mussels exposed to zinc only, the median lethal concentration was estimated at 16 mg/L for dissolved zinc and was > 50 mg/L for nanozinc oxide based on shell opening responses. However, the air-time survival dropped from 19 days in controls to 12 days in mussels exposed to 2.5 mg/L nanozinc oxide for 96 h. The air-time survival did not significantly change in mussels exposed to the same concentration of dissolved Zn. Significant weight losses were observed at 0.5 mg/L nanozinc oxide and at 2.5 mg/L for dissolved zinc chloride, and were also significantly correlated with air-time survival ($r=0.53$; $p<0.01$). Air exposure significantly increased COX activity in control mussels and in mussels exposed to 0.5 mg/L nanozinc oxide and zinc chloride. LPO was significantly increased in mussels exposed to zinc chloride followed by exposure to air. Peroxidase activity was significantly decreased in mussels exposed to air only and to nanozinc oxide followed by air exposure. Exposure to air also increased phospholipase 2 (PLA2) activity and acetyl CoA levels, whereas pre-exposure to both forms of zinc mitigated this response. The levels of glycerol, an indicator of lipid catabolism, were also enhanced after air exposure where both forms of zinc increased this effect. The data suggest that air-time survival could be affected by exposure to chemicals such as dissolved and nanozinc oxide. Exposure to air produced an inflammation reaction (COX activity) and weight loss in mussels, which are also influenced by the presence of metals and nanoparticles, further suggesting that health impacts of prolonged exposure to air from low water levels could be increased in the presence of environmental contaminants. francois.gagne@ec.gc.ca *CANCELLED*

Platform 22 **11:40 a.m.** **March 23, 2015**	**TURBIDITY CONTROL IN AQUATIC SYSTEMS WITH POLYACRYLAMIDE: ASSESSING DIFFERENCES IN FORMULATION AND RESULTING TOXICITY TO NATIVE FRESHWATER MUSSELS.** Sean B. Buczek[1], W. Gregory Cope[1], Richard A. McLaughlin[2], and Thomas J. Kwak[3]. [1]Department of Applied Ecology, North Carolina State University, Raleigh, NC; [2]Department of Soil Science, North Carolina State University, Raleigh, NC; [3]U.S. Geological Survey, NC Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC.

Polyacrylamide (PAM) is widely used as a chemical flocculent in many different industries including; wastewater treatment, paper manufacturing, agriculture, and construction. PAM has become an effective tool for reducing suspended sediment and turbidity, which are considered to have significant impacts on aquatic ecosystems and are a leading cause of the continued degradation of North American streams. However, little is known about the effects of PAM on many freshwater organisms, and no information exists on the toxicity of PAM formulations to native freshwater mussels (Family Unionidae). Following ASTM standard guidelines, we exposed juveniles (96-h) and glochidia (24-h) of the yellow lampmussel (*Lampsilis cariosa*), an Atlantic slope species and endangered in North Carolina, Appalachian elktoe (*Alasmidonta raveneliana*), a federally endangered interior basin species, and washboard (*Megalonaias nervosa*), a common interior basin species to six different formulations of anionic PAM. The mussels were exposed at concentrations of 5, 50, 100, 200, 500, and 1000 mg/L and assessed for viability. Generally, we found that PAM concentrations typically recommended for turbidity control (1–5 mg/L), regardless of molecular weight or charge density, were not acutely toxic to the mussel species and life stages tested, indicating minimal risk of short-term exposure effects. However, potential chronic and sublethal effects still require additional investigation. This research will aid in improved management and regulatory decision making for turbidity control best management practices. sbbuczek@ncsu.edu

SESSION 5	**RELOCATION & REINTRODUCTION** **Monday, March 23, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom A**
Platform 23 **1:40 p.m.** **March 23, 2015**	**AN EVALUATION OF MUSSEL RELOCATION AS A CONSERVATION STRATEGY: 25 YEARS REVISITED**. W. Gregory Cope[1], Heidi L. Dunn[2], and Diane L. Waller[3]. [1] North Carolina State University, Department of Applied Ecology, Raleigh, NC; [2]Ecological Specialists, Inc., O'Fallon, MO; [3]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. *INVITED SPEAKER*
State and federal resource agencies, recognizing the importance of preserving the native mussel fauna, have used relocation (translocation) of mussels as a conservation and management tool. Relocation has been used to recolonize mussels in areas where populations had been eliminated by prior pollution events, to remove mussels from construction zones, to re-establish or augment populations of state and federally endangered species, and to protect at-risk unionid populations from colonization by invasive species like zebra mussels *Dreissena polymorpha*. More recently, mussel relocation has been used in stream restoration initiatives where removal of dams has jeopardized existing populations during demolition activities. Tremendous advances in relocation techniques and procedures have been made over the past 25 years. For example, many of the variables that ultimately control survival, recovery, and mussel health such as emersion duration, appropriate water and air temperatures, mussel density, marking and tagging, placement in the substrate, destination site habitat selection, monitoring duration, and assessment of physiological condition have been determined and included in current relocation guidelines. Advances continue to be made in assessing mussel health and in freshwater gastropod relocation methods. Current practitioners should utilize the established body of knowledge in developing and designing future site-specific relocation protocols. We will highlight future directions for relocation science and its continued application to conservation of freshwater mollusks. gcope@ncsu.edu	
Platform 24 **2:00 p.m.** **March 23, 2015**	**COOPERATIVE RECOVERY ON A LANDSCAPE SCALE: THE RE-INTRODUCTION OF NORTHERN RIFFLESHELL (*EPIOBLASMA TORULOSA RANGIANA*) AND CLUBSHELL (*PLEUROBEMA CLAVA*) TO SITES IN SIX STATES WITHIN THEIR HISTORIC RANGE.** Robert Anderson[1], Nevin Welte[2], Jordan Allison[2], Janet Clayton[3], Barbara Douglas[4], Patricia Morrison[5], G. Thomas Watters[6], Angela Boyer[7], Leroy Koch[8], Monte McGregor[9], Brant Fisher[10], and Jeremy Tiemann[11]. [1]USFWS, State College, PA; [2]PA Fish and Boat Commission, Bellefonte, PA; [3]WV Division of Natural Resources, Elkins, WV; [4]USFWS, Elkins, WV; [5]USFWS, Williamstown, WV; [6]OSU Museum of Biological Diversity, Curator of Molluscs, Columbus, OH; [7]USFWS, Columbus, OH; [8]USFWS, Frankfort, KY; [9]KY Dept. of Fish and Wildlife Resources, Frankfort, KY; [10]Indiana Dept. of Natural Resources, Edinburgh, IN; [11]Illinois Natural History Survey, Champaign, IL.

The northern riffleshell and clubshell have been listed as federally endangered throughout their entire range since 1993. The northern riffleshell occurred historically in 54 streams systems in eight states and the province of Ontario, Canada. As of the 2009 status review for this species, its current distribution is restricted to nine populations in 12 rivers, with only four recognized as reproducing populations. The clubshell was more widely distributed, extending historically across 100 streams in nine states. There were only 13 extant populations in 21 streams recognized in the 2009 status review, with reproduction documented in eight populations. These two species often co-occur in riverine habitats in Pennsylvania, and their most abundant populations today remain in the Allegheny River drainage. The large populations of these two species in Pennsylvania represent a potential source of animals to implement recovery actions consistent with their recovery plans, including translocations and stocking of juveniles propagated from these populations. Although many mollusk species recovery actions have been implemented over the past 10 years, most are localized to one or a few streams or rivers within the same state. Beginning in 2007, cooperators in six upper Ohio River Basin states began establishing small pilot populations (50 to 200 individuals) of clubshell and northern riffleshell in suitable historic habitats to assess the 1 to 3 year survival and growth of these animals in their new homes. If these pilot projects are successful, additional adults and juveniles of both species will augment the pilot sites to result in new populations of at least 2000 per species per site or river system. We will offer our experience on how to coordinate these activities on a large scale, and manage state and federal permitting and other administrative issues. These bold management actions will hopefully lead to the establishment of at least 25 clubshell and 30 northern riffleshell "new site populations" in 12 rivers in six states, extending over 550 miles from their source populations in PA. The ultimate goal of these efforts is the down-listing or delisting of these keystone riverine species. patricia_morrison@fws.gov

Platform 25 2:20 p.m. March 23, 2015	**EVALUATION OF SYSTEMATIC QUADRAT AND MARK-RECAPTURE SAMPLING DESIGNS: MONITORING A REINTRODUCED POPULATION OF OYSTER MUSSELS (*EPIOBLASMA CAPSAEFORMIS*) IN THE UPPER CLINCH RIVER, VIRGINIA**. Caitlin S. Carey[1,2], Jess W. Jones[2,3], Robert Butler[4], Eric M. Hallerman[2], and Marcella J. Kelly[2]. [1]Conservation Management Institute, Virginia Polytechnic Institute and State University, Blacksburg, VA; [2]Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA; [3]U.S. Fish and Wildlife Service; [4]U.S. Fish and Wildlife Service, Asheville, NC.

Quadrat sampling designs have commonly been used to monitor freshwater mussel populations by collecting demographic data and estimating parameters such as abundance, density, age-class structure, and survival. Once a less frequently used sampling design for monitoring mussels, mark-recapture is increasingly being used to assess mussel populations. The ability to accurately and precisely estimate population demographics is important to determining population viabilities and for consequential management decisions. Our objective was to evaluate the relative effectiveness of these two designs to estimate demographic parameters for freshwater mussels. Using systematic quadrat and mark-recapture, we collected data on a reintroduced population of federally endangered *Epioblasma capsaeformis* and two non-listed, naturally occurring species—*Actinonaias pectorosa* and *Medionidus conradicus*—in the upper Clinch River, Virginia, over two years to estimate and compare species-specific population sizes between estimators. Additionally, we used mark-recapture to estimate apparent survival and investigate factors influencing capture. Generally, both sampling methods produced similar population size estimates; however, precision varied between methods among species. Capture probabilities varied by time and were a function of length for all three species and apparent survival rates were high (>99%) for *E. capsaeformis*. Our results indicated that systematic quadrat and mark-recapture sampling have useful applications in population monitoring, but the choice among them is dependent on project objectives and logistics. We recommend that monitoring projects utilize systematic quadrat sampling when the objective is to simply estimate and detect trends in population size of species at moderate to higher densities (>0.2/m^2). Mark-recapture should be used when objectives include assessing reintroduced populations, obtaining precise parameter estimates such as survival and recruitment, or estimating population size for species of low to moderate densities (0.1–0.2/m^2). Uniquely marking individuals before reintroductions or augmentations creates an opportunity to observe the fate of individuals over time and improve our understanding of species-specific demographic characteristics. cscarey@vt.edu

Platform 26 2:40 p.m. March 23, 2015	**USE OF PIT TAGS TO ASSESS SURVIVAL, PERIODIC GROWTH AND GROWTH CESSATIONS OF LABORATORY-REARED ENDANGERED CUMBERLANDIAN COMBSHELL (*EPIOBLASMA BREVIDENS*) BASED ON A HIERARCHICAL BAYESIAN APPROACH INCORPORATING INDIVIDUAL HETEROGENEITY.** Dan Hua[1, 2], Yan Jiao[1], Richard Neves[1], and Jess Jones[1, 3]. [1]Department of Fish and Wildlife Conservation, College of Natural Resources, Virginia Polytechnic Institute and State University, Blacksburg, VA; [2]Freshwater Mollusk Conservation Center, Virginia Polytechnic Institute and State University, Blacksburg, VA; [3]U.S. Fish and Wildlife Service, Blacksburg, VA.

The federally endangered Cumberlandian combshell (*Epioblasma brevidens*) was propagated and reared to tagable size (5-10 mm), and released to the Powell River, Tennessee to augment a relict population. A mark-recapture monitoring process using Passive Integrated Transponder (PIT) tags was used to assess survival and growth of released mussels. A set of hierarchical Bayesian models incorporating variations of individuals were developed to estimate survival and growth. Non-hierarchic models without considering individual variation and hierarchic models incorporating individual and seasonal variations were compared and resulted in similar results for detection probability and survival rate of mussels. The hierarchical model that incorporated individual growth variation yielded the lowest deviance information criterion value and resulted in the best reasonable model parameters. The overall mean detection probability and survival rate of released individuals reached 97.8% to 98.4% and 99.7% to 99.9% (per month), respectively, during 9 successive recapture occasions in the 2-year study period, regardless of seasonality. The growth models were constructed to include periodic growth rates and growth cessations, along with multiple release occasions and were compared to the classic von-Bertalanffy growth model. Mussels exhibited different growth increments at various rates of (K), including 0.015, 0.026, 0.110 and 0.050 ($year^{-1}$), corresponding to the duration of laboratory culture, ages 2, 3 and 4 years old, respectively; and a growth cessation (GC) for 5.98 months. The other parameters of asymptotic length L_∞ and age at the length of zero (t_0) were 51.36 mm and -0.648 months, respectively. The flexible structure of Bayesian hierarchical models allowed us to examine survival and growth characteristics of *E. brevidens* in a changing environment to better understand details of its growth and lifespan, and thus, provide useful data for conservation management. Additionally, the newly developed models can be modified and used for other species under various environmental circumstances. huad@vt.edu

Platform 27 **3:00 p.m.** **March 23, 2015**	**HEALTH ASSESSMENT OF RELOCATED FRESHWATER MUSSEL *AMBLEMA PLICATA* USING METABOLOMICS**. Ieva Roznere, G. Thomas Watters, Barbara A. Wolfe, and Marymegan Daly. The Ohio State University, Columbus, OH. *STUDENT PRESENTATION*

Freshwater mussel conservation often requires the animals to be relocated to other habitats or brought into captive research facilities. Although critical to the success of this endeavor, knowledge of the impact of relocation on freshwater mussel health remains extremely limited. The objective of this study was to assess the effects of stress in captive and relocated mussels using metabolomics techniques. Freshwater mussels of the species *Amblema plicata* were collected from the Muskingum River in Washington Co., OH, in June 2012. Half of the mussels were brought into captivity inside the Freshwater Mussel Conservation and Research Center in Powell, OH and half were transported to Big Darby Creek in Franklin Co., OH. Hemolymph samples were taken in the wild immediately upon collection in June 2012 and subsequently in August and October 2012 and May and August 2013. The samples were analyzed on gas chromatography-mass spectrometry and liquid chromatography-mass spectrometry platforms. Biochemicals involved in energy and carbohydrate metabolism showed similar seasonal variation among all groups of mussels. The stress of relocation was evidenced in changes in polyamine and nucleic acid metabolism. While levels of metabolites involved in polyamine synthesis were elevated in the wild mussels later in the year, these same metabolites decreased or remained unchanged in both groups of relocated mussels. Similarly, metabolites indicative of nucleic acid turnover and degradation tended to increase in the wild mussels and decrease in the relocated mussels. The significantly lower levels of polyamine and nucleic acid metabolites suggests decreased cell growth and proliferation, which in the long-term may impair tissue maintenance and cause decreased rates of growth. roznere.1@buckeyemail.osu.edu

SESSION 6	**PROPAGATION I** **Monday, March 23, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom B**
Platform 28 **1:40 p.m.** **March 23, 2015**	**100 YEARS OF MUSSEL PROPAGATION: WHAT HAVE WE LEARNED AND WHERE ARE WE GOING?** Chris Barnhart[1] and Monte McGregor[2]. [1]Missouri State University, Springfield, MO; [2]Kentucky Department of Fish and Wildlife Resources, Frankfort, KY.

A century ago, mussel propagation began as an effort to sustain the pearl button industry. In contrast, efforts of the past 25 years have aimed at preventing extinctions. Simple rearing systems and artificial diets enable efficient laboratory production of juveniles, and systems for holding in raceways, rivers and ponds allow grow-out with natural food. Continuing advances are improving survival and growth rates. Since the 1990s, at least 18 North American resource agencies, universities, and zoos have developed conservation-oriented mussel culture programs. To date, 122 species have been metamorphosed on fish hosts or *in vitro*, 79 species have been cultured to several months of age, and several to sexual maturity. 49 species have been stocked for population restoration or augmentation. Releases since 2010 totaled well over 100,000 individuals and current annual production estimates are well over 1 million. Equally important is the use of propagated mussels for research, particularly in toxicology. Studies of sensitivity to ammonia, metals, ions, and organic pollutants have informed regulatory agencies, leading to major settlements against polluters and tightening of federal and state water quality criteria. Many challenges remain. Particular needs include continued research on physical and dietary requirements of habitat specialists and on the potential positive and negative genetic impacts of stocking programs. Laboratory toxicology results can be extended to the field, using experimental releases or caged juveniles. Many ecological questions can be addressed with propagated mussels, including effects of habitat, predation, population density, and host relationships in limiting recruitment. Stream ecosystems are increasingly fragmented. As populations become smaller and more isolated, their vulnerability will increase. Impacts of pollution, invasive species, and climate change are unlikely to abate. The capacity of resource agencies to rear, stock, and track released mussels is a necessity to manage mussels and prevent further extinctions over coming decades.
ChrisBarnhart@MissouriState.edu

Platform 29 2:00 p.m. March 23, 2015	**OPTIMIZING HOMESTASIS IN MEDIA MUSSEL (IN VITRO) CULTURE.** Christopher Owen and Monte McGregor. Center for Mollusk Conservation, Kentucky Department of Fish and Wildlife Resources, Frankfort, KY.

Current methods for media culture of freshwater mussels were based on mammalian cell culture techniques and have demonstrated successful metamorphosis of glochidia *in vitro*. However, results have varied between sera and plasma sources despite similar nutritional profiles of the different protein sources. While nutrient deficiencies ultimately cause poor development, the response is chronic and unlikely to be responsible for any acute mortality early in media mussel cultures. We investigated the biological chemistries regulating homeostasis in freshwater fish and modeled the media mussel cultures to provide an optimal environment. Several differences exist between the regulation of homeostasis in fish and mammals, including pH and pH buffering system, blood sugar concentration and serum protein composition and concentrations. While mammalian systems utilize a bicarbonate buffering system to maintain pH, fish are unable to accumulate bicarbonate due to its high solubility in water and instead regulate through the use of phosphate buffers, amino acids and renal excretion. Additionally, mammalian blood proteins primarily consist of serum albumins, and fish blood contains very little serum albumin (in many species it is nonexistent). Fish instead utilize VLDL (very low density lipoproteins) to serve as carrier molecules and regulate oncotic pressure. Lastly, blood glucose concentrations in mammals are different from fish. We tested several mussel species using two different *in vitro* culture recipes, one based on mammalian culture and one modified based on fish blood chemistry. Metamorphosis was observed with both recipes, however, metamorphosis and post-metamorphic survival was higher in the fish recipe. Additionally, the lag period following dilution from media to freshwater was reduced from several hours to only minutes, resulting in earlier crawling behavior and burial into substrate in grow-out systems. Differences in homeostasis between mammals and fish explain much of the variation observed in early investigations of media mussel culture.
christopher.owen@ky.gov

Platform 30 2:20 p.m. March 23, 2015	**RECENT CHANGES AND IMPROVEMENTS IN FRESHWATER MUSSEL CAGE CULTURE AT GENOA NATIONAL FISH HATCHERY (NFH).** Nathan Eckert and Jorge Buening. Genoa National Fish Hatchery, S5631 State Hwy 35, Genoa, WI.

The Genoa NFH has been involved in cage culture of freshwater mussels of the Upper Mississippi River Basin since those efforts began in 2000. Since that time multiple styles of cages have been tested, and various modifications have been made to suit culture location or species specific needs. Until recently, the cage culture protocol involved placing inoculated fish in the cages, and after fish removal, leaving the cages un-disturbed for approximately 18 months (two growing seasons) to allow the mussels to achieve a size suitable for stocking. While this strategy has proven successful, recovery and stocking rates have been found to improve when the cages are harvested and assessed in the fall of the first year. Smaller juveniles are recovered at this point, which require more captive care, but the result has been an increased number of tagged mussels for release. In addition to the changed harvest strategy a pond at Genoa NFH has been used for multiple years as a cage culture location. Cage placements in 2014 lead to a recovery rate of 588 mussels/cage. This effort has shown that pond fertilization is beneficial for mussel culture at this location, and that a small dose of an algaecide containing copper can be used without a negative impact to mussel culture. Placement of cages in hatchery ponds helps to eliminate some of the uncertainty associated with cage culture at wild locations due to factors such as flooding. nathan_eckert@fws.gov

Platform 31 **2:40 p.m.** **March 23, 2015**	**COMMUNITY LEVEL LOOK AT GLOCHIDIAL INFESTATIONS AND FISH CHARACTERISTICS THAT PROMOTE INFESTATION.** Katherine D. Bockrath and John P. Wares. University of Georgia, Department of Genetics, Athens, Georgia 30602

Freshwater mussels are highly diverse but severely imperiled group of bivalves. With almost 300 species of freshwater mussel in North America and over 70% of those species in decline, understanding the factors required to maintain and promote mussel populations in a must. Freshwater mussels have an obligate parasitic larval stage where mussel larvae, known as glochidia, require a fish host to complete their lifecycle. Some mussel species are very specific in their host requirements and will only transform into juveniles on a few fish species, while others are more generalistic and will transform on a large number of fishes. The largest contributor to mussel decline is habitat destruction and construction of multiple impoundments on large river drainages. With habitat modifications water quality is altered and suitable host fish can be eliminated. The aim of this study was to assess mussel infestations across a community of fishes in an urbanized impounded stream. By sampling across fish species, we determine which fish are infested with glochidia, the proportion of fish with glochidia, infestation densities, and the mussel species recovered. Though some fish species had a higher proportion of infestations, there was no significant difference in infestation occurrence between any fish species. Additionally, all fish species infested carried multiple mussel species that later successfully transformed to juveniles, suggesting the mussels in this community may be host generalists. Because there is no strong evidence for fish host preference across the sampled fish community, we aim to determine what fish characteristics are important in fostering glochidial infestations. We assess glochidial infestations in relation to fish physical features (gap size, gill area, body length), behavior (feeing mode and time, position in the water column, time of most activity), and phylogenetic relationships. katiebockrath@gmail.com

Platform 32 **3:00 p.m.** **March 23, 2015**	**LOCAL ADAPTATION STUDIES AND CONSERVATION: THE RELATIONSHIP OF A FRESHWATER MUSSEL SPECIES WITH TWO OF ITS SYMPATRIC AND ALLOPATRIC HOST FISH SPECIES**. Lea D. Schneider[1], P. Anders Nilsson[1,2], and Martin E. Österling[1]. [1]Department of Biology, Karlstad University, SE-651 88 Karlstad, Sweden; [2]Department of Biology, Aquatic Ecology Unit, Ecology Building, Lund University, SE-223 62 Lund, Sweden. *STUDENT PRESENTATION*

The study of antagonistic interactions between hosts and their parasites offers interesting opportunities to explore coevolutionary dynamics. Host-parasite systems are predicted to lead to parasitic local adaptation, where parasites have higher infection success on sympatric hosts than on allopatric hosts. Theory generally predicts that the parasites should have an advantage to adapt to their local host if they have shorter generation times, larger population sizes and higher migration rates. The long-lived freshwater unionoid mussels have a life cycle including a larval parasitic stage on fish, which are often relatively short-lived in comparison to the parasitic mussel species. Still, local adaptation to sympatric host fish species, resulting in large numbers of juvenile mussels leaving the host fish, would be important for growth and survival of mussel populations. Since many of the unionoid mussel species are highly threatened, increased knowledge of local adaptation patterns may be helpful for conservation, perhaps especially when reintroducing mussels or their host fish species. The thick-shelled river mussel *Unio crassus* is Europe's most threatened unionoid species and is considered to be highly valuable for conservation. To investigate patterns of local adaptation of *U. crassus*, we conducted a common garden experiment where we cross-infested the European minnow *Phoxinus phoxinus* and the bullhead *Cottus gobio* from two rivers, with their sympatric and allopatric mussel larvae. Interestingly, local adaptation was not river specific, nor species specific. Therefore, our study suggests that the conservation of *U. crassus* gains from studies of local-adaptation using more than one host fish species. lea.schneider@kau.se

SESSION 7	STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES III Monday, March 23, 2015 | 3:40 p.m. – 5:00 p.m. Grand Ballroom A
Platform 33 3:40 p.m. March 23, 2015	**THE IMPORTANCE OF COMPLETE WATERSHED POPULATION DATA FOR FRESHWATER MUSSEL NICHE MODELS**. Daniel E. Symonds, Joshua A. Banta, and Neil B. Ford. University of Texas at Tyler, 3900 University Blvd, Tyler, TX. *STUDENT PRESENTATION*
Species richness is often determined by numerous abiotic and biotic factors, especially in stream ecosystems. Hydrology and geomorphological characteristics, which shape stream conditions, are some of the most important factors determining freshwater mussel (family Unionidae) population richness and abundance. These factors change along a longitudinal scale as water flows from headwaters into larger rivers, which also leads to changes in mussel assemblages. East Texas Rivers have yet to be examined for these longitudinal changes in species composition, which would be useful for conservation efforts. This study examined 43 survey sites in the Neches and Trinity River watersheds in East Texas, focusing on smaller tributaries and headwater streams. These sites revealed new presence data for multiple state threatened species, as well as displayed a species composition gradient from smaller streams to mainstem rivers. Niche models for threatened species have been generated and shown to be accurate and useful for predicting the presence of various mussel species. This study added tributary data and expanded existing models to more accurately display potential suitable mussel habitat. Preliminary results suggest that the examination of these smaller streams is critical for localized knowledge of species distribution as well as for creating more accurate niche models. These niche models are valuable tools that can be used as guides for further research and implemented as part of conservation plans for threatened or endangered species. dsymonds2@patriots.uttyler.edu	
Platform 34 4:00 p.m. March 23, 2015	**SURVEY FOR THE THREATENED PURPLE BANKCLIMBER (*ELLIPTOIDEUS SLOATIANUS*) TO ASSESS FLOW ENHANCEMENTS OF A HYDROELECTRIC PROJECT ON THE FLINT RIVER, GEORGIA.** Mary T. McCann. HDR, Engineering, Inc., 970 Baxter Boulevard, Portland, ME.
In 2003, a field survey was conducted for *Elliptoideus sloatianus* in the middle reach of the Flint River. The survey was conducted in support of the Lake Blackshear Hydroelectric Project relicensing activities. This survey found large numbers of *E. sloatianus* downstream of the project, but few juveniles. Further, the survey noted a trend of decreasing length frequency with distance downstream of the Project. The Project was issued a new license in 2008, which included a flow modification to enhance aquatic life downstream of the Project. One of the license requirements, associated with Section 7 endangered species consultation, was to conduct three post-license mussel surveys to monitor changes in *E. sloatianus* populations that may result from the enhancements, and to monitor recruitment and length frequency trends. To that end, the first post-license survey was conducted in 2013. This survey repeated the previous survey for comparison, but also included the addition of quadrat samples in an attempt to evaluate recruitment. Results of the 2013 survey were comparable to the previous 2003 mussel survey conducted at the same locations, while also observing several additional species, including a single specimen of the shinyrayed pocketbook, a federally-endangered species. The quadrat samples collected juveniles of common species but were not successful in collecting juvenile *E. sloatianus.* Mary.McCann@hdrinc.com	
Platform 35 4:20 p.m. March 23, 2015	**DISTRIBUTION AND STATUS OF *ANODONTOIDES DENIGRATA* (LEA 1852), CUMBERLAND PAPERSHELL, IN KENTUCKY.** Michael C. Compton and Evelyn G. Brett. Kentucky State Natures Preserves Commission, Frankfort, Kentucky.

The Cumberland Papershell (*Anodontoides denigrata*) is endemic to the Cumberland River drainage. The species was not formally recognized as part of the mussel fauna in Kentucky until 2003, but it is considered endangered by the State of Kentucky, though its taxonomy is still unsettled. Currently, the species exists within the Upper Cumberland River drainage in eastern Kentucky and adjacent Tennessee. Mussel surveys in Kentucky over the past century have indicated 15 extant populations within the Upper Cumberland River, above and below the Cumberland Falls, with all occurrences being upstream of the ancestral origin of the falls. In 1983 fresh dead specimens were collected from the Little River (lower Cumberland River) in western Kentucky and have been tentatively identified as Cumberland Papershell. This record confounds the assumed distribution of the species because it represents an extremely disjunct western population. During 2011–2014, nearly 130 sites were surveyed within the Upper Cumberland River drainage in eastern Kentucky and within the Little River system in western Kentucky. Surveys consisted of 1–4 person-hour timed searches of available habitat from historical stream reaches and additional streams that may yield the species. Six of the 15 historical populations in eastern Kentucky were confirmed extant, and a new population discovered. However, only three of those populations appear stable. In western Kentucky, one live specimen that appeared to match the shell material from the historical collection in the Little River system was retained to genetically confirm its identification. The distribution of the species has declined substantially in Kentucky since 2000, with historical and contemporary impacts from fossil fuel extraction and exploration representing the largest threats. Upon taxonomic resolution and clarification of the western extent of its range, a federal conservation designation seems inevitable. Mike.Compton@ky.gov

Platform 36 **4:40 p.m.** **March 23, 2015**	**DETECTION, QUANTIFICATION, AND CONSERVATION OF RARE UNIONIDS: SNUFFBOX OF MICHIGAN.** Daelyn A. Woolnough, Mandi Caldwell, and Shaughn Barnett. Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mt. Pleasant, MI.

Snuffbox (*Epioblasma triquetra*) is federally endangered in the United States and Canada and is a member of arguably the most imperiled genera in the Family Unionidae. In Michigan, we have quantified snuffbox using stratified random techniques while incorporating wadable and non-wadable methods. We have been successful in finding populations that have not been documented or quantified in recent history. We will present data on 4 populations of snuffbox (i.e., 1 from the Lake Erie and 3 from the Lake Michigan watersheds). These populations vary in their size, influence of invasive species (i.e., dreissenids and Asian clams), distribution relative to other species, their use of host fish, and evidence of recruitment. Our data indicate that river reaches downstream of low-head dams can support large, reproducing populations of snuffbox. We have shown that snuffbox can use both logperch (*Percina caprodes*) and blackside darter (*Percina maculata*) as hosts and that transformation can occur on hosts from other watersheds. Host test results suggest seasonal differences in the developmental stages of snuffbox juveniles between spring and fall. We found that invasive mollusk abundance ($p = 0.021$, $r_s = -0.316$) and biomass ($p = 0.008$, $r_s = -0.357$) may negatively influence snuffbox length. However, relationships with dreissenids and Asian clams on snuffbox differed in the rivers studied. Finally, we have been able to quantify the unionid assemblages with which snuffbox co-occur. Overall, these data are important for the conservation of snuffbox and other mollusk species and the process we used for detection and quantification can be used in conservation management. wooln1d@cmich.edu

SESSION 8	**PROPAGATION II** **Monday, March 23, 2015 | 3:40 p.m. – 5:00 p.m.** **Grand Ballroom B**
Platform 37 **3:40 p.m.** **March 23, 2015**	***IN VITRO* CULTURED FATMUCKET, *LAMPSILIS SILIQUOIDEA* (BARNES, 1823) SUCCESSFULLY REPRODUCED AND GLOCHIDIA INOCULATED ONTO HOST LARGEMOUTH BASS FOLLOWING LABORATORY REARING AND HATCHERY GROW OUT.** Monte A. McGregor, Christopher Owen, Adam C. Shepard, Travis Bailey, Andy McDonald, Fritz Vorisek, and David Cravens. Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY.

Freshwater mussel propagation has advanced over the last few decades to now include transformation of juvenile mussels without the use of a host fish. *In vitro* culture is a process by which glochidia are removed from the adult mussels, placed in nutrient solutions in incubators, and allowed to metamorphose to the juvenile stage. Over 50 species have been cultured *in vitro*, including several rare species. However, few media mussels have been grown to the adult stage and allowed to repeat the life cycle using *in vivo* (fish host) to verify reproductive viability. In 2006, we cultured a few hundred fatmuckets, *Lampsilis siliquoidea* (Barnes, 1823), using *in vitro* culture methods and reared the juveniles in a laboratory setting in small research systems for 1 year, and long-term reared the juveniles at hatchery utilizing flow-through natural river water for the next several years. Also, 100 marked individuals were released into the wild and have been observed to develop similarly to those in the hatchery. In 2011, individuals at the hatchery showed signs of sexual dimorphism. In 2012 and 2013, individuals were examined and found to be gravid. In June 2014, larvae were extracted from one female fatmucket and inoculated onto 32 three to five inch hatchery reared largemouth bass. Juveniles successfully transformed on the host fish in 16-18 days and ~ 3,000 juveniles were collected. These juveniles were reared with a controlled diet for a few months to check for development and growth. After five months, juveniles had grown to 10-13mm and appeared to be no different than *in vivo* juveniles. *In vitro* culture methods are a useful alternative to traditional culture methods for mussel conservation purposes and can be used if host fish are not available or even unknown. monte.mcgregor@ky.gov

Platform 38 **4:00 p.m.** **March 23, 2015**	**DETERMINING VIABLE HOST-FISH SPECIES FOR *FUSCONAIA ASKEWI*, *POTAMILUS AMPHICHAENUS*, AND *PLEUROBEMA RIDDELLII* IN EAST TEXAS.** Erin Bertram[1], John S. Placyk, Jr.[1], and Lance R. Williams[1]. [1]The University of Texas at Tyler, Biology Department, Tyler, Texas, 3900 University Boulevard. *STUDENT PRESENTATION*

Freshwater Unionid mussels provide some of the most important ecosystem services in fresh water systems, yet are the most imperiled group of organisms in North America. In addition to anthropogenic and natural disturbances that contribute to their decline, the absence of their obligate host-fish species is also a cause of their diminishing diversity and abundance. Because of this co-evolutionary relationship and dependence of mussels on their obligate host-fish species, it is extremely important to know the distribution of fish in fresh water ecosystems and their roles as hosts. With this, we can understand the distribution and successful reproduction of freshwater mussels. The Texas Pigtoe, Louisiana Pigtoe, and the Texas Heelsplitter are state threatened species of Texas with no known host-fish species on record. There have been various methods used to test for host-fish species including artificial infestations in lab studies and by collecting naturally infested fish from the field and examining the gills and fins for glochidial encystment. This study aims to determine naturally occurring and viable host-fish species for three state threatened mussel species by collecting naturally parasitized fish from the wild and collecting fully metamorphosed juvenile mussels that have naturally dropped off. These juveniles are in the process of being identified to species through DNA sequencing with amplification of the ND1 gene. The sequences are compared to an adult molecular key that has been created for all 37 mussel species that occur in East Texas. The predicted outcomes of this study is to confirm host-fish species for state threatened freshwater mussels in accurately representing the fish-mussel interactions that occur in nature that may aid in implementing conservation methods for fresh water mussels of East Texas. ebertram@patriots.uttyler.edu

Platform 39 **4:20 p.m.** **March 23, 2015**	**EVALUATION OF A FLUORESCENT DYE ASSAY TO ASSESS GLOCHIDIAL HEALTH**. Kathryn Mitchell[1], William Wayman[2], Jaclyn Zelko[2], Robert B. Bringolf[3] and James A. Stoeckel[1]. [1]School of Fisheries, Aquaculture, and Aquatic Sciences, Auburn University, Auburn, AL; [2]USFWS Warm Springs Fish Technology Center, Warm Springs, GA; [3]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA. *STUDENT PRESENTATION*

Assays to assess glochidial viability are vital to studies examining a range of subjects such as ecotoxicology and host suitability. The salt test is currently the most common viability assay, but it has some drawbacks. It is not a sensitive predictor of glochidial health. If < 90% of glochidia in a brood close upon exposure to salt, viability cannot be reliably predicted. Furthermore, the salt test scores all glochidia that are initially closed as nonviable. This is particularly problematic for studies involving cryopreservation where cryoprotectants and/or the freezing process cause glochidia to close even if they are still viable. We evaluated the potential of a dual staining assay as an alternative to the salt test for assessing glochidia viability. Fluorescein diacetate (FDA) is a non-toxic dye that penetrates intact cell membranes and is hydrolyzed by intracellular esterases to produce fluorescein – a compound that fluoresces green, indicating intact cells. Propidium iodide can only penetrate damaged nuclear membranes, staining nucleic acids. Red fluorescence therefore indicates cells with damaged nuclear membranes. Laboratory experiments confirmed that 1) dead glochidia fluoresced red whereas live glochidia fluoresced green, and 2) the dye assay worked for glochidia that were initially closed. A dose-response assay using a reference toxicant showed that whereas "viability" as assessed by the salt test quickly declined to zero within the first three toxicant concentrations, "percent live" glochidia as assessed by the dye assay declined in a more gradual fashion, indicating 100% mortality only at the highest concentration. Use of the dye assay as a screening procedure showed that glycerol, dimethyl sulfoxide, ethylene glycol, and 1,2 propanediol caused heavy mortality and/or cellular damage to glochidia and were poor candidates for cryoprotectant studies. Methanol was less toxic and least likely to cause heavy mortality and/or cellular damage prior to freezing. kmm0024@tigermail.auburn.edu

Platform 40 **4:40 p.m.** **March 23, 2015**	**THE EFFECTS OF GLOCHIDIA INFECTION INTENSITY AND STRESS LEVELS ON THE METAMORPHIC SUCCESS OF *LAMPSILIS SILIQUOIDEA*.** Karel Douda[1], Michael Martin[2], Elizabeth Glidewell[2], Chris Barnhart[2]. [1]Department of Zoology and Fisheries, Czech University of Life Sciences Prague, CZ16521, Czech Republic; [2]Department of Biology, Missouri State University, Springfield, MO.

Increasing number of studies demonstrate the critical role of the host–parasite relationship for the persistence and distribution of unionid populations. Laboratory experimental methods are a powerful tool for quantifying the physiological compatibility between the mussel and the fish host and are clearly applicable to species conservation. Recent findings however indicate potential need for more thorough approaches to control for biases caused by overinfestation and increased stress levels during experimental procedures. In this study, we verified the robustness of freshwater mussel-fish compatibility testing against stress stimuli in laboratory experiments. Glochidia metamorphic success of *Lampsilis siliquoidea* on *Lepomis macrochirus* were quantified in a laboratory environment together with the Cortisol level quantification in host fish plasma. The main aims were to investigate the relationship between the levels of glochidia infection and the success of metamorphosis and to quantify the differences in the observed mussel-fish compatibility between traditional and stress-free infection approach. Our results indicate non-significant effect of glochidia bath density (1000-4000-8000 glochidia per litre) on transformation success of *Lampsilis siliquoidea* glochidia on *Lepomis macrochirus* and only weak differences between both approaches used for the infestation. Overall, standard host compatibility testing approaches likely represent relatively robust methods for the evaluation of host compatibility but more emphasis on laboratory settings may help to further improve infestation protocols for glochidia of freshwater mussels to provide more repeatable data. Implications for the strategies of host evaluation in laboratory experiments are discussed. k.douda@gmail.com

SESSION 9	**GENETICS & PHYLOGENY I** **Tuesday, March 24, 2015 | 8:00 a.m. – 10:00 a.m.** **Grand Ballroom A**
Platform 41 **8:00 a.m.** **March 24, 2015**	**NICHE DIFFERENTIATION IN EVOLUTIONARY LINEAGES OF A FRESHWATER MUSSEL SPECIES COMPLEX**. Ashley D. Walters[1], Kentaro Inoue[1], John L. Harris[2], & David J. Berg[3]. [1]Department of Biology, Miami University, Oxford, OH; [2]Department of Biological Sciences, Arkansas State University, State University, AR; [3]Department of Biology, Miami University, Hamilton, OH. *STUDENT PRESENTATION*

Obovaria jacksoniana and *Villosa arkansasensis* form a species complex in the lower Mississippi and Gulf Coast drainages of the US; this complex consists of five clades corresponding to river drainages, with high genetic divergence among clades. We constructed ecological niche models using Maxent with ENMTools, and created habitat suitability maps using abiotic parameters for the complex as a single species, for the two morphologically defined species, and for each of the five clades. We compared model fit among these taxonomic groupings. We then examined correlations among divergence time and niche overlap for pairs of clades using Mantel tests. Niche models for the five separate clades provided better fits than models that were based on a single species or two species, with AUC>0.75. The importance of abiotic parameters for predicting the fundamental niche varied by clade; however, soil data were the most important predictors of habitat suitability for most models. Results indicate that models for each clade were significantly different from one another; however, the clade inhabiting the White River, Arkansas had a niche that overlapped with the East Gulf clade and the Red River clade. We found a negative correlation between divergence time and niche overlap; thus, clades that diverged most recently occupied the most-similar niches. The most recent divergence was approximately 0.58 million years ago indicating that ecological speciation can occur on relatively short timescales. Recent speciation within this complex, likely due to geographic isolation, appears to have been accompanied by niche differentiation. Rather than two species, defined morphologically, this complex consists of five species that are distinguishable both genetically and ecologically. While providing insight into the process of speciation, our study also suggests that niche differentiation may be a useful measure for identifying taxonomic units of conservation interest. dunithad@miamioh.edu

Platform 42 **8:20 a.m.** **March 24, 2015**	**RAPID GENETIC BARCODE-BASED SPECIES IDENTIFICATION OF FRESHWATER MUSSEL GLOCHIDIA RECOVERED FROM NATURALLY-INFESTED FISH HOSTS.** Katherine D. Bockrath[1], Nathan A. Johnson[2], John P. Wares[1]. [1]Department of Genetics, University of Georgia, Athens, GA; [2]US Geological Survey, Southeast Ecological Science Center, Gainesville, Florida. *STUDENT PRESENTATION*

Freshwater mussels in North America are species rich and vastly diverse in morphology and habitat use. Because of this diversity, the ecosystem functions mussels provide (e.g.: water filtration, nutrient cycling) are likely to occur across freshwater systems. Due to habitat destruction, many mussel populations are in decline. In order to maintain current populations, glochidia must successfully recruit to replenish populations as well as establish new populations. Because mussels have an obligate parasitic larval stage, recruitment is dependent on host availability. Some mussel species have adapted methods of attracting fish hosts with lures and host use is best understood for these taxa. Conversely, there is little known about host use in mussel taxa that lack conspicuous lures. Recently, genetic data have provided insights into host use in mussel taxa that lack lures because genetic markers can be used to identify glochidia on fish hosts in nature. Unfortunately, the genetic markers used in these studies are found in both mussel and host and the risk of contamination from host tissue is high. An ideal genetic marker for would be unique to mussel genomes yet capable of distinguishing between mussel species. Here, we show that Female-specific Open Reading Frame (FORF) is an ideal genetic marker for mussel species identification and host use determination. The FORF database presented here is specific to mussel taxa in the Apalachicola River Basin (ACF), but could easily be extended to include other river drainages. Representatives of all extant mussel taxa were collected from the ACF and, using tissue samples, a FORF genetic barcode database was generated. Using glochidia recovered from naturally infested host fish, FORF was able to identify the mussel species. The implication for the use of this genetic marker is simple species identification of mussel larvae collected from host tissue without host contamination. katiebockrath@gmail.com

Platform 43 **8:40 a.m.** **March 24, 2015**	**IDENTIFICATION OF FRESHWATER MUSSEL COMMUNITY COMPOSITION USING ENVIRONMENTAL DNA AND NEXT-GENERATION SEQUENCING.** David M. Hayes. Department of Biological Sciences, Eastern Kentucky University, Richmond, KY.

In recent years, environmental DNA (eDNA) has rapidly gained attention as a potentially powerful tool for wildlife monitoring. Thus far, most studies utilizing eDNA for species monitoring have focused on single-species detection, however, with advances in next-generation sequencing (NGS) technology it is possible to simultaneously screen for an entire community in a water sample. Freshwater mussels (Bivalvia: Unionidae) are an ideal candidate for this type of monitoring because they can be difficult to detect through traditional means (particularly when they are in low abundance), and they likely produce large amounts of eDNA through their filtration activities. The objective of this study was to determine the feasibility of combining eDNA with NGS to detect and identify the species composition of a community of freshwater mussels from a water sample. Three liters of water was obtained from a mussel hatchery in Frankfort, KY, eDNA was extracted and amplified from the water sample using five mini-barcode primer sets developed in this study, and amplicons were sequenced using the Illumina MiSeq platform. Sequences were analyzed using QIIME and Galaxy and were identified using unionid sequences deposited in GenBank. While several positive species detections were identified, there were also a high number of false detections and a small number of species present in the hatchery were undetected. The results of this study are promising and suggest that detection of unionid communities using eDNA is possible, but it also highlights the fact that before these methods are implemented for monitoring purposes, there is a need for a more comprehensive database of unionid reference sequences, which will facilitate the design of improved mini-barcodes with more discriminatory power and will allow for more accurate identification of unionid eDNA sequences. David.Hayes@eku.edu

Platform 44 **9:00 a.m.** **March 24, 2015**	**THE TREE OF BROKEN DREAMS: A MOLECULAR ANALYSIS OF *ELLIPTIO*.** Raquel Fagundo[1], Michael Perkins[1], David Campbell[2], Andrew Mahon[3], Lynn Siefferman[1], Ken Halanych[4] and Michael Gangloff[1]. [1]Department of Biology, Appalachian State University, Boone, NC; [2]Department of Natural Sciences, Gardner-Webb University, Boiling Springs, NC; [3]Department of Biology, Central Michigan University, Mount Pleasant, MI; [4]Department of Biological Sciences, Auburn University, Auburn, AL. *STUDENT PRESENTATION*

The freshwater mussel genus *Elliptio* is currently believed to be the most diverse and widespread in North America. However, *Elliptio* is also known for its remarkable phenotypic plasticity. Numerous recent attempts at resolving species boundaries in this group using conventional molecular markers have revealed that species boundaries in this group are unclear and that genetic introgression among seemingly morphologically distinct taxa is widespread. We conducted an extensive meta-analysis of the 910 published cytochrome oxidase subunit I (COI) gene fragments as well as new sequences from our own recent collections. We obtained data from 25 of the 36 currently-recognized *Elliptio* taxa occurring in Gulf and Southeast Atlantic Slope drainages. We calculated genetic distance estimations, generated haplotype networks, and reconstructed phylogenetic relationships using maximum likelihood and Bayesian algorithms. Phylogenetic analyses suggest that *Elliptio* is paraphyletic and taxa currently included in *Elliptio* comprise at least 5 evolutionarily distinct lineages. Additionally, extensive haplotype introgression was observed among putative species with extensive introgression observed among Coastal Plain populations. These data strongly suggest a molecular based re-evaluation of this group is urgently needed in order to quantify genetic species boundaries and understand the role of physiographic variability and gene expression in shaping shell morphology. fagundora@email.appstate.edu

Platform 45 **9:20 a.m.** **March 24, 2015**	**PHYLOGEOGRAPHY AND GENETIC STRUCTURE OF TWO FRESHWATER MUSSEL SPECIES (BIVALVIA: UNIONIDAE) ALONG HYPOTHESIZED POST-GLACIAL DISPERSAL ROUTES INTO THE GREAT LAKES.** Trevor L. Hewitt and David T. Zanatta. Department of Biology, Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI. *STUDENT PRESENTATION*

Freshwater mussels (Bivalvia: Unionidae) are among the most endangered animals in North America. Understanding the genetic diversity of imperiled species across a large spatial scale is necessary for developing appropriate conservation strategies. Genetic data is important for investigating population connectivity, uniqueness (Evolutionarily Significant Units), and testing biogeographic hypotheses regarding post-glacial colonization. Mitochondrial sequences and microsatellite loci were used to analyze the population genetics of two common and widespread unionid species (*Lampsilis cardium* and *Lasmigona costata*) from the Great Lakes and the historically connected Wabash, Illinois, and Wisconsin river drainages; which may have acted as conduits for mussels from refugia south of the Pleistocene glacial maximum. Approximately 30 individuals of each species were collected from two separate sampling locations per watershed and a mantle clip was removed for genetic analysis. Using standard methods, a fragment of the mitochondrial gene CO1 was sequenced and a suite of microsatellite loci (6 for *Lam. cardium* and 8 for *Las. costata*) were genotyped. Mitochondrial DNA sequences resulted in 26 haplotypes for *Lam. cardium* and 18 haplotypes for *Las. costata*. Ten of the putative *L. cardium* haplotypes found in the Maumee (Great Lakes) and Wabash (Ohio River) drainages were revealed to be more similar to *Lampsilis ovata* sequences available on GenBank rather than *Lam. cardium*. *Lampsilis cardium* and *Lam. ovata* may be interbreeding in the drainage where they co-occur; analysis of microsatellite DNA genotypes may help to reveal if this is the case. Analyses of phylogeographic and population genetic data are ongoing. This study will provide greater understanding of large-scale genetic variation and structure linked to the complex redistribution of mussels into new habitats following the dramatic climactic shift at the end of the Pleistocene. trevorlhewitt825@gmail.com

Platform 46 **9:40 a.m.** **March 24, 2015**	**PHYLOGENY OF THE CRITICALLY ENDANGERED NORTH AMERICAN SPINYMUSSELS (UNIONIDAE: *ELLIPTIO* AND *PLEUROBEMA*).** Michael A. Perkins and Michael M. Gangloff. Biology Department, Appalachian State University, Boone, NC. *STUDENT PRESENTATION*

Despite being common in numerous marine bivalve lineages, lateral spines are rare among freshwater bivalves. The North American freshwater mussel fauna includes three taxa that commonly exhibit spines: *Elliptio spinosa, Elliptio steinstansana,* and *Pleurobema collina*. All three taxa are endemic to the Southeastern US, critically endangered, and protected by the US Endangered Species Act. Currently, these species are recognized in two genera and the group is a source of considerable taxonomic confusion within the unionid tribe Pleurobemini (*Elliptio* and *Pleurobema*). Because freshwater mussels exhibit phenotypically plastic shell morphology, morphologically-based diagnoses are often problematic. We sequenced two mtDNA gene fragments (*ND1* and *COI*) and a fragment of the nuclear *ITS-1* locus from >70 specimens using standard Sanger techniques. Bayesian phylogenetic reconstructions suggest that the spinymussels do not comprise a monophyletic group. *Elliptio steinstansana* is sister to *P. collina* and these taxa form a monophyletic clade that appears to have diverged from its nearest ancestor (possibly an ancestral *Elliptio* or *Pleurobema* lineage) in the late Miocene, ~6 mya. Additionally, *E. spinosa* forms a monophyletic clade that diverged from members of the core *Elliptio* lineage in the mid Pliocene, >1.5 million years before multiple radiations within the *Elliptio* clade. Furthermore, *E. spinosa* is highly divergent from the other spinymussels, suggesting that spines, while extremely rare in freshwater mussels worldwide, have evolved separately in two distinct bivalve lineages endemic to this region. These findings suggest a need to revise the taxonomy of this highly imperiled mussel group. perkinsma@email.appstate.edu

SESSION 10	**CONSERVATION I** **Tuesday, March 24, 2015 | 8:00 a.m. – 10:00 a.m.** **Grand Ballroom B**
Platform 47 **8:00 a.m.** **March 24, 2015**	**WORKING TOWARDS A LARGE-SCALE ASSESSMENT OF MOLLUSKS: IMPROVING CONSERVATION OF FRESHWATER SNAILS AND MUSSELS NATIONALLY.** Wesley M. Daniel[1], Kay McGraw[2], Dana M. Infante[1], Gary Whelan[3]. [1]Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48823; [2]NOAA Restoration Center, Silver Spring, MD 20910; [3]Michigan Department of Natural Resources, Lansing, MI 48909

Diversity of freshwater snail and unionid mussels is higher in the United States than in most other countries across the globe, yet mollusks have been assessed as one of the most endangered taxonomic groupings in the country. Similar to freshwater fishes, threats to mollusks include habitat loss and/or alteration, invasive species, anthropogenic watershed and riparian development, overharvest, water pollution, and loss of connectivity between populations. However, unlike mobile fish species, mollusks may be particularly susceptible to threats because of poor dispersal capabilities, complex life cycles and/or relatively long life cycles. Together, these facts underscore the importance of a national effort that will aid in conserving mollusks into the future. The National Fish Habitat Partnership (NFHP) may be one opportunity to help meet that need. Initially established in 2004, NFHP has funded 341 conservation projects in 46 states to improve fish habitats nationally. Further, NFHP has supported a national assessment of fish habitat completed in 2010 with an update to be released in fall 2015 that identifies both threats to stream fishes and conservation opportunities. Currently, NFHP has supported the development of the most comprehensive database characterizing condition of and threats to stream fish habitat nationally, and many of these data are publically available at http://ecosystems.usgs.gov/fishhabitat/. Using these environmental data along with a large-scale and potentially multi-regional representation of mollusk diversity would support an assessment of freshwater mussel habitats and would identify threats to those habitats. We propose development of a large-scale, integrated database characterizing current mollusk distributions nationally, an effort that can only be possible by coordination and cooperation among state and federal agencies, scientists, and environmental organizations. America's natural resource heritage includes both freshwater fishes and mollusks, and a large-scale assessment of mollusks would improve opportunities to conserve freshwater habitats and the mollusks that inhabit them. danielwe@msu.edu

Platform 48 **8:20 a.m.** **March 24, 2015**	**BIOTIC AND ABIOTIC INFLUENCES ON THE OCCURRENCE AND DETECTION OF FRESHWATER MUSSELS AT MULTIPLE SCALES**. Tamara J. Pandolfo[1], Thomas J. Kwak[2], W. Gregory Cope[3], Ryan J. Heise[4], Rob B. Nichols[5], and Krishna Pacifici[3]. [1]North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University Raleigh, NC; [2]U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC; [3]Department of Applied Ecology, North Carolina State University, Raleigh, NC; [4]North Carolina Wildlife Resources Commission, Creedmoor, NC; [5]North Carolina Wildlife Resources Commission, Raleigh, NC. *STUDENT PRESENTATION*

Relevant ecological information is urgently needed to guide freshwater mussel management and conservation in the face of global change. However, the imperiled status and cryptic nature of these animals complicate research efforts. We adopted a modeling approach that incorporates detection probability and enhances inference on rare species by borrowing data among species in a hierarchical framework to conduct the most comprehensive occupancy analysis for freshwater mussels to date. Within this framework, we examined effects of biotic and abiotic factors at multiple spatial scales on the occurrence of 14 mussel species and the entire assemblage of the Tar River basin of North Carolina. The single assemblage estimate of detection probability for all species was 0.42 (95% CI, 0.36 –0.47) with no species- or site-specific detection effects identified. Mean occupancy probability among species ranged from 0.04 (95% CI, 0.01 – 0.16) for *Alasmidonta undulata,* an undescribed *Lampsilis* sp.*,* and *Strophitus undulatus* to 0.67 (95% CI, 0.42 – 0.86) for *Elliptio icterina*. Median occupancy probability among sites was < 0.30 for all species with the exception of *E. icterina*, and the maximum predicted occupancy probabilities for 71% of the species did not exceed 0.50. Site occupancy probability generally related to mussel conservation status, with reduced occupancy for endangered and threatened species. Catchment scale abiotic variables (stream power, agricultural land use) and species traits (brood time, host specificity, tribe) influenced the occupancy of mussel assemblages more than reach- or microhabitat-scale features. We empirically observed 15 mussel species in the basin, but estimated total species richness at 20 (95% CI, 16-24) when accounting for imperfect detection. Our findings reflect the complexity of mussel biology and ecology and indicate that habitat restoration alone may not be adequate for mussel conservation. tjpandol@ncsu.edu

Platform 49 **8:40 a.m.** **March 24, 2015**	**USING OCCUPANCY APPROACHES TO MONITOR RARE FRESHWATER MUSSELS IN VIRGINIA AND TENNESSEE.** Brett J. K. Ostby[1], Tim W. Lane[2], Shane Hanlon[3], Megan Bradley[4], Braven B. Beaty[1]. [1]Daguna Consulting LLC, Rochester, MN; [2]Virginia Tech, Department of Fish and Wildlife Conservation, Blacksburg, VA; [3]U. S. Fish and Wildlife Service, Southwestern Virginia Field Office, Abingdon, VA; [4]Virginia Department of Game and Inland Fisheries, Marion, VA.

We review recent and ongoing studies that employed occupancy modeling approaches to establish baseline data for monitoring federally and state-listed mussels. These studies used spatial and temporal replication in different ways to derived occupancy (ψ) and detection (p) estimates. We estimated the federally endangered James spinymussel (*Pleurobema collina*) occupied 63% of the 30 reaches surveyed in the Rivanna River watershed (Virginia) during 2011 and 2012 (ψ=0.63, ±0.14 SE). More intensive qualitative and quantitative follow-up surveys that did not employ occupancy approaches, largely failed to detect this species. Nevertheless, anecdotal observations confirmed *P. collina* persists and recruited since 2012. The federally endangered purple bean (*Villosa perpurpurea*) occupied Beech Creek (Tennessee) at ψ=0.65 (±0.10 SE) in 2012 and had seasonally variable detection rates; this derived occupancy estimate contradicted a narrative of a declining population that was based on visits to established monitoring sites. These studies suggest spatial and temporal population dynamics of both species render traditional qualitative and quantitative methods ineffective. Furthermore, they suggest traditional methods can be potentially misleading monitoring tools. In both cases, occupancy approaches provided a more appropriate, cost-effective alternative. In an ongoing study, we are using historical Virginia survey records to estimate occupancy rates for several state-listed species by stream reach and decade. We demonstrate how these historical occupancy rates could provide a baseline for monitoring and empirical targets for management decisions. ptychobranchus@gmail.com

Platform 50 9:00 a.m. March 24, 2015	**IDENTIFICATION OF IMPACT AVOIDANCE AREAS FOR AQUATIC SYSTEMS IN THE APPALACHIAN LCC.** Braven Beaty and Freshwater Team, The Nature Conservancy Central Appalachian Whole System. The Nature Conservancy, Clinch Valley Program, 146 East Main St., Abingdon, VA.

The Appalachian region supports a high concentration of freshwater species, including over 200 endemic species of mollusk, fish and crayfish (Abell et al., 2000). The Ohio and Tennessee/Cumberland river systems within the Appalachian LCC area have been identified as Globally Outstanding and 2 of the 6 most important freshwater ecosystems for conservation in North America (Abell et al., 2000). Given the historic and current energy and human development pressures on this landscape, a regional scale analysis of priority reaches to shelter from negative impacts is necessary for effective application of the mitigation hierarchy. The Nature Conservancy (TNC) is conducting such an analysis using landscape characteristics, biodiversity conservation significance, and resilience of aquatic systems at the scales of 8-digit and 12-digit Hydrologic Unit Classification (HUC) areas. Initial assessments are based on the existing set of priority stream segments identified in TNC ecoregional plans, which select streams supporting critical aquatic communities for conservation within each ecoregion. The current level of impervious cover (IC), calculated from the 2011 National Land Cover Dataset (USGS MRLC) and adjusted for areas impacted by coal mining and gas development, serves as a surrogate for human impact within each watershed. In addition, the level of impact near stream corridors is assessed to determine watersheds that have a low overall level of impact but significant impacts directly interacting with streams. Out of 3403 total HUC-12's in priority watersheds, 65.6% have less than 1% IC, 16.4% between 1 and 2%, 14.4% between 2 and 8%, 3.5% over 8% IC. This is very similar to the 66.5%, 16.8%, 13.5%, 3.1%, respectively, for all HUC's in the analysis area including non-priority watersheds. However, the IC adjacent to priority streams is 54.7%, 18.7%, 21.7%, and 4.8%, respectively, suggesting higher IC levels near streams. bbeaty@tnc.org

Platform 51 9:20 a.m. March 24, 2015	**LINKS BETWEEN LANDUSE, STREAM PHYSICOCHEMICAL PARAMETERS AND APPALACHIAN ELKTOE (*ALASMIDONTA RAVENELIANA*) POPULATIONS IN WESTERN NORTH CAROLINA.** Gary S. Pandolfi and Michael M. Gangloff. Biology Department, Appalachian State University, Boone, NC. *STUDENT PRESENTATION*

Alasmidonta raveneliana is endemic to the upper Tennessee River Drainage streams draining the Blue Ridge Physiographic Province in North Carolina and Tennessee. Recently, *A. raveneliana* populations in some Western North Carolina streams have undergone dramatic, yet enigmatic, declines and few parsimonious mechanisms have been proposed to explain the near complete extirpation of this already rare mussel from its key strongholds in high-quality streams. Historic water quality data were used to examine temporal changes in temperature, pH, dissolved oxygen, specific conductance and nitrates over the last ~40 years for 10 streams supporting the most robust *A. raveneliana* populations (Cane, Little Tennessee, Nolichucky, North Toe, West Fork Pigeon, South Toe, Tuckasegee, Rivers). In 2 of 8 streams that have seen recent *A. raveneliana* declines, the Little Tennessee and the North Toe River, we observed significant increases in summer and early spring temperatures. These trends were generally absent from streams with stable *A. raveneliana* populations, although the Tuckasegee River where the largest known *A. raveneliana* population currently resides, exhibited significant warming in 6 of 12 months across a 35+ year time span, possibly foretelling the eventual collapse of this population. We examined changes in land use over the past 20+ years in focal watersheds and found that more forested watersheds exhibited less dramatic increases water temperature at the decadal and monthly scales. On-going analyses will examine links between changing habitat conditions and *A. raveneliana* shell growth rates. These patterns suggest that landuse, rather than climate change may be driving elktoe declines. We speculate that exurban development is a primary threat to Appalachian elktoe populations but other factors including dams and dam operations may impact or mediate elktoe persistence in some streams. Moreover, highly forested watersheds like the South Toe River will be key refuges for this temperature-sensitive and highly endangered mussel.
pandolfigs@email.appstate.edu

Platform 52 **9:40 a.m.** **March 24, 2015**	**DEMOLITION OF WEST MILTON DAM AND THE INFLUENCE OF FRESHWATER MUSSELS ON DESIGN AND IMPLEMENTATION.** W. Cody Fleece[1], E. Bocksiegel[1], J.D. Kiser[2], T. White[3], and J. Scheibly[1]. [1]Stantec Consulting, 11687 Lebanon Road, Cincinnati, Ohio; [2]Stantec Consulting, 10509 Timberwood Circle Suite 100, Louisville, Kentucky; [3]Stantec Consulting, 1500 Lake Shore Drive Suite 100, Columbus, Ohio.

Demolition of West Milton dam on the Stillwater River in Miami County, Ohio began on October 27, 2014. Prior to demolition activities, pre-project surveys determined that the Federally Endangered snuffbox (*Epioblasma triquetra*) was present in the project area necessitating formal consultation with the U.S. Fish and Wildlife Service. Potential direct effects included crushing of mussels present within the construction footprint, stranding or entrapment of mussels associated with the rapid lowering of the dam pool, and channel adjustments that may dislodge mussels as the bed adjusts to new hydraulic conditions. Mussels were cleared from construction areas using standard techniques. We incorporated data from two dimensional hydrodynamic models in the demolition design to control the spatial extent of search areas and limit emersion times for stranded mussels. Nearly 3,000 mussels comprised of 14 species where rescued and relocated to an upstream area outside of the influence of the project. Fourteen live snuffbox were rescued from the former dam pool. Mussel assemblages differed markedly as a function of longitudinal position relative to the dam. Channel adjustment and sediment export from the former impoundment were controlled through the use of constructed riffles. Riffle dimensions were adjusted in the field to replicate the characteristics of an upstream relocation site with a known snuffbox population. Cody.Fleece@stantec.com

SESSION 11	**GENETICS & PHYLOGENY II** **Tuesday, March 24, 2015 | 10:20 a.m. – 12:00 p.m.** **Grand Ballroom A**
Platform 53 **10:20 a.m.** **March 24, 2015**	**USING GENETIC STRUCTURE OF A COMMON FRESHWATER MUSSEL SPECIES (*LEPTODEA FRAGILIS*) TO EXAMINE THE IMPACT OF HOST FISH DISPERSAL ON AN ENDANGERED MUSSEL SPECIES (*LEPTODEA LEPTODON*).** Jer Pin Chong and Kevin J. Roe. Department of Natural Resource Ecology and Management, Iowa State University, Ames, IA. *STUDENT PRESENTATION*

Most freshwater mussels are obligate parasites on fishes. Because mussels are infaunal and largely sessile, it is reasonable to assume that the majority of gene flow between mussel populations relies on the dispersal of glochidia by host fishes. If a mussel species only infests a single species of host fish, the genetic structure of the mussel populations should be congruent with the genetic structure of the host fish. I examined the correlation between the genetic structure of two closely related species, *Leptodea leptodon* and its sister species *Leptodea fragilis* with their sole host fish, freshwater drum *Aplodinotus grunniens. Leptodea leptodon* is a federally endangered species while *L. fragilis* is common and widely distributed. It is of conservation interest to uncover the mechanisms allowing one species to be widely distributed while the other is endangered, when these closely related species share their lifecycle with the same host fish. We non-destructively collected and genotyped about 110 samples for all three species from the Gasconade, Meramec and Bourbeuse rivers in Missouri. All three species were collected from the same sampling sites in each river to ensure that these populations are affected under similar environmental conditions. The F_{ST} results indicate that the genetic structure of all three species are consistent with high levels of gene flow and are thus congruent. Estimated gene flow (N_m) among fish populations is 10x higher than either mussel species. Despite its imperiled status, *L. leptodon* shows similar levels of gene flow as *L. fragilis*. These results imply that host dispersal of *A. grunniens* has similar effects on maintaining the connectivity between mussel populations, and gene flow among imperiled *L. leptodon* populations is not as limited as previously assumed. This finding also indicates that the rarity of *L. leptodon* is perhaps due to habitat specificity rather than limited host dispersal. jchong@iastate.edu

Platform 54 **10:40 a.m.** **March 24, 2015**	**MOLECULAR PHYLOGENETIC EVALUATION OF EXTANT POPULATIONS OF ENDANGERED *VILLOSA PERPURPUREA* (LEA 1861) AND *VILLOSA TRABALIS* (CONRAD 1834).** Tim W. Lane[1], Eric M. Hallerman[1], Jess W. Jones[2]. [1]Department of Fish and Wildlife Conservation, Virginia Tech University, Blacksburg, VA; [2]United States Fish and Wildlife Service, Department of Fish and Wildlife Conservation, Virginia Tech University, Blacksburg, VA.

Conflicting reports on the taxonomy, historical distribution, and connectivity of two federally endangered taxa, *Villosa perpurpurea* (Lea 1861) and *Villosa trabalis* (Conrad 1834), have hindered biologists from making informed decisions that could increase the likelihood for each species' recovery. For over 100 years, the purple nacre of "purple bean" and white nacre of "Cumberland bean" have been the only defining phenotypic characteristics used to distinguish each species. Genetic samples were collected non-lethally from 140 individuals at 10 sites across Virginia, Tennessee and Kentucky. A 784-bp fragment of the mitochondrial DNA *ND1* region was amplified and sequenced to provide molecular inference on the taxonomic validity and phylogeography of these putative taxa. Results from our phylogenetic analyses showed a clear division between two distinct clades (~4% divergence), one occurring in the Cumberland River basin and the other occurring in the Tennessee River basin. In contrast, mean genetic distance of haplotypes within each clade was <1%, indicating that historically, populations within each clade were inter-connected by substantial gene flow within their respective drainages. In individuals collected from the Cumberland River basin, nacre color of shells was entirely white, but in the Tennessee River basin, it graded from white to pink to dark purple throughout all collected samples, indicating that color was an inconsistent character across the species' range and led to the taxonomic confusion. Our data suggest that these morphologically similar species have been isolated in each basin for a long period of time and thus have experienced allopatric speciation. Mantle-lure displays and shell characteristics between individuals in the basins will be compared. This additional data could provide even more justification to differentiate the taxa. In addition, 12 microsatellite DNA loci have been developed and are being screened in order to infer more recent population-level connectivity. twln@vt.edu

Platform 55 **11:00 a.m.** **March 24, 2015**	**DNA BARCODING REVEALS A CRYPTIC NEW GENUS OF ZEBRA MUSSELS (MOLLUSCA: BIVALVIA: DREISSENIDAE) IN SOUTH AMERICA.** Michael Gangloff[1], Michael Perkins[1], Susan Geda[1], Erin Abernethy[1,2], Nathan Lujan[3], Mark Sabaj Pérez[4], Maria Cristina Dreher Mansur[5], and Lynn Siefferman[1]. [1]Biology Department, Appalachian State University, Boone, NC USA; [2]Department of Ecology, University of Georgia, Athens, GA USA; [3]Royal Ontario Museum, Ontario, Canada; [4]Academy of Natural Sciences, Philadelphia, PA USA; [5]Univeridade Federal do Rio Grande do Sul, Porto Alegre, Brasil.

The freshwater bivalve family Dreissenidae includes 3 genera; the highly-invasive *Dreissena* and *Mytilopsis* and the troglobitic *Congeria*. *Dreissena* and *Mytilopsis* readily colonize freshwater and estuarine ecosystems and have resulted in substantial economic costs worldwide. In 2003, we discovered specimens of an unknown dreissenid inhabiting rapids in the upper Rio Ventuari in Venezuela. Additional material from a similar-appearing taxon from the Rio Xingu (Brazil) rapids was discovered in 2012. We used a molecular bar-coding approach and sequenced a portion of the mtDNA COI gene to verify the identity of this taxon and assess the likelihood that these populations represent introduced taxa or alternatively an un-described taxon. Phylogenetic reconstructions and genetic distance estimates indicate that specimens from both rivers are not closely related to any known freshwater bivalve genera and likely represent a new dreissenid genus. Our data indicate that at least two species occur in South American rivers but that number is likely higher. As development of South America's rivers continues, it is increasingly likely that this group may become translocated. This is worrisome because other dreissenid genera (*Dreissena* and *Mytilopsis*) are invasive and have colonized freshwater lake and estuarine systems (respectively) on every continent except Antarctica with substantial ecological and economic costs. We speculate that this taxon may be an emerging invasion threat and may have the potential to invade lotic systems on a global scale. Currently, we have very little information about this group's ecological tolerances illustrating a need for more focused studies of these cryptic dreissenids. gangloffmm@appstate.edu

Platform 56 **11:20 a.m.** **March 24, 2015**	**PLEUROCERID POPULATION STRUCTURE ASSESSED WITH ISSRS**. Bethany L. McGregor[1] and Russell L. Minton[2]. [1]School of Science, University of Louisiana at Monroe, Monroe, LA; [2]Division of Natural Sciences, School of Science and Computer Engineering, University of Houston Clear Lake, Houston, TX.

Inter-simple sequence repeats (ISSRs) represent a useful, cost-effective means of assessing genetic population structure across plant and animal taxa. ISSRs are generated by amplifying regions between microsatellites, scoring the fragments as present or absent, and analyzing the resulting binary matrix. We aimed to explore genetic structure in pleurocerids at three levels: within a population and between populations of a single species; and between populations of two unrelated species. We collected 50 snails each from four populations of *Elimia potoisiensis*, along with 50 snails from a single population of *Pleurocera canaliculatum*, and generated ISSRs using four different primers. The binary matrix of 250 snails and 125 markers was analyzed in both GenAlEx and STRUCTURE. An analysis of molecular variance (AMOVA) indicated that while most of the variation was seen within populations (~75%), there were significant genetic differences between populations of *E. potosiensis* and between *E. potosiensis* and *P. canaliculatum*. A STRUCTURE analysis clearly separated each population of snails, and placed *E. potosiensis* into two geographic groups. Our results support the utility of ISSRs as population markers in freshwater snails, and planned future implementations of the method will be discussed. Minton@UHCL.edu

Platform 57 **11:40 a.m.** **March 24, 2015**	**DRAFT GENOME ASSEMBLY *LEPTOXIS AMPLA* (GASTROPODA: PLEUROCERIDAE): A RESOURCE FOR CONSERVATION STUDIES**. Nathan V. Whelan[1], Paul D. Johnson[2], Ellen E. Strong[3]. [1]Department of Biological Sciences, Auburn University, Auburn, AL; [2]Alabama Aquatic Biodiversity Center, Alabama Department of Conservation and Natural Resources, 2200 Highway 175, Marion, AL; [3]Department of Invertebrate Biology, National Museum of Natural History, Smithsonian Institution, Washington, DC.

Pleuroceridae is one of the most imperiled families of freshwater gastropods in North America. However, taxonomic uncertainties hinder conservation efforts because boundaries of species and genera are generally not well defined. Furthermore, studies on pleurocerid gene flow and population connectivity would enhance management plans. Thus far, efforts to revise pleurocerid systematics have relied heavily on mitochondrial markers that have proven insufficient for resolving species boundaries, and no study has assessed population connectivity. A whole pleurocerid genome sequence would bring systematic and management efforts into the genomic era and provide considerable resources for future studies. To this end, we extracted whole genomic DNA from two individuals of the federally threatened *Leptoxis ampla* for whole genome sequencing on the Illumina HiSeq platform. Three Illumina libraries were sequenced on a single HiSeq lane each: 1) a small insert paired-end library (180bp) 2) a larger insert paired-end library (400bp) 3) a large inset mate-pair library (4000bp). *De novo* assembly was performed with SOAPdenovo2 and Velvet. The draft assembly of the *Leptoxis* genome will be made publically available. Potential conservation applications for this resource include development of microsatellite markers, SNP mapping for conservation genetic studies, and nuclear marker selection for phylogenetics at the species-level and above. Given the current conservation status of the Pleuroceridae, successful resolution of species and generic boundaries arguably ranks as one of the most critical conservation targets among freshwater mollusks. By bringing pleurocerids into the genomic era, the application of these cutting-edge tools will help to resolve these long-standing issues and will be an invaluable resource for conservation of this critically imperiled family. nathan.whelan@gmail.com

SESSION 12	THREATS Tuesday, March 24, 2015 | 10:20 a.m. – 12:00 p.m. Grand Ballroom B
Platform 58 10:20 a.m. March 24, 2015	**PREDICTING THE EFFECT OF CLIMATE CHANGE ON POPULATION CONNECTIVITY AND GENETIC DIVERSITY IN RIVERINE SYSTEMS: A CASE STUDY OF *CUMBERLANDIA MONODONTA* (BIVALVIA: MARGARITIFERIDAE).** Kentaro Inoue[1] and David J. Berg[2]. [1]Department of Biology, Miami University, Oxford, OH, [2]Department of Biology, Miami University, Hamilton, OH. *STUDENT PRESENTATION*
Rapid changes in global climate regimes impact ecological processes in terrestrial and aquatic ecosystems. Organisms often respond to temperature change by shifting their ranges poleward or to higher altitudes. However, the direction of range shifts in riverine systems is less clear. Because rivers are dendritic networks, there is only one dispersal route from any given location to another. Thus, range shifts are only possible if branches are connected by suitable habitat, and stream-dwelling organisms can disperse through these branches. *Cumberlandia monodonta* is a useful species for investigating the effects of climate change on population connectivity because a majority of contemporary populations are panmictic. We used mtDNA and microsatellite markers, along with ecological niche models (ENMs), to investigate the effects of climate change on population connectivity and genetic diversity of *C. monodonta*. The ENMs were constructed using bioclimatic and landscape data to project shifts in suitable habitat under future climate scenarios. We then used a time-forward genetic simulation to project potential changes in genetic diversity and population connectivity based on these range shifts. ENM results under current conditions indicated highly suitable habitat across rivers where *C. monodonta* is known to be abundant; populations in the upper Mississippi River remain connected by suitable habitat, likely supporting panmixia. Future climate scenarios projected northward and headwater-ward range shifts and drastic declines in suitable habitat for most extant populations throughout the Mississippi River Basin. Genetic simulations indicated that climate change would greatly reduce genetic diversity and connectivity across populations. Results suggest that a single, large population of *C. monodonta* will become fragmented into several smaller populations, each of which is isolated from remaining populations. *Cumberlandia monodonta* is a widely distributed mussel species and thus is a good model for examining the persistence and connectivity of stream-dwelling organisms in response to future climate change. inouek@miamioh.edu	
Platform 59 10:40 a.m. March 24, 2015	**ASSEMBLAGE RESPONSE OF FRESHWATER MUSSELS TO LOW-HEAD DAMS AND LOW-HEAD DAM REMOVALS IN MICHIGAN, USA.** Shaughn Barnett and Daelyn Woolnough. Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mt. Pleasant, MI, 48859. *STUDENT PRESENTATION*
Large-scale modifications of rivers in the United States have drastically impacted the richest areas for freshwater mussels. While many studies have focused on the effects of larger controlled dams in the eastern United States, smaller dams such as low-head dams have begun to receive increased attention. In addition, dam removals nationwide have targeted low-head dams, yet the impacts of dam removals on freshwater mussels are largely understudied. Dam removal is widely considered beneficial for aquatic organisms, however <10% of removals have had any follow up studies. As well, studies suggest that low-head dams are not as detrimental to freshwater mussels as other dam types, and may provide downstream habitat which is conducive to high mussel diversity. The purpose of this study was to determine the downstream impacts of low-head dams and low-head dam removals on assemblages of freshwater mussels. A quantitative survey was conducted at ten sites in the Lake Michigan watershed during the summer of 2014 (i.e., 3 uncontrolled low-head dam sites, 2 controlled low-head dam sites, and 5 low-head dam removal sites). Our results indicate that there is not a distinct change in mussel diversity along a longitudinal gradient for all dam and removal sites. In addition, we did not find a difference in mussel diversity between our low-head dam and low-head dam removal sites. However, when we separated our sites into controlled dams, uncontrolled dams, and dam removals, we found significant differences for all diversity indices (Kruskal-Wallis; $p < 0.05$). Uncontrolled low-head dams had higher species richness and evenness than controlled low-head dams and removals. Due to the variation in the 2014 results we plan to sample 5 additional sites during the summer of 2015. These data are valuable for management decisions about dam removals in the Great Lakes region. barne1se@cmich.edu	
Platform 60 11:00 a.m. March 24, 2015	**A COMPARISON OF FILTER FEEDING AND DEPOSIT FEEDING IN THE INVASIVE ASIAN CLAM, *CORBICULA FLUMINEA*, AND THE FATMUCKET, *LAMPSILIS SILIQUOIDEA*.** Caitlin Wilhelm and Chris Barnhart. Department of Biology, Missouri State University, Springfield, MO. *STUDENT PRESENTATION*

Corbicula fluminea is a highly successful invasive species and has been suspected of negative impacts on native bivalves. Previous research indicates that *C. fluminea*'s success is at least partly related to the ability to feed on deposited particles in addition to suspension-feeding from the water column. The purpose of our study is to quantify and compare deposit and suspension-feeding behavior between *C. fluminea* and juvenile native fatmucket, *Lampsilis siliquoidea,* of similar body size (0.2-1 gram total body mass). We used 5-micron fluorescent polystyrene beads as markers for feeding in sediments and water column in 70-ml static systems. Sediment was composed of two sizes of glass beads (~0.2 & ~2 mm, 2:1 W:W respectively) and had measured pore space of 32%. Water contained algae to promote feeding and beads of different color to label the substrate interstitial water and the water column. Both species were tested simultaneously in pairs placed with ventral side down on the substrate. After 60 minutes, individuals were rinsed and isolated with water and food. 5 hours later feces were collected, resuspended, and measured using a fluorescence plate reader. Feeding from water column and sediment was quantified using relative fluorescence emitted by beads in the feces. 60 individuals of each species were tested, and 70/120 individuals produced labeled feces. Similar total fluorescence was recovered from both species, indicating similar feeding rates. Both labels were present in 60/70 labeled samples. The ratio of labels varied widely among individuals but was similar between the two species. The mean inferred proportion of feeding from the substrate was 57±SD30% for *Corbicula* and 51±SD29% for fatmucket. The results suggest that both species fed from both water column and interstitial water. Further experiments will test whether these bivalves shift their feeding in response to different food concentrations in the two compartments. Wilhelm211@live.missouristate.edu

Platform 61 **11:20 a.m.** **March 24, 2015**	**ZEBRA MUSSEL DISTRIBUTION: TRACKING AN INVASION IN THE MARAIS DES CYGNES RIVER, KANSAS.** Judith S. Bilyea[1], David R. Edds[1], Scott S. Crupper[1], Jason M. Goeckler[2]. [1]Department of Biological Sciences, Emporia State University, Emporia, Kansas; [2]Kansas Department of Wildlife, Parks and Tourism, Box 1525, Emporia, Kansas. *STUDENT PRESENTATION*

Zebra mussels (*Dreissena polymorpha*) are native to lentic environments of the Black and Caspian seas. We sought to determine patterns of distribution of these invasive mussels in the Marais des Cygnes River, Kansas, and which of four common detection methods was most effective. In 2013-2014, we compared visual inspection, monitoring of settlement structures, cross-polarized light microscopy, and environmental DNA detection by means of PCR to find which was the best detection method in a lotic environment. We also sampled at different site types (flowing vs. inundated) to determine which provided a higher likelihood of zebra mussel detection. Zebra mussels were more likely to be found in areas of inundated water via visual inspection and cross-polarized light microscopy. jbilyea@g.emporia.edu

Platform 62 **11:40 a.m.** **March 24, 2015**	**ASSESSING THE EFFECTS OF WASTEWATER TREATMENT PLANT EFFLUENTS ON FRESHWATER MUSSELS.** Serena Ciparis[1], Susan Lingenfelser[2], and Luke Iwanowicz[3]. [1]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [2]U.S. Fish and Wildlife Service Virginia Field Office, Gloucester, VA; [3]U.S. Geological Survey Leetown Science Center, Kearneysville, WV.

Effluents produced by municipal wastewater treatment plants (WWTPs) contain mixtures of compounds that can affect the physiology of aquatic organisms. Freshwater mussels may be particularly sensitive to these mixtures due to their sessile nature and filter-feeding activities. The purpose of this study was to assess the effects of WWTP effluents and land use in surrounding watersheds on in-stream contaminant concentrations and freshwater mussel physiology. Juvenile mussels (*Lampsilis fasciola*) were deployed upstream and downstream of six WWTPs in the Clinch-Powell watershed, Virginia, USA, for eight weeks during low-flow conditions (August-October 2013). The WWTPs were located in drainages with different nonpoint sources of pollution, including agriculture (3 sites) and mining (3 sites). During the deployment, major ion and nutrient concentrations were measured in water samples and organic and inorganic contaminant concentrations were measured in sediment. At the end of the deployment, mussel tissues were analyzed for activities of enzymes involved in ion regulation, detoxification, and the antioxidant system and for concentrations of major ions and energy substrates. The presence of WWTPs had a significant effect on concentrations of dissolved inorganic N, total P, Na, K, and polybrominated diphenyl ethers. Only one downstream site had measureable concentrations of ammonia-N. The presence of mining in the watershed had a significant effect on concentrations of total dissolved solids, SO_4^{-2}, Cu, Ni, and polycyclic aromatic hydrocarbons. Ion regulation in freshwater mussels was not affected by WWTPs or watershed land use. However, activities of detoxification (glutathione-S-transferase) and antioxidant (catalase) enzymes were elevated in mussels downstream of WWTPs. The degree of induction was dependent on effluent volume, treatment type, and surrounding land use. This study highlights the importance of managing both point and nonpoint sources of pollution to protect mussel health and the need to develop relationships between individual-level toxicological endpoints and potential effects on mussel populations. sciparis@vt.edu

SESSION 13	LIFE HISTORY & ECOLOGY I Tuesday, March 24, 2015 | 1:40 p.m. – 3:20 p.m. Grand Ballroom A
Platform 63 1:40 p.m. March 24, 2015	**VARIATION IN MUSSEL GROWTH ACROSS TIME AND SPACE.** Wendell R. Haag[1], Andrew L. Rypel[2], Zanethia Choice[1], and Martin Daufresne[3]. [1]US Forest Service, Oxford, MS; [2]Wisconsin Department of Natural Resources, Madison, WI; [3]National Research Institute of Science and Technology for Environment and Agriculture (IRSTEA), Aix-en-Provence, France.
Freshwater mussel shells provide records of growth that can be used to examine differences in environmental conditions across time and space. We used museum specimens to build long-term growth histories for freshwater mussels in the Ohio, Illinois, Mississippi, and Sangamon rivers. The longest of these histories spans the time period 1810-1985 (Ohio River), but all histories span at least 100 years and begin in the mid-1800s. Researchers have long speculated that stream enrichment and climate change over the last century have resulted in increased mussel growth rates and size. However, our preliminary analyses show few strong differences over time in growth or size at age, with the exception of *Pleurobema cordatum* in the Ohio River, which showed a modest increase in size at age. The most conspicuous result was an apparent dampening of annual variation in growth following impoundment of some streams, particularly the Ohio River. We also examined variation in growth of *Quadrula pustulosa* across its range and attempted to relate this variation to environmental variables. Surprisingly, we found no strong relationships of growth rate or size with latitude or water hardness -- both of which have shown strong relationships to growth in other studies – or to any other measured variables. These results are preliminary, but they suggest that mussel growth responses to the environment are complex and may vary considerably among species. whaag@fs.fed.us	
Platform 64 2:00 p.m. March 24, 2015	**SUICIDAL TENDENCIES? EVIDENCE FOR "SUICIDAL REPRODUCTION" IN FEMALE SCALESHELL MUSSEL. (*LEPTODEA LEPTODON*) BIVALVIA: UNIONIDAE.** Kevin J. Roe. Department of Natural Resource Ecology and Management, Iowa State University, Ames, IA.
Semelparity, or death following reproduction is documented as occurring in a large number of bacteria, plants and animal species, and represents one extreme of a range of reproductive strategies. The term "suicidal reproduction" was coined for cases in which mortality occurred following reproduction due to the intensity of the reproductive effort and the amount of energy expended. True suicidal reproduction, that is death as a result of sacrificial behavior during reproduction has so far not been documented in any organism. It has been hypothesized that *L. leptodon* utilizes the remarkable strategy of suicidal reproduction, also called "female sacrifice" to infest its host, the freshwater drum, *Aplodinotus grunniens*. Although it is difficult to directly test suicidal reproduction for *L. leptodon* since its host fish is molluscivorous, suicidal reproduction predicts several outcomes that if true would lend support to the hypothesis. Predictions of life history features that would be consistent with suicidal reproduction in female scaleshell includes a.) a sex ratio skewed toward a higher proportion of males, b.) females achieve a smaller size relative to males of the same age, c.) females will exhibit a reduction in age relative to males. An extreme drought in the summer of 2012 allowed the collection of a large number of intact, recently dead *L. leptodon* and *L. fragilis* specimens. These shells were measured and aged using largely standard approaches and were combined with measurements from live collected mussels to estimate age structure and growth rate of the two species. It was predicted that *L. leptodon* would exhibit life history features that are consistent with suicidal reproduction whereas *L. fragilis* would not. Although the above predictions for *L. leptodon* and *L. fragilis* were not universally supported, some results were consistent with the phenomena of suicidal reproduction. Implications of these results will be discussed. kjroe@iastate.edu	
Platform 65 2:20 p.m. March 24, 2015	**INVESTIGATING THE EFFECTS OF CORTISOL ON LARVAL *LIGUMIA SUBROSTRATA*.** Jace Nelson and Robert Bringolf. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA.

It is estimated that more than 70% of the approximately 300 species of North American Unionid mussels are currently imperiled or of special concern. In addition to habitat destruction and degradation, mussels are made more vulnerable by their reliance on the presence of fish hosts. Some mussel species are known to metamorphose on a large number of fish, while others have been shown to metamorphose on only a single fish species. Evidence suggests that the mechanisms regulating this host specificity are immunological in nature. Cortisol, the primary corticosteroid in fish, is released as part of a stress response and has system-wide immunosuppressant effects. Elevated levels of plasma cortisol may increase metamorphosis rates of attached glochidia to the juvenile stage. Until host relationships are established for the many imperiled unionid species, captive propagation programs may serve as a bridge to sustain the remaining wild populations. By studying the effects of exogenous cortisol on glochidial metamorphosis rates, this project will expand the existing knowledge of the physiological factors underpinning the mussel/fish host relationship and may provide captive propagation alternatives for mussel species for which a host has not yet been identified. Multiple levels of exogenous cortisol will be administered to multiple fish species (*Micropterus salmoides* and *Lepomis macrochirus*), mimicking a state of chronic stress. Fish will then be exposed to glochidia, sloughed glochidia and successfully metamorphosed juveniles will be quantified, and the resulting rates metamorphosis will be compared across cortisol treatments. It is expected that increasing levels of exogenous cortisol will result in significantly higher rates of glochidial metamorphosis. jacenelson88@gmail.com

Platform 66 **2:40 p.m.** **March 24, 2015**	**FACTORS AFFECTING GROWTH OF *ANODONTA ANATINA* (UNIONIDAE) IN 14 BOREAL LAKES.** Jouni Taskinen. Department of Biological and Environmental Science, University of Jyväskylä, P.O. Box 35, FI-40014 University of Jyväskylä, Finland

Freshwater clams of the family Unionidae are wide-spread organisms having important roles in the function of the freshwater ecosystem, but many unionids have recently declined. Growth of unionid clams can vary significantly from population to population, but the role of water quality parameters, or parasitism, in determining the growth rate of unionid clams is poorly known. Aim and methods: We studied the growth of *Anodonta anatina* in relation to pH, conductivity, turbidity, colour, total phosphorus, phosphate phosphorus, total nitrogen, chlorophyll a, alkalinity and calcium in13 Finnish lakes. Length of the third annulus was used as the measure of growth. To avoid the influence of between-year variation in growth conditions, only mussels between 3 and 4 years of age were included. Results: We found a positive relationship of the mean growth to total nitrogen, turbidity, colour and chlorophyll a. Factor analysis suggested two principal components: PC1 included pH, conductivity, alkalinity and the concentrations of calcium and total nitrogen while PC2 included total phosphorus, phosphate phosphorus, total nitrogen, chlorophyll a, turbidity and colour. Regression analysis indicated that PC2, only, had a statistically significant contribution to clam growth. Therefore, factors related to productivity, nutrients, colour and turbidity (PC2) were more important for growth of *A. anatina* growth than those related to water hardness (PC1). However, when the lakes with trematode parasitism (*Rhipidocotyle campanula*, *R. fennica*, *Phyllodostomum* sp.) were compared to the unparasitized lakes, it appeared that the mean growth rate of *A. anatina* was significantly lower in the parasitized than in the unparasitized lakes (length of third annulus 51.8±4.9 and 68.1±11.2 mm, respectively). Conclusions: Growth of *A. anatina* in the present material was higher in productive, nutrient-rich, dark-water, turbid lakes, but also parasitism may contribute to *A. anatina* growth at the population level. jouni.k.taskinen@jyu.fi

Platform 67 **3:00 p.m.** **March 24, 2015**	**ASSESSMENT OF NUTRITIONAL SUBSIDIES TO FRESHWATER MUSSELS USING A MULTIPLE NATURAL ABUNDANCE ISOTOPE APPROACH.** Amy M. Weber, James E. Bauer, and G. Thomas Watters. Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, OH.

To assess nutritional resources important to freshwater mussels we measured the natural abundance isotopic ratios ($\delta^{13}C$, $\delta^{15}N$, $\delta^{2}H$, and $\Delta^{14}C$) of mantle tissue for five species of freshwater mussels and of their potential nutritional resources at four sampling times in a moderate sized (7^{th} order) river in Ohio (USA). The proportional importance of the potential nutritional resources to mussel biomass was evaluated using bulk benthic vs. pelagic organic matter (OM) pools, general autochthonous vs. allochthonous OM sources, and specific individual OM sources using a Bayesian mixing model (MixSIAR). The combination of all individual potential nutritional resources sampled constrained mussel tissue using all isotopes. Mussels had similar $\delta^{13}C$ and $\delta^{15}N$ values to previous studies (all of which have used $\delta^{13}C$ and $\delta^{15}N$ exclusively). In spite of the relatively small species and temporal differences in $\delta^{13}C$, $\delta^{15}N$, $\delta^{2}H$, and $\Delta^{14}C$ isotopic values of mussels, these differences were generally significant. Isotopic differences were particularly evident for *Quadrula pustulosa* and for samples collected in August and June vs. October. The pelagic bulk OM pool assumed greater relative importance (~68% of mussel tissue) than the benthic OM pool (~33% of mussel tissue). The autochthonous sources grouping assumed greater importance (~65% of mussel tissue) than the allochthonous sources grouping (~35% of mussel tissue). No single potential individual nutritional OM source could explain the isotopic values of the freshwater mussel tissues, supporting the contention that they have an omnivorous multi-source diet. Phytoplankton and bacteria+fungi were the most important individual OM subsidies to freshwater mussel nutrition at our study site. Temporal shifts in freshwater mussel tissue isotopic values were minimal, suggesting either a) that mussels may not be limited by individual nutritional resources or b) that the long turnover times of freshwater mussel tissues made detection of temporal differences difficult. abarrett.571@gmail.com

SESSION 14	**CONSERVATION II** **Tuesday, March 24, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom B**
Platform 68 **1:40 p.m.** **March 24, 2015**	**ASSESSMENT OF SITE SUITABILITY FOR RESTORING LABORATORY-REARED JUVENILE MUSSELS TO HISTORICAL RIVER REACHES IN VIRGINIA AND TENNESSEE**. Dan Hua[1, 2], Yan Jiao[1], Richard Neves[1], and Jess Jones[1, 3]. [1]Department of Fish and Wildlife Conservation, College of Natural Resources, Virginia Polytechnic Institute and State University, Blacksburg, VA; [2]Freshwater Mollusk Conservation Center, Virginia Polytechnic Institute and State University, Blacksburg, VA; [3]U.S. Fish and Wildlife Service, Blacksburg, VA.
Laboratory-reared juveniles of the rainbow mussel (*Villosa iris*) and wavy-rayed lampmussel (*Lampsilis fasciola*) were released at three sites in the Clinch and Powell rivers using three types of release methods (untagged, tagged and caged) to test habitat suitability for restoration of these two species. Systematic sampling was used to sample the juveniles at the release sites. Mark-recapture was used to monitor the survival and individual growth of released mussels during a 4-year period. Two types of exponential survival models with and without incorporating individual variation were used to estimate the natural mortality of released mussels. Our study found that the growth rates of released mussels were significantly different ($p < 0.05$) among the 3 sites. Mussels released at Horton Ford, Clinch River, exhibited significantly faster growth than those released at Fugate Ford, Powell River ($p < 0.001$). Mussels released at Fugate Ford grew slower than those at the other 2 sites ($p < 0.05$); however, mussels kept in cages and deployed at Fugate Ford and Payne Property, Clinch River, exhibited slightly different trends in growth rates. Although Hallprint tags have no influence on mussel mortality, the estimated annual mortality rate (*M*) of tagged mussels was higher than that of untagged mussels of *V. iris*. The estimated catchability was lower in tagged mussels than that of untagged mussels. Estimates of *M* for *L. fasciola* were much less in caged mussels than those for tagged and free-released mussels. Evaluation of site suitability based on in-situ survival and growth of juveniles indicated that Horton Ford is the most suitable site for mussel restoration, while Fugate Ford is deemed unsuitable for mussel restoration and recovery. huad@vt.edu	
Platform 69 **2:00 p.m.** **March 24, 2015**	**METAGENOMIC PROFILES OF WATER, SEDIMENT, AND APPALACHIAN ELKTOE (*ALASMIDONTA RAVENELIANA*) AND WAVY-RAYED LAMPMUSSEL (*LAMPSILIS FASCIOLA*) GUT CONTENTS IN THE LITTLE TENNESSEE AND TUCKASEGEE RIVERS, NC.** Scott Salger[1], Jay F. Levine[1], Chris Ellis[2], Steve Fraley[3], Mike Gangloff[4], Mac Law[1], Luke Borst[1], Chris Osburn[5]. [1]NC State University, College of Veterinary Medicine, Raleigh, NC; [2]Eli Lilly and Company, Indianapolis, IN; [3]North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, Raleigh, NC; [4]Appalachian State University, Department of Biology, Boone, NC; [5]NC State University, Department of Marine, Earth, and Atmospheric Sciences, Raleigh, NC.

The Appalachian Elktoe (*Alasmidonta raveneliana*) population in the Little Tennessee River, NC has experienced a substantial decline since 2004. A similar decline has not been observed in *A. raveneliana* in a tributary, the Tuckasegee River, or in the Wavy-rayed Lampmussel (*Lampsilis fasciola*) in either river. Surveys have indicated that densities of the invasive species *Corbicula fluminea* have been increasing, and are higher in the Little Tennessee River than in the Tuckasegee River. We hypothesized that the decline of *A. raveneliana* might be associated with food-resource competition with *C. fluminea*. Metagenomic studies can serve as a valuable tool for assessing the availability of food web resources in a river system and the microbiom within the gastrointestinal tract of resident fauna. Microbiome studies of gastrointestinal, sediment and water column flora were conducted to compare and contrast the availability of food-resources available in the Little Tennessee and Tuckasegee Rivers as well as the gastrointestinal tract of *C. fluminea, A. raveneliana*, and *L. fasciola*. We collected digestive gland contents of 10 *A. raveneliana* and *L. fasciola* to serve as baselines and 51 sentinel *A. raveneliana* and 70 sentinel *L. fasciola* that had been held in cages at 3 sites in each river and 36 *C. fluminea* found at these sites. To determine what food resources were available to these mussels we also collected water and sediment samples once a month for a year at the same sites. Results of Illumina MiSeq-based 16S rRNA metagenomic sequencing will be presented that compare and contrast what was available for ingestion and actually ingested by these three species. jflevine@ncsu.edu

Platform 70 **2:20 p.m.** **March 24, 2015**	**WATER AND SEDIMENT QUALITY STRESSORS AND UNEXPLAINED DECLINES OF FRESHWATER MUSSELS IN THE CLINCH RIVER**. Christine M. Bergeron[1], Jennifer M. Archambault[1], W. Gregory Cope[1], Peter R. Lazaro[2], Jess W. Jones[3], Braven Beaty[4], Damian Shea[2], Thomas J. Kwak[5], Brian Evans[6], and Steven Alexander[7]. [1]Department of Applied Ecology, North Carolina State University, Box 7617, Raleigh, NC; [2]Department of Biological Sciences, North Carolina State University, Box 7633, Raleigh, NC; [3]U.S. Fish and Wildlife Service, Department of Fish and Wildlife Conservation, 106a Cheatham Hall, Virginia Tech, Blacksburg, VA; [4]The Nature Conservancy, 146 East Main Street, Abingdon, VA; [5]U.S.Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Applied Ecology, North Carolina State University, Raleigh, NC; [6]U.S. Fish and Wildlife Service, 330 Cummings Street, Abingdon, VA; [7]U.S. Fish and Wildlife Service, 446 Neal Street, Cookeville, TN.

The Clinch River watershed of Virginia and Tennessee supports one of the nation's greatest concentrations of freshwater biodiversity, but agricultural and mining practices, land development, contaminant spills, and other anthropogenic activities have degraded water and sediment quality in the Virginia section. Mussel populations in certain reaches have declined in both species richness and abundance, and there is a critical need to investigate the effects of potential chemical alterations to the system. The goal of this research is to understand the potential causes of ongoing declines by characterizing contaminants (metals and organics) at 8 mainstem sites, extending upstream and downstream of the zone of mussel decline, and 4 tributary sites. At each site, we deployed juvenile rainbow mussels (*Villosa iris*; 2012) and wavy-rayed lampmussels (*Lampsilis fasciola;* 2013) in enclosures (cages in the sediment and silos above the sediment) for 4-5 months. Throughout the mussel deployment period (June-November), we collected samples for contaminant analyses of surface water (using passive sampling devices and grab samples), sediment, pore water, and adult resident mussel tissue. After retrieval of mussels from enclosures, we determined survival, growth, and contaminant body burdens. Juvenile mussel survival was high (>80% at most sites) in both cages and silos, and there was no significant survival difference among sites. At most sites, mussels increased in length during the study, but mussels from the downstream reach with stable or increasing native populations were larger than mussels from upstream sites. We performed hierarchical agglomerative cluster analyses to aid interpretation of the differences among the 12 sites in terms of the 21 metals analyzed, and did not find consistent clustering among sites for any matrix type analyzed. However, in most cases, the tributary sites clustered separately from the mainstem sites indicating a different metal signature, and providing additional evidence that these streams are influencing contaminant loads to the Clinch River. cmberger@ncsu.edu

Platform 71 **2:40 p.m.** **March 24, 2015**	**METABONOMIC STUDY OF THE APPALACHIAN ELKTOE (*ALASMIDONTA RAVENELIANA*) AND WAVY-RAYED LAMPMUSSEL (*LAMPSILIS FASCIOLA*) IN THE LITTLE TENNESSEE RIVER AND TUCKASEGEE RIVERS, NC.** Scott A. Salger[1], Suraj Dhungana[2], Steve Fraley[3], Mike Gangloff[4], Mac Law[1], Susan Sumner[2], and Jay F. Levine[1]. [1]NC State University, College of Veterinary Medicine, Raleigh, NC; [2]RTI International, Research Triangle Park, NC; [3]North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, Raleigh, NC; [4]Appalachian State University, Department of Biology, Boone, NC.

A precipitous decline in the Appalachian Elktoe (*Alasmidonta raveneliana*) has been documented in the Little Tennessee River, NC since 2004. In contrast, similar population declines have not been observed in a tributary, the Tuckasegee River. Previous surveys found that *Corbicula fluminea* densities were higher in the Little Tennessee River than at Tuckasegee River sites. This prompted the hypothesis that *C. fluminea* may be contributing to the decline by outcompeting *A. raveneliana* for available food resources. To test this hypothesis, 82 *A. raveneliana* were harvested from the Tuckasegee River and 82 Wavy-rayed Lampmussels (*Lampsilis fasciola*), reared in captivity, were placed at 3 sites in each of the Little Tennessee and Tuckasegee Rivers to serve as environmental sentinels. Gill tissue was collected from 10 mussels that provided baseline data and from sentinel mussels at 6 months and 12 months. Broad spectrum metabolomics was used to profile the gill tissues. Primary analysis focused on metabolic pathways associated with the nutritional health of the mussels. Twenty-one *A. raveneliana* and 3 *L. fasciola* either died or were lost during the course of the study, and *A. raveneliana* held at the Little Tennessee sites showed marked tissue atrophy. In total, gill tissue from 48 *A. raveneliana* and 52 *L. fasciola* was examined. Glycogen, a primary energy store in bivalves, was significantly lower in *A. raveneliana* at each site after 6 months and in *L. fasciola* after 6 and 12 months when compared with the baseline values. It was also lower in mussels held in the Little Tennessee River than mussels held in the Tuckasegee River. Amino acids, small peptides, and nucleotides in both species were elevated above baseline, which suggested tissue catabolism. These results are consistent with a decrease in nutritional health seen in the sentinel animals during our study. jflevine@ncsu.edu

Platform 72 3:00 p.m. March 24, 2015	**TIMING, GROWTH AND PROPORTION OF SPAWNERS OF THE THREATENED UNIONOID MUSSEL *MARGARITIFERA MARGARITIFERA*: INFLUENCE OF WATER TEMPERATURE, TURBIDITY AND MUSSEL DENSITY.** E. Martin Österling, Department of Biology, Karlstad University, SE 651 88 Karlstad, Sweden.

Anthropogenic disturbances often cause decline and extinction of threatened species. The present field study investigated how gravid freshwater mussels, Margaritifera margaritifera, were affected by turbidity and water temperature, and by mussel density. At an early date of mussel spawning, there were lower proportions of gravid mussels in streams with evidence of mussel recruitment than in streams without mussel recruitment. At a late spawning date, this pattern was reversed. Higher water temperature in streams without recruitment was probably responsible for this difference. The combination of high water temperature and turbidity may be one reason for reduced growth of gravid mussels in streams without recruitment. There was a positive relationship between adult mussel density and the proportions of gravid mussels. Early gravidity may lead to early release of larvae, early infestation on the host fish and an earlier start of the benthic phase, which may reduce survival rates. Clear-cutting of forests and global warming are factors that are likely to cause increased turbidity/sedimentation and water temperatures in streams. One restoration measure that reduces sediment input and water temperatures is maintaining or restoring riparian zones, but these are long-term measures that require many years before they have an effect in streams. martin.osterling@kau.se

SESSION 15	**STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES IV Tuesday, March 24, 2015 | 3:40 p.m. – 5:00 p.m. Grand Ballroom A**
Platform 73 3:40 p.m. March 24, 2015	**TOWARDS A STRATEGIC AND SPATIALLY-EXPLICIT FRESHWATER MUSSEL CONSERVATION ASSESSMENT AND MONITORING PROGRAM IN MISSOURI – OUR VISION.** Amanda Rosenberger[1] and Stephen E. McMurray[2]. [1]U.S. Geological Survey Missouri Cooperative Fish and Wildlife Research Unit, University of Missouri, Columbia, Missouri; [2]Missouri Department of Conservation, Central Regional Office and Conservation Research Center, 3500 E. Gans Road, Columbia, MO.

Missouri is steward to a particularly diverse freshwater mussel fauna, with 69 species including 8 Ozark endemic species, 10 federally listed species, and 29 Species of Conservation Concern. Despite their status as one of the most endangered taxonomic groups in the state, their ecology, distribution, and population numbers remain poorly understood. Further, their cryptic coloration and clustered distribution patterns hinder rigorous monitoring to detect population or distributional trends. We will present our vision for establishing a statewide conservation effort to monitor and recover diverse concentrations of mussels. Monitoring and conservation initiatives will be at the assemblage level, rather than species, incorporating landscape factors anticipated to lead to mussel concentrations within target river systems. Without this strategic or guiding framework for decision making, identification of risks and threats to mussel assemblages can be subjective. Monitoring programs would be less likely to detect or document significant declines or recovery of the species, while important gaps in monitoring remain unidentified. A strategic and spatially-explicit approach to management based on ecological and physical processes important for overall ecological health of a system is required for cost-effective management and concrete recovery of threatened and endangered species. We are planning this assessment in stages: 1) identification of meaningful biological units; 2) assessment of risks to those units; 3) identification of threats that contribute to risk; 4) spatially-explicit acknowledgement of core areas of populations strength or assemblage diversity; and 5) development of a spatially-explicit monitoring program that best identifies areas that will be most sensitive to species or assemblage expansion or declines. rosenbergera@missouri.edu

Platform 74 **4:00 p.m.** **March 24, 2015**	**DEVELOPING A BIOTIC INDEX FOR FRESHWATER MUSSELS IN IOWA.** Jennifer Kurth. Iowa Department of Natural Resources, 502 E. 9th St., Des Moines, IA.

Freshwater mussels are an integral part of a healthy stream community. As filter feeders they help to clean the water. They also stabilize the stream bottom and provide habitat for many benthic organisms. Historically, Iowa had 55 species of freshwater mussels. Unfortunately, approximately ten species are believed to be extirpated, and another eight are currently only found in the Mississippi River. An additional 29 species are listed as endangered, threatened, or of greatest conservation need by the state of Iowa A six-year, state-wide freshwater mussel survey was begun in 2011 to assess the status of mussels in Iowa's rivers and streams. In order to accurately assess the health of mussel communities in Iowa, a biotic index for mussels was developed. A biotic index is a scale for showing the quality of an environment by indicating the types of organisms present in it. It is often used to assess the quality of water in rivers. Our biotic index is comprised of 8 metrics: number of species found, number of threatened and endangered (T & E) species found, relative abundance of T & E individuals, catch per unit effort, percent of top three species, fish host tolerance, the Shannon-Weiner Diversity Index, and a reproductive factor. Based on the aggregated metric score, sites are rated as excellent, good, fair, and poor for freshwater mussels. Because mussel assemblages can vary greatly in Iowa based on watershed, biotic indexes are being developed for each of the major river basins in Iowa. This information will be used to assess changes in the composition of mussel communities as well as identifying areas with unique mussel resources that may be in need of further protection. Jennifer.Kurth@dnr.iowa.gov

Platform 75 **4:20 p.m.** **March 24, 2015**	**CURRENT AND HISTORIC AREA OF OCCURRENCE FOR SPECIES IN THE GENUS *MEDIONIDUS* IN FLORIDA RIVER BASINS.** Matthew Rowe[1], Jordan Holcomb[1], Jim Williams[1], and Sandra Pursifull[2]. [1]Florida Fish and Wildlife Conservation Commission, 7386 NW 71st St, Gainesville, FL; [2] US Fish and Wildlife Service, Panama City Field Office, 1601 Balboa Ave, Panama City, FL

The genus *Medionidus* currently contains six recognized species, all of which are native to the southeastern United States and are currently listed as threatened, endangered, or in review for listing. Florida River basins are home to four species of *Medionidus*, three of which are federally listed and two, which until recently, were presumed by many to be extinct. We gathered previous collection records from a variety of sources, including government agencies and museum collections, as well as conducted field surveys to establish current and historic distributions of *Medionidus* species in Florida. We hoped to use this information to determine trends in the area of occurrence of this rare genus and to identify areas which should receive additional survey effort. We found decreases in the current area of occurrence of *M. acutissimus*, *M. penicillatus*, and *M. walkeri* when comparing historic and recent collection records indicating a steady decline over the past century. *M. simpsonianus* received a 25 mile range extension into a previously unreported portion of the Ochlockonee River below Talquin Reservoir but has disappeared from previous known locations above the reservoir. Despite apparent range wide declines in *Medionidus* species in Florida drainages, recent extensive surveys in the Lower Ochlockonee and Suwannee River Basins have yielded new records for *M. simpsonianus* and *M. walkeri*, two species which had not been seen in almost two decades. The presence of these animals has likely gone unnoticed due to lack of search effort in difficult to reach areas and preferred *Medionidus* habitat. These findings provide some hope that, with additional search effort, we may be able to better quantify and manage Florida's remaining *Medionidus*. Matthew.Rowe@MyFWC.com

Platform 76 **4:40 p.m.** **March 24, 2015**	**MONITORING OF MARKED MUSSELS IN ZERO VISIBILITY ENVIRONMENTS**. Krista McDermid and Brian Cowan. Zara Environmental LLC, 1707 W. FM 1626, Manchaca, Texas 78652.

In 2012 and 2013, Zara Environmental LLC (Zara) relocated 1064 native freshwater mussels from two sites in the Trinity River near Dallas, Texas. The collection and relocation sites for these individuals are in deep water with zero visibility in a highly technical dive environment. Zara is monitoring 308 marked individuals, including 175 state-listed (threatened) species (Texas Pigtoe [*Fusconaia askewi*] and Louisiana Pigtoe [*Pleurobema riddellii*]). Six monitoring events have been scheduled at each of the two relocation sites over three years. Four events have been completed at one site, with a cumulative recovery rate of 59%; two events have been completed at the other site, with a cumulative recovery rate of 22%. According to extensive literature review and interviews with other species experts, these two long term projects may represent the first ever attempt at tagging and relocating native freshwater mussels in deep water with zero visibility. Other tagging and relocation efforts in the state of Texas have been in shallow or clear water where wading, snorkeling, or visual searches while diving were viable methods. Recovery rates for these projects so far indicate that relocation of native freshwater mussel species in deep water, zero visibility environments is a viable approach to avoiding take of listed unionid species. krista@zaraenvironmental.com

SESSION 16	**LIFE HISTORY & ECOLOGY II** **Tuesday, March 24, 2015 | 3:40 p.m. – 5:00 p.m.** **Grand Ballroom B**
Platform 77 **3:40 p.m.** **March 24, 2015**	**DO NATIVE UNIONID MUSSELS CREATE COUPLED DENITRIFICATION-NITRIFICATION HOTSPOTS?** Carla L. Atkinson[1,2], Matt Trentman[3], and John Brant[3]. [1]Dept. of Biological Sciences, University of Alabama, Tuscaloosa, AL; [2]Oklahoma Biological Survey, University of Oklahoma, Norman, OK; [3]Division of Biology, Kansas State University, Manhattan, KS.

Recent research has shown that aggregating animals that occur at high densities create patches or "hotspots" of biogeochemical activity through nutrient regeneration and material flux within and across systems. The direct impacts of animals on biogeochemical cycling have received a great deal of attention, but animals also have the ability to alter biogeochemical activities indirectly through their movement. Freshwater mussels present an interesting system to study the impact of animals on coupled nitrification-denitrification because they have the ability to increase rates of both denitrification and nitrification through the remineralization of N, but also can reduce denitrification rates through bioturbation of sediments. We sampled pore-water chemistry and sediment for denitrification-nitrification assays at ten sites across a gradient of mussel densities in the Kiamichi River, Oklahoma. Benthic denitrification rates were determined using the acetylene-inhibition method with N and C limiting assays and nitrification was measured using Nitrapyrian inhibition. Pore-water NO_3 and NH_4 were higher with greater mussel densities while PO_4 was not affected. Our results indicated that denitrification decreased with increased densities of mussels under ambient nutrient conditions. However, when excess N was available, increasing mussel densities supported higher denitrification suggesting N limitation in the system, while there was no relationship when C was added. Mussels, particularly *Actinonaias ligamentina*, stimulated nitrification likely because there is additional NH_4 due to excretion and possibly additional O_2 due to bioturbation that supports the nitrification pathway when more mussels are present. This indicates that mussels have both direct (e.g. remineralization) and indirect (e.g. bioturbation) impacts on N-cycling in aquatic ecosystems and these effects can be species specific (e.g. excretion rates, movement and burial rates). Our results suggest that mussels are more influential in low nitrate systems, but in systems with a higher nitrate load, mussels could stimulate denitrification, an important ecosystem service. carlalatkinson@gmail.com

Platform 78 **4:00 p.m.** **March 24, 2015**	**BIOGEOCHEMICAL HOTSPOTS: TEMPORAL AND SPATIAL SCALING OF THE IMPACT OF FRESHWATER MUSSELS ON ECOSYSTEM FUNCTION.** Caryn C. Vaughn[1] and Carla L. Atkinson[1,2]. [1]Oklahoma Biological Survey, Department of Biology and Ecology and Evolutionary Biology Graduate Program, University of Oklahoma, Norman, OK; [2]Department of Biological Sciences, University of Alabama, Tuscaloosa, AL.

Aggregations of consumers can create local patches (hotspots) of nutrient regeneration and material flux in streams. We examined the potential for aggregations of freshwater mussels to create such hotspots. We measured nitrogen (N) and phosphorus (P) excretion rates and body tissue composition of mussel species. We combined these data with population densities of surveyed mussel beds in the Kiamichi River, OK, to estimate reach-scale and stream-scale nutrient recycling and storage. We estimated volumetric excretion at a reach scale and combined this with discharge and temperature data to estimate temporal variability in the magnitude of mussel nutrient recycling. Mussel beds constituted 1.45% of the area of the Kiamichi River. Mussel nutrient excretion varied greatly across beds (11.1-699.5 ?mol N m^{-2} h^{-1} and 0.8-53.0 ?mol P m^{-2} h^{-1}) because of varying mussel densities. The community-wide average excretion N:P (molar) of the mussel communities was 29.57, with higher excretion N:P significantly associated with higher abundances of *Actinonaias ligamentina*. Total nutrient storage per bed varied two orders of magnitude (6.3-631.7 kg N and 2.3-227.5 kg P) among mussel beds. Moreover, areal nutrient storage varied among the beds (11.2- 133.7 mg N m^{-2}, 4.1-48.9 mg P m^{-2}) with the majority of nutrient storage in a long-term store, shell (~87% of total N storage, ~95% of total P storage). Our results demonstrate that freshwater mussels can be important to nutrient dynamics through nutrient regeneration and the creation of storage hotspots, but importance varies with mussel patchiness, flow conditions and background nutrient concentrations. In future work we are examining the importance of mussel hotspots in additional rivers and determining the spatial and temporal overlap between mussel and fish hotspots. carynvaughn@gmail.com

Platform 79 **4:20 p.m.** **March 24, 2015**	**IMPACT OF STREAM SIZE ON THE MUSSEL COMMUNITIES IN THE UPPER NECHES RIVER BASIN OF TEXAS.** David F. Ford[1], Ashley D. Walters[2], Lance R. William[3] and Neil B. Ford[3]. [1]Halff Associates, Inc., Richardson, Texas; [2]Department of Biology, Miami University, Oxford, Ohio; [3]Department of Biology, Univ. of Texas at Tyler, Tyler TX.

Species composition and abundance in stream ecosystems are influenced by environmental factors that operate at different spatial scales shaped by the hydrologic forces related to the size of the stream as it travels through the landscape. Freshwater mussels are a speciose group that is extremely important in lotic environments. Understanding how stream size impacts mussel assemblages is necessary if we are to conserve this important and endangered fauna. We compared the mussel assemblages in three segments of the Neches River of eastern Texas; the mainstem of the Neches River, the intermediate sized Angelina River and the smaller Attoyac Bayou. All areas sampled fell within the same general latitude and so differences should primarily reflect impacts based on stream size. Non-metric multidimensional scaling was used to compare the unionid assemblages and indicated distinct communities between the northern and southern sites within both the Attoyac Bayou and the Angelina River and a distinct mussel abundance structure within each river. As has been seen in other river systems, the smallest stream, the Attoyac Bayou, had unique species known to be able to withstand low flow and stagnant conditions. The intermediate sized Angelina River was more similar in composition to the Neches River than the Attoyac Bayou and the largest stream, the upper Neches River, had the highest diversity and abundance. Our results corroborate other findings that suggest that small streams have lower mussel diversity and abundance, and have different faunas composed of species tolerant of variable conditions. Conversely, larger streams have higher species diversity and larger mussel populations. This diversity has been suggested to relate to larger rivers having multiple habitat types. For Texas, this includes a number of state listed species and emphasizes the need to preserve undammed stretches of the larger rivers. NFord@uttyler.edu

Platform 80 **4:40 p.m.** **March 24, 2015**	**OVERVIEW OF USEPA AQUATIC LIFE CRITERIA FOR AMMONIA AND HIGHLIGHTS OF STAKEHOLDER'S MEETING REGARDING CRITERIA IMPLEMENTATION.** Scott Hall, ENVIRON International Corporation. Brentwood, TN. *INVITED SPEAKER*

In 2013, the USEPA published its final freshwater aquatic life criteria for ammonia and supporting documents related to criteria implementation in the NPDES program. The criteria are based on an extensive toxicity test database, and reflect the high ammonia sensitivity of Unionid mussels and gill-bearing snails. The revised criteria, expressed across a range of pH and temperature conditions, are lower than the previously published criteria, and will be adopted by state regulatory agencies for use in NPDES Permits, thus impacting municipal and industrial wastewater facilities. In October 2014, a variety of stakeholders met in Washington, DC to review the new criteria, and identified areas needing additional data and information in order to more appropriately implement the criteria based on site-specific conditions. These include potential issues related to the use of mixing zones, appropriate determinations that mussels and/or gill-bearing snails are present at the site (especially with respect to flow, habitat, and pH regimes that do not support mussels), conducting field surveys that consider the statistical validity of findings of mussels present/absent, appropriate pH and temperature conditions to use in discharge permits to reflect conditions occupied by mussels and snails, use of Monte Carlo water quality modeling in lieu of defaulting to worst-case conditions, and determining the most appropriate means to develop site-specific ammonia criteria. This presentation will overview the history and basis of the new ammonia criteria, data driving the new criteria, key USEPA guidance related to criteria implantation, and focus on the areas of concern identified by participants at the Washington, DC stakeholders meeting. Also provided will be a decision matrix developed at the stakeholder's meeting that identifies sequential paths of evaluation of mussel presence at a site, and the various options available to develop site-specific criteria. shall@environcorp.com

JOINT PLENARY I	**CONSERVING AQUATIC ECOSYSTEMS – AT THE CONFLUENCE OF THE PAST AND FUTURE** **Wednesday, March 25, 2015 | 8:30 a.m. – 10:00 a.m.** **Grand Ballroom A/B**
Plenary 1 **8:30 a.m.** **March 25, 2015**	**THE ORIGINAL RIVER PARTNERSHIP - THE UPPER MISSISSIPPI RIVER CONSERVATION COMMITTEE.** Pam Thiel[1] and Janet Sternburg[2]. [1]U.S. Fish and Wildlife Service (retired), La Crosse, WI; [2]Missouri Department of Conservation, Jefferson City, MO. *INVITED SPEAKER*
The Upper Mississippi River Conservation Committee (UMRCC) was organized in 1943 by biologists from the five Upper Mississippi River (UMR) states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. Recognizing that the river's aquatic and floodplain habitats would continue to degrade in the future due to river and land use alterations within the UMR system, the states agreed to work together to ensure fish and wildlife, and resource-related recreation needs were addressed. The UMRCC also plays a critical role in ensuring that the impacts to the river's natural resources and recreational concerns are considered as part of water quality regulations and during river development projects. The UMRCC is directed by an executive board that consists of representatives from the five-state natural resource or conservation agencies, chairpersons of its six technical sections, a U.S. Fish and Wildlife Service-provided coordinator, and an observer from the UMR National Wildlife and Fish Refuge. The technical sections represent the disciplines of fisheries; wildlife; conservation law enforcement; water quality; outreach, recreation, environmental education and interpretation; and mussels. The technical sections exchange information, collaborate on projects, produce publications and outreach materials, and are the backbone of the organization. The UMRCC has been integral in raising concerns for fish and wildlife impacts from hydropower and navigation channel maintenance and expansion projects, and helped influence Congress to declare the UMR System a "nationally significant ecosystem" and authorize the internationally recognized Environmental Management Program, now known as the UMR Restoration program. Into the future, the UMRCC will continue serving as a voice for the Mississippi River on important resource issues. Concern for the status of mussels prompted the UMRCC to host a mussel symposium in 1979, a workshop in 1986, develop the mussel ad hoc committee in 1990, and sponsor two more symposiums in 1992 and 1995. These latter symposia served as the springboard that launched the Freshwater Mollusk Conservation Society. jctpat@aol.com	
Plenary 2 **8:50 a.m.** **March 25, 2015**	**THE FRESHWATER MOLLUSK CONSERVATION SOCIETY: PERSPECTIVES ON ITS BEGINNING, NEAR-TERM, AND FUTURE.** Teresa J. Newton[1] and W. Gregory Cope[2]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI; and [2]North Carolina State University, Department of Applied Ecology, Raleigh, NC. *INVITED SPEAKER*

The Freshwater Mollusk Conservation Society (FMCS) exists because of a core group of scientists passionate about the conservation and management of freshwater mollusks. In 1992, 14 people from an ad hoc committee on mussels from the Upper Mississippi River Conservation Committee organized a workshop on the Conservation and Management of Freshwater Mussels, which turned out to be the beginning of a journey that led to the creation of the FMCS in 1998. The goal of the FMCS is to conserve, and be an advocate for, freshwater mollusks. Membership in the society is open to anyone interested in freshwater mollusks who supports the stated purposes of the Society which are to advocate conservation of freshwater molluscan resources, serve as a conduit for information about freshwater mollusks, promote science-based management of freshwater mollusks, promote and facilitate education and awareness about freshwater mollusks and their function in freshwater ecosystems, and assist with the facilitation of a national strategy for the conservation of native freshwater mussels. The Society has grown from 44 charter members in 1998 to over 500 members in 2014. Currently, about 21% of the membership are students and about 5% of the membership are from outside North America, including members from 22 countries. The Society hosts annual meetings in even years and topic-specific workshops in odd years. Recently, the Society has held joint meetings with other Societies and has held several mussel-inspired sessions at other scientific conferences (e.g., Society for Conservation Biology, Society of Environmental Toxicology and Chemistry). Much of the work of the Society is done through ~10 standing committees and ~2 ad hoc committees. Some of the Society's major accomplishments include a national strategy document for the conservation of native freshwater mussels published in 1998, an online journal named Walkerana (soon to be Journal of the FMCS), an informative and timely newsletter named Ellipsaria, and many influential position statements for improved conservation and aquatic resource management. Future directions for the Society are to enhance international representation, gastropod conservation, and beneficial services to members, policy makers, and the general public. This presentation will summarize the contribution of key individuals, recent accomplishments, and future directions of the FMCS. tnewton@usgs.gov

Plenary 3 **9:10 a.m.** **March 25, 2015**	**SCIENCE AND DECISION-MAKING ON LARGE RIVERS – THE LOWER MISSOURI RIVER EXAMPLE.** Robert B. Jacobson. Columbia Environmental Research Center, US Geological Survey, Columbia, MO. *INVITED SPEAKER*

Large rivers present substantive challenges to accommodation of traditional socio-economic and ecological values. The Lower Missouri River (LMOR) is a good example of the difficulties of developing science sufficient to support accommodation in decision making. The LMOR is a highly altered, multi-use river; it is just downstream of North America's largest reservoir storage system and 92% of the 1,304 km river is channelized for navigation. The river is managed for power production, water supply, flood control, recreation, navigation, as well as for fish and wildlife, and threatened and endangered species. A generic tension in decision-making exists between very precise, monetized evaluation of socio-economic goods and services, and the much-less precise, non-monetized evaluation of ecological values. Moreover, for the last decade motivation and funding for ecological restoration and management on the LMOR, like many rivers, have been driven by compliance with the Endangered Species Act. This emphasis has focused science on development of quantitative understanding of specific processes related to hypothesized bottlenecks for reproduction, growth, and survival of three species (interior least tern, piping plover, pallid sturgeon) rather than on ecological indicators or on processes that might lead to a broader and more holistic restoration. Notwithstanding these limitations, decision-making challenges on large rivers like the LMOR have been responsible for substantive advances in large-river ecology. In particular, hydroacoustics, genetics, microchemistry, and modeling tools have greatly improved understanding of fundamental ecosystem processes. rjacobson@usgs.gov

Plenary 4 **9:30 a.m.** **March 25, 2015**	**WHOLE SYSTEM CONSERVATION THE UPPER MISSISSIPPI RIVER BASIN: AN NGO PERSPECTIVE.** Steven J. Herrington. The Nature Conservancy, Missouri Chapter, St. Louis, MO. *INVITED SPEAKER*

From the northern Minnesota to southern Illinois, the Upper Mississippi River (UMR) sustains many of the nation's natural communities and its economic strength. Its extensive network of streams, floodplains, lakes and uplands provide habitat for a significant portion of the continents biological diversity and comprise the largest area of contiguous freshwater wildlife habitat in the central United States. The UMR has been extensively modified during the last century by locks, dams and levees. In most places, the river no longer inundates its floodplains during high water periods, contributing to a decline in the abundance and diversity of plant and animal life. With fewer flooded wetlands to filter the river's flows, increased run-off of excess nutrients and sediment has reduced water and habitat quality throughout the UMR, ultimately influencing the dead zone in the Gulf of Mexico. The Nature Conservancy teams in five UMR states are working together to address some of the river's most critical threats. I will review The Nature Conservancy's conservation strategies in the UMR, including reconnecting the river with its floodplain, working with farmers to identify sustainable approaches to land use and nutrient reduction, and building support for the river at both the highest levels of government and the community level. sherrington@tnc.org

JOINT PLENARY II	BIG RIVER/LANDSCAPE ECOLOGY Wednesday, March 25, 2015 | 10:20 a.m. – 12:00 p.m. Grand Ballroom A/B
Plenary 5 **10:30 a.m.** **March 25, 2015**	**MOVING FROM SITE-BASED MANAGEMENT TO PROCESS-BASED MANAGEMENT ON THE UPPER MISSISSIPPI RIVER SYSTEM.** Charles H. Theiling, Great River IWRM, Davenport, IA. *INVITED SPEAKER*

The maturation of Upper Mississippi River System natural resource management, restoration, and monitoring since the inception of Upper Mississippi River Restoration in 1986 paralleled the development of ecosystem restoration as a professional discipline. The first set of UMRR projects focused on learning about restoration measures and site-specific problems. A second round of project planning ca. 2000 was more transparent and incorporated a broader "Habitat Needs Assessment" approach considering unique reach-specific characteristics, but purposely excluded watershed considerations except at tributary confluences. Navigation expansion studies provided an impetus to consider navigation and ecosystem restoration integration that emphasized the role of ecological process and function in environmental management. Much learning has occurred through implementation and monitoring of 54 UMRR projects, but the true innovation comes with planning the next generation projects. Incorporating landscape ecology principles into natural resource evaluation has recently been successfully demonstrated for many ecosystem components, and the tools can be incorporated into more standardized, system-wide resources (i.e., data layers and models) to support data-driven restoration project identification and prioritization. Significant floodplain restoration was authorized without funding in Water Resources Development Act 2007, but several UMRR projects, private restorations, and hunt club management achieve site-specific success. Existing levee and drainage district infrastructure can also be used to achieve greater watershed and floodplain ecosystem services with little change to ongoing land use and potentially enhanced economic opportunity. Upland material loading can be partially mitigated by redirecting controlled tributary flow into levee district sedimentation basins and ditch systems converted into large scale treatment wetlands. Floodplain farmers are also considering alternative hydroponic crop systems that use abundant UMR surface water nutrients to grow useful biological feedstock while also cleansing surface water. Non-structural Flood Risk Management will be a large component of UMRS climate change adaptation and floodplain ecological drivers and outcomes will be important issues considered in that planning process. The future may see greater consideration of "Watershed Based Budgeting" which I believe includes opportunities to monitor ecosystem process and function in economic markets like carbon and nutrient markets. Charles.h.theiling@usace.army.mil

Plenary 6 **10:45 a.m.** **March 25, 2015**	**LANDSCAPE CONSERVATION COOPERATIVES (LCC): MEETING LARGE-SCALE MISSISSIPPI BASIN CHALLENGES FROM DUCKS AND PALLID STURGEON TO GULF COAST SHRIMP.** Andrew Stephenson[1], Gwen White[2], Glen Salmon[2], Rick Nelson[3], John Rogner[4], Nicole Athearn[5], Bill Bartush[6], and Greg Wathen[7]. [1]University of Northern Iowa, Cedar Falls, IA; [2]Eastern Tallgrass Prairie & Big Rivers LCC, US Fish and Wildlife Service, Bloomington, IN; [3]Plains & Prairie Potholes LCC, Bismarck, ND; [4]Upper Midwest & Great Lakes LCC, East Lansing, MI; [5]Great Plains LCC, Norman OK; [6]Gulf Coast Prairie LCC, Lafayette, LA; [7]Gulf Coast Plains & Ozarks LCC, Hermitage, TN. *INVITED SPEAKER*

According to water quality model assessments, Midwestern states currently contribute the greatest nutrient load to the Gulf of Mexico hypoxic zone. The Mississippi River Basin / Gulf Hypoxia Initiative, spearheaded by the seven LCCs, is undertaking a systematic and transparent process to create an integrated framework that supports planning, design, configuration, and delivery of wildlife conservation practices within the watershed. This framework consists of multiple quantitative objectives and associated metrics representing three interests of wildlife, water quality, and agricultural productivity, a tiered set of conservation strategies to achieve those objectives within five production agriculture systems (corn & soybean; grazing lands; floodplain forest; rice; cotton), and a modeling approach to determine where to best implement those actions within four key ecological systems of the Mississippi River Basin (headwater row crop fields; upland prairies; mid-sized riparian streams; mainstem floodplains in the upper and lower basin). Conceptual models will explore relationships and leveraging points where actions affect objectives or where uncertainty requires additional research. Scenario planning for landscape change could provide forecasts and adaptation strategies over time scales across key portions of this landscape in response to ecological, social or economic drivers. An analysis of barriers and opportunities will be used to rate feasible strategies with high leverage value. The initial framework was developed through web meetings and three Structured Decision Making (SDM) workshops, culminating in Memphis, TN, on August 12-14, 2014, with an interdisciplinary group of 50 stakeholders. Additional input will continue to refine the conceptual models to support a spatial analysis resulting in a landscape conservation design. This effort is intended to be complementary to related on-going efforts, like the Gulf of Mexico Hypoxia Task Force, Mississippi River Basin Initiative, and state nutrient reduction initiatives, but with an added emphasis on the ecological and social values of wildlife habitat. gwen_white@fws.gov

Plenary 7 **11:00 a.m.** **March 25, 2015**	**ENVIRONMENTAL DNA TO AID CONSERVATION: USING eDNA TO LOCATE SPECIES OF CONSERVATION CONCERN.** Emy M. Monroe. Whitney Genetics Laboratory, US Fish and Wildlife Service, Onalaska, WI. *INVITED SPEAKER*

Environmental DNA (eDNA) has been used in terrestrial wildlife biology for decades, but has only recently been applied in freshwater and marine systems. eDNA is a non-invasive technique using samples that are generally easier to obtain than direct sampling of organisms in the field, but is not without challenges and limitations. Development has been rapid for detection of aquatic invasive species, but it also may be useful to detect threatened and endangered aquatic species. However, before using eDNA to locate species of conservation concern, research is needed to refine and develop this technique to maximize application to species management. Scientists are currently testing and refining eDNA methods to detect rare and threatened amphibians, mollusks, and fish in small streams, large rivers, and lentic systems. This presentation will provide a review of the currently used eDNA techniques, suggest areas of additional research needed to refine eDNA methods for rare species research and management, and highlight important limitations that managers need to understand prior to implementing this tool. emy_monroe@fws.gov

Plenary 8 **11:15 a.m.** **March 25, 2015**	**ECOHYDRAULICS AND HABITAT: USING HYDRODYNAMIC TOOLS FOR MUSSELS IN THE UPPER MISSISSIPPI RIVER.** Steven J. Zigler and Teresa J. Newton. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI. *INVITED SPEAKER*

Large floodplain rivers are fundamentally different from smaller systems in their lateral complexity and hydrology. Beginning in the early 1900s, it was widely recognized that native mussels in rivers occupied specific habitats. However, most descriptions of mussel habitat have remained vague and untested, and traditional descriptors of habitat (e.g., velocity, depth, substrate type) have proven largely unsuccessful at predicting the occurrence or density of mussels. More recent studies have suggested that certain complex hydraulic variables (e.g., shear stress, Reynolds number), which have a long history of use by hydraulic engineers, may be more predictive in the Upper Mississippi River and other systems. Development of habitat models that might be used to conserve or restore mussel habitat are often challenged by a lack of biological and environmental data. However, recent advances in technology (e.g., remote sensing, low cost 2- and 3-D hydraulic models) and techniques for statistical and geospatial modeling can facilitate efforts to model mussel habitat and processes (e.g., hydraulic dispersal of juveniles) that control mussel distributions. These tools will be critical for guiding habitat restoration projects to benefit mussel assemblages in large rivers, and forecasting likely outcomes under differing management scenarios and emerging issues such as climate change. szigler@usgs.gov

Plenary 9 **11:30 a.m.** **March 25, 2015**	**SUB-LETHAL EFFECTS OF CONTAMINANTS AS AN ADDED POPULATION STRESSOR.** James S. Candrl and Donald E. Tillitt. United States Geological Survey, Columbia Environmental Research Center, Columbia, MO. *INVITED SPEAKER*

Contaminants are known to be stressors on aquatic organisms and their populations. For good reason, the focus in environmental toxicology has been on lethal effects of pollution. However, sub-lethal effects of contaminants can have a tremendous influence on population dynamics, yet are more difficult to link directly to population declines. We describe two studies that examine pronounced effects on two major fish species of importance to fisheries managers – lake sturgeon (*Acipenser fulvescens*) and largemouth bass (*Micropterus salmoides*). Lake sturgeons occur throughout the entire Great Lakes region and historically are an economically important fish. Traditional stressors such as habitat alterations, water quality and overfishing have contributed to population declines, but the importance of pollution has been difficult to document because of a lack of information on sensitivity of this species. We exposed newly fertilized lake sturgeon embryos to graded concentrations of either PCB 126 or TCDD and monitored lethal and sublethal effects on development. We observed significant pathologies in fish exposed to both PCB 126 and TCDD, with reduced swimming endurance in fish exposed to PCB 126. Lake sturgeon exhibited a 37- 45 fold greater sensitivity to PCB 126 and 16 - 20 fold greater sensitivity to TCDD than Scaphirhynchus species. Largemouth bass are a prized sport fish and widely distributed across North America, thus receive exposure to many sources of water pollution. In this study we exposed adults to an environmentally relevant concentration of ethinyl estradiol for 18 months in an outdoor pond. Exposed males developed a condition of intersex (eggs in the testes) at a rate 6-fold greater than control fish. Developmental pathologies, reduced swimming endurance, endocrine disruption and reduced survival are just some of the factors that contaminants negatively impact. Integrating contaminant risk into other more traditional population stressor assessments will lead to a more effective analysis of population dynamics. jcandrl@usgs.gov

Plenary 10 11:45 a.m. March 25, 2015	**BABY STEPS AND HURDLES ALONG THE PATH TO UNDERSTANDING AND VALUING OUR GOLDEN GEESE (I.E. RIVER ECOSYSTEM SERVICES).** Ken Lubinski, U.S.Geological Survey, retired, Brownsville, MN. *INVITED SPEAKER*

Recent advances in quantifying and applying our knowledge of ecosystem services are both inspirational and cause for concern. On one hand, scientists like Costanza, Daily, and others have identified a much needed concept to emphasize the links between ecosystem, economic, and social conditions, with real potential to change the way society perceives and values ecosystems. Tockner and others have done the same for services provided specifically by river ecosystems. But from the perspective of innovative application, examples remain scarce, especially for large systems with complicated governance mechanisms. At the U. S. federal level, the most common, and perhaps less-than inspired, application of river ecosystem services information seems to be in increasing agency flexibility to decide which projects are appropriate for ecosystem restoration or flood mitigation funding. At worst, quantifying (including monetizing) ecosystem services threatens to become mostly a short-lived exercise in codifying values so that agencies can do their accounting consistently. Will this help society at large better understand and appreciate how dependent we are on our ecosystems? Are we preparing future river communities, for example, to take the filtering/water clarification capacity of thousands of native mussels into account when a proposed development threatens to disturb a river bottom? A few studies and discussions about river ecosystem services have dotted the science and management landscape of the Upper Mississippi River. This presentation describes several efforts to quantify the river ecosystem production functions that underlie common services, and compares the current plans of three federal agencies to incorporate ecosystem services information into their decision-making processes. kenlubinski@outlook.com

SESSION 17	**LARGE RIVER MANAGEMENT ISSUES Wednesday, March 25, 2015 | 1:40 p.m. – 3:20 p.m. Grand Ballroom A**
Platform 81 1:40 p.m. March 25, 2015	**EFFICIENCY AND EFFICACY OF USING SIDE SCAN SONAR AND GROUND TRUTHING TO ASSIST IN LARGE SCALE MUSSEL SURVEYS.** Donald Craig Fortenbery and Charles Albert Morgan III. Mainstream Commercial Divers, Inc., 322 C. C. Lowry Drive, Murray, KY.

Side scan sonar surveys have been used in recent years to delineate different types of river bottom substrate in many larger rivers. While side scan imagery cannot be used to find mussels directly, these surveys can often be used to determine the presence and location of substrates that are less than ideal in regard to mussel habitat. For this purpose, ground truthing surveys are typically used in conjunction with side scan imagery to classify those substrates and provide a complete determination of the substrate's composition. Additionally, short duration qualitative mussel surveys can be performed at each ground truthing location, which is useful in ascertaining the relative abundance and distribution of mussels in each substrate area. One of the many applications of this side scan sonar/ ground truthing method involves the river bottom dredging industry, which generally leases large sections of river, often of many miles in length. Large areas such as these are costly in both time and resources to perform traditional mussel surveys, and much of that time is spent searching areas where mussels likely do not reside, such as in substrates to which they are generally unsuited. Side scan sonar and ground truthing surveys can be used to quickly determine which portions of a particular river bottom are not ideal for mussel habitat, such as unstable shifting sand, and which substrates are likely ideal. In this way, dredging companies can be given access to those non-ideal substrates, which they typically prefer for dredging, while avoiding the ideal ones, and malacologists have a much better idea of where to focus their time and efforts insofar as quantitative and qualitative mussel surveys. charlie@mainstreamdivers.com

Platform 82 **2:00 p.m.** **March 25, 2015**	**EFFECTS OF UNDERWATER BLASTING PRESSURES ON THE FRESHWATER MUSSEL, *AMBLEMA PLICATA*.** Gregory N. Anderson[1], Thomas M. Keevin[2], Gregory L. Hempen[2], and David J. Schaeffer[3]. [1]Southern Illinois University-Edwardsville, Edwardsville, IL; [2]U.S. Army Corps of Engineers, St. Louis District, St. Louis, MO 63103, [3]University of Illinois, Urbana, IL.

Freshwater mussels are potentially exposed to underwater blasting during bridge pier removal, dam removal, demolition projects, seismographic studies, and navigation channel maintenance. The effects of underwater explosions on freshwater mussels are unknown. This study was conducted to better understand the effects of underwater explosions on mussels and provide data for impact assessment purposes. Threeridge mussels (*Amblema plicata*) were exposed to 2 kg high-explosive, open-water charges at five distances (2.5, 5.0, 7.5, 10, and12.5 meters) from the blast. The test was replicated (two test shots). Controls were used for each test, receiving the same treatment as experimental animals with the exception of exposure to blast pressures. For the two test shots, mortality at 96 hrs was 67 and 75% at 2.5 meters, 4 and 8% at both 5 and 7.5 meters, and 0% at both 10 and 12.5 meters. Control mortality was 0 and 4%. In comparison, under identical testing conditions, Bluegill (*Lepomis macrochirus*) experienced mortality to a distance of 42.5 meters. The relative immunity of freshwater mussels, when compared to Bluegill, will be discussed in relation to the anatomy of fish/mussels. The study results will be compared to the limited data available for bivalves and other invertebrate species. Blast pressures and mortality from the open-water testing program will be discussed in relation to anticipated pressures from confined construction blasting. Thomas.M.Keevin@usace.army.mil

Platform 83 **2:20 p.m.** **March 25, 2015**	**PRE-RESTORATION SURVEY GUIDES RECOVERY EFFORTS AT MISSISSIPPI RIVER TRAIN DERAILMENT SITE.** Jorge Buening and Nathan Eckert. Genoa National Fish Hatchery, S5631 State Hwy 35, Genoa, WI.

A train derailment along the west bank of the Mississippi River, pool 11, impacted a well-established and diverse mussel bed. An initial survey was conducted to determine the extent of the impact. After completion of the NRDA process a pre-restoration survey was conducted in order to determine the current status of the impact zone and focus restoration efforts. This survey sought to replicate the previous survey to provide an adequate comparison between the two. The survey included 240 ¼M^2 quadrat samples and 5.5 hours of qualitative data collected in four assessment areas. Resulting density indicated a significant decline ($P < 0.05$) in Area I (22.2/M^2 vs. 9.6/M^2) and Area IV (37.4/M^2 vs. 29.9/M^2) and a significant increase in Area III (5.8/M^2 vs. 9.1/M^2). Qualitative data showed an equivalent number of mussels for the overall mussel community (1,064 vs. 999) with no significant changes in species composition between the two samples. Both *Truncilla truncata* and *Quadruala nodulata* were collected in the pre-restoration survey after not being recorded in the initial survey. Pre-restoration survey data will be used to establish target species and goals for restoration efforts. Based on survey results restoration of Iowa's state listed species: *E. lineolata, L. higginsii*, *L. teres, P. sintoxia* and *S. undulatus* is recommended. In addition, the mussel community could benefit from augmentation of individuals whose numbers comprise less than 3% of the overall community including: *Actinonaias ligamentina*, *Arcidens confragosus*, *Lampsilis cardium*, *Ligumia recta*, *Megalonaias nervosa*, *Obovaria olivaria*, *Potamilus alatus* and *Truncilla truncata.* Jorge_Buening@fws.gov

Platform 84 **2:40 p.m.** **March 25, 2015**	**PATTERNS IN RECRUITMENT OF FRESHWATER MUSSELS AS A FUNCTION OF RIVER DISCHARGE.** Patricia Ries[1], Teresa Newton[1], Steve Zigler[1], Roger Haro[2], and Mike Davis[3]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI; [2]River Studies Center, University of Wisconsin-La Crosse, La Crosse, WI; [3]Minnesota Department of Natural Resources, Lake City, MN.

Overall abundance of native mussels has substantially declined in the Upper Mississippi River (UMR). One hypothesis for this decline is the lack or slowing of recruitment, however, minimal research on recruitment is available. Our objective was to estimate the inter-annual variability in recruitment of mussels (defined as mussels ≤ 5 years of age) and explore the potential role of discharge on recruitment. Using a 5-year quantitative dataset on a mussel assemblage in the UMR, a direct assessment and catch-curve analysis were performed to assess recruitment. Direct assessment revealed a significant declining trend in juvenile density and in the percent of species with juvenile representatives over the past 5 years, suggesting weak recruitment. Catch-curve analyses were done for the most abundant species *Amblema plicata*, and for species grouped into equilibrium, and periodic life history strategies. This quantified past recruitment strength of the 1994-2006 cohorts and provided evidence of strong and/or weak year classes. Generalized linear regression models containing July maximum and April minimum discharge explained 64% of the variation in recruitment strength in *A. plicata*. The best model for the equilibrium strategists, short-term brooders with long lifespans and low growth rates, explained 86% of the variation in recruitment and contained the same variables as *A. plicata* but also incorporated the 7-d minimum discharge. For the periodic strategists, long-term brooders with shorter life spans and higher growth rates, the model containing the number of low flow pulses and the mean duration of high flow pulses explained 56% of the variation in recruitment strength. Understanding variation in recruitment dynamics in native mussel assemblages and its relationship to river discharge will be useful in designing effective management strategies to enhance conservation of this imperiled fauna. pries@usgs.gov

Platform 85 **3:00 p.m.** **March 25, 2015**	**SURVIVAL ESTIMATES AND THE LONG TERM DECLINE IN NATIVE MUSSEL POPULATIONS IN LAKE PEPIN, MISSISSIPPI RIVER – THE ROLE OF AN INVASIVE SPECIES.** Rick A. Hart[1], Mike Davis[2], James W. Grier[3], Andrew C. Miller[4], and Zebulin Secrist[2]. [1]U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, TX; [2]Minnesota Department of Natural Resources, Division of Ecological Services, Lake City; [3]North Dakota State University, Department of Biological Sciences, Fargo; [4]US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi.

An impending zebra mussel (*Dreissena polymorpha*) invasion prompted the initiation of a mark-recapture research program in 1996 to measure survival of a native unionid mussel, *Amblema plicata*, in the Lake Pepin reach of the Mississippi River Wisconsin and Minnesota, and the Otter Tail River, Minnesota, USA. In addition, mussel monitoring sites were established in the Mississippi River beginning in 1991 to measure changes in mussel species richness and population density. Zebra mussels invaded the Mississippi River in the early 1990s but were not present in the Otter Tail River, which was used as a study control site. In 1996, 960 and 240 *A. plicata* were marked in the Mississippi and Otter Tail rivers respectively. In 1997, 1998, 1999, 2000, and again in 2013 we recaptured marked mussels. Recovered marked mussels were identified, survival determined, and if alive returned to the substratum. An extensive survey of the area around two of the Mississippi river study areas in 2011 and 2013 revealed no living marked native mussels remaining. By 1997 zebra mussels had colonized all available hard substrate at the Mississippi study sites. Zebra mussels have not colonized our control site in the Otter Tail River where populations of *A. plicata* remained normal and large. In 2013, seventeen years after initial marking, we recovered 73 live marked animals at the Otter Tail site, approximately 30 percent of the 240 originally marked in 1996. This remarkably high recovery rate produced a mean annual survival rate of 97.5%. From 1991 to 2005, the last year we were able to quantitatively sample at the monitoring sites, mussel populations and species richness were reduced in the reaches of the Upper Mississippi River that we studied. Zebra mussels will likely impact other areas, including the Otter Tail River, in their continuing and expanding invasion of North American freshwater systems. rick.hart@noaa.gov

SESSION 18	**CONSERVATION III** **Wednesday, March 25, 2015 | 1:40 p.m. – 3:20 p.m.** **Grand Ballroom B**
Platform 86 **1:40 p.m.** **March 25, 2015**	**EVALUATION OF FLOW AUGMENTATION AS A SHORT-TERM MUSSEL CONSERVATION ACTION IN A SOUTHEASTERN STREAM.** Jason M. Wisniewski[1], Sandy Abbott[2], and Andrew Gascho Landis[1]. [1]Wildlife Resources Division, Georgia Department of Natural Resources, Social Circle, GA. [2]US Fish & Wildlife Service, Georgia Ecological Services, Ft. Benning, GA.

Recurrent and prolonged droughts, coupled with agricultural water withdrawal are threatening mussel populations through stream drying, elevated water temperatures, and low dissolved oxygen concentrations. Augmentation of stream flows via groundwater pumping has been proposed as a strategy to temporarily maintain flows and adequate water quality in reaches with important freshwater mussel populations. We investigated the effects of water augmentation on mussel populations in Spring Creek, Georgia between August 2011 and September 2014. Using capture-mark-recapture methods, we monitored mussel populations in a non-augmented stream reach and two adjacent stream reaches with augmented streamflows. We hypothesized that mussel survival would be higher in augmented reaches than in the non-augmented reach and temporary emigration (burrowing) would be higher in the non-augmented reach than in augmented reaches. Mean survival between sampling occasions was high among all species (0.95-0.98) and did not differ among study reaches. Temporary emigration differed among study reaches but did not support our hypothesis. In contrast to our expectation, temporary emigration increased with increasing stream stage rather than at lower stream stages suggesting that stream flows did not drop below a threshold which would invoke burrowing as a behavioral response. Water temperature was on average 3.8°C cooler and dissolved oxygen was 4.0 mg/L higher in the augmented reaches than in the control reach. Hence, water quality conditions measured during our study indicated that water augmentation in Spring Creek could alleviate thermal and hypoxic stress on freshwater mussels during exceptionally low flow periods. Several factors may be responsible for not observing the hypothesized beneficial effects of water augmentation on mussel survival. Because, mussels within the control reach were able to survive previous drought, this reach may contain sufficient flow during low flow periods and preclude mortality or behavioral responses except under extreme conditions. jason.wisniewski@dnr.state.ga.us

Platform 87 2:00 p.m. March 25, 2015	**A GUILD APPROACH TO DEVELOP ENVIRONMENTAL FLOW RECOMMENDATIONS FOR FRESHWATER MUSSELS USING SPECIES TRAITS**. Kiza K. Gates[1], Caryn C. Vaughn[1], and Jason P. Julian[2]. [1]Oklahoma Biological Survey, Department of Biology and Ecology and Evolutionary Biology Graduate Program, University of Oklahoma, 111 E. Chesapeake St., Norman, OK, USA; [2]Department of Geography, Texas State University, 601 University Drive, ELA 139, San Marcos, TX, USA.

North American freshwater mussels (Unionidae) are a diverse and imperiled fauna that are highly sensitive to flow alterations. Previous attempts to develop environmental flows for mussels have struggled to accommodate their varied habitat requirements and complex life histories. We review what is known about the habitat requirements of mussels, how they can vary among species within a community, and how this variation influences the effectiveness of different environmental flow methodologies. We propose a trait based environmental flow method that addresses the needs of mussel guilds differentiated by their thermal tolerances and reproductive strategies. Used previously for fish, plants and macroinvertebrates, the guild approach groups species by traits and identifies flow requirements of guilds as opposed to entire communities. We apply the guild approach to the mussel fauna of the Kiamichi and Little Rivers in southeastern Oklahoma where differing water management practices have created different bottlenecks impeding mussel recruitment and population persistence. We illustrate how changes in the hydrograph can be made to better meet the seasonal flow needs of differing mussel guilds and their host fish. The guild environmental flow method can provide flow recommendations that cater to the life history and habitat requirements represented within diverse mussel communities. In addition, the method can be adapted among regions where trait data are available or combined with rating models that estimate trait data for understudied species. kizagates@gmail.com

Platform 88 2:20 p.m. March 25, 2015	**MEASURING ECOSYSTEM SERVICES FOR OKLAHOMA FRESHWATER SYSTEMS: A SOCIAL-ECOLOGICAL APPROACH**. Antonio J. Castro and Caryn C. Vaughn. Oklahoma Biological Survey, University of Oklahoma, Norman, OK 73019.

Healthy freshwater ecosystems provide important ecosystem services (the benefits that people obtain from ecosystems) to society. We performed an interdisciplinary valuation to address the supply and demand of a suite of ecosystem services provided by the Kiamichi River watershed in the south-central U.S., a region with intense water conflict. Our approach pays special attention to assessing the impact of water flows as main driver affecting the provision of ecosystem services. The valuation included metrics that quantified the biophysical capacity of the watershed to provide services (supply side) to socio-cultural and economic valuations to explore the social demand for services. We quantified the supply of ecosystem services provided by mussel species (e.g., biofiltration and nutrient recycling and storage), which at the watershed level contribute to water purification and carbon sequestration. We identified and characterized ecosystem service beneficiaries according to how they use, enjoy and value services. We analyzed the factors underlying sociocultural and economic support for maintaining these services. Finally, we used a willingness to pay approach to identify the economic value of ecosystem services and explored potential biases in water management based on social and cultural attributes. We found that recent droughts led to a decrease in ecosystem services provided by mussels and to watershed-level ecosystem services. Beneficiaries identified water quality and habitat for species as the most important and valuable watershed services, but results differed between user groups and identified potential conflicts. Our study demonstrates that it is useful to quantify both the supply of and the social demand for ecosystem services in watershed management. We suggest that managers can use this approach to resolve conflicts by examining beneficiaries attitudes towards specific ecosystem services and including ecological and economic values of ecosystem services. acastro@ou.edu

Platform 89 **2:40 p.m.** **March 25, 2015**	**ADVANCED AGRICULTURAL WATER CONSERVATION MEASURES AND THEIR EFFECT ON FRESHWATER MUSSEL COMMUNITIES OF THE LOWER FLINT RIVER BASIN.** Nathalie Smith, Stephen Golladay, Brian Clayton and David Hicks. Joseph W. Jones Ecological Research Center, Newton, GA.

Declines in freshwater mussel populations of the lower Flint River Basin (FRB) in southwestern Georgia appear to be associated with periodic droughts and increased withdrawal for agricultural water use. Concerns about stream health and recognition of the need to manage water efficiently led to the development of Advanced Agricultural Water Conservation Measures (AAWCM). The Flint River Soil and Water Conservation District has worked with partners in deploying ten demonstration sites designed to maximize irrigation efficiency and offset the impact of low-flow conditions on aquatic-based ecosystems. In 2012 and 2014, we examined the effects of operational AAWCM installations on in stream habitat, flow and mussel populations in two major tributaries of the lower Flint River Basin: Spring Creek and Ichawaynochaway Creek. Study reaches were positioned upstream, adjacent to, and downstream of AAWCM sites. Compared to historic mussel surveys (1999/2001) there was an overall decline in mussel abundance. In 2014, Spring Creek mussel abundance increased through recruitment at sites adjacent to AAWCM farms and at two of three downstream locations. Limited recruitment in Spring Creek appeared related to reduction in drought conditions and more normal growing season stream flows. Ichawaynochaway Creek mussel abundance remained constant or decreased at all sites. Historic surveys noted 2-11 mussel species at sampling sites compared to 2014 surveys that noted 0-8 species. Abundance also declined from 8-1028 individuals per 100m reach to 0-629 individuals. Endangered species were rare at all sites and surveys. With ongoing declines in freshwater mussels, a shared goal should focus on the innovative water conservation strategies and improved efficiency. Our results suggest that restoration of growing season flows could result in reproduction of some mussel species. nsmith@jonesctr.org

Platform 90 **3:00 p.m.** **March 25, 2015**	**INVESTIGATION OF FRESHWATER MUSSEL GLOCHIDIA PRESENCE ON ASIAN CARP AND NATIVE FISHES OF THE ILLINOIS RIVER.** Sarah A. Douglass[1], Alison P. Stodola[1], Andrea K. Fritts[2], and Rachel M. Vinsel[1]. [1]Illinois Natural History Survey, University of Illinois Urbana-Champaign, 1816 S. Oak Street, Champaign, Illinois; [2]Illinois Natural History Survey, Illinois River Biological Station, 704 N. Schrader Ave., Havana, IL.

Densities of Asian carp (Silver and Bighead) in Illinois rivers are among the highest in the world and glochidia may inadvertently attach to these species. Asian carp have been reported to serve as fish hosts to freshwater mussels in their native territories. However, no one has conducted research on the potential for Silver, Bighead, or Black Carp to host North American freshwater mussels or if they serve as reproductive "sinks". In this preliminary investigation, native fishes and non-native species—Silver, Bighead, and Common Carp—were collected from the Illinois River during summer of 2014. In addition, Silver and Bighead Carp gills were collected from several major tributaries to the Illinois River. By collecting native fish and non-natives, we intend to document that glochidial release did occur and were available to attach to Asian carp. Preserved fins, tail, and gills of native and non-natives were observed, of which gills were first treated with potassium hydroxide (KOH). An initial KOH test on multiple-sized gills suggested at least 20 minutes in 5% KOH to increase transparency of preserved gills, especially for medium and large-sized gills. Although transparency became apparent in small gills in less time at 5% KOH, intactness and greater transparency still occurred at 20 min. Our primary objective is to evaluate the potential presence of glochidia on non-native fishes in the Illinois River system; if found, this will be the first documented record (for Silver and Bighead Carp) in North America and would provide great incentive to pursue further studies to elucidate if Asian carp could serve as a successful host fish for native mussels or if they are serving as reproductive sinks, a possibility that could have a major impact on the future stocks of currently imperiled freshwater mussels. sabales@illinois.edu

SESSION 19	OUTREACH IN NATURAL RESOURCES Wednesday, March 25, 2015 | 3:40 p.m. – 5:00 p.m. Grand Ballroom A
Platform 91 **3:40 p.m.** **March 25, 2015**	**INTRODUCING THE MISSOURI STREAM TEAM ACADEMY: ENGAGING CITIZENS IN AQUATIC CONSERVATION THROUGH EDUCATION AND STEWARDSHIP.** Amy Meier, Missouri Department of Conservation, Jefferson City, MO.
The Missouri Stream Team Program is a working partnership of citizens who are concerned about Missouri streams and is sponsored by the Missouri Department of Conservation, Missouri Department of Natural Resources, and the Conservation Federation of Missouri. The Stream Team Program's three primary goals are education, stewardship, and advocacy for healthy waterways. Volunteers help achieve these goals through a number of on-the-ground activities such as litter pickups, water quality monitoring, and tree planting. Throughout the history of the Program, volunteers' interest in technical knowledge of watershed dynamics and stream biota increased as their involvement and exposure to the Program increased. As a result, the Stream Team Academy was initiated in 1997 to provide the opportunity for citizens to gain a greater understanding of stream-related issues. The Academy was designed as "a university without walls" and includes classroom and field/lab components to help enhance citizens' stewardship and advocacy efforts. Educational opportunities through the Academy also provide the potential for volunteers to participate in additional stewardship activities on the ground alongside professional biologists. The Stream Team Program is currently comprised of over 4,000 active Teams across the state with participation by over 80,000 volunteers annually. To date, Academy workshops featuring 23 different stream-related topics have been attended by nearly 1,400 volunteers, and continue to develop as new topics of interest emerge. Amy.Meier@mdc.mo.gov	
Platform 92 **4:00 p.m.** **March 25, 2015**	**IS THERE AN APP FOR THAT? DEVELOPMENT OF A FRESHWATER MUSSEL IDENTIFICATION WEBSITE AND MOBILE DEVICE APP.** Susan Rogers Oetker[1], Arthur E. Bogan[2], Stan Martin[3], Jon Sundin[3], John L. Harris[4], Nathan A. Johnson[5], and Charles Randklev[6]. [1]U.S. Fish and Wildlife Service, Atlanta, GA; [2]North Carolina Museum of Natural Sciences, Raleigh, NC; [3]Science Apps L3C, High Point, NC; [4]Department of Biological Sciences, Arkansas State University, Jonesboro, AR; [5] U.S. Geological Survey, Southeast Ecological Science Center, Gainesville, FL; [6]Texas A&M Institute of Renewable Natural Resources, College Station, TX.

The Freshwater Mollusk Conservation Society (FMCS) has been engaged in an ongoing effort to develop a mussel identification app for smartphones. At long last, the first version will be released to the membership for beta testing. Rather than using a dichotomous key, the app is based on location and a matrix of shell characteristics; the user will select the characters they can identify based on their specimen, and the app will return a list of possible species. The app will be available for download onto Android phones at this time, and it will also be accessible on the web, with subsequent development for iPhones. We request the membership to download the app, test it, and provide us with suggested changes, comments, and additional photographs. Eventually this app will be linked to the Freshwater Mussel Atlas, which will contain information about freshwater mollusks found in Canada and the United States. FMCS would like to make this information readily available to both specialists and the general public in a user friendly, interactive environment. susan_oetker@fws.gov

Platform 93 **4:20 p.m.** **March 25, 2015**	**DEVELOPING AND IMPLEMENTING A FRESHWATER MUSSEL IDENTIFICATION AND SURVEY METHODOLOGY TRAINING PROGRAM FOR THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STAFF WITH THE GOAL OF THE TRAINEES RECEIVING SURVEY PERMITS BY THE END OF THE PROGRAM.** Timothy W. Savidge. The Catena Group Inc., 410-B Millstone Drive, Hillsborough, NC.

There has long been debate on the level of training and knowledge that is needed to obtain survey/collection permits for Threatened and Endangered freshwater mussel species. Requirements to obtain permits can vary greatly between states, from simply requiring a recommendation letter from an active permit holder, to passing identification tests held by the permitting agency. The Catena Group Inc. was contracted by the South Carolina Department of Transportation to train two of their biologists in mussel identification, particularly the Carolina Heelsplitter (*Lasmigona decorata*), the only mussel species in the state that is federally listed. There are currently 28 other mussel species known to occur in SC, with all of the species occurring within at least one of the river basins known to support the Carolina Heelsplitter, and at least six species may receive federal protection in the near future. One of the conditions for T&E survey permits is the submission of annual survey reports detailing all of the species encountered; therefore, a permit holder must be familiar with all of the species within the range of the target species. We have developed a two-year training program designed to develop proficiency in field survey techniques, habitat evaluation and mussel identification. The program involves a minimum of 72 field days, two visits to the collection at NC State Museum of Natural Sciences, and one visit to the collection at Smithsonian. The program outlines various milestones to be achieved along the way through field and lab testing, and ends with a final exam. The program began in the fall of 2014 and is expected to be completed in the spring of 2016. tsavidge@thecatenagroup.com

Platform 94 **4:40 p.m.** **March 25, 2015**	**FRESHWATER MUSSEL OUTREACH PROGRAMS UTILIZED BY THE GENOA NATIONAL FISH HATCHERY.** Jorge Buening and Nathan Eckert. Genoa National Fish Hatchery, S5631 State Hwy 35, Genoa, WI.

Outreach programs are a means by which an organization can demonstrate the importance of specific programs. They also allow the general public a more in-depth look at why program parameters are established, how they are met, and when they are achieved. Outreach programs allow us to convey the importance of our work to future generations so it is not lost but continues on. Genoa National Fish Hatchery integrates outreach programs with standard culture programs. This is achieved by utilizing volunteer assistance for cage maintenance, mussel and host fish collections, host infestations, and on monitoring surveys. Genoa also involves itself with area schools, children's events (Mississippi River Adventure Days and Youth Outdoor Fest), and environmental organizations (Friends of Pool 9 and Friends of the Upper Mississippi) in order to facilitate its mission and increase awareness about the hatchery. Jorge_Buening@fws.gov

SESSION 20	**BACK TO THE FUTURE: USING ARCHAEOLOGICAL RESOURCES FOR CONSERVATION OF FRESHWATER MOLLUSKS** **Wednesday, March 25, 2015 | 3:40 p.m. – 5:00 p.m.** **Grand Ballroom B**
Platform 95 **3:40 p.m.** **March 25, 2015**	**INTEGRATION OF CURRENT COLLECTIONS, HISTORIC FIELD NOTES, AND MUSEUM RECORDS TO ASSESS LAND USE EFFECTS ON FEDERALLY ENDANGERED OCHLOCKONEE MOCCASINSHELL (*MEDIONIDUS SIMPSONIANUS*).** Jordan Holcomb[1], Matthew Rowe[1], Jim Williams[1], and Sandra Pursifull[2]. [1]Florida Fish and Wildlife Conservation Commission, 7386 NW 71st St, Gainesville, FL; [2] US Fish and Wildlife Service, Panama City Field Office, 1601 Balboa Ave, Panama City, FL.

The federally endangered Ochlockonee Moccasinshell (*Medionidus simpsonianus*), OMS, is a freshwater mussel endemic to the Ochlockonee River basin in Georgia and Florida. Historically, OMS was known from about 10 locations in the Ochlockonee River proper in Florida and Georgia and one location from the Little River in Georgia. The last OMS taken live was in 1995 and many thought this species to be extinct. In 2014, we discovered a population of OMS in the lower Ochlockonee River at six locations downstream of Lake Talquin. We sought to determine possible reasons for disappearance of OMS from the Ochlockonee River upstream and existence of OMS downstream of Lake Talquin. Historic field notes deemed reliable and museum data were used to supplement more recent (post 2005) survey data, identifying 8 discrete sampling locations that produced OMS prior to 1995. ArcHydro was used to generate a watershed for each sampling location. We used these watersheds to clip National Land Cover Dataset (NLCD) land use data to identify land use percentage changes in each watershed over 22 years. Student's t-tests revealed largely minor changes in land use practices in the locations where OMS is extirpated and still exists. Urbanization has had a concomitant increase across all watersheds. Watersheds in which OMS have disappeared contained significantly lower percentages of forested land and greater percentages of agricultural land in 1992 and 2011 than watersheds still harboring OMS. Watershed land use degradation in the upper Ochlockonee River basin has likely contributed to disappearance of OMS upstream of Lake Talquin. Conversely, lower historic watershed disturbance via state and federal land ownership in the lower Ochlockonee River may explain continued OMS survival. Lake Talquin likely filters excess sediment, nutrients, and toxicants from degraded reaches of river upstream, thus benefitting OMS in the lower Ochlockonee River downstream of the lake. Jordan.Holcomb@MyFWC.com

Platform 96 **4:00 p.m.** **March 25, 2015**	**HISTORIC MUSSEL SHELLS ILLUMINATE LEGACY CONTAMINANT PATTERNS OVER THE PAST 1000 YEARS.** Andrea K. Fritts[1], W. Aaron Shoults-Wilson[2], Jason Unrine[3], Mark W. Fritts[1], and Andrew F. Casper[1]. [1]Illinois Natural History Survey, Illinois River Biological Station, Havana, IL; [2]Department of Biological, Chemical, and Physical Sciences, Roosevelt University, Chicago, IL; [3]Department of Plant and Soil Sciences, University of Kentucky, Lexington, KY.

Legacy contaminants can persist in aquatic environments and have substantial impacts on the health of aquatic ecosystems. Potentially Toxic Trace Elements (PTTEs) released by human activity can be especially pernicious since unlike organic contaminants, they do not break down over time. Bivalves are considered ideal organisms to use as biomonitors of PTTEs because of their longevity, filter-feeding habit, and relatively sessile nature. The calcareous shells of freshwater mussels provide a unique opportunity to enhance our understanding of the spatial and temporal variability of PTTE concentrations because divalent metals can be metabolically incorporated into the shell matrix in a manner similar to calcium. We examined historic mussel shells (*Amblema plicata* and *Quadrula quadrula*) that date back to the 1870s for the lower Illinois River and back to the 1950s for the Chicago region. Shells from the modern era and from museum collections were compared against archeological specimens from 1000 A.D., which provided a pre-industrial environmental baseline of metal concentrations prior to large-scale human alterations of aquatic environments. Mussel shells were thin-sectioned along the axis of growth, aged and then analyzed for trace element concentration. Concentrations of As, Co, Cu, Fe, Mn, Ni and Zn were readily detected in most shells, while concentrations of Al, Cr, Hg, Pb, Se and V were below detection in most shells. Cd and U were occasionally detectable. Shells collected at time points ranging from 1897-2013 had significantly higher concentrations of As, Co, and Cu than archaeological shells but significantly lower concentrations of Mn. Samples from 1897 to 2013 also showed a significant positive correlation between concentration and time for Co, Cu, and Fe. Arsenic concentrations appear to have decreased in 2013 samples relative to earlier samples, although this change is not significant. These results indicate the presence of anthropogenic PTTEs and can be used to elucidate historic trends in contamination. afritts@illinois.edu

Platform 97 **4:20 p.m.** **March 25, 2015**	**FRESHWATER MOLLUSK SHELLS AS CHART RECORDERS: THE RECONSTRUCTION OF MODERN AND ANCIENT RIVERINE ENVIRONMENTS.** David L. Dettman. Geosciences Department, University of Arizona, Tucson, AZ 85721.

River management and ecological research often lack detailed historical records of baseline data on aquatic systems. In addition, the study of remote fluvial or lacustrine systems is hampered by lack of detailed historical data on the stability or variability of the hydro-environment. Establishing long term monitoring programs in the latter case requires a long-term and costly research effort. The use of modern mollusk shells as chemical recorders of their local environment can provide researchers with useful data on the recent history of the water bodies under study. Shells can also be recovered from sediments or museum collections to significantly expand the historical record extracted from shell chemistry. Stable isotope ratios of oxygen in shell carbonate respond to the isotopic composition of the water and to temperature, providing a strong contrast between groundwater-buffered fluvial systems and streams dominated by rainfall and runoff. They also establish a seasonal calendar within the shell that can be used to map other chemical tracers on the annual cycle. Although carbon isotope ratios respond to internal factors, such as growth rate and reproduction, they are dominated by variation in food resources and changes in dissolved inorganic carbon in the water body. Stable isotopes can also be measured in periostracum and conchiolin layers in the shell, allowing a direct measure of both carbon and nitrogen isotope ratios of tissue produced by the mollusk in response to changes in the food and nutrient resources. Nutrient loading, agricultural runoff, and aquatic productivity variation can lead to changes in the isotopic composition of organic particulates in rivers ingested by the mollusks, which affect isotope ratios in shell organics. Seasonal variation in diet, shell growth, and runoff/turbidity is demonstrated for the modern and pre-industrial Big Sunflower River (Mississippi) and the modern Tennessee River (Kentucky). dettman@email.arizona.edu

Platform 98 **4:40 p.m.** **March 25, 2015**	**ARCHAEOLOGICAL AND RECENT FRESHWATER MUSSEL FAUNAS IN THE ILLINOIS RIVER BASIN: COMPOSITIONAL VARIATION AND CHANGE.** Robert E. Warren, Anthropology, Illinois State Museum, Springfield, IL.

Malacologists have compiled vital qualitative records of freshwater mussels native to the Illinois River Basin based on historical surveys and museum collections. However, presence-absence data tell us little about the compositions and habitat associations of mussel communities before they were transformed by human impacts during the 19th and 20th centuries. This study uses archaeological shell collections to explore compositional variation among native mussel communities and to develop a proxy baseline for looking at the magnitude of compositional change in recent mussel faunas. The archaeological material includes 49 shell samples from 30 archaeological sites; 50 species are represented in the total sample of 29K identified specimens. The leading dominant species in most samples is either *Amblema plicata* or *Elliptio dilatata*, but five other species predominate in one or more samples. A multivariate ordination of abundance data using detrended correspondence analysis (DCA) orders samples and species along two principal axes of variation. Correlations of sample DCA coordinates with independent variables suggest that compositional variation reflects (1) down-valley geographical differences among mussel communities, (2) local access to a range of aquatic habitats, and (3) cultural selection of one species as raw material for shell artifacts. Mussel samples likely gathered from the Illinois River mainstem show evidence of community variability and habitat associations that are missing in recent mussel faunas. Riffle and shoal habitats are indicated not just in the upper Illinois River, which was historically infamous for its dangerous rapids, but also in the central and lower sections of the valley where reaches of deeper water also occurred. Recent mussel surveys document a significant decline in species diversity during the 20th century, when about half of the river's species were extirpated. Baseline data from the archaeological model indicate there was also a narrowing of mussel community variability and a constriction of habitat associations. warren@museum.state.il.us

FMCS & UMRCC JOINT MEETING – ST. CHARLES CONVENTION CENTER, ST. CHARLES, MISSOURI: MARCH 22 – 26, 2015

Conserving Aquatic Ecosystems – At the Confluence of the Past and Future

POSTER SESSION

Grand Ballroom C/D

Monday, March 23, 2015 | 7:00 p.m. – 11:00 p.m.

Author's Present 7:00 – 9:00 p.m.- Monday, March 23, 2015

*Note: Abstracts are alphabetized by **presenting** author*

Poster 1	**A PRELIMINARY CHECKLIST OF THE AQUATIC GASTROPODS OF KANSAS.** Joseph A. Arruda. Department of Biology, Pittsburg State University, Pittsburg, KS.

There has not been a synthesis of Kansas aquatic gastropod species since the 1959 publication of "A Handbook of Gastropods in Kansas" by A.B. Leonard. Following limited new field collections and updating of species names, a preliminary list of Kansas aquatic snails was generated on which to build a new review. The list was based primarily on considering Leonard, A.B. (1959) and Johnson et al. (2013), but also Burch, J. (1989), Hubendick, B. (1951), Wethington and Lydeard (2007), and Wu et al. (1997). The preliminary list includes 21-26 likely extant species, depending on the evolving nature of aquatic gastropod taxonomy. The list includes the sole Kansas endangered gastropod species (*Pomatiopsis lapidaria*, the Slender Walker snail) and two Kansas threatened species (*Probythinella emarginata*, the Delta Hydrobe and *Pleurocera acuta*, the Sharp Hornsnail). Two other species (*Amnicola limosa* and *Campeloma crassulum*) may exist, but have not been recently collected. Two additional exotic species (*Cipangopaludina japonica*, the Japanese Mysterysnail, and *Cipangopaludina chinensis*, the Chinese Mysterysnail) have been collected in the state. Further collections throughout the state will be needed to better document the distribution and abundance of aquatic snails in Kansas. jarruda@pittstate.edu

Poster 2	**PRELIMINARY CHARACERIZATION OF SURFACE AND PORE WATER QUALITY AS A POTENTIAL STRESSOR TO DWARF WEDGEMUSSEL (*ALASMIDONTA HETERODON*) IN MARYLAND.** Matthew J. Ashton[1], Alfred E. Pinkney[2], Katie M. Kline[3], and Ray P. Morgan II[3]. [1]Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, 580 Taylor Ave. C-2, Annapolis, MD; [2]U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, 177 Admiral Cochrane Drive, Annapolis, MD; and [3]University of Maryland Center for Environmental Science, Appalachian Laboratory 301 Midlothian Road, Frostburg, MD.

Numerous abiotic stressors have been attributed to the decline of North American freshwater mussels. Degraded water quality, particularly concentrations of nutrients and metals in sediment, is especially harmful to some species. We investigated whether degraded water quality may explain the recent reduction in dwarf wedgemussel distribution within Browns Branch, a predominantly agricultural stream of Maryland's Coastal Plain. In Browns Branch, water was sampled at the downstream extents of the current and former dwarf wedgemussel population, approximately 4.6 stream kilometers apart. We also sampled one location in Nanjemoy Creek as a reference because it is predominantly forested and dwarf wedgemussel distribution has not changed over the same time period. Surface and pore water samples were collected approximately monthly at each site from April through November. Preliminary results show 1) expected differences in chemical concentrations between watersheds given concomitant differences in their land use and 2) minor differences between nutrient and ion concentrations within Browns Branch. This suggests that while some chronic water chemistry parameters (e.g., nitrate) were at concentrations considered harmful to aquatic life throughout Browns Branch, they may not explain the change in dwarf wedgemussel distribution. However, we cannot discount the potential impact from acute concentrations of pollutants as we sampled during base-flow or synergistic affects (e.g., unionized ammonia interacting with *Corbicula*) as both are known to effect mussel survival. Designs for a pore water sampling apparatus are also presented. matthew.ashton@maryland.gov

Poster 3	**ASSESSMENT OF A FRESHWATER MUSSEL COMMUNITY AND SHORT DISTANCE TRANSLOCATION IN NORTHERN ILLINOIS.** Sarah J. Baker-Wylie, Jeremy S. Tiemann, Christopher A. Phillips, and Michael J. Dreslik. Illinois Natural History Survey, University of Illinois at Urbana-Champaign, 1816 S. Oak St., Champaign, IL.

Freshwater mussels have undergone dramatic population declines due largely to habitat alteration. To mitigate the effects of anthropogenic habitat disturbance on mussels, short-distance translocations of individuals are commonly used. However, few studies can quantify the success of translocations due to lack of sufficient post-translocation monitoring. Prior to the reconstruction of a bridge over the Kishwaukee River (Rock River – Mississippi River drainage) in northern Illinois, we evaluated the mussel community adjacent to the impacted reach and began to determine the efficacy of short distance translocations as a mitigation tool for threatened/endangered species. Using hand-picking surveys we found the mussel community at the site consisted of 15 species. The community was relatively diverse but was dominated by two species, *Lampsilis cardium* and *Actinonaias ligamentina*. We also recorded 17 *Ligumia recta*, a state threatened species. Using the two common species as a proxy for the co-occurring state-threatened species, we examined apparent survival rates following a short-distance translocation. We marked all individuals using passive integrated transponder (PIT) tags, and released them ~ 200 m upstream of the construction site. We then monitored them monthly from May through October of 2013-2014. We used Cormack-Jolly-Seber models to estimate warm season apparent survival rates. Our data suggests apparent survival is lowest the first month after translocation, and stabilizes thereafter, indicating short distance translocation is a viable tool for species conservation but will not eliminate all mortality from anthropogenic habitat disturbance. sjbaker2@illinois.edu

Poster 4	**EFFECTS OF ANABOLISM VERSUS CATABOLISM ON THE STABLE ISOTOPIC SIGNATURE OF RELOCATED JUVENILE UNIONIDS.** Michelle Bartsch[1], Lynn Bartsch[1], William Richardson[1], Steve Zigler[1], Byron Karns[2], and Brenda Moraska Lafrancois[3]. [1]U.S. Geological Survey, La Crosse, WI; 2National Park Service, St. Croix Falls, WI; [3]National Park Service, Ashland, WI.

Invasions of aquatic non-native species are increasing and can result in catastrophic changes in community and ecosystem function. Recent invasion of the St. Croix National Scenic Riverway (SACN) by zebra mussels (ZM: *Dreissena polymorpha*) is likely to severely impact the diversity and abundance of the native mussel populations. Juvenile *Lampsilis siliquoidea* were deployed in cages for 82 d in areas of low (19/m^2, Stillwater), medium (143/m^2, St. Croix Bluffs), and high (915/m^2, Prescott) ZM density. Seston, chlorophyll *a*, and total suspended and volatile solid samples (<10 µm and whole water fractions) were collected monthly (July, August, and September) to assess the food quality and quantity available for juveniles. Overall, recovery of juveniles was 48% at Stillwater, 96% at St. Croix Bluffs, and 100% at Prescott and survival of recovered juveniles was 98, 99, and 100%, respectively. Growth was significantly different among sites ($P < 0.001$) with lowest growth occurring at St. Croix Bluffs and the highest at Prescott. There were significant isotopic ($\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$) differences between juveniles and ZM at all three sites. At St. Croix Bluffs, juveniles were depleted in $\delta^{15}N$ by 2.0‰, enriched in $\delta^{13}C$ by 0.6‰, and depleted in $\delta^{34}S$ by 1.1‰ compared with ZM. At Stillwater and Prescott, juveniles were enriched in $\delta^{15}N$ by <0.47‰ and depleted in $\delta^{34}S$ by <0.45‰ compared with ZM. ZM densities did not appear to directly affect juvenile growth but may indirectly affect their food resources. mbartsch@usgs.gov

Poster 5	**SURVIVAL OF FRESHWATER MUSSELS RELOCATED DURING THE WEST MILTON DAM REMOVAL AND IMPOUNDMENT DRAWDOWN.** Elizabeth Bockstiegel and Cody Fleece. Stantec Consulting Services Inc., 11687 Lebanon Road, Cincinnati, OH.

Dam removal is increasingly used as a tool to restore impaired systems to riverine conditions; however, freshwater mussels can become stranded in exposed substrate during the impoundment drawdown. Stranded mussels can be collected and relocated as a strategy to minimize mortality due to stranding and desiccation during dam removals, but little is known about the survival rate of mussels after a relocation effort. The West Milton Dam in Miami County, Ohio was removed in October and November 2014, and nearly 3,000 mussels were collected and moved to a site upstream of the former impoundment. We PIT tagged 125 mussels from the upstream site and tagged 125 stranded mussels that were relocated to the upstream site. We will conduct a survey next year to determine survivorship of the relocated mussels compared to the resident mussels. These data will be used to inform decisions regarding the means and methods used in dam removals in an ongoing effort to minimize adverse effects from dam removals. Liz.Bockstiegel@stantec.com

Poster 6	**THE GUADALUPE RIVER: AN ENIGMATIC MUSSEL STRONGHOLD IN SOUTHCENTRAL TEXAS.** Ben R. Bosman[1], Charles R. Randklev[1], and Clint Robertson[2]. [1]Institute of Renewable Natural Resources, Texas A&M University, College Station, TX. [2]River Studies Program, Texas Parks and Wildlife Department, San Marcos, TX.

The Guadalupe River flows 230 miles from the headwaters in Kerr County to the Gulf of Mexico and is impounded many times along its length by flood control and small hydropower dams. Both it and major tributaries flow through the rapidly urbanizing I-35 corridor between Austin and San Antonio, and rural landscapes dominated by pastureland and oil and gas extraction. Despite these impacts, sections of this river are known to support populations of three state listed species that have also been petitioned for federal listing: *Fusconaia mitchelli* (false spike), *Quadrula aurea* (golden orb), and *Quadrula petrina* (Texas pimpleback). However, the current status and distribution of these species in the Guadalupe River is unknown, particularly from Gonzales to Victoria, Texas. The focus of this ongoing study is to determine the status of these species as well as provide a baseline for future monitoring in this river section. To date, a total of 222 person-hour searches and 1,140 ¼m^2 quadrats have been sampled, yielding 17,954 mussels representing 13 species from 57 sites between Gonzales and Cuero, Texas. Of that total, 5,750 individuals were state listed species, but surprisingly, this river lacks several widespread species found in adjacent basins. The preliminary results from this study indicate that the lower Guadalupe continues to harbor a fairly intact mussel assemblage with stronghold populations for several state threatened species. As such, increased conservation efforts are needed in the lower Guadalupe River to protect what is probably one of the most impressive mussel faunas in Texas to date. Ben.Bosman@ag.tamu.edu

Poster 7	**CAPTIVE PROPAGATION OF ALABAMA PEARLSHELL (*MARGARITIFERA MARRIANAE*, R.I. JOHNSON, 1983).** Michael L. Buntin, Todd B. Fobian, and Paul D. Johnson. Alabama Department on Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, AL.

Margaritifera marrianae, listed as endangered under the Endangered Species Act in 2012, currently persists in 5 highly fragmented populations in Conecuh River drainage. Almost nothing is known about its reproductive biology or host fishes. Gravid female *M. marrianae* were collected in March 2012 and 2013 and brought back to the Alabama Aquatic Biodiversity Center (AABC) for host trials. The 2012 host trial consisted of two infections of 20 fish species. Speckled Madtom (*Noturus leptocanthus*) and Redfin Pickerel (*Esox americanus*) yielded a small numbers of transformed juveniles. Transformation rates were insufficient to consider either a primary host. The 2013 trial testing 13 fishes and 2 amphibians was conducted almost entirely in water sourced near the mussel broodstock locality. Because Alabama Pearlshell typically occurs in small streams with very low hardness, utilizing source water in host trials minimized water chemistry changes prior to glochidial encystment. Of 15 potential host species, only a single Redfin Pickerel (1 of 2) produced metamorphosed juveniles (n = 310, 35–45 d post infection). Juveniles were placed in small containers containing fine sediment and filtered pond water supplemented with commercially supplied maricultured algae. Water and sediment were changed weekly for 4 months then twice weekly afterwards. Attempts to transition *M. marrianae* to traditional mussel culture systems (upwellers and submerged sediment trays) resulted in complete mortality within 2 wks. Currently, 168 juveniles remain in culture and range from 1.5 -3 mm length. Though some success has been demonstrated in documenting the reproductive life history of Alabama Pearlshell, natural host fish relationships remains largely unknown and juvenile culture protocols are still under development. An additional host trial is scheduled for spring 2015. Michael.Buntin@dcnr.alabama.gov

Poster 8 *Student Poster*	**ENVIRONMENTAL DRIVERS OF SHELL SHAPE IN A FRESHWATER GASTROPOD FROM INLAND LAKES AND COASTAL LAKE MICHIGAN.** Kandis R. Cazenave[1] and David T. Zanatta[2]. [1]College of Forest Resources, Mississippi State University, 775 Stone Blvd., Mississippi State, MS; [2]Department of Biology, Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI.

Elimia livescens is a freshwater gastropod common in the Great Lakes region. We examined the correlation of shell shape of *Elimia livescens* from along the shoreline of Lake Michigan (4 sites) and three inland lakes on Beaver Island and Manitou Island (8 sites) to several environmental variables. Environmental variables included water temperature, pH, turbidity, dissolved oxygen, specific conductance, collection depth, depth of soft sediment, percent composition, shoreline slope, and fetch length. Procrustes superimposition was used to control for size differences between individual snails. Canonical Variates Analysis (CVA) found significant differences in shell shape among the sites sampled from inland lakes and those on the Lake Michigan shoreline. An assignment test based on the CVA found that individual snails could be 62.8% correctly assigned to their site of origin and 83.3% correctly assigned to their lake of origin. CVA axes were tested for correlations with the environmental variables. Shell shape in *E. livescens* correlated most significantly with fetch length. Higher fetch lengths produce higher energy wave action and may result in a larger aperture, more globose shape, and lower spire in individuals (better for anchorage). Lower fetch lengths produced lower energy wave action and may result in a smaller aperture, more elongate shape, and higher spire (better for navigating above soft sediment). It appears that similar environmental processes to those documented in classic studies on marine snails affect shell shape in freshwater snails in similar ways. We suggest that morphometric plasticity is a critical process in regional adaptation and success among *E. livescens*. krc219@msstate.edu

Poster 9 *Student Poster*	**HOTSPOTS OF UNIONID BIODIVERSITY IN EAST TEXAS.** Gina Cerbie[1], Ashley D. Walters[1], Neil B. Ford[2], and David J. Berg[3]. [1]Department of Biology, Miami University, Oxford, OH; Department of Biology, University of Texas at Tyler, Tyler, TX; [3]Department of Biology, Miami University, Hamilton, OH.

Texas contains a high diversity of freshwater mussels belonging to the family Unionidae, with a unique composition in the eastern part of the state. However, with increasing population size and water demands, east Texas rivers are threatened with habitat alteration as a result of reservoir construction. In order to identify hot spots of biodiversity, we utilized multiple abiotic variables and the ecological niche modeling software MAXENT. We modeled the habitat suitability of 30 mussel species throughout the eastern part of the state. Only models with AUC > 0.75 were incorporated into subsequent analyses. All useful habitat suitability maps were overlaid in ArcMap and areas with the highest habitat suitability scores were identified. Results indicate that soil type and landcover were important predictors of habitat suitability. Additionally, the upper Neches River within the Big Thicket National Preserve contains the highest quality habitat for the greatest number of unionid species. This segment is classified as a wild and scenic river, indicating that it is free of many impoundments and pollution. The preserve is surrounded by bottomland hardwood forests mostly unaffected and unaltered by anthropogenic activities, making it suitable habitat for a variety of unionid species. More hotspots were identified along the Trinity River which lies west of the Neches River. Hotspots represent areas that have highly suitable habitat for unionid species so protection efforts should be focused on these places. Our results are useful to inform conservation and management strategies for this imperiled fauna. cerbiegm@miamioh.edu

Poster 10	**TESTING TWO THEORIES OF LONGITUDINAL STRUCTURE IN FRESHWATER MUSSEL ASSEMBLAGES OF AN AGRICULTURALLY DOMINATED WATERSHED.** Amanda J. Chambers and Daelyn A. Woolnough. Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mt. Pleasant, MI.

In lotic ecosystems, there is a comprehensive understanding of how changes in the physical environment translate into changes in biota along a continuum from the headwaters to the mouths of rivers. Several patterns can be observed with regard to the downstream succession of species, but continual addition and biotic zonation are among the most cited aquatic assemblage theories. Patterns in assemblage structure are influenced by natural variation in the landscape and by anthropogenic disturbances. Like other riverine organisms, unionids exhibit longitudinal patterns in distribution and abundance; however, the environmental variables that structure mussel assemblages are poorly understood. This study examines the patterns and determinants in the longitudinal structure of freshwater mussel assemblages in the Pine and Chippewa rivers, Michigan, USA. A stratified random design based on differences in surficial geology has been developed to sample mussels at 56 sites (28 per river). Mussels will be quantitatively surveyed to assess differences in density and diversity among sites and between rivers. Analyses of mussel health (e.g., glycogen and fatty acid concentrations) will be conducted in an attempt to gain a mechanistic understanding of the factors influencing mussel distribution. Additionally, GIS analyses will be used to determine which landscape-scale factors explain the most variation in mussel assemblage structure. Due to its hierarchical influence over a number of instream variables, surficial geology is expected to explain patterns of mussel assemblage structure in both rivers; with continual addition occurring within surficial geologic strata and biotic zonation being observed in reaches influenced by nutrient inputs. Furthermore, it is hypothesized that the condition of mussels downstream of anthropogenically disturbed sites will be reduced due to deficiencies in mussel diet. Ultimately, this study will provide the first assessment of the mussel assemblages in these rivers, while also improving on our understanding of the factors that structure mussel assemblages. chamb3aj@cmich.edu

Poster 11 *CANCELLED*	**DOES EXPOSURE TO DUCK MUSSEL (*ANODONTA ANATINA*) IMMUNIZE BROWN TROUT (*SALMO TRUTTA*) AGAINST THE ENDANGERED FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA*)?** Motiur Chowdhury, Jouni K. Salonen, and Jouni Taskinen. Department of Biological and Environmental Science, University of Jyväskylä, P.O. Box 35, FI-40014 University of Jyväskylä, Finland.

Freshwater pearl mussel (*Margaritifera margaritifera)* is endangered throughout its range of distribution in Europe. In some rivers *M. margaritifera* co-occurs with the duck mussel (*Anodonta anatina)*. Brown trout (*Salmo trutta)* is a suitable fish host for both mussel species. Thus, we tested if the exposure of brown trout to *A. anatina* increases resistance of the fish against *M. margaritifera* glochidia. One group of juvenile brown trout was exposed to *A. anatina* glochidia in late May and another group was kept as control. In late August, when the *A. anatina* glochidia were developed and dropped off from the fish, both the infected and control group were infected by *M. margaritifera* glochidia. The mean number and size of *M. margaritifera* glochidia in both fish groups were evaluated in 4 different time points September, December, May and June. Effect of fish length to *M. margaritifera* glochidiosis was also studied. The mean number of *M. margaritifera* glochidia was significantly lower in the fish previously exposed to *A. anatina* larvae than in the control fish only in the first time point, in September, but not later. Fish length had also a significant positive effect on number of glochidia. No effect of duck mussel exposure on size of glochidia was observed in any time point. Results suggest that cross immunization by exposure to *A. anatina* glochidia may not possess a significant threat for *M. margaritifera* conservation. mdmorach@student.jyu.fi

Poster 12	**MAJOR IONS IN VIRGINIA'S CLINCH AND POWELL RIVERS: ASSESSING ECOTOXICOLOGICAL INFLUENCE ON A NATIVE MUSSEL.** Serena Ciparis[1], Andrew Phipps[1], David Soucek[2], Carl Zipper[3], and Jess W. Jones[4]. [1]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [2]Illinois Natural History Survey, Champaign, IL; [3]Department of Crop, Soils, and Environmental Sciences, Virginia Tech, Blacksburg, VA; [4]U.S. Fish and Wildlife Service, Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA.
The Clinch and Powell rivers, Virginia and Tennessee, are known for high freshwater mussel diversity and endemicity. These rivers harbored at least 55 species historically and 48 are extant; an unparalleled 21 federally endangered mussel species still occur in the two rivers. Various land disturbances, especially coal mining, have led to release of major ions into large reaches of each river in Virginia. These river reaches currently exhibit elevated concentrations of Ca^{2+}, Mg^{2+}, SO_4^{2-}, and HCO_3^- relative to historic levels. In sections of the Clinch and Powell rivers with the highest concentrations of these ions, mussels have been extirpated or populations are declining. One current hypothesis is that elevated levels of major ions are in part responsible for mussel declines. Hence, we assessed effects of major ion concentrations on growth and survival of juvenile *Villosa iris*. Lab cultured 3.5-month old *V. iris* were exposed to waters with environmentally relevant mixtures of major ions in solution for 55 days. The two treatments were designed to mimic worst-case low-flow concentrations of Ca^{2+}, Mg^{2+}, SO_4^{2-}, HCO_3^-, Na^+, K^+ and Cl^- in the Clinch (total concentration =419 mg L^{-1}) and the Powell (total concentration = 942 mg L^{-1}) rivers, respectively. Mussel survival (>90%) in the two treatments showed little variation, and was not significantly different than in the control with lower ion concentrations. Mean growth for both treatments also showed no significant difference relative to the control. The effect of handling mussels at 2 week intervals for growth measurements was examined and found to be negligible and not statistically significant. Results indicate that the effects of major ion concentrations alone may not be the cause of mussel declines in the Clinch and Powell rivers. sciparis@vt.edu	
Poster 13	**A FRESHWATER MUSSEL SURVEY OF THE UNCHANNELIZED LOWER PORTION OF LOCUST CREEK, MISSOURI.** Jane E. Cotton. Missouri Department of Conservation, Fisheries Division, 15368 LIV 2386, Chillicothe, MO.
Locust Creek runs through Pershing State Park and Fountain Grove Conservation Area and is a tributary to the Grand River. The lower 18 miles of Locust Creek has remained unchannelized, rare for a prairie stream in North Missouri. The health of aquatic populations of the lower portion of Locust Creek has been continually threatened by sediment deposition in the stream bed, divergence of flow into a nearby drainage ditch, and the complete cessation of flow in 2007 and again in 2012. Our objectives were to survey the entire length of the unchannelized portion and to document the freshwater mussel species present. During July – September 2012 we surveyed the 18.8 mile portion of Locust Creek from the head cut (UTM: 15 S 480159 4404353) to the confluence with the Grand River (UTM: 15 S 475479 4390807)), and 1 mile of the Grand River from Greenawalt Access (UTM: 15 S 474888 4392356) to one mile upstream (UTM: 15 S 473391 4392981). In total, eleven freshwater mussel species, including both live and freshly dead specimens, were collected in 2012. Five of these species (white heelsplitter, yellow sandshell, fragile papershell, pink papershell, and mapleleaf) were previously documented during earlier survey efforts conducted between 1997 and 2009 at various sites in Locust Creek. Creeper, giant floater, and pondmussel were previously observed but were not seen during this survey. Threehorn wartyback, pink heelsplitter, lilliput, fawnsfoot, pimpleback, and pistol grip were observed for the first time during this survey. The highest species diversity was near the confluence of the mainstem of Locust Creek and Hickory Branch which carries the flow diverted by the head cut. This indicates the need to continue efforts previously made to create a braided channel maintaining critical flow. Jane.Cotton@mdc.mo.gov	
Poster 14	**WATER TEMPERATURE AND GLOCHIDIAL RELEASE AND ENCYSTMENT TIMES IN THE ENDANGERED TAR RIVER SPINYMUSSEL (*ELLIPTIO STEINSTANSANA*).** Chris B. Eads[1], Rachael A. Hoch[2], Robert B. Nichols[3], Tamara J. Pandolfo[4], Jay F. Levine[1]. [1]NC State University, College of Veterinary Medicine, Raleigh, NC; [2]North Carolina Wildlife Resources Commission, Division of Inland Fisheries, Marion, NC; [3]North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, Raleigh, NC; [4]North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, North Carolina State University, Raleigh, NC.

Water temperature is a driving force in freshwater ecosystem processes and is subject to anthropogenic change from a variety of sources. Even relatively small changes in stream temperature could potentially affect ecosystem function. We sought to evaluate how changes in environmentally relevant water temperature affected reproductive processes in the federally endangered Tar River spinymussel (*Elliptio steinstansana*). As part of ongoing propagation efforts, we held adult *E. steinstansana* in a hatchery setting with a natural temperature regime for 7 years and monitored temperature and gravidity or glochidial release. The onset of the time of glochidial release varied by as much as a month from year to year, and mussels were found to be spawning and/or brooding glochidia at temperatures from 15-28°C. The brooding season ranged from mid-March through mid-July. We also evaluated the effects of small changes in temperature on glochidial attachment time on host fish. We monitored glochidial excystment from host fish held at 20, 21, 22, 23, and 24°C in 5 separate trials with each trial testing a separate brood of glochidia. Fish held at 24°C consistently yielded transformation in 13-14 days. Each degree cooler caused an approximate 2-day increase in encystment time. The length of time in which the glochidia were actively excysting from the fish also increased with decreasing temperature. Our results indicate that even small changes in stream temperature can have significant effects on the reproductive efforts of *E. steinstansana*. chris_eads@ncsu.edu

Poster 15	**INNOVATIONS AND ADVANCES IN FRESHWATER MUSSEL PROPAGATION AND RECOVERY AT THE AQUATIC WILDLIFE CONSERVATION CENTER, VIRGINIA.** M.E. Bradley, J.J. Ferraro, S.L.Colletti. Aquatic Wildlife Conservation Center, Virginia Department of Game and Inland Fisheries, 1724 Buller Hatchery Rd., Marion, VA.

Freshwater mussels are some of the most threatened taxa in North America and more than 80 species were once found in Virginia with 42 extant and 7 extirpated species in the Tennessee River drainage in Virginia. Following a spill in the Clinch River in 1998 the Aquatic Wildlife Conservation Center was built to recover species lost or impacted in this drainage. Since its construction, the facility has endeavored to develop new techniques to first propagate then culture these rare species. Recent innovations include a move towards increased seasonal use of natural sources of food through ½ and ¼ acre pond systems. These include systems in the ponds (Floating Upweller Systems and baskets) and systems along the ponds, which employ filtration, that hold both newly transformed juveniles and larger sub-adults. These external systems include upwellers, downwellers and substrate-filled tanks. Juvenile culture has been significantly improved by the outdoor systems resulting in faster growth and improved survival. The systems accommodating newly transformed juveniles have resulted in the first successful culture of *D. dromas* and *L. rimosus* at AWCC as well as the first large-scale grow-out *of Cyprogenia stegaria* and *Lasmigona holstonia*. Survival and growth have also been improved through the transition from flow-through to recirculating RU (rearing unit) systems for the over-wintering of juvenile mussels. Joseph.Ferraro@dgif.virginia.gov

Poster 16	**REPRODUCTIVE BIOLOGY AND REINTRODUCTION OF PALE LILLIPUT (*TOXOLASMA CYLINDRELLUS,* LEA 1868*)* INTO THE DUCK RIVER.** Todd Fobian[1], Michael Buntin[1], Jeff Powell[2], Don Hubbs[3], Jeff Garner[1] and Paul Johnson[1]. [1]Alabama Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, 2200 Highway 175, Marion, AL; [2]United States Fish and Wildlife Service, 1208 Main Street, Daphne, AL; [3]Tennessee Wildlife Resources Agency, Camden, TN.

Toxolasma cylindrellus was listed as endangered by the USFWS in 1976. A middle-Tennessee River Basin endemic, *T. cylindrellus* historically ranged from the Duck River system in central Tennessee to northern Alabama. The species currently occupies 20 km of the upper Paint Rock River system, with only a few live individuals encountered in the last decade. *Toxolasma cylindrellus* is often considered to be one of the most imperiled mussel species in North America. However, one extremely localized healthy population has been discovered in recent years. In 2013, a quantitative survey at the 200 m site in the Estill Fork indicated an estimated current population of approximately 720 individuals. State resource agencies (ADCNR and TWRA) and the USFWS have identified *T. cylindrellus* as a priority for recovery through artificial propagation and reintroduction. *Toxolasma cylindrellus* has rapid glochidial development and mature glochidia can be found from early May to July. Fecundity ranged from about 2,000 to 20,000 glochidia per female. Multiple host trials determined that Northern Studfish (*Fundulus catenatus*), Blackspotted Topminnow (*Fundulus olivaceus*) and Blackstripe Topminnow (*Fundulus notatus*) likely serve as the primary hosts. *Toxolasma cylindrellus* gravid females were found predominantly in very shallow water along stream margins, often near water willow (*Justicia* sp.). This may spatially position the females in such a way that maximizes contact with the primary hosts which often occupy marginal shallows. To date, a total of 802 *T. cylindrellus* have been propagated and reintroduced to one locality on the Duck River, and approximately 1200 additional animals are under culture pending release in 2015. Site selection followed flow and oxygen concentration improvements and habitat restoration in the Duck River which have been underway since 1991. The released mussels were tagged and will be monitored in 2015. Additional Duck River releases are planned in an effort to establish self-sustaining populations and improve genetic diversity and other reintroductions will be carried out in other reaches within the historical range of this species. Todd.Fobian@dcnr.alabama.gov

Poster 17	**COMPARISON OF REPRODUCTION AND HOST FISH AMONG POPULATIONS OF RABBITSFOOT, *QUADRULA CYLINDRICA CYLINDRICA*.** Todd Fobian[1], Chris Barnhart[2], and Bryce Maynard[2]. [1]Alabama Wildlife and Freshwater Fisheries, Marion AL; [2]Missouri State University, Springfield, MO.

Rabbitsfoot (*Quadrula c. cylindrica*) formerly occurred throughout the Ohio, Cumberland, Tennessee, and lower Mississippi River drainages. The species has been lost from about 64 percent of its historical range, and remaining populations are generally small and isolated, leading to recent federal classification of rabbitsfoot as threatened. We compared fish hosts, fecundity, glochidia morphology, and reproductive timing at sites including the Paint Rock River in northern Alabama, the Black River in northeastern Arkansas and the Spring River in western Missouri and eastern Kansas. Laboratory tests identified cyprinid hosts including *Cyprinella venusta, C. spiloptera, C. camura, C. lutrensis, Luxilus cardinalis, L. chrysocephalus, Lythrurus fasciolari* and *Notropis atherinoides*. Fecundity ranged among populations from about 50,000 to 169,000 larvae per female and was highest in the Black River, where glochidia were significantly smaller than in the Spring or Paint Rock. The brooding period varied widely among rivers and was correlated with differences in the average timing of the fall of hydrograph in spring and summer. Rabbitsfoot brooded in the Paint Rock River from April to mid-May, in the Black River in June, and in the Spring River from July to early August. Anecdotal accounts from multiple observers indicate that rabbitsfoot is unusually mobile and that females move into shallow water during the brooding period, perhaps to more effectively encounter host fish. The distinctive morphology of rabbitsfoot may be an adaptation to these movements. Disturbance of shallow water habitats by flow fluctuations, channel modifications, and other anthropogenic factors could have unusual impacts on reproduction in this species. Differences in reproductive timing, glochidia morphology, and fish host use indicate that rabbitsfoot populations should be treated as separate management units possessing significant biological diversity. Todd.Fobian@dcnr.alabama.gov

Poster 18 *Student Poster*	**USE OF MOLECULAR BAR-CODING TO IDENTIFY CRYPTIC MUSSELS IN APPALACHIAN MOUNTIAN STREAMS.** Thomas Franklin[1], Jason Mays[2], and Michael M. Gangloff[1]. [1]Appalachian State University, Boone NC; [2]US Fish & Wildlife Service, Asheville NC.

Morphological and geographic range-based diagnoses of freshwater mussel taxa may be difficult given the extreme phenotypic plasticity exhibited by many species and the uncertainty of natural range boundaries. Molecular tools offer a fast, cost-effective method for both verifying problematic identifications, resolving geographic range boundaries and potentially identifying introduced populations. We used a molecular bar-coding approach to examine disjunct populations of *Lasmigona subviridis* (Green floater) and *Strophitus undulatus* (Creeper) in the French Broad and New River drainages in western North Carolina. The upper New River *L. subviridis* population is perhaps the last extant population of this species in the Interior Basin and its disjunct distribution compared to its widespread occurrence on the Atlantic Slope has led some authors to consider this an introduced population. *Strophitus undulatus* is known from a number of Interior and Atlantic Slope drainages but populations in the upper French Broad exhibit a distinctly compressed shell morphology that is more similar to *S. connasaugaensis* and *S. subvexus* than to typical *S. undulatus*. Genomic DNA was extracted from tissue swabs as well as adductor tissue samples. We amplified portions of the mitochondrial COI gene then compared sequences to data on Genbank and our supplemental datasets. New River *L. subviridis* exhibited a single haplotype and were closely related to Atlantic Slope conspecifics. These data are consistent with an introduced or highly bottlenecked population. *Strophitus undulatus* populations in the French Broad were closely related to other populations in the Interior Basin but relatively distant from populations on the Atlantic Slope. Although these results are not necessarily surprising, they were generated over the course of several weeks at very little cost illustrating that questions to important biogeographic questions can now be obtained within time frames and costs that are consistent with shrinking budgets and growing responsibilities of resource management agencies. franklintw@email.appstate.edu

Poster 19	**GROWTH PATTERNS OF FRESHWATER MUSSELS OF THE ILLINOIS RIVER OVER THE PAST 1000 YEARS.** Andrea Fritts[1], Mark Fritts[1], Wendell Haag[2], Andrew Rypel[3], Jason DeBoer[1], and Andrew Casper[1]. [1]Illinois Natural History Survey, Illinois River Biological Station, Havana, IL; [2]Center for Bottomland Hardwoods Research, US Forest Service, Oxford, MS; [3]Wisconsin Department of Natural Resources, Madison, WI.

The shells of freshwater mussels provide a unique opportunity to conduct investigations of historical changes in aquatic ecosystems. Mussels deposit annual growth rings in their calcareous shells, much like tree growth rings, so that shells from archeological and museum collections can serve as records of long-term environmental change over the past 1000 years. We used sclerochronology techniques to evaluate changes in age-and-growth patterns in two mussel species collected from the Illinois River near Havana, IL from 1894-2013, as well as archeological specimens dated to 1000 years before present. Von Bertalanffy analyses indicated that modern animals are growing at a 50% greater rate and reaching a maximum size that is 20 mm larger than their 1894 counterparts. By studying changes in the growth of mussels, we can better understand the dynamics of aquatic systems and how freshwater mussel populations have responded to landscape level changes over the past century and beyond. afritts@illinois.edu

Poster 20	**EGG LAYING IN THE PLEUROCERID *LITHASIA ARMIGERA* (SAY, 1821) – A WINTER'S TALE.** Trisha Gibson[1], Jacqualyn Halmbacher[1], Jeremy Tiemann[2] and G. Thomas Watters[1]. [1]Ohio State University and Columbus Zoo and Aquarium, Columbus, OH; [2]Illinois Natural History Survey, Prairie Research Institute at the University of Illinois, Champaign. IL.

The pleurocerid snail *Lithasia armigera* (Say, 1821) is a globally vulnerable freshwater snail in the upper Cumberland, Ohio, and Tennessee river basins. This species was one of several impacted by a chemical spill on the Ohio River mainstem near Marietta, OH. Mitigation efforts to restore the species include propagating the snail in captivity for release into the wild. Specimens of *L. armigera* were collected in October, 2013, from a newly discovered population in the Mississippi River near St. Louis, Missouri. These were maintained at the Columbus Zoo & Aquarium Freshwater Mussel Research Facility near Shawnee Hills, Ohio, in 75 L glass aquaria with flow through river water and natural sunlight. Numerous egg masses were deposited on the aquarium glass beginning on February 4, 2013, at a water temperature of 5.7 C . Eggs masses consisted of several back and forth passes of gelatinous material in which were embedded several hundreds of eggs in 2-3 parallel rows. Eggs were laid continuously well into May. Some eggs were artificially warmed to ca. 24-25 C whereas others continued in ambient temperatures. Regardless of treatment, eggs hatched after 3-4 weeks once water reached ca. 15 C suggesting hatching occurred when a threshold temperature was reached rather than after a set duration. Most pleurocerids deposit eggs during the summer but our previous work did not observe summer egg laying in this species. Egg laying during the winter in near freezing temperatures was unexpected and may represent a novel adaptation. watters.1@osu.edu

Poster 21 *Student Poster*	**THE EFFECT OF SCULPTURING ON THE ACCURACY OF EXTERNAL SHELL AGING FOR FRESHWATER MUSSELS.** Andrew R. Glen, Leslie K. Crawford, Matthew C. Schrum, and Amanda Rosenberger. Missouri Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Columbia, MO.

For imperiled unionoid mussels, understanding population age structure is important for guiding conservation and management policies. Long-lived mussels, in particular, can persist in areas without recruitment for decades - consequently, presence/absence or abundance data could fail to detect impending population collapse. We therefore require mussel monitoring and management plans with information on population dynamics and recruitment. Freshwater mussels produce shell growth annuli often used for external age evaluations. However, the reliability of external aging can be biased due to false annuli and shell sculpturing. Internal aging using shell thin sections can also be used for mussel aging and may more accurately identify false annuli occurring in response to stress or changes in environmental conditions. This study examines the accuracy of external aging techniques for mussels and if bias differs between sculptured versus non-sculptured mussel species. We compared external annuli to shell thin sections of 50 individuals representing two species; the unsculptured Ellipse (*Venustaconcha ellipsiformis*) and the sculptured Threehorn Wartyback (*Obliquaria reflexa*). arg2nf@mail.missouri.edu

Poster 22	**FIVE YEARS OF FRESHWATER MUSSEL PROPAGATION AT THE NORTH CAROLINA WILDLIFE RESOURCES COMMISSION'S MARION CONSERVATION AQUACULTURE CENTER.** Rachael A. Hoch[1], Stephen J. Fraley[2], Rob B. Nichols[2], and Ryan J. Heise[2]. [1]North Carolina Wildlife Resources Commission, Division of Inland Fisheries, Marion, NC; [2]North Carolina Wildlife Resources Commission, Aquatic Wildlife Diversity Program, Raleigh, NC.

Of the 57 species of native freshwater mussels known in North Carolina, 43 (75%) are either federally listed, state listed, or of conservation concern. Recent habitat improvements in North Carolina have provided opportunities for reintroductions and augmentations of rare freshwater mussels. The North Carolina Wildlife Resources Commission (NCWRC) has devoted resources to captive propagation of rare aquatic species through partnerships with NC State University and the USFWS as well as the development of an internal propagation facility. In 2008, the NCWRC established the Marion Conservation Aquaculture Center (MCAC) in Marion, North Carolina to aid in the restoration of the NCWRC's Wildlife Action Plan priority species through captive propagation, research, and temporary refugia. Over the past five years the MCAC has actively propagated seven species of freshwater mussels and held 18 species for long term grow out and/or research. Since 2009, the MCAC has released over 35,000 mussels into eight streams across five basins. Notable releases of three endangered species include 4,430 *Alasmidonta raveneliana* into the Cheoah River in Graham County, N.C., 260 *Elliptio steinstansana* into Little Fishing Creek in Halifax Co., N.C., and 394 *Lasmigona decorata* into Goose and Duck Creeks in Union Co., NC. Additional species that have been stocked include over 14,000 *Lampsilis fasciola* and approximately 9,700 *Villosa iris* into the Cheoah River. Propagation techniques at the MCAC have varied and include fine substrate and upweller systems. Recirculating systems with fine substrate (<125µm) have supported the best anodontine growth and survival. In 2013, the MCAC produced over 11,000 *A. raveneliana* (2-9mm, 1yr survival 60%) and 1,800 *Alasmidonta viridis* (4-9mm, 1yr survival 70%). In addition, we are using an Epilog Zing 16 laser to more efficiently tag the periostracum of stocked mussels. Future work at the MCAC will continue to address genetic diversity, survivorship, growth, and tagging. rachael.hoch@ncwildlife.org

Poster 23	**GENETIC STRUCTURE OF THE MAPLELEAF MUSSEL (*QUADRULA QUADRULA*) ON THE NIAGARA PENINSULA, ONTARIO, CANADA: INFERRING EFFECTS OF CANAL AND DAM CONSTRUCTION OVER THE LAST 200 YEARS.** Jordan R. Hoffman, Wendy L. Paterson, Todd J. Morris, and David T. Zanatta. Department of Biology, Central Michigan University, Mount Pleasant, MI; Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, ON 4A6 Canada.
Alterations to watercourses have numerous effects on connectivity in aquatic systems, and thus can majorly influence the dispersal abilities of aquatic biota. Canals create connections between water bodies, which can be used as corridors for dispersal by opportunistic invaders, while dams act as isolating barriers, fragmenting populations. The Niagara Peninsula of Ontario, Canada has a 200-year history of dam and canal construction, resulting in the major alteration of the watercourses of the region. These modifications have allowed the entry of numerous invasive species into the upper Great Lakes (e.g., sea lamprey) and have likely facilitated dispersal in native species as well. The purpose of this study is to explore the effects of canal and dam construction on the genetic structure of Mapleleaf mussels (*Quadrula quadrula*). While native to the upper Great Lakes and Mississippi drainage system, *Q. quadrula* has recently been found in an eastern Lake Ontario harbor. The establishment of *Q. quadrula* in Lake Ontario may have been a recent event, facilitated by the Niagara Peninsula's history of canal construction. Additionally, previous research indicates the Dunnville Dam on the Grand River, ON (a Lake Erie tributary) may be acting as an upstream gene flow barrier to *Q. quadrula*. Microsatellite DNA analysis will be used to evaluate these hypotheses and examine the effect of watercourse alterations on the genetic structure of mussel populations. Ultimately, this information has the potential to be used to improve conservation strategies for this and other unionid species at risk. hoffm3jr@cmich.edu	
Poster 24	**EARLY LIFE HISTORY OF THE SHEEPNOSE (*PLETHOBASUS CYPHYUS*) (MOLLUSCA: BIVALVIA: UNIONOIDA).** Mark C. Hove[1,5], Bernard E. Sietman[2], Matthew S. Berg[3], Erika C. Frost[1], Kiru Wolf[1], Tony R. Brady[4], Sarah L. Boyer[5], and Daniel J. Hornbach[5]. [1]Dept. of Fisheries, Wildlife and Conservation Biology, University of Minnesota, Saint Paul, MN; [2]Division of Ecological and Water Resources, Minnesota Dept. of Natural Resources, Saint Paul, MN; [3]Biology Dept., Grantsburg High School, Grantsburg, WI; [4]Natchitoches National Fish Hatchery, U.S. Fish and Wildlife Service, LA; [5]Biology Dept., Macalester College, St. Paul, MN.
Managing a rare species can be improved with knowledge of its natural history needs. The sheepnose (*Plethobasus cyphyus*) is a freshwater mussel recently listed by the U.S. as federally endangered. We used standard methods to study *P. cyphyus* brooding and glochidia release behaviors, host fishes in the laboratory and under natural conditions, and glochidial morphology. We monitored a population of *P. cyphyus* in the Chippewa River, WI during spring and summer 2007-2009 and 2011 and found brooding animals between mid-May-early August. Gravid individuals ranged between 5-27 yr old (mean =13±4 yr). *Plethobasus cyphyus* brooded glochidia in outer gills, which varied in color from red, orange, pink, cream, or white. We observed mature glochidia more commonly in individuals with cream or white gills and these glochidia were released in a clear, adhesive, mucus matrix. In laboratory trials we found several minnow and topminnow species (29 spp.) served as productive suitable native hosts. The mean number of juvenile mussels released per cyprinid per day was significantly higher for trials conducted at 22-25 °C compared to those at 18-20 °C, and 83% of trials conducted at 18-20 °C using suitable host species produced no juveniles. Glochidia had a unique outline and shell morphometrics that distinguished *P. cyphyus* from seven other Chippewa River mussel species that produce similar-sized glochidia. Using morphometrics we determined that mimic shiners (*Notropis volucellus*) were natural hosts for *P. cyphyus*, round pigtoe (*Pleurobema sintoxia*), and Wabash pigtoe (*Fusconaia flava*). Releasing mucus-bound glochidia has evolved in a variety of mussel species and may be more common than is currently realized. Our data show that *P. cyphyus* is a cyprinid host specialist, and propagation efforts for this species can be strengthened through improved access to mature glochidia by using females with cream-colored gills and increased juvenile production through warmer fish holding temperatures. Mark_Hove@umn.edu	
Poster 25 *Student Poster*	**GENETIC ASSOCIATIONS OF FRESHWATER MUSSELS IN THE UPPER TALLAPOOSA RIVER DRAINAGE.** Jada Isenhower and Michael M. Gangloff. Department of Biology, Appalachian State University, Boone NC.

The Mobile River Basin (MRB) is a hotspot of temperate freshwater mussel diversity and its four major tributary drainages, the Black Warrior, Cahaba, Coosa and Tombigbee all historically supported at least 45 species. By comparison, the Tallapoosa River Drainage supports a relatively species-poor mussel assemblage and 15 mussel taxa occur in its headwaters upstream of the falls at Tallassee, Alabama. The mussel fauna of the upper Tallapoosa includes one putatively endemic taxon *Quadrula archeri*, one federally-listed species, *Hamiota altilis*, and a population of what may be an un-described *Pleurobema* sister to, but morphologically distinct from *P. decisum*. Additionally, genetic data suggest that the taxon currently attributed to *Elliptio arca* is not closely related to *E. arca* in other Mobile Drainage streams and instead is closely related to *E. pullata* from the Apalachicola Drainage. We are currently undertaking a drainage-wide assessment of the distribution and genetic diversity of freshwater mussels in the upper Tallapoosa Drainage with the goal of clarifying phylogenetic and phylogeographic relationships and identifying cryptic diversity. Preliminary genetic analysis of *Hamiota altilis* samples from the upper Tallapoosa Drainage suggest that populations exhibit pronounced geographic structuring and are distinct from Mobile Basin conspecifics but that genetic differences are relatively low (~1.0-1.7%) compared to differences observed between Upper Tallapoosa and Mobile '*E. arca*' (~3-4%). *Hamiota* data are consistent with management unit-level divergence rates and suggest recent gene flow that mirrors differences observed among *H. altilis* populations in other Mobile Basin tributaries. On-going analyses will attempt to date divergence times between Upper Tallapoosa mussels and populations in adjoining drainages to provide a more complete picture of biodiversity in this drainage.
gangloffmm@appstate.edu

Poster 26	**FRESHWATER MUSSEL FAUNA (BIVALVIA: UNIONIDAE) OF THE MIDDLE MISSISSIPPI RIVER.** Thomas M. Keevin[1], Jeremy S. Tiemann[2], and Kevin S. Cummings[2]. [1]Environmental Analysis Branch, U.S. Army Corps of Engineers, St. Louis District, St. Louis, MO; [2]Illinois Natural History Survey, Prairie Research Institute at the University of Illinois, Champaign, IL.

Freshwater mussel surveys were conducted on the Middle Mississippi River (MMR) during the extreme low-flow periods of 1988-89 and 2012-13 when large areas of benthic habitat were exposed. Based on these surveys, nineteen unionid species are currently extant in the MMR. During the 1988-89 survey, 2,537 specimens of 17 fresh-dead freshwater mussel species were collected from twenty-eight collection sites. The three most abundant species collected, Giant Floater *Pyganodon grandis* (Say, 1829), Fragile Papershell *Leptodea fragilis* (Rafinesque, 1820), and Pink Papershell *Potamilus ohiensis* (Rafinesque, 1820), made up 88% of the total number of individuals collected. During the 2012-13 survey, 194 live or fresh-dead specimens of 12 unionid species were collected from forty sites. The three most abundant species, *Leptodea fragilis*, Threehorn Wartyback *Obliquaria reflexa* Rafinesque, 1820, and Hickorynut *Obovaria olivaria* (Rafinesque, 1820), made up 72% of the total number of individuals collected. The main channel and main channel border of the MMR provide little suitable habitat for the development of a diverse mussel fauna due to the unstable sand substrate, the continuous downstream movement of sand waves, and high turbidity levels. Side channels and floodplain lakes do support a lacustrine mussel fauna. However, they are susceptible to desiccation during droughts or severe low-water periods and are subject to poor water quality. Only one exotic bivalve, the Asian Clam *Corbicula fluminea* (Müller, 1774), was collected in 1988-89. Subsequently, the Zebra Mussel *Dreissena polymorpha* (Pallas, 1771) and *Corbicula largillierti* (Philippi, 1844) invaded the MMR and all three invasive species are now widespread.
Thomas.M.Keevin@usace.army.mil

Poster 27	**REFINING TEST CONDITIONS FOR CONDUCTING WATER-ONLY TOXICITY TESTS WITH JUVENILE FRESHWATER MUSSELS.** James L. Kunz[1], Chris G. Ingersoll[1], Ning Wang[1], M. Chris Barnhart[2]. [1]USGS, Columbia Environmental Research Center, Columbia, MO; [2]Missouri State University, Department of Biology, Springfield, MO

Over the past decade, our laboratory has conducted more than thirty 4-week water-only toxicity tests with juvenile freshwater mussels. Tests have included five species of freshwater mussels, each starting with about 2-month-old juveniles. Survival in these tests typically exceeded the ASTM E2455 water-only test acceptability criterion (TAC) of ≥80% control survival. However, ASTM E2455 does not provide a TAC for control growth. Although up to 5-fold increases in dry weight of mussels have been observed in previous 4-week tests, batch-to-batch growth has sometimes been inconsistent. Because mussel growth is often a more sensitive endpoint than survival, consistency in growth across studies is important to better define mussel sub-lethal responses. The objective of this study was to evaluate different water-only test conditions to maximize survival and growth of juvenile fatmucket (*Lampsilis siliquoidea*) under control conditions (no addition of toxicant) in 4- to 12-week treatments. Conditions evaluated included: (1) varied daily feeding levels, food types, and feeding frequencies, (2) presence or absence of a sand substrate, (3) flow-through versus static-renewal of water, and (4) recirculation of water within test chambers. At 4 weeks, mean survival in all treatments was ≥88% and met the ASTM TAC. Mean dry weight in the treatment under traditional ASTM conditions increased about 3 fold relative to initial weight. However, other feeding treatments exhibited a 6- to 16-fold dry weight increase. The results indicate that the addition of sand, increased feeding amount or frequency, and frequent beaker replacement enhance 4-week mussel growth. At week 12, mean survival in all treatments except one was ≥83% and dry weight increased 20- to 60-fold. These results will be used to draft revisions to ASTM E2455 for conducting 4-week to perhaps 12-week water-only toxicity tests with juvenile mussels and allow for establishing an ASTM TAC for growth in these tests. jkunz@usgs.gov

Poster 28 *Student Poster*	**INTENSIVE VS EXTENSIVE SAMPLING METHODS: EFFECTIVNESS OF VISUAL METHODS FOR ASSESSING SPECIES RICHNESS WITHIN FRESHWATER MUSSEL COMMUNTIES**. Leslie K. Lueckenhoff[1] and Amanda E. Rosenberger[2]. [1]Department of Fisheries and Wildlife Sciences, University of Missouri-Columbia, Columbia, MO; [2]Missouri Cooperative Fish and Wildlife Research Unit, Columbia, MO.

Managers require standardized and validated methods to determine the effectiveness of applied monitoring practices for unionoid mussel communities. However, the state of Missouri currently lacks standardized techniques for sampling native freshwater mussels with known levels of effectiveness. Determining the effectiveness of common sampling methods for assessing select community metrics is the first step in developing a standardized sampling framework and can provide managers with a tool for choosing methods to best implement their project's objectives. The primary intent of sampling is often to determine species presence and quantify species richness. Without a standardized method for sampling, species lists and total richness may differ based on the nature of the sampling method (extensive or intensive). We report the effectiveness of five visual sampling techniques at assessing unionoid species richness within the Meramec River basin in Missouri. Preliminary results suggest extensive sampling is most effective for determining total numbers of species; however intensive sampling over smaller areas may reveal cryptic species that would otherwise be missed. lkc6x2@mail.missouri.edu

Poster 29	**THE POTENTIAL ROLE OF A NEWLY REGISTERED BIO-PESTICIDE FOR MANAGING DREISSENID MUSSEL SPECIES IN THE PRESENCE OF NATIVE UNIONID MUSSELS.** James A. Luoma[1], Kerry L. Weber[1], Diane L. Waller[1], Jeremy K. Wise[1] and Denise A. Mayer[2]. [1]USGS-Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, LaCrosse, WI; [2]New York State Education Department, New York State Museum Field Research Laboratory, 51 Fish Hatchery Road, Cambridge, NY.

Dreissena spp. mussels impact multiple trophic levels in aquatic systems, including alteration of planktonic communities, extirpation of unionid mussels, fouling of spawning habitats and transfer of contaminants. More recently, dreissenids have been implicated in the development of harmful algal blooms due to nutrient cycling. Resource managers largely have become resigned to the perturbed conditions in established dreissenid-infested systems while having few management options. In July 2014, the USEPA approved open-water use of the biopesticide, Zequanox®, for *Dreissena* spp. control. This registration offers a potential tool for selective management and control of dreissenids and concomitant restoration and/or preservation of habitat and aquatic communities. We evaluated the sensitivity of 7 species of native unionid mussels to Zequanox exposure. Toxicity tests were conducted within replicated 350-L test tanks positioned in a mobile research laboratory situated along the Black River at La Crosse, Wisconsin. Five 5 species of subadult and 2 species of adult unionid mussels were exposed to 50 and 100 mg/L Zequanox for 8 and 24 hours. Mean survival of all species, regardless of treatment concentration or exposure duration exceeded 95%.We also evaluated the efficacy of Zequanox for reducing the dreissenid mussel burden on unionid mussels in an inland lake (Lake Darling, MN). Zequanox concentrations of 0 (control), 50 and 100 mg/L were applied for an 8 hour exposure period to replicate 2.25 m^2 enclosures containing fatmucket (*L. siliquoidea*) unionid mussels with adhering zebra mussels. A ≤ 68% reduction in the number of live zebra mussels adhering to unionids was observed and no difference ($p > 0.23$) was detected in mean unionid mussel survival between the control and treated groups 18-20 days post exposure. These trials demonstrate the potential use of Zequanox for managing dreissenid mussels within open water environments that contain unionids or for use in unionid mussel restoration/conservation programs. jluoma@usgs.gov

Poster 30	**UPPER THERMAL LIMITS OF JUVENILE *MEGALONAIAS NERVOSA* IN RAMPED TEMPERATURE EXPOSURES**. Kathryn Martin[1], Chris Barnhart[1], and Nathan Eckert[2]. [1]Department of Biology, Missouri State University, Springfield, MO; [2]Genoa National Hatchery, Genoa WI.

Several anthropogenic impacts potentially expose unionids to periods of acutely elevated temperature. These include flow interruption and dewatering related to hydropower and reservoir management, thermal effluents, and water removal during drought. I am investigating the tolerance of juvenile *Megalonaias nervosa* to 16-h ramped temperature excursions, in water and air, to mimic the time course of a day of solar heating. My proposed study design includes three comparisons: 1) populations from two latitudes, propagated and cultured in similar conditions, 2) winter versus summer acclimatized animals, and 3) immersed in aerated water and emersed in damp sand, simulating stranded conditions. The *M. nervosa* tested were 1-year old juveniles, 1-1.5 cm shell length, captive-cultured from glochidia originating in the Sac River in Missouri or from the upper Mississippi River. In my preliminary experiment, groups of juveniles from culture at 23C were tested at 6 temperatures from 25 to 40C in aerated water or in damp sand. The groups were warmed from 23C to peak temperatures over six hours, reflecting the rates of change observed in natural river conditions. The mussels were then held at their group's peak temperature for 2 hours before cooling linearly to 23°C over eight hours. Mortality was monitored during and for several weeks following the experiment. Results were similar among the northern and southern test populations and were pooled for calculation of LT50. The estimated LT50 of peak temperature in these ramped exposures was 40C in water and 37.5C in air. Both populations are currently in outdoor culture and will be tested seasonally during the next year. Kathryn6@live.missouristate.edu

Poster 31 *Student Poster*	**EFFECTS OF LANDUSE ON MUSSEL ASSEMBLAGES IN THE BUTTAHATCHEE RIVER, MISSISSIPPI AND ALABAMA.** Daniel Mason[1], Gary S. Pandolfi[1], Paul D. Hartfield[2], and Michael M. Gangloff[1]. [1]Department of Biology, Appalachian State University, Boone NC; [2]US Fish and Wildlife Service, Jackson, MS.

The Mobile Basin exhibits some of the highest diversity of imperiled freshwater mussels (Unionidae) in North America. The Buttahatchee River Drainage in northeastern Mississippi and northwestern Alabama is unique among large Mobile River tributaries in that it still supports a species-rich (30+ spp.) mussel assemblage including 4 federally listed (listed) species and the last extant population of *Epioblasma penita*. We quantified changes in mussel assemblages and current land cover in the Buttahatchee River from 1990-2014 with the goal of describing relationships between catchment-scale landuse and the presence of endangered mussels. We used ArcMap 10.2 to model landuse using USGS 2011 land cover data. We calculated the percentage of each land cover type present in the upstream catchment for 26 sites across the drainage. We then examined differences in land cover among sites where listed mussels were detected. Land cover was primarily forest (mean = 58%) but forest cover was highly variable among sites (range 36-92%). Shrub (21%, presumed to be re-generating clear cuts), agriculture (9.5%), and developed land (5.8%) comprised the other major land cover classes. Sites with listed mussels did not have significantly higher catchment scale forest cover but had lower proportions of agriculture and developed land compared to sites without listed mussels. Ongoing analyses will focus on local (i.e., riparian) scale landuse and examine links to in-stream habitat parameters including geomorphic instability. These data will provide important insights that will be used to guide conservation efforts in the Buttahatchee watershed. Conservation groups are currently working to acquire and restore riparian zones along the mainstem Buttahatchee and these efforts will be critical to ensuring the continued persistence of critically endangered species like *Epioblasma penita*. Moreover, landuse data may help target sampling during subsequent surveys to help identify sites supporting species rich mussel assemblages. masondh@email.appstate.edu

Poster 32 *Student Poster*	**SPERM MT-DNA OF *VENUSTACONCHA PLEASII*.** Amy Maynard, Chris Barnhart, and Laszlo Kovacs. Department of Biology, Missouri State University, Springfield, MO.

The mechanism of sex determination in freshwater mussels (Unionidae) is not well understood. Unionids maintain two mitochondrial lineages, F-mt within somatic tissue of males and females, and M-mt within male gonadal tissue. Mussels appear to lack sex chromosomes. Some evidence suggests that two types of sperm might exist, perhaps carrying alternate mitochondria haplotypes (F-mt or M-mt). Based on these findings it was hypothesized that the presence of F-mt or M-mt in sperm may determine sex of the offspring (Breton et al. 2011). I am testing the hypothesis that sperm may carry both mt types and related questions using molecular genetic techniques. I have developed primers that amplify two haplotype-specific mt genes, the male or female open reading frames (*M-ORF* or *F-ORF*). I designed these primers based on orthologous genes in *Venustaconcha ellipsiformis* mtDNA. I am using nested PCR to test for the presence of these two genes within samples of sperm recovered from spawning males of *Venustaconcha pleasii*. I have cloned the mtDNA fragments and sequenced both strands of the target genes. My results to date indicate that the primers were specific to the intended *M-ORF* or *F-ORF* target, and that both genes are represented in the *V. pleasii* population as several different haplotypes. Cravens212@live.missouristate.edu

Poster 33	**BACTERIAL DIVERSITY AND ABUNDANCE IN FRESHWATER SNAIL SHELL BIOFILMS**. Russell L. Minton[1], Clinton Charles Creech[2], and Debra W. Jackson[3]. [1]Division of Natural Sciences, School of Science and Computer Engineering, University of Houston Clear Lake, Houston, TX; [2]School of Science, University of Louisiana at Monroe, Monroe, LA; [3]School of Health Sciences, Natural Sciences, and Math, Louisiana Delta Community College, Monroe, LA.

Mollusk shells provide a hard substrate for aquatic biofilm colonization. Work on biofilms with mollusks has focused on bivalve shells and grazing, though little has focused on gastropod shells and the microbes growing on them. We explored snail shell biofilms in two metagenomic studies, one focused on diversity and abundance from a single species (*Pleurocera canaliculatum*) and one comparing biofilms from *P. canaliculatum* and *Campeloma decisum*. Biofilms from fourteen *P. canaliculatum* showed that microbial diversity varied between individuals, and rarefaction suggested that 63 snails would need to be sampled to capture all of the estimated genus-level diversity. Cyanobacteria and species of *Novosphingobium* and *Methylosoma* were the most abundant taxa across all shells. A comparison of *P. canaliculatum* and *C. decisum* biofilms suggested that shells of the two species harbor very different taxa, likely due to differences in their ecology. We highlight and describe the most abundant taxa on each species, and describe how mollusk shells and their associated microbiota play an important role in shaping freshwater ecosystems. Minton@UHCL.edu

Poster 34 *Student Poster*	**AN INVESTIATION OF CRYPTIC SPECIATION: EXAMINING THE GENETIC AND MORPHOLOGICAL VARIATION OF FIVE POPULATIONS OF THE FRESHWATER WRINKLED MARSHSNAIL (*STAGNICOLA CAPERATA*) AT DIFFEREING ELEVATIONS.** Cayla R. Morningstar[1], Kentaro Inoue[2], Brian K. Lang[3], David J. Berg[1]. [1] Department of Biology, Miami University, Hamilton, Ohio; [2] Department of Biology, Miami University, Oxford, Ohio; [3]23 Llanito Road, Bernalillo, New Mexico.

The accurate estimate of biodiversity is hindered by many factors, including underestimation of species richness due to cryptic speciation, which is often observed in benthic invertebrates of desert springs. The wrinkled marshsnail (*Stagnicola caperata*) is a freshwater pulmonate widely distributed throughout the U.S., but listed as endangered in New Mexico. Morphological variation among populations of this species has been observed at differing altitudes in New Mexico and West Texas. We are conducting an assessment of the phylogenetic relationships, morphological variation, and soft-tissue structure of four populations of *S. caperata* in New Mexico and west Texas, as well as the population from the type locality of the species in New Harmony, Indiana. Given the isolation of the populations and mountain ranges as possible dispersal barriers, we expect to see that southwestern populations of similar morphology are more closely related. We sequenced two mtDNA genes and a nuclear gene of eight to twenty-four individuals from each population. We also compared shell morphology and soft tissue anatomy between the five populations. Phylogenetic analysis shows that *S. caperata* is polyphyletic, suggesting that one population is not *S. caperata*, but another closely related species. Genetic data show that southwestern populations exhibit low genetic diversity in comparison to the type locality population. A principal component analysis showed that 63% of shell variation represents shell elongation and 15% is due to shell width. A large amount of variation in shell shape between the populations with no distinct morphological pattern likely indicates a high level of phenotypic plasticity. Confirmation of the identity of the populations will require description of soft-tissue morphology. Proper species identification is important for the conservation of this species in New Mexico, and low diversity in these populations would mean that they are of a greater conservation concern. mcabeecr@miamioh.edu

Poster 35	**IS RELOCATION OF FRESHWATER MUSSELS AN EFFECTIVE TOOL TO MITIGATE HARM?** Todd J. Morris and Julie Vanden Byllaardt. Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, ON, Canada.

Relocation of freshwater mussels is often proposed as a means to mitigate potential harm to federally listed species in Canada. The 2008 *Ontario Protocol* has been adopted as the standard methodology to be employed when carrying out a relocation and outlines the methods to be followed during a relocation and the schedule of follow-up monitoring. We examined the results of 14 relocation events undertaken in Southern Ontario between 2006 and 2012 which followed the procedures outlined in the *Ontario Protocol.* We investigated recovery, survival, and mortality of relocated mussels that were monitored 1, 12, and 24 months post-relocation with the intent of determining whether relocation was an effective means to mitigate potential harm associated with in-stream works (e.g., road construction, bridge crossings, pipeline installation). Our results indicate that confirmed species mortality was consistently low and ranged from 0 – 7.7%. However, recovery rates were also low and, not unexpectedly, decreased with time for all groups (relocated, resident, control). Of particular concern, relocated mussels demonstrated significantly lower recovery rates (48.3 – 18.6%) than control mussels (49.0 – 37.2%), and these recovery rates were species-specific. These low recovery rates make interpretation of true mortality associated with relocation events a difficult task. Several possibilities exist to explain site and species differences and include migration (due to competition for food/space or unsuitable habitat), undetected mortality, and species-specific habitat restrictions. Todd.Morris@dfo-mpo.gc.ca

Poster 36	**TEST AND APPLICATION OF A NON-DESTRUCTIVE PHOTO-METHOD INVESTIGATING THE PARASITIC STAGE OF THE THREATENED MUSSEL *MARGARITIFERA MARGARITIFERA* ON ITS HOST FISH (*SALMO TRUTTA*).** Martin Österling**,** Department of Biology, Karlstad University, SE 651 88 Karlstad, Sweden

The objective was to test the application of a novel, non-destructive photo-method estimating the larval encystment of one of the highly threatened unionid mussels, the freshwater pearl mussel (*Margaritifera margaritifera*) on the gills of its host fish, brown trout (*Salmo trutta*). There were significant correlations between the encystment intensity based on microscope counts and using the new photo-method for both young-of-the-year and older brown trout just after the encystment in October 2007 and just before larval release from the host fish in June 2008. The mean encystment intensity based on the two methods did not differ from each other for the two age classes of trout when based on comparisons including all individuals. An aquaria experiment showed that there were no differences in survival or growth between fish subjected to the treatments: photo-method and individual marking, photo-method and a control. When applied to encystment in single streams, there were significant correlations between the mean encystment intensity in each stream based on the methods for both trout age classes. Therefore, it may be possible to get reliable estimation of the encystment rates without injuring the mussel or the host fish, which may also be used in restoration and cultivation work. Furthermore, the larvae of *M. margaritifera* are among the smallest of all the worldwide-distributed, threatened unionid mussel species. The photo-method may therefore also be used for other mussel species with larger larvae, as they are more easily recognized on photos. Therefore, it may now be possible to investigate every life stage of unionid species without using harmful methods at all. martin.osterling@kau.se

Poster 37	**FRESHWATER MUSSEL TRAINING AT THE NATIONAL CONSERVATION TRAINING CENTER (NCTC)**. Matthew A. Patterson. United State Fish and Wildlife Service, Shepherdstown, WV.

The U.S. Fish and Wildlife Service's National Conservation Training Center (NCTC) is developing a formal training curriculum on freshwater mussel conservation. The first course in the series is entitled Conservation Biology of Freshwater Mussels and is taught by Dr. Chris Barnhart and Heidi Dunn. This is an introductory course on the biology and ecology of freshwater mussels and the topics covered include anatomy, physiology, life history, health, ecosystem services, mussels as biomonitors, conservation status, population impacts, conservation measures, legal issues, and field and survey techniques. Since piloting this course in August of 2012, we have trained 72 students from a variety of agencies including FWS, EPA, FERC, USACE, DOE, Virginia DOT, West Virginia DOT, and Duke Energy in freshwater mussel biology and ecology. In September 2014, NCTC piloted the second course in the series entitled Freshwater Mussel Propagation for Restoration. This also was an introductory course designed to be an equal mix of lecture, in class discussion, laboratory exercises, and field trips; exploring all culture activities associated with freshwater mussels. State and federal employees from across the country received hands-on experience with the latest culture techniques as they followed freshwater mussels through their entire life cycle in a culture facility, from the collection of gravid females to stocking cultured juvenile freshwater mussels. Future plans for the curriculum include a Freshwater Mussel Identification course. Matthew_Patterson@fws.gov

Poster 38 *Student Poster*	**THE CONTEMPORARY AND LATE HOLOCENE FRESHWATER MUSSEL COMMUNITY OF THE LEON RIVER, CENTRAL TEXAS.** Traci Popejoy[1], Steve Wolverton[1], Charles R. Randklev[2], and Lisa Nagaoka[1]. [1]Department of Applied Geography, University of North Texas; [2]Institute of Renewable and Natural Resources, Texas A & M.

The Leon River, a low order river in central Texas, is highly impacted by multiple impoundments, enrichment from agricultural runoff, and decreased dissolved oxygen levels. This degraded river contains sixteen unionid species, two of which are both endemic to the region and candidates for the federal endangered species listing. While there is a short historical record for this river basin and a recent modern survey completed in 2011, zooarchaeological data can support conservation efforts by increasing the time depth of data available and providing another conservation baseline. Zooarchaeological data for the Leon River are available from the two Late Holocene archaeological faunas: 41HM61 and the Belton Lake Assemblages. Data generated from these assemblages describe the prehistoric freshwater mussel community of the Leon River. By comparing this zooarchaeological data to the data generated by the longitudinal modern survey of the Leon River completed by Randklev et al. (2013), long term changes within the freshwater mussel community can be detected. Implications of potential habitat change in the Leon River will also be explored. Inferential statistics are used to compare the prehistoric freshwater mussel community to the modern freshwater mussel community at an ordinal scale. An NMDS ordination of both the modern and prehistoric assemblages is used to elucidate potential habitat change in the Leon River. The results of these analyses indicate that the modern unionid assemblage is significantly different from the Late Holocene unionid assemblage. These analyses add further resolution to the complex conservation conversation regarding freshwater mussels and support habitat conservation and remediation in the Leon River. TraciPopejoy@my.unt.edu

Poster 39 *Student Poster*	**ADVANCING THE TOOLS OF FRESHWATER MUSSEL CONSERVATION: DETERMINING THE RELATIVE CHEMICAL SENSITIVTY OF *IN VITRO* AND *IN VIVO* PROPAGATED JUVENILE MUSSELS**. Anakela Popp[1*], W. Gregory Cope[1], Monte McGregor[2], Christopher Owen[2], Leroy Koch[3], Anthony Velasco[3], Christopher Ingersoll[4], Ning Wang[4], Thomas J. Kwak[1], and Damian Shea[5]. [1]North Carolina State University, Department of Applied Ecology, Raleigh, NC. [2]Center for Mollusk Conservation, Kentucky Department of Fish & Wildlife Resources, Frankfort, KY. [3]Environmental Quality Program, USFWS, Frankfort, KY. [4]Columbia Environmental Research Center, U.S. Geological Survey, Colombia, MO. [5]North Carolina State University, Department of Biological Sciences, Raleigh, NC.
Substantial resources have been invested into the propagation and culture of native Unionid mussels over the past two decades. These efforts have produced great advances in propagation techniques, determination of nutritional needs, and long-term growth and maintenance of propagated mussels. Improving standard host-fish (*in vivo*) infection techniques has been a significant contributor to this success, but recently, *in vitro* culture methods have made it possible to transform thousands of juvenile mussels at a time, requiring less space and costing less than traditional *in vivo* culture methods. Despite these propagation benefits, no studies have yet compared the chemical sensitivity of juveniles produced by *in vitro* and *in vivo* culture methods. Consequently, *in vitro* cultured juveniles are not currently recommended by the American Society for Testing and Materials for toxicity testing. The objective of this study is to evaluate the relative sensitivity of *in vitro* and *in vivo* produced juvenile mussels to chemical toxicants from different classes and modes of action. Comparisons will be made between *in vitro* and *in vivo* propagated juveniles of three mussel species (*Lampsilis cardium, L. abrupta, and Pyganodon grandis*). Standard 96-hour acute toxicity tests will be conducted with chloride, copper, a neonicotinoid pesticide (e.g., imidacloprid), nickel, and an aquatic herbicide (e.g., endothall); and median effective concentrations (EC50s) will be calculated. Replicate tests in time will be conducted with select species and chemicals for comparative purposes. Testing is scheduled to begin early in 2015. Successful completion of this project will provide federal and state natural resource managers and decision makers with the information needed to assess mussel sensitivity to contaminants, facilitate the refinement of mussel testing guidelines, and improve the overall conservation and management of this valuable, but imperiled, faunal group. apopp@ncsu.edu	
Poster 40	**DISTRIBUTION, ABUNDANCE, AND HABITAT USE BY FRESHWATER MUSSELS IN THE LOWER SABINE RIVER, TEXAS.** Charles R. Randklev[1], Ben R. Bosman[1], Mark Cordova[1], Eric Tsakiris[2], Clint Robertson[3], and Kevin Mayes[3]. [1]Institute of Renewable Natural Resources, Texas A&M University, College Station, TX; [2]Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX;[3]River Studies Program, Texas Parks and Wildlife Department, San Marcos, TX.
The Sabine River drainage supports a unique and diverse freshwater mussel assemblage. Four taxa, *Fusconaia askewi* (Texas pigtoe), *Lampsilis satura* (sandbank pocketbook), *Pleurobema riddellii* (Louisiana pigtoe), and *Potamilus amphichaenus* (Texas heelsplitter) occur in this drainage, are considered state-threatened, and may be listed for protection under the Endangered Species Act. However, the conservation status for these and other more common species is poorly known, particularly in the lower Sabine River where there are limited points of access and hydropower generation from Toledo Bend Reservoir can stymie sampling efforts. Therefore, the focus of this study was to establish baseline data for the distribution and abundance of mussels in the lower Sabine River. Mussel surveys consisted of timed tactile and visual surveys within a fixed area and habitat associations were tested using Indicator Species Analysis. A total of 6,396 live individuals of 22 species were collected among 82 sites from the study area. *Lampsilis teres* (yellow sandshell), *Plectomerus dombeyanus* (bankclimber), *Quadrula mortoni* (western pimpleback), and *Quadrula apiculata* (southern mapleleaf) were the most abundant species. Two state-threatened species, *Fusconaia askewi* and *Lampsilis satura,* were found in the study area, but neither species was abundant or widely distributed. Indicator Species Analysis revealed affinities of several mussel species for certain mesohabitat/cover types that were higher than expected by chance. Protected habitats, such as bank, backwater, and woody debris were most productive and each had a number of unique indicator species. Our results indicate that the lower Sabine River supports a diverse mussel fauna and that mesohabitat type influenced both abundance and assemblage structure. However, additional studies are needed to determine whether other ecological responses such as survival, growth, and reproduction also differ between mesohabitat/cover types. Such information may be helpful for conservation efforts focused on designing long-term monitor programs and developing environmental flow recommendations. crandklev@ag.tamu.edu	
Poster 41	**MULTIPLE SCALES OF PATCHINESS AND PATCH STRUCTURE OF FRESHWATER MUSSELS IN THE UPPER MISSISSIPPI RIVER, USA.** Patricia Ries, Nathan De Jager, Teresa Newton, and Steve Zigler. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI.

It has been suggested that multiple physical and biological factors structure freshwater mussel communities in large rivers and that their distributions are 'clumped' or 'patchy'. However, few surveys of mussel populations have been conducted over areas large enough and at resolutions fine enough to quantify spatial patterns in their distribution. We used global and local indicators of spatial autocorrelation (i.e., Moran's I) to quantify spatial patterns of adult and juvenile (≤ 5 years of age) freshwater mussels across multiple scales using survey data from four reaches (navigation pools 3, 5, 6, and 18) of the Upper Mississippi River, USA. Native mussel densities were sampled at a resolution of ~300 m and across distances ranging from 21 km to 37 km, making these some of the most spatially extensive surveys conducted in a large river. The degree of patchiness varied by river reach. For example, juveniles and adults displayed patchy distributions in Pool 18, but were randomly distributed in Pool 6. We also observed differences in spatial distribution between juveniles and adults. For example, juveniles were patchily distributed in Pools 3 and 5 whereas adults were randomly distributed in Pool 3 and followed a gradient pattern in Pool 5. Quantifying basic attributes of the spatial patterns in freshwater mussels can identify hot spots of adult and juvenile mussels and provide insight into the role spatial heterogeneity of mussels might play in riverine ecosystem function. pries@usgs.gov

Poster 42 *CANCELLED*	**AMERICAN INVADER, BROOK TROUT (*SALVELINUS FONTINALIS*) THREATENS FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA*) IN EUROPE.** Jouni K. Salonen, Timo J. Marjomäki and Jouni Taskinen. Department of Biological and Environmental Science, University of Jyväskylä, P.O. Box 35, FI-40014 University of Jyväskylä, Finland**.**

Brook trout (*Salvelinus fontinalis*), originally an American salmonid fish and a suggested host of the freshwater pearl mussel (*Margaritifera margaritifera*) there, was introduced to Europe lately and it is now replacing the native salmonid and a host of European *M. margaritifera*, brown trout (*Salmo trutta*), in many rivers. Therefore, there is an urgent need to assess the suitability of this invader as a host for European *M. margaritifera*. The study was performed in the River Iijoki catchment, Northern Finland, by exposing brook trout, brown trout and Atlantic salmon (*Salmo salar*) to *M. margaritifera* glochidiosis in laboratory and field experiments, in addition to a field survey where wild brook trout from *M. margaritifera* rivers were caught and the occurrence of brook trout investigated. In all experiments, brook trout was less often infected and harboured fewer glochidium larvae than the original hosts. The size of larvae was also smallest in brook trout, and the results from long-term laboratory study indicated underdevelopment and premature drop of larvae from brook trout. The field observations were in line with the experimental results, except in one river where some *M. margaritifera* larvae were observed to have remained in brook trout at least 9 months. Brook trout was found relatively more often in *M. margaritifera* + brown trout rivers than in brown trout rivers without *M. margaritifera* population, supporting the enemy release hypothesis; since glochidiosis is costly to the host, the poor infectivity in brook trout may offer a competition advantage for this alien over the native salmonids in the mussel rivers. Overall, brook trout is an unsuitable host for European *M. margaritifera*, and therefore its accelerated dispersion should be considered a threat not only to the original European salmonids, but also to the critically endangered *M. margaritifera* populations, by removing their necessary host fish. jouni.k.salonen@jyu.fi

Poster 43 *Student Poster*	**COMPARISON OF VISUAL AND QUANTITATIVE METHODS FOR FRESHWATER MUSSEL DENSITY ESTIMATES IN THE MERAMEC RIVER BASIN, MISSOURI.** Matthew C. Schrum and Amanda E. Rosenberger. USGS Missouri Fish and Wildlife Cooperative, Department of Fisheries and Wildlife Sciences, School of Natural Resources, University of Missouri-Columbia, Columbia, MO

Freshwater mussels are among the most threatened aquatic fauna in North America. Given the need for continued monitoring of threatened populations, estimating bias of metrics from visually-based sampling methods is an essential step in assessing populations of these mollusks. We surveyed 15 sites in the Meramec River Basin in East Central Missouri. At each site, we employed three visual methods for estimating abundance; timed visual searches, systematic strip transects, and stratified randomly placed visual .25 m^2 quadrats. We excavated substrate at each .25 m^2 quadrat to determine abundances for each species, and eliminate the influence of visual bias. We compare the results of abundance estimates of each of the visual methods with the results of excavated quadrat samples. Results will be used to estimate the sampling efficiency of visual methods and determine if visual techniques provide reasonable approximation of overall mussel abundances. mcs7gb@mail.missouri.edu

Poster 44	**THE PRE AND POST CONSTRUCTION MONITORING METHODS UTILIZED BY PENNDOT ON STREAMS WITH FEDERALLY LISTED FRESHWATER MUSSELS: MILLER STATION BRIDGE.** Greg Zimmerman[1], Ryan J. Schwegman[1], Joel Bingham[1], and Autumn Kelly[2]. [1]EnviroScience, Inc., Stow, OH; [2]PennDOT (District 1), Oil City, PA.

Formal coordination between PennDOT, FHWA and USFWS, as well as PFBC, and EnviroScience, Inc. has resulted in the implementation of a pre and post construction BMPs that strive to conserve freshwater mussels and mussel habitat surrounding PennDOT bridge replacement projects within the upper Ohio River watershed. At the Miller Station Bridge, a pre-construction survey was completed to determine the local mussel distribution and diversity of mussel resources within the proposed project area. A series of avoidance and minimization measures were then designed and implemented by PennDOT in coordination with USFWS and PFBC. BMPs included relocation of mussels, monitoring of the river bed elevation and substrate types before, during construction and twice (2) following construction after high water events. Monitoring of the river bed changes focused on areas with known mussel beds. A post construction underwater habitat survey was completed. to ensure adequate removal of construction debris by the contractor. The final post construction mussel monitoring survey for the Miller Station Bridge was completed in 2014. Valuable data collected during this and several similar projects have assistance PennDOT and the coordinating agencies in developing and refining construction practices that reduce impacts and contribute to the conservation of freshwater mussels. Results and conclusions of the Miller Station Bridge and similar pre and post monitoring projects will be presented and discussed. rschwegman@enviroscienceinc.com

Poster 45	**TRANSFER OF THE NEW MEXICO MUSEUM OF NATURAL HISTORY AND SCIENCE FRESHWATER MOLLUSK COLLECTION TO RALEIGH, NORTH CAROLINA.** Jamie M. Smith, Heather B. Leslie, William S. Bugg, and Arthur E. Bogan. North Carolina Museum of Natural Sciences, 11 West Jones Street, Raleigh, NC.

The New Mexico Museum of Natural History and Science contacted the North Carolina Museum of Natural Sciences in 2013 about donating a collection of freshwater mollusks from the southeastern United States. This gift was accepted and the United States Fish and Wildlife Service (USFWS) funded the packing and transfer of this collection. The collection consisted of approximately 4,000 lots of dry shell material, 1,000 lots of alcohol preserved specimens, and a large collection of unidentified lots. The cataloged specimen data was provided in an excel spreadsheet. The New Mexico Museum packed the alcohol specimens in 24 5-gallon buckets and the dry collections in 74 boxes, each with an inventory of the contents attached to the outside. The collection was carefully loaded onto a U-Haul truck and transferred to its new home in May, 2014. We have databased 112 lots comprising of 1,927 specimens of petitioned species to date. jamie.smith@naturalsciences.org

Poster 46	**GENETIC CONFIRMATION OF PUTATIVE LOUISIANA FATMUCKET IN ILLINOIS.** Alison P. Stodola[1], Charles Lydeard[2], James T. Lamer[1,2], Sarah A. Douglass[1], and Kevin S. Cummings[1]. [1]Illinois Natural History Survey, Prairie Research Institute, University of Illinois, Champaign, IL; [2]Department of Biological Sciences, Western Illinois University, Macomb, IL.

The range of the Louisiana fatmucket (*Lampsilis hydiana*) spans watersheds in Texas, northward to southern Arkansas, and eastward to western Mississippi. However, specimens with morphological similarities to the Louisiana fatmucket have been collected in watersheds in southern and south-central Illinois for several decades and were presumed to be strangely shaped fatmuckets (*L. siliquoidea*). To determine if both species co-occur in Illinois, specimens were collected from throughout the state and analyzed genetically using DNA sequences of the mitochondrial *cox1* and *nad1* genes. Phylogenetic analysis yielded two genetically distinct clades that support the recognition of two different species – *L. siliquoidea* and putative *L. hydiana*. The presence of *L. hydiana* in Illinois represents a substantial range expansion, so it is imperative that we obtain topotype material to determine if putative Illinois *L. hydiana* is indeed *L. hydiana* or another closely related species. alprice@illinois.edu

Poster 47	**A FRESHWATER SPONGE-MUSSEL ASSOCIATION IN THE RIO XINGU, BRAZIL.** Jeremy S. Tiemann[1], Kevin S. Cummings[1], and Maria Cristina Dreher Mansur[2]. [1]Illinois Natural History Survey, University of Illinois, Urbana-Champaign, Illinois; [2]Universidade Federal do Rio Grande do Sul, Centro de Ecologia, Porto Alegre, RS, Brazil

Various relationships exist between aquatic invertebrates and freshwater sponges. Several aquatic insect taxa are obligate, specialized feeders on sponges, and certain water mites live and lay their eggs in sponges. However, few accounts have been published on interactions between freshwater sponges and bivalves. Sphaeriids have been reported adhering to the surface or interior of some sponges from the rio Juruá, Brazil, and sponge growth has been observed on live unionids and non-native dreissenids throughout North America, often with deleterious effects to the bivalves. We collected freshwater mollusks in the rio Xingu (rio Amazonas drainage) in the state of Pará, Brazil, during November 2014. During the expedition, we collected five hyriid species and one mycetopodid species that had sponges adhering to the exposed posterior end of the mussels. Most of the mussels were alive and appeared to be utilizing both their incurrent and excurrent apertures through two openings in the sponge on the mussel's posterior end. However, we did encounter a few fresh-dead specimens. We speculate that sponge growth was so luxuriant that it killed the mussels by interfering with the animals' normal feeding and respiration activities. In muddy or sandy areas, as was the case in the lower rio Xingu, the exposed posterior end of a mussel may offer one of the few firm substrates available for sponge colonization. We also assume sponges benefit from this relationship with mussels by consuming some of the suspended food particles drawn toward it by the current from the incurrent aperture of the mussel. jtiemann@illinois.edu

Poster 48	**COMPARING GROWTH AND SURVIVAL OF SUBADULT FRESHWATER MUSSELS AMONG SITES IN THE DEGRADED REACH OF THE CLINCH RIVER, VIRGINIA.** Terry Vencil[1], Megan E. Bradley[2], Sarah L.Colletti[2], Michael J. Pinder[3]. [1]Team Estonoa, 3126 Deacon Drive Post Office Box 66 St. Paul, VA; [2] Aquatic Wildlife Conservation Center, Virginia Department of Game and Inland Fisheries, 1724 Buller Hatchery Rd., Marion, VA, [3]Virginia Department of Game and Inland Fisheries, 1796 Highway Sixteen, Marion, VA.

Freshwater mussels are some of the most threatened taxa in North America. More than 80 species were once found across Virginia with 42 extant and 7 extirpated species in the Tennessee River drainage. Habitat loss, non-point and stochastic pollution events, and increased sedimentation have contributed to the decline of freshwater mussels in the Clinch River. Following a spill in 1998, the Department of Game and Inland Fisheries' Aquatic Wildlife Conservation Center was built to recover species lost or impacted. Wetlands Estonoa is a student initiated, place based, service learning project comprised of local high school students who work on environmental education projects at their outdoor center and wetland. They have partnered with AWCC to deploy mussel silos in the Clinch River over 3 summers (2014, 2011, 2010). Silos have been deployed from Cleveland, at the end of the remaining high quality reach of the Virginia Clinch, downstream to Dungannon, with the reach from Carbo to Dungannon representing a highly-degraded reach. In 2014 mussel silos were deployed at four sites in the Clinch River from Carbo to Carfax and surveyed four times over a five month period. At all sites from Carterton downstream, subadult freshwater mussels showed greater than 95% survival with variable growth rates. This project has served dual purposes as an educational opportunity for local high school students and to inform future conservation efforts and advise on the viability of prospective mussel release sites. tvencil@russell.k12.va.us

Poster 49	**ASSESSING THE IMPACTS OF CONTROL METHODS FOR INVASIVE ASIAN CARP ON UNIONID MUSSELS.** Diane Waller, Michelle Bartsch, Kim Fredericks, Nathan Jensen, Sue Schleis, USGS-Upper Midwest Environmental Sciences Center (UMESC), La Crosse, WI.

A variety of tools are under consideration to deter movement of Asian carp from the Upper Mississippi River watershed into the Great Lakes. Studies underway at USGS-UMESC are evaluating the impacts of two of these tools, waterguns and CO_2 barriers, on unionid mussels. A pond trial of the watergun was conducted in 2014 to compare the response of three species (*Amblema plicata, Pyganodon grandis, Lampsilis cardium*) to high pressure underwater sound waves. Mussels were placed into a 0.1 ha pond at three distances from the gun and exposed to 100 shots. Mortality and net movement were assessed on all species. Radiographic imaging was used to detect shell damage in a subset of *P. grandis* that were placed immediately below the gun. No mortality or treatment-related shell damage occurred in any treatment group; movement was minimal in all species. CO_2 barriers are also being evaluated as a means to block Asian carp movement. Since an increase in CO_2 concentration is accompanied by a decrease in pH, high CO_2 concentrations may cause a reduction in mussel shell growth and/or loss of shell calcium. Tests are currently underway to test this hypothesis with juvenile *L. siliquoidea* mussels. Mussels are exposed to concentrations of CO_2 ranging from 75 to 300 mg/L, including a control, in a flow-through diluter system for 28 days. In addition to monitoring mortality of mussels, changes in shell dimensions are determined by image analysis of digital photographs and fluorescent marking with calcein. Results of both studies will help inform resource managers of the conservation concerns for native mussels in the wake of invasive species control. dwaller@usgs.gov

Poster 50	**ATLANTIC SLOPE FRESHWATER MUSSEL PROPAGATION AT THE VIRGINIA FISHERIES AND AQUATIC WILDLIFE CENTER.** B.T. Watson[1], R. Mair[2], M.C. Odom[2], M.E. Pletta[3], and D.L. Peterson[2]. [1]VA Department of Game & Inland Fisheries, 1132 Thomas Jefferson Road, Forest, VA; [2]Harrison Lake National Fish Hatchery, U.S. Fish & Wildlife Service, 11110 Kimages Road, Charles City, VA; [3]VA Department of Game & Inland Fisheries, 3801 John Tyler Memorial Highway, Charles City, VA.

Over the past decade, propagation of freshwater mussels has become a vital component in the effort to conserve and recover this critically imperiled fauna. Once conducted at a few universities alongside other unionid-related research, now no less than 15 facilities operate at universities and state and federal facilities ranging across the United States from the Midwest to the Mid-Atlantic to the Southeast and extending to Europe. However, little effort has been directed at the Atlantic Slope fauna, most likely since the number of threatened and endangered species is not as numerous as other major drainages like the Ohio and Tennessee. To help fill this gap, the Virginia Department of Game & Inland Fisheries and the U.S. Fish & Wildlife Service partnered to start the cooperative Virginia Fisheries and Aquatic Wildlife Center (VFAWC) at Harrison Lake National Fish Hatchery in 2007. Starting in a 500 square-foot building, we expanded to include a 2nd, 1,000 square-foot building in 2012. Over the past seven years, VFAWC has worked with nine species, producing over 5.1 million mussels. Starting at just over 12,000 juveniles in our first year of production in 2008, we produced over 2.3 million mussels in 2014. Most propagation and grow out systems we use are similar to other facilities like Aquatic Habitat Units and Barnhart buckets but we also have developed unique systems. While most species propagated are not threatened or endangered, all are identified as Species of Greatest Conservation Need in Virginia and VFAWC is the only facility to produce tidewater mucket (*Leptodea ochracea*) and alewife floater (*Anodonta implicata*). Over 107K mussels have been released since 2009, all of which were tagged and many of which have spawned in the wild. Until 2014, work was done without a dedicated staff as we use a mix of biologists from the Agencies and volunteers. Brian.Watson@dgif.virginia.gov