10th Biennial Symposium

Sunday, March 26, 2017 – Thursday, March 30, 2017

2017 FMCS Symposium Schedule At A Glance

Sunday 3/26/2017	Monday 3/27/2017	Tuesday 3/28/2017	Wednesday 3/29/2017	Thursday 3/30/2017
Registration 12-8pm	Registration 7am - 5pm	Registration 7am - 5pm	Registration 7am - 10:00am	Optional Field Trips 9:00-5:00 p.m.
	Continental Breakfast 7:30 - 8:00 a.m.	Continental Breakfast 7:30 - 8:15 a.m.	Breakfast OYO	
	Welcome/Announcements Keynote and Plenary Presentations 8:00 - 10:00 a.m.	Announcements and Plenary Presentations 8:15- 10:00 a.m.	Concurrent Paper Sessions 8:20 - 10:00 a. m. SESSION 19, SESSION 20, SESSION 21	
Workshops	Morning Break 10:00 - 10:30 a.m.		Morning Break 10:00 - 10:40 a.m.	
International Committee Meeting 2:00 - 3:30 p.m.	Concurrent Paper Sessions 10:30 a.m. - 12:30 p.m. SESSION 1, SESSION 2, SESSION 3	Concurrent Paper Sessions 10:30 a.m. - 12:30 p.m. SESSION 10, SESSION 11, SESSION 12	Concurrent Paper Sessions 10:40 a.m. - 12:20 p.m. SESSION 22, SESSION 23, SESSION 24	
	Lunch On Your Own 12:30 - 2:00 p.m.	Lunch On Your Own 12:30 - 2:00 p.m.	FMCS Business Lunch 12:30 - 2:30 p.m.	
FMCS Board Meeting 4:00 - 6:00 p.m.	FMCS Comm. Mtgs (Lunch Provided) 12:30 - 2:00 pm *Gastropod Status & Distribution* *Outreach* *Guidelines & Techniques* *Genetics* *Symposia*	FMCS Comm. Mtgs (Lunch Provided) 12:30 - 2:00 pm *Mussel Status & Distribution* *Propagation and Restoration* *Information Exchange – Publications* *Environmental Quality and Affairs* *Awards* *Ad Hoc - Professional Certification*		
		Cumberlandia Working Group Meeting 3:00 - 5:00 p.m		
	Concurrent Paper Sessions 2:00 - 3:20 p.m. SESSION 4, SESSION 5, SESSION 6	Concurrent Paper Sessions 2:00 - 3:30 p.m. SESSION 13, SESSION 14, SESSION 15	Concurrent Paper Sessions 2:40 - 4:40 SESSION 25, SESSION 26	
	Afternoon Break 3:20 - 3:40 p.m.			
Student - Mentor Mixer *First in FMCS History* 6-7 p.m.	Concurrent Paper Sessions 3:40 - 5:00 p.m. SESSION 7, SESSION 8, SESSION 9	Concurrent Paper Sessions 3:40 - 5:00 p.m. SESSION 16, SESSION 17, SESSION 18		
		Ad Hoc Monetary Values 5:00 - 6:00 p.m.		
Welcome Reception 7 - 10 p.m.	Mixer and Poster Session 6:00 - 10:00	Mixer and Auction 6:00 - 11:00	Mixer and Music 7:00 - 10:00 *Abby Normal and the Detroit Lean*	
Sunday Mixer Includes: Eat Local Appetizers (West Side Market cheeses, pierogis, and more)	Monday Mixer Includes: Diner Grub (sliders, tots, rueben fritters, salad, and more) and Italian Station	Tuesday Mixer Includes Buffet Style Dinner	Wednesday Mixer Includes **OPEN BAR 7:00 - 8:00 pm!** Cash Bar 8:00 - 10:00 p.m.	
	Continental Breakfast Includes: Coffee, Tea, Assorted Muffins, Danishes, Bagels, and Croissants, and Biscuit Breakfast Sandwiches			
	Mid-Morning Breaks Include: Granola Bars, Yogurt, Coffee, and Tea			
	Mid-Afternoon Breaks Include: Sweet Treats, Coffee, and Tea			

2017 Meeting Organizers

Rebecca Winterringer
TRC Environmental Corporation
rwinterringer@trcsolutions.com

Greg Zimmerman
EnviroScience, Inc.
gzimmerman@enviroscienceinc.com

Dave Zanatta
Central Michigan University
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Phil Mathias
EnviroScience, Inc.
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Symposium Planning Committee

Joe Snavely – Announcements
Susan Oetker and Daelyn Woolnough – Student Workers
Jeremy Tiemann, Nathan Whalen, Paul Johnson, Jeff Garner – Gastropod Workshop
Tom Watters – Advanced Unionid Taxonomy Workshop
Ryan Schwegman – Field Trips
Steve Ahlstedt and Lisie Kitchel – Auction and Sponsorships
Jennifer Archambault and Megan Bradley – Student- Mentor Mixer
Emily Grossman – Registration

2017 FMCS Officers

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Teresa Newton
US Geological Survey
La Crosse, WI

Past President
Patricia Morrison
USFWS - Ohio River Islands NWR
Williamstown, WV

President Elect
Heidi Dunn
Ecological Specialists, Inc.
O'Fallon, MO

Secretary
Janet Clayton
West Virginia Division of Natural Resources
Elkins, WV

Treasurer
Emily Grossman
Ecological Specialists, Inc.
O'Fallon, MO

FMCS Standing Committees and Their Chairs/Co-chairs

If you are interested in participating in committee activities, please contact one of the appropriate chairs.

Awards
W. Gregory Cope - North Carolina State University greg_cope@ncsu.edu
Teresa Newton - Upper Midwest Environ. Science Center tnewton@usgs.gov
Emy Monroe - Midwest Fisheries Center emy_monroe@fws.gov

Environmental Quality & Affairs
Steve McMurray - Missouri Dept. of Conservation stephen.mcmurray@mdc.mo.gov
Braven Beaty - The Nature Conservancy bbeaty@tnc.org

Gastropod Status and Distribution
Nathan Whelan - Auburn University nwhelan@auburn.edu
Jeremy Tiemann - Illinois Natural History Survey jtiemann@illinois.edu

Genetics
David J. Berg - Miami University bergdj@miamioh.edu
Curt Elderkin - The College of New Jersey elderkin@tcnj.edu

Guidelines and Techniques
Mary McCann - HDR, Inc. mary.mccann@hdrinc.com
Ryan Schwegman - EnviroScience, Inc. RSchwegman@EnviroScienceInc.com

Information Exchange Newsletter
John Jenkinson - Clinton, Tennessee jjjenkinson@hotmail.com

Information Exchange Journal
G. Thomas Watters - OSU Museum of Biological Diversity Watters.1@osu.edu
W. Gregory Cope - North Carolina State University greg_cope@ncsu.edu
Wendell R. Haag - U.S. Forest Service whaag@fs.fed.us

Mussel Status and Distribution
Arthur E. Bogan – North Carolina State Museum of Natural Sciences arthur.bogan@ncdenr.gov
John L. Harris - Arkansas State University omibob1@gmail.com

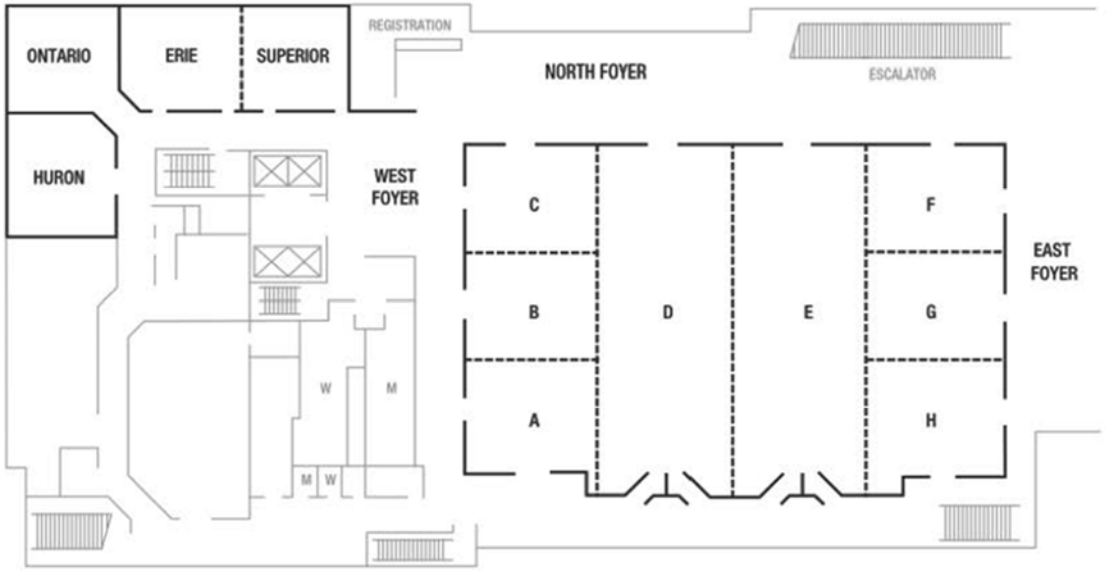
Nominations
Leroy Koch - U.S. Fish and Wildlife Service leroy_koch@fws.gov

Outreach
Megan Bradley - U.S. Fish and Wildlife Service Megan_Bradley@fws.gov
Jennifer Archambault - North Carolina State University jmarcham@ncsu.edu

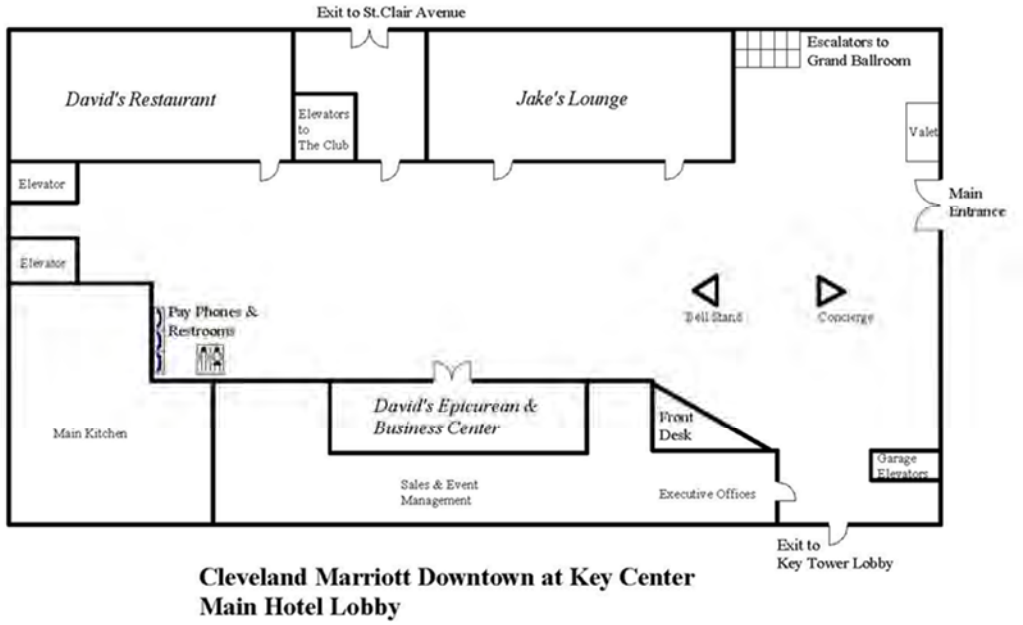
Propagation, Restoration, & Introduction
Dan Hua - Tennessee Wildlife Resources Agency Dan.Hua@tn.gov
Rachael Hoch - North Carolina Wildlife Resources Comm. rachael.hoch@ncwildlife.org

Symposium
Heidi L. Dunn Ecological Specialists Inc. Hdunn@ecologicalspecialists.com

Meeting Space Layout



Marriott – Ground Level/Lobby



Cleveland Marriott Downtown at Key Center
Main Hotel Lobby

Parking at the Marriott

On-site parking: $8.00 hourly, $22.00 daily
Valet parking: $30.00 daily

Parking fees include in/out privilege

Contents

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

Want a chance to win prizes while meeting new people, reconnecting with colleagues, and engaging in awesome symposium activities?! Well, then let's play BINGO! On the honor system, mark a square when you complete an activity. ***See page 119 for your Bingo Card and Instructions.***

Committee Sponsors

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Caryn Vaughn

2017 FMCS Symposium Schedule Overview

Sunday 3/26/2017	Monday 3/27/2017	Tuesday 3/28/2017	Wednesday 3/29/2017	Thursday 3/30/2017	
Registration 12:00 - 8:00 p.m.	Registration 7:00 a.m. - 5:00 p.m.	Registration 7:00 a.m. - 5:00 p.m.	Registration 7:00 a.m. - 10:00 a.m.	Optional Field Trips 9:00-5:00 pm	
FMCS Board Meeting 4:00 - 6:00 p.m. *Erie-Superior*	Continental Breakfast 7:30 - 8:00 a.m. *East Foyer*	Continental Breakfast 7:30 - 8:15 a.m. *East Foyer*	Breakfast on Your Own		
	Salons A - D				
	Welcome 8:00 - 8:10 Keynote Speaker: Dr. Jeffrey Reutter 8:10-8:30 a.m.	Announcements 8:15 - 8:30 a.m.	Concurrent Paper Sessions 8:20 - 10:00 SESSION 19: Threats I SESSION 20: Special Session I - Mussel Habitat SESSION 21: Conservation IV		<u>Monday & Tuesday</u> Continental Breakfast Includes: Coffee, and Tea, Assorted Muffins, Danishes, Bagels, and Croissants Biscuit Breakfast Sandwiches <u>Mid-Morning Breaks</u> Include: Granola Bars, Yogurt, Soda, Coffee and Tea <u>Mid-Afternoon Breaks</u> Include: Sweet Treats, Soda, Coffee and Tea <u>Sunday Mixer</u> Includes: Eat Local Appetizers (smokies, cheeses, pierogis, and more) <u>Monday Mixer</u> Includes: Diner Grub (sliders, tots, rueben fritters, salad, and more) and Italian Station <u>Tuesday Mixer</u> Includes: Buffet Style Dinner <u>Wednesday Mixer</u> Includes: OPEN BAR 7-8pm!
	Plenary: Valuation Mr. Tom Wilmoth 8:30 - 9:00 a.m.	Plenary: Ecosystems Dr. David Strayer 8:30 - 9:00 a.m.			
Advanced Unionid Taxonomy Great Lakes Fauna 8:30 a.m. - 5:00 p.m. *Salon C* Lunch Provided	Plenary: Mollusks as Ecosystem Engineers Dr. Timothy Hoellein 9:00 - 9:30 a.m.	Plenary: Practice Dr. Greg Cope 9:00 - 9:30 a.m.			
	Panel Discussion 9:30 - 10:00				
	Morning Break 10:00 - 10:30 a.m.		Morning Break 10:00 - 10:40 a.m.		
	Concurrent Paper Sessions 10:30 - 12:30 a.m. SESSION 1: Status, Trends, and Monitoring I SESSION 2: Contaminants & Ecotoxicology I SESSION 3: Conservation I	Concurrent Paper Sessions 10:30 a.m. - 12:30 a.m. SESSION 10: Life History SESSION 11: Methods SESSION 12: Ecology I	Concurrent Paper Sessions 10:40 a.m. - 12:20 p.m. SESSION 22: Threats II SESSION 23: Special Session II - Mussel Habitat SESSION 24: S Status, Trends, and Monitoring IV		
	Lunch On Your Own 12:30 - 2:00 p.m .	Lunch On Your Own 12:30 - 2:00 p.m .	FMCS Business Lunch 12:30 - 2:30 p.m.		
	FMCS Comm. Mtgs (Lunch Provided) 12:30 - 2:00 p.m.	FMCS Comm. Mtgs (Lunch Provided) 12:30 - 2:00 p.m.			
Basic Gastropod Taxonomy and Sampling 8:30 a.m. - 4:30 p.m. *John Carroll University* Lunch Provided	Concurrent Paper Sessions 2:00 - 3:20 p.m. SESSION 4: Propagation I SESSION 5: Contaminants & Ecotoxicology II SESSION 6: Conservation II	Concurrent Paper Sessions 2:00 - 3:30 p.m. SESSION 13: Status, Trends, and Monitoring III SESSION 14: Ecology II SESSION 15: Environmental DNA	Concurrent Paper Sessions 2:40 - 4:40 p.m. SESSION 25: Ecology IV SESSION 26: Genetics and Phylogeny II and Conservation V		
	Afternoon Break 3:20 - 3:40				
Student - Mentor Mixer *First in FMCS History* 6:00 - 7:00 p.m. *Huron*	Concurrent Paper Sessions 3:40 - 5:00 p.m. SESSION 7: Propagation II SESSION 8: Status, Trends, and Monitoring II SESSION 9: Conservation III	Concurrent Paper Sessions 3:40 - 5:00 p.m. SESSION 16: Status, Trends, and Monitoring IV SESSION 17:Ecology III SESSION 18: Genetics and Phylogeny I			
	Dinner (Mixer to Provide)	Dinner (Mixer to Provide)	Dinner (On Your Own)		
	Salons E - H				
Welcome Reception 7:00 - 10:00 p.m.	Mixer and Poster Session 6:00 - 10:00 p.m (Cash Bar)	Mixer and Auction 6:00 - 11:00 p.m. (Cash Bar)	Mixer and Music 7:00 - 10:00 p.m. *Abby Normal and the Detroit Lean* (Open Bar 7:00 - 8:00 p.m. Cash Bar 8:00 - 10:00 p.m.)		

Keynote and Plenary Sessions

Monday

Keynote Speaker - Dr. Jeffery Reutter

HARMFUL ALGAL BLOOMS AND DEAD ZONES IN LAKE ERIE, THE GREAT LAKES AND AROUND THE WORLD: UNDERSTANDING THE PROBLEMS AND SOLUTIONS. Dr. Reutter began working on Lake Erie in 1971 and directed four programs at The Ohio State University from 1987 to 2015: F.T. Stone Laboratory, Ohio Sea Grant College Program, Center for Lake Erie Area Research, and the Great Lakes Aquatic Ecosystem Research Consortium. He received the Friends of Stone Laboratory Lifetime Achievement Award in 2015, the 2015 Lifetime Achievement Award from the Ohio Environmental Council, and the 2015 Water Conservationist of the Year Award from the League of Ohio Sportsmen. More information is available at ohioseagrant.osu.edu and at stonelab.osu.edu.

Plenary: Valuation - Mr. Tom Wilmoth

A REVIEW OF FRESHWATER MOLLUSKS AND THE ENDANGERED SPECIES ACT. Mr. Tom Wilmoth, Attorney and partner at Blankenau, Wilmoth, Jareckle LLP. He and his partners provide sophisticated solutions to complex legal matters across the country. His practice is devoted to Water, Natural Resources, Energy, Agribusiness, and Environmental Law. Tom has extensive experience with litigation regarding water rights and the Endangered Species Act at the highest levels of the U.S. legal system, including cases related to freshwater mollusk species. Additional information is available at http://aqualawyers.com/

Plenary: Mollusks as Ecosystem Engineers - Dr. Timothy Hoellein

ECOSYSTEM ENGINEERS: ROLE OF BIVALVES IN NUTRIENT TRANSFORMATIONS AND RETENTION Dr. Timothy Hoellein is an Aquatic Ecologist at Loyola University of Chicago. Dr. Hoellein's research interests are ecosystem processes and biogeochemistry; the use of metrics of ecosystem function and seasonal dynamics for evaluation of human impacts and restoration in aquatic ecosystems. Currently, he is conducting research projects related to the influence of restoration on nitrogen cycling in eutrophic coastal habitats in New York City, measuring the role of bivalves on nitrogen transformations, and analyses of biofilm activity on anthropogenic litter and microplastic in aquatic ecosystems. More information is available at http://www.luc.edu/biology/hoellein.shtml

Tuesday

Plenary: Ecosystems - Dr. David L. Strayer

WHAT ARE FRESHWATER MUSSELS WORTH? Dr. David L. Strayer, Distinguished Senior Scientist, Emeritus, Cary Institute of Ecosystem Studies in New York. Dr. Strayer recently retired from 30+ years working as a freshwater ecologist at the Cary Institute. His recent research has focused on freshwater ecology, especially on the Hudson River; the distribution and roles of freshwater invertebrates, especially bivalves; the ecology of biological invasions; conservation ecology; and shore zone ecology. More information about Dr Strayer and his work is available at http://www.caryinstitute.org/science-program/our-scientists/dr-david-l-strayer

Plenary: Practice - Dr. Gregory Cope

ADVANCES IN FRESHWATER MOLLUSK RESEARCH: PERSPECTIVES ON PRACTICE, REGULATION, AND EMERGING NEEDS Dr. Gregory Cope is a William Neal Reynolds Distinguished Professor in the Department of Applied Ecology North Carolina State University (NCSU), and Extension Leader and Coordinator of the NCSU Agromedicine Institute. Dr. Cope's research interests are in aquatic toxicology, ecology, and physiology, and in the transport, fate, and effects of aquatic pollutants and other human-mediated stressors on freshwater mollusks and fish. His research utilizes sentinel aquatic organisms, biomarkers of exposure, effect, or susceptibility, or alternative toxicological models from which linkages to environmental and human health are evaluated. The following site has more information about Dr. Cope's work: https://appliedecology.cals.ncsu.edu/faculty/w-gregory-cope/

Panel Discussions: The purpose of the Panel Discussion is to encourage dialogue between Symposium attendees and those with the "muscle" behind the mollusk. We encourage you to hold your questions, observations, and thoughts on the Plenary topic for the panel that will follow Plenaries on Monday and Tuesday.

Information

GETTING AROUND DOWNTOWN CLEVELAND

Take a moment for Safety - Walk with a Buddy, Know your Surroundings

Smile and Ride Free – Trolley - The RTA Trolleys are the quick, easy, and free way to get around downtown Cleveland. And with three unique lines, odds are there's a Trolley nearby that's ready to take you to most of Cleveland's major civic and business centers, world-class restaurants, entertainment destinations, tourist attractions, hotels, and the casino. All you need is a sense of adventure and a smile to hop on and ride for free.

Bookmark the Interactive App - http://map.thisiscleveland.com/

Show Your Badge Program: To ensure you have a memorable experience in Cleveland, we've partnered with local restaurants, attractions, shopping venues, spas, and sports and recreation organizations to provide exclusive discount offers through the Show Your Badge program. To participate, attendees simply show their conference badge when visiting our participating partners found at www.thisiscleveland.com/syb in order to receive their exclusive offer.

Destination Cleveland App - The Destination Cleveland app is your personalized guide to Cleveland's must-see attractions, restaurants and events. Find your way around town and create our own experience, save your favorite items, and receive insider information on locations to get the most out of your trip to Cleveland. Don't forget to remind your attendees to download the new Destination Cleveland app. The app is available in the App Store and Google Play.

Did you know? *The Cuyahoga River was a retreat from the last glaciers ever seen in the United States. It is called an "infant glacial river", because it is young compared to all of the other rivers formed by glaciers. The river was formed about 13,000 years ago, but the Cuyahoga Valley has been there even longer.*

Sessions Quick Reference

Pages: Session/Abstracts	PLATFORM SESSIONS – QUICK REFERENCE	Session/Abstracts	PLATFORM SESSIONS – QUICK REFERENCE
PS1/ 20	**PLENARY SESSION 1: Valuation** (Value of Mollusks - Monetary, Human, and Ecosystems) Monday, March 27, 2017 | 8:30 a.m. – Salons A - D	PS3/ 43	**PLENARY SESSION 3: Ecosystem Services** (Implications for a Changing Environment) Tuesday, March 28, 2017 | 8:30 a.m. – Salons A - D
PS2/ 21	**PLENARY SESSION 2: Engineers** (Mollusks as Ecosystem Engineers) Monday, March 27, 2017 | 9:00 a.m. – Salons A - D	PS4/ 43	**PLENARY SESSION 4: Practice** (A Review in Mollusk Research – Lessons Learned from Research to Regulation to Practice) Tuesday, March 28, 2017 | 9:00 a.m. – Salons A - D
	Panel Discussion Monday, March 27, 2017 | 9:30 a.m. – Salons A - D		**Panel Discussion** Tuesday, March 28, 2017 | 9:30 a.m. – Salons A - D
10 / 22	SESSION 1: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES I Monday, March 27, 2017 | 10:30 a.m. – Salon D	13 / 44	SESSION 10: LIFE HISTORY Tuesday, March 28, 2017 | 10:30 a.m. – Salon D
10/ 25	SESSION 2: CONTAMINANTS & ECOTOXICOLOGY I Monday, March 27, 2017 | 10:30 a.m. – Salon A/B	13 / 47	SESSION 11: METHODS Tuesday, March 28, 2017 | 10:30 a.m. – Salon C
10/ 28	SESSION 3: CONSERVATION I Monday, March 27, 2017 | 10:30 a.m. – Salon C	13 / 50	SESSION 12: ECOLOGY I Tuesday, March 28, 2017 | 10:30 a.m. – Salon A/B
11 / 31	SESSION 4: PROPAGATION I Monday, March 27, 2017 | 2:00 p.m. – Salon D	14 / 53	SESSION 13: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES III Tuesday, March 28, 2017 | 2:00 p.m. – Salon D
11 / 33	SESSION 5: CONTAMINANTS & ECOTOXICOLOGY II Monday, March 27, 2017 | 2:00 p.m. – Salon A/B	14 / 55	SESSION 14: ECOLOGY II Tuesday, March 28, 2017 | 2:00 p.m. – Salon A/B
11 / 35	SESSION 6: CONSERVATION II Monday, March 27, 2017 | 2:00 p.m. – Salon C	14 / 57	SESSION 15: ENVIRONMENTAL DNA Tuesday, March 28, 2017 | 2:00 p.m. – Salon C
12 / 37	SESSION 7: PROPAGATION II Monday, March 27, 2017 | 3:40 p.m. – Salon D	15 / 60	SESSION 16: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES IV Tuesday, March 28, 2017 | 3:40 p.m. – Salon D
12 / 39	SESSION 8: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES II Monday, March 27, 2017 | 3:40 p.m. – Salon A/B	15 / 62	SESSION 17: ECOLOGY III Tuesday, March 28, 2017 | 3:40 p.m. – Salon A/B
12 / 41	SESSION 9: CONSERVATION III Monday, March 27, 2017 | 3:40 p.m. – Salon C	15 / 64	SESSION 18: GENETICS AND PHYLOGENY I Tuesday, March 28, 2017 | 3:40 p.m. – Salon C

Pages: Session/Abstracts	PLATFORM SESSIONS – QUICK REFERENCE
16 / 66	SESSION 19: THREATS I Wednesday, March 29, 2017 | 8:20 a.m. – Salon D
16 / 69	SESSION 20: SPECIAL SESSION – MUSSEL HABITAT: FROM COMPUTER MODELS TO IN-STREAM APPLICATIONS I Wednesday, March 29, 2017 | 8:20 a.m. – Salon A/B
16 / 71	SESSION 21: CONSERVATION IV Wednesday, March 29, 2017 | 8:20 a.m. – Salon C
17 / 73	SESSION 22: THREATS II Wednesday, March 29, 2017 | 10:40 a.m. – Salon D
17 / 75	SESSION 23 SPECIAL SESSION – MUSSEL HABITAT: FROM COMPUTER MODELS TO IN-STREAM APPLICATIONS II Wednesday, March 29, 2017 | 10:40 a.m. – Salon A/B
17 / 77	SESSION 24: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES V Wednesday, March 29, 2017 | 10:40 a.m. – Salon C
18 / 79	SESSION 25: ECOLOGY IV Wednesday, March 29, 2017 | 2:40 p.m. – Salon D
18 / 82	SESSION 26: GENETICS AND PHYLOGENY II / CONSERVATION V Wednesday, March 29, 2017 | 2:40 p.m. – Salon A/B

POSTER NUMBER	POSTER SESSION – QUICK REFERENCE
1 – 16, 69	CONSERVATION
17 - 19	CONTAMINANTS
20 - 34	ECOLOGY
35 - 45	GENETICS
46 - 48	LIFE HISTORY
49 - 50	METHODS
51 - 58	PROPAGATION
59 - 68	STATUS/TRENDS

SESSION 1: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES I **Monday, March 27, 2017 | 10:30 a.m. – 12:30 p.m.** **Salon D** *Moderator: Todd Morris, Fisheries and Oceans Canada, Burlington, Ontario Canada*		**SESSION 2: CONTAMINANTS & ECOTOXICOLOGY I** **Monday, March 27, 2017 | 10:30 a.m. – 12:30 p.m.** **Salon A/B** *Moderator: Robert Bringolf, University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA*		**SESSION 3: CONSERVATION I (DAMS)** **Monday, March 27, 2017 | 10:30 a.m. – 12:30 p.m.** **Salon C** *Moderator: Alan D. Christian, University of Massachusetts, School for the Environment, Boston, MA*	
Platform 1 10:30 a.m.	**FRESHWATER MUSSELS (UNIONIDA) OF VIETNAM: DIVERSITY, DISTRIBUTION AND CONSERVATION STATUS.** Arthur E. Bogan and Do Van Tu	**Platform 7 10:30 a.m.**	**IS JUVENILE MUSSEL CHEMICAL SENSITIVITY INFLUENCED BY PROPAGATION METHOD AND AGE? A COMPARISON OF *IN VITRO* AND *IN VIVO* PROPAGATED JUVENILES.** Anakela Popp*, W. Gregory Cope, Monte McGregor , Leroy Koch, Thomas J. Kwak, Tom Augspurger, and Jay F. Levine **STUDENT SPEAKER*	**Platform 13 10:30 a.m.**	**BASELINE QUALITATIVE AND QUANTITATIVE MUSSEL SURVEYS ASSOCIATED WITH DAM REMOVALS IN THE MILL RIVER WATERSHED, MASSACHUSETTS.** Alan D. Christian
Platform 2 10:50 a.m.	**SURVEY OF THE FRESHWATER MUSSEL FAUNA (BIVALVIA: UNIONIDAE) OF MALAYSIA.** Arthur E. Bogan, Khairul Adha A. Rahim, Ronaldo Sousa, Alexandra Zieritz, and Manuel Lopes-Lima	**Platform 8 10:50 a.m.**	**EFFECTS OF HARDNESS AND ION MIXTURES ON MAJOR ION TOXICITY TO FRESHWATER MUSSEL GLOCHIDIA.** Robert B. Bringolf, Robert L. Ratajczak, Ian McIvor, Anthony Knafala, and James A. Stoeckel	**Platform 14 10:50 a.m.**	**MODELING THE VARIABLE EFFECTS OF LOW-HEAD DAMS ON FRESHWATER MUSSEL ASSEMBLAGES.** Tara M. Early, Michael M. Gangloff[2], and Christpher S. Thaxton **STUDENT SPEAKER*
Platform 3 11:10 a.m.	**EARLY WORKERS ON FRESHWATER MUSSELS (BIVALVIA: UNIONIDA) IN SOUTH AMERICA.** Kevin S. Cummings	**Platform 9 11:10 a.m.**	**BIOACCUMULATION OF METALS IN JUVENILE MUSSELS EXPOSED TO AMBIENT STREAM CONDITIONS.** Jacob Culp, Wendell Haag, Monte McGregor, and Garrett Stillings	**Platform 15 11:10 a.m.**	**STRANDED FRESHWATER MUSSELS IN THE GREEN RIVER, KENTUCKY, FOLLOWING FAILURE OF LOCK & DAM 6.** William Cody Fleece, James Kiser, and Ken Kerns
Platform 4 11:30 a.m.	**STATUS OF FRESHWATER MUSSEL POPULATIONS IN CENTRAL EUROPE AND THE NEED FOR SPECIES-SPECIFIC CONSERVATION CONCEPTS.** Katharina Stoeckl and Juergen Geist	**Platform 10 11:30 a.m.**	**EFFECTS OF CHLORIDE EXPOSURE ON THE FEDERALLY ENDANGERED NORTHERN RIFFLESHELL MUSSEL.** Galbraith, H.S., Blakeslee, C.J., Cole, J.C., Patnode, K.A., Latanzi, L., Anderson, R.M., and Weaver, S.A	**Platform 16 11:30 a.m.**	**HABITAT USE AND TRANSLOCATION OF RARE MUSSELS PRIOR TO DAM REMOVAL.** Peter D. Hazelton
Platform 5 11:50 a.m.	**DECLINE OF NATIVE FRESHWATER MUSSELS WITH EVIDENCE OF LOCALISED REFUGIA FROM ZEBRA MUSSEL INVASION IN THE RIDEAU RIVER, EASTERN ONTARIO.** André L. Martel, Noel Alfonso, and Jacqueline B. Madill	**Platform 11 11:50 a.m.**	**ASSESSING SALINITY TOXICITY OF *POPENAIAS POPEII* (TEXAS HORNSHELL) FROM THE RIO GRANDE, TEXAS.** Michael A. Hart, Charles R. Randklev	**Platform 17 11:50 a.m.**	**DAM REMOVAL AND FRESHWATER MUSSELS: GUIDANCE FOR RESTORATION, CASE STUDIES, AND GAPS IN KNOWLEDGE.** Erin S. McCombs
Platform 6 12:10 p.m.	**CHANGES IN A COASTAL WETLAND ASSEMBLAGE: SIMPLIFICATION OF THE ST. CLAIR DELTA FAUNA.** Todd J. Morris, Kelly McNichols-O'Rourke, and Clint Jacobs	**Platform 12 12:10 p.m.**	**USE OF PARTIAL LIFECYCLE TESTS TO DETERMINE EFFECTS OF NITRATE AND AN ESTROGEN ON FATMUCKET (*LAMPSILIS SILIQUOIDEA*).** Adrian P. Moore, Robert B. Bringolf, and M. Christopher Barnhart **STUDENT SPEAKER*	**Platform 18 12:10 p.m.**	**FRESHWATER MUSSEL RECOLONIZATION UPSTREAM OF A DAM AFTER INSTALLATION OF A FISH LADDER.** Jennifer E. Price, Chris B. Eads, and Jay F. Levine
12:30-2:00 p.m. **LUNCH (ON YOUR OWN)** **COMMITTEE MEETINGS (Box Lunch Provided – ERIE/SUPERIOR/Salons A-D)** **Gastropod Status & Distribution / Outreach** **Guidelines & Techniques / Genetics / Symposia**					

SESSION 4: PROPAGATION I **Monday, March 27, 2017 | 2:00 p.m. – 3:20 p.m.** **Salon D** *Moderator: Monte McGregor, Center for Mollusk Conservation, KY Dept. of Fish and Wildlife Resources, Frankfort, KY*		**SESSION 5: CONTAMINANTS & ECOTOXICOLOGY II** **Monday, March 27, 2017 | 2:00 p.m. – 3:20 p.m.** **Salon A/B** *Moderator: Robert Bringolf*, [1]University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA		**SESSION 6: CONSERVATION II** **Monday, March 27, 2017 | 2:00 p.m. – 3:20 p.m.** **Salon C** *Moderator: Dave Berg, Department of Biology, Miami University, Ohio*	
Platform 19 2:00 p.m.	**RECENT CHANGES AND IMPROVEMENTS IN FRESHWATER MUSSEL CULTURE AT GENOA NATIONAL FISH HATCHERY (NFH).** Nathan Eckert and Megan Bradley	**Platform 23 2:00 p.m.**	**ASSESSMENT OF THE TOXICITY OF AN ENVIRONMENTALLY RELEVANT MIXTURE OF MAJOR IONS AND THE TRACE ELEMENT NICKEL ON JUVENILE RAINBOW (*VILLOSA IRIS*) AND OYSTER (*EPIOBLASMA CAPSAEFORMIS*) MUSSELS.PROPAGATED JUVENILES.** A. T. Phipps, S. Ciparis, M. J. Keefe, C.E. Zipper, J. W. Jones	**Platform 27 2:00 p.m.**	**DAM REMOVALS ON THE WEST FORK RIVER: A CASE STUDY IN OVERCOMING OBSTACLES TO HABITAT RESTORATION.** Barb Douglas, John Schmidt, Nick Millet, Callie McMunigal, Sarah Veselka
Platform 20 2:20 p.m.	**A STRATEGY FOR ESTIMATING THE COST OF MUSSELS PRODUCED AND CULTURED AT GENOA NATIONAL FISH HATCHERY.** Megan E. Bradley, Nathan L. Eckert, Doug B. Aloisi	**Platform 24 2:20 p.m.**	**OPTIMIZATION OF CLEARANCE RATE AS AN EFFECT ENDPOINT IN TOXICITY TESTING WITH FRESHWATER MUSSELS.** Joseph Salerno, Jim Bennett, Patricia Gillis, Paul Sibley, Ryan Prosser **STUDENT SPEAKER*	**Platform 28 2:20 p.m.**	**REMOVAL OF THREE LOW-HEAD DAMS ON THE WEST FORK RIVER – FRESHWATER MUSSEL IMPLICATIONS.** Sarah Veselka, Janet Clayton, Barb Douglas, Brian Carlson, John Schmidt, Nick Millett, Callie McMunigal
Platform 21 2:40 p.m.	**USE OF SEROTONIN TO INDUCE RELEASE OF GLOCHIDIA BY CONGLUTINATE-PRODUCING FRESHWATER MUSSELS.** Chris B. Eads, Tom Fox, Rachael Hoch, Nathan L. Eckert, Jay F. Levine	**Platform 25 2:40 p.m.**	**USING SURVIVAL AND GROWTH OF JUVENILE MUSSELS TO IDENTIFY SOURCES OF WATER QUALITY DEGRADATION.** Lesley Sneed, Wendell Haag, Jacob Culp, Monte McGregor, Robert Durborow **STUDENT SPEAKER*	**Platform 29 2:40 p.m.**	**AQUATIC FAUNA RESTORATION IN CHEOAH RIVER, WESTERN NORTH CAROLINA.** Steve Fraley, T.R. Russ, Rachael Hoch, Wendell Pennington
Platform 22 3:00 p.m.	**IN VITRO RESEARCH AT THE COLUMBUS ZOO & AQUARIUM'S FRESHWATER MUSSEL CONSERVATION AND RESEARCH FACILITY.** Jacqualyn Halmbacher	**Platform 26 3:00 p.m.**	**COMBINED EFFECTS OF MERCURY CONTAMINATION AND THERMAL STRESS ON FRESHWATER MUSSELS AND ECOSYSTEM FUNCTION.** Brent N. Tweedy, Caryn C. Vaughn	**Platform 30 3:00 p.m.**	**DEVELOPMENT OF RESTORATION CRITERIA FOR FRESHWATER MUSSEL SPECIES IN GREATEST CONSERVATION NEED IN ILLINOIS.** Sarah A. Douglass, Alison P. Stodola, Scott J. Chiavacci
AFTERNOON BREAK **3:20-3:40 p.m.**					

SESSION 7: PROPAGATION II **Monday, March 27, 2017 | 3:40 p.m. – 5:00 p.m.** **Salon D** *Moderator: Megan Bradley, Genoa National Fish Hatchery, U.S. Fish and Wildlife Service, Genoa, WI*		**SESSION 8: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES II** **Monday, March 27, 2017 | 3:40 p.m. – 5:00 p.m.** **Salon A/B** *Moderator: Steve Ahlstedt, Norris, TN*		**SESSION 9: CONSERVATION III** **Monday, March 27, 2017 | 3:40 p.m. – 5:00 p.m.** **Salon C** *Moderator: Peter Hazelton, Massachusetts Division of Fisheries & Wildlife, Westborough, MA*	
Platform 31 3:40 p.m.	**PROPAGATION AND JUVENILE MUSSEL CULTURE AT THE CUMBERLAND RIVER AQUATIC CENTER.** Dan Hua[1], Dave McKinney, David Sims, Don Hubbs, and Kou Peng	**Platform 35 3:40 p.m.**	**FRESHWATER MUSSELS OF THE HIWASSEE RIVER (APALACHIA CUTOFF) IN POLK COUNTY, TENNESSEE - AN ISOLATED AND TENUOUS COMMUNITY.** Steven A. Ahlstedt, Charles S. Howard, Matthew P. Reed, James Herrig	**Platform 39 3:40 p.m.**	**DISTRIBUTION OF WAVYRAYED LAMPMUSSEL (*LAMPSILIS FASCIOLA*) IN THE LOWER SPEED RIVER, ONTARIO.** Courtney Beneteau
Platform 32 4:00 p.m.	**CURRENT STATUS OF REINTRODUCTION EFFORTS FOR THREE FEDERALLY ENDANGERED FRESHWATER MUSSELS IN ALABAMA, MISSISSIPPI, AND TENNESSEE.** Paul D. Johnson, Todd B. Fobian, Michael L. Buntin, Jesse T. Holifield Thomas A. Tarpley, Jeffrey T. Garner	**Platform 36 4:00 p.m.**	**POPULATION DISTRIBUTION ANALYSIS OF THE ALABAMA SPIKE (*ELLIPTIO ARCA*) IN THE MOBILE RIVER BASIN.** Daniel Mason*, Michael M. Gangloff **STUDENT SPEAKER*	**Platform 40 4:00 p.m.**	**ENDANGERED SPECIES RESTORATION IN WEST VIRGINIA.** Janet L. Clayton, Patricia A. Morrison
Platform 33 4:20 p.m.	**PROPAGATION AND CULTURE AT VIRGINIA FISHERIES AND AQUATIC WILDFLIFE CENTER.** Amy Maynard, Rachel Mair, Brian Watson, Michael Odom, Ben Davis	**Platform 37 4:20 p.m.**	**POPULATION STATUS AND DEMOGRAPHICS OF THE DWARF WEDGEMUSSEL IN THE DELAWARE RIVER BASIN: PERSPECTIVES ON SPECIES RECOVERY.** J.C. Cole, H.S. Galbraith, C.J. Blakeslee, B.S. White, W.A. Lellis	**Platform 41 4:20 p.m.**	**HOW THE USE OF SUBMERSIBLE UPWELLING SYSTEMS ARE SPREADING THE CONSERVATION BIOLOGY MESSAGE TO IOWA AND WISCONSIN HIGH SCHOOL STUDENTS.** Jared McGovern, Mikaela Foust, and Megan Bradley
Platform 34 4:40 p.m.	**CANCELED** EVALUATING THE USEFULNESS OF COMMERCIALLY AVAILABLE PROBIOTICS IN THE DIETS OF [illegible] MUSSELS. Andrew T. McDonald, David Cravens, Fritz E. Vorisek, Travis Bailey, Adam C. Shepard, Monte A. McGregor	**Platform 38 4:40 p.m.**	**LONG TERM MONITORING OF *PLEUROBEMA COLLINA* ON SOUTH FORK POTTS CREEK, MONROE COUNTY, WEST VIRGINIA.** Michael E. Everhart, Janet L. Clayton	**Platform 42 4:40 p.m.**	**USING CREATIVE NONFICTION TO COMMUNICATE SCIENCE IN IMMERSION: THE SCIENCE AND MYSTERY OF FRESHWATER MUSSELS.** Abbie Gascho Landis
MIXER/POSTER SESSION **6:00-10:00 p.m. (poster set up 1:00-6:00 p.m.)**					

SESSION 10: LIFE HISTORY **Tuesday, March 28, 2017 | 10:30 a.m. – 12:30 p.m.** **Salon D** *Moderator: Steve Fraley, North Carolina Wildlife Resource Commission, Waynesville, NC*		**SESSION 11: METHODS** **Tuesday, March 28, 2017 | 10:30 a.m. – 12:30 p.m.** **Salon C** *Moderator: Jeremy Tiemann, Illinois Natural History Survey Champaign, IL*		**SESSION 12: ECOLOGY I** **Tuesday, March 28, 2017 | 10:30 a.m. – 12:30 p.m.** **Salon A/B** *Moderator: Carla Atkinson, Department of Biological Sciences, University of Alabama, Tuscaloosa, Alabama*	
Platform 43 10:30 a.m.	**SYNCHRONIZATION OF REPRODUCTION BY TEMPERATURE IN DEERTOE MUSSEL (*TRUNCILLA TRUNCATA*).** Kendell Loyd*, Chris Barnhart, Bernard Seitman, Mike Davis **STUDENT SPEAKER*	**Platform 48 10:30 a.m.**	**UNDERWATER VIDEO IS AN EFFECTIVE TOOL TO REVEAL *DREISSENA* SPATIAL DISTRIBUTION.** Alexander Karatayev, Lyubov Burlakova, Knut Mehler, Vadim Karatayev, Thomas Nalepa, Ashley Elgin, Elizabeth Hinchey	**Platform 54 10:30 a.m.**	**LATITUDINAL VARIATION IN *AMBLEMA PLICATA* SIZE AND GROWTH CHARACTERISTICS IN NORTH AMERICA.** Traci Popejoy*, Caryn C. Vaughn **STUDENT SPEAKER*
Platform 44 10:50 a.m.	**REPRODUCTIVE LIFE HISTORY AND HOST FISH SELECTIVITY OF *FUSCONAIA MITCHELLI* AND *QUADRULA PETRINA*.** Jack F. Dudding, Clint Robertson, Charles R. Randklev **STUDENT SPEAKER*	**Platform 49 10:50 a.m.**	**EVALUATION OF COSTS ASSOCIATED WITH ADHESION OF PIT TAGS TO FRESHWATER MUSSELS USING TWO COMMONLY EMPLOYED ADHESIVES.** Matthew J. Ashton, Jeremy S. Tiemann	**Platform 55 10:50 a.m.**	**SPATIAL MODELS TO UNDERSTAND SPECIES DISTRIBUTIONS AND NUTRIENT SEQUESTRATION AND FLUXES PROVIDED BY SPECIES-RICH COMMUNITIES.** Carla L. Atkinson, Brian C. van Ee
Platform 45 11:10 a.m.	**THE EFFECT OF *GEOBACTER SULFURREDUCENS* ON JUVENILE *LAMPSILIS RADIATA* GROWTH AND SURVIVAL.** Stephanie P. Gill, David Perkins, Derek Lovley **STUDENT SPEAKER*	**Platform 50 11:10 a.m.**	**AUTOMATED MUSSEL DETECTION USING MOBILE PHONE MICRO-CAMERA AND COMPUTER VISION TECHNIQUES.** David Perkins, Aftab Usmani, Dan Holcomb **CANCELED**	**Platform 56 11:10 a.m.**	**GOING WITH THE FLOW: EVIDENCE FOR ADVECTIVE DISPERSAL OF ADULT UNIONIDS FROM A CASE STUDY ON THE RIO GRANDE AND INSIGHTS FOR CONSERVATION.** Vadim A. Karatayev, Lyubov E. Burlakova, Alexander Y. Karatayev, Tom Miller, Luojun Yang
Platform 46 11:30 a.m.	**LOOKS CAN BE DECEIVING: IDENTIFICATION OF SEXUAL DIMORPHISM OF *LAMPSILIS TERES*.** Megan C. Hess, Wayne P. Hal, Eric T. Tsakiris, Michael Hart, Kentaro Inoue, Clint Robertson, Charles R. Randklev	**Platform 51 11:30 a.m.**	**EXPLORING THE POTENTIALITY OF UNDERWATER DRONES FOR FRESHWATER MUSSELS SURVEY.** Nicoletta Riccardi, Manuel Lopes-Lima, Davide Morea, Giannandrea Carpanzano, Angela Boggero	**Platform 57 11:30 a.m.**	**TO GO WITH THE FLOW? HOW STREAM DISCHARGE INFLUENCES MUSSEL SURVIVAL AND PERSISTENCE.** Alison P. Stodola, Scott J. Chiavacci, Kirk W. Stodola, Jeremy S. Tiemann
Platform 47 11:50 a.m.	**GLOCHIDIAL DEVELOPMENT OF THE FRESHWATER SWAN MUSSEL (*ANODONTA CYGNEA*, LINNAEUS 1758) ON NATIVE AND INVASIVE FISH SPECIES.** Verena Huber, Juergen Geist **STUDENT SPEAKER*	**Platform 52 11:50 a.m.**	**INVESTIGATING SOURCES OF BIAS IN FRESHWATER MUSSEL SAMPLING METHODS IN THE MERAMEC RIVER BASIN, MISSOURI.** Matthew C. Schrum, Amanda E. Rosenberger, Stephen McMurray **STUDENT SPEAKER*	**Platform 58 11:50 a.m.**	**GOING WITH THE FLOW: BEHAVIORAL RESPONSES OF ENDANGERED MUSSELS TO REDUCTIONS IN FLOW.** Kendall R. Moles, James B. Layzer
		Platform 53 12:10 p.m.	**APPROACHES FOR ESTIMATING ABUNDANCE OF FRESHWATER MUSSELS IN AN ATLANTIC COASTAL RIVER, AND IMPLICATIONS FOR ASSESSING NATURAL CAPITAL.** Barbara St. John White, Daniel E. Spooner, William A. Lellis, Jeffrey C. Cole, and Donald R. Hamilton	**Platform 59 12:10 p.m.**	**DUCK MUSSELS *ANODONTA ANATINA* FILTER *DIPLOSTOMUM* EYE FLUKE LARVAE AND REDUCE FLUKE INFECTION IN RAINBOW TROUT.** Jouni Taskinen, Mikhail Gopko, Katya Mironova

12:30-2:00 p.m.
LUNCH (ON YOUR OWN)
COMMITTEE MEETINGS (Box Lunch Provided – ERIE/SUPERIOR/Salons A-D)
Mussel Status & Distribution / Propagation and Restoration
Information Exchange – Publications / Environmental Quality and Affairs
Awards / Ad Hoc - Professional Certification

SESSION 13: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES III **Tuesday, March 28, 2017 | 2:00 p.m. – 3:20 p.m.** **Salon D** *Moderator: John Harris, Welch/Harris, Inc., Scott, AR*		**SESSION 14: ECOLOGY II** **Tuesday, March 28, 2017 | 2:00 p.m. – 3:20 p.m.** **Salon A/B** *Moderator: Heather Galbraith, U.S. Geological Survey, Leetown Science Center, Northern Appalachian Research Laboratory, Wellsboro, PA*		**SESSION 15: ENVIRONMENTAL DNA** **Tuesday, March 28, 2017 | 2:00 p.m. – 3:20 p.m.** **Salon C** *Moderator: Nathan Whelan, U.S. Fish and Wildlife Service, Warm Springs Fish Technology Center, Warm Springs, GA*	
Platform 60 2:00 p.m.	**ASSESSING THE CONSERVATION STATUS OF FRESHWATER MUSSELS IN THE RIO GRANDE DRAINAGE, TEXAS.** Charles Randklev, Michael Hart, Tom Miller	**Platform 64 2:00 p.m.**	**ASSESMENT OF MULTIPLE APPROACHES USING THE ELECTRON TRANSPORT SYSTEM (ETS) ASSAY TO COMPARE THERMAL TOLERANCE OF UNIONID MUSSELS.** Lindsay M White, James A. Stoeckel **STUDENT SPEAKER*	**Platform 68 2:00 p.m.**	**ENVIRONMENTAL DNA AS A MONITORING TOOL FOR FRESHWATER MUSSELS: A SUBSTITUTE FOR CLASSICAL SURVEYS?** Bernhard Stoeckle, Ralph Kuehn, Juergen Geist
Platform 61 2:20 p.m.	**DISTRIBUTION AND ECOLOGY OF SIX STATE THREATENED MUSSEL SPECIES OF EAST TEXAS.** Neil B. Ford, Andrew R. Glen, Jared Dickson, Lance Williams, Marsha Williams, John Placyk, Harmonie Hawley, Josh Banta	**Platform 65 2:20 p.m.**	**USE OF THE ELECTRON TRANSPORT SYSTEM (ETS) ASSAY TO TEST FOR DIFFERENCES IN THERMAL TOLERANCE OF EIGHT MUSSEL SPECIES IN THE SIPSEY RIVER, ALABAMA.** Hisham A. Abdelrahman, Lindsay White, Carla L. Atkinson, Troy Farmer, and James A. Stoeckel	**Platform 69 2:20 p.m.**	**ENVIRONMENTAL DNA: AN EFFICIENT, NON-INVASIVE APPROACH FOR MONITORING THREATENED AND ENDANGERED MUSSEL DISTRIBUTIONS.** Eric R. Waits, Amy Bergdale, Matthew Ashton, Kathleen A. Patnode, Janet L. Clayton, Lucas M. Smith
Platform 62 2:40 p.m.	**COMPREHENSIVE ILLUSTRATED CATALOGUE OF PRIMARY TYPES OF THE PLEUROCERIDAE.** Jeffrey T. Garner, Ellen E. Strong, Arthur E. Bogan, Thomas A. Tarpley, Paul D. Johnson	**Platform 66 2:40 p.m.**	**UPPER THERMAL LIMITS OF FRESHWATER MUSSELS (BIVALVIA, UNIONOIDA) IN RAMPED TEMPERATURE EXPOSURES.** Kathryn C. Martin, M. Christopher Barnhart	**Platform 70 2:40 p.m.**	**A NOVEL WATER COLLECTION TECHNIQUE FOR ENVIRONMENTAL DNA STUDIES OF FRESHWATER MUSSELS.** Caitlin Byrne, Mike Brittain, Kody Kuehnl, Barb Wolfe, Doug Warmolts, G. Thomas Watters **CANCELED**
Platform 63 3:00 p.m.	**FILLING THE GAPS: THE IMPORTANCE OF DENSE GEOGRAPHIC SAMPLING FOR ASSESSING THE DIVERSITY OF WESTERN NORTH AMERICAN *JUGA* (GASTROPODA, SEMISULCOSPIRIDAE).** Ellen E. Strong, Nathan V. Whelan	**Platform 67 3:00 p.m.**	**A WEIGHT OF EVIDENCE APPROACH FOR DEFINING THERMAL TOLERANCE IN A FEDERALLY ENDANGERED SPECIES.** Blakeslee, C.J., Galbraith, H.S., Lellis, W.A.	**Platform 71 3:00 p.m.**	**DETECTION OF FOUR FRESHWATER MUSSEL SPECIES AT RISK (UNIONIDAE) FROM ENVIRONMENTAL DNA (eDNA) AT ESTABLISHED MONITORING SITES.** Charise A. Currier*, Todd J. Morris, Chris C. Wilson, Joanna Freeland **STUDENT SPEAKER*
AFTERNOON BREAK 3:20-3:40 p.m.					

SESSION 16: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES IV **Tuesday, March 28, 2017 | 3:40 p.m. – 5:00 p.m.** ***Salon D*** *Moderator: Monte McGregor, Center for Mollusk Conservation, KY Dept. of Fish and Wildlife Resources, Frankfort, KY*		**SESSION 17: ECOLOGY III** **Tuesday, March 28, 2017 | 3:40 p.m. – 5:00 p.m.** **Salon A/B** *Moderator: Heather Galbraith, U.S. Geological Survey, Leetown Science Center, Northern Appalachian Research Laboratory, Wellsboro, PA*		**SESSION 18: GENETICS AND PHYLOGENY I** **Tuesday, March 28, 2017 | 3:40 p.m. – 5:00 p.m.** **Salon C** *Moderator: David Zanatta, Central Michigan University, Department of Biology, Institute for Great Lakes Research, Mount Pleasant, MI*	
Platform 72 3:40 p.m.	**COMMUNITY CHANGES IN A FRESHWATER MUSSEL BED FROM 2005 TO 2016 IN THE GREEN RIVER, KENTUCKY.** Monte A. McGregor, Adam C. Shepard, Travis Bailey, Andrew T. McDonald, Fritz E. Vorisek, David Cravens, Julieann M. Jacobs	**Platform 76 3:40 p.m.**	**DETERMINING THERMAL TOLERANCES OF FRESHWATER MUSSELS IN TEXAS.** Jennifer N. Morton, Clint Robertson, Charles R. Randklev **STUDENT SPEAKER*	**Platform 80 3:40 p.m.**	**INVESTIGATION OF GENE EXPRESSION IN WILD AND CAPTIVE FRESHWATER MUSSELS.** Ieva Roznere, Brandon T. Sinn, Marymegan Daly, G. Thomas Watters
Platform 73 4:00 p.m.	**NEW DISTRIBUTIONAL RECORDS FOR THE SPECTACLECASE MUSSEL FROM THE OUACHITA RIVER IN ARKANSAS.** William R. Posey II, Kendall R. Moles, Kelly J. Irwin	**Platform 77 4:00 p.m.**	**THE RELATIONSHIP BETWEEN MESOHABITAT STRUCTURE AND MUSSEL COMMUNITIES IN EAST TEXAS RIVERS.** Andrew R. Glen, Lance Williams, Neil B. Ford **STUDENT SPEAKER*	**Platform 81 4:00 p.m.**	**ASSESSING THE CONTRIBUTIONS OF SPERM AND GLOCHIDIA TO GENE FLOW IN FRESHWATER MUSSELS (BIVALVIA: UNIONIDAE).** Jer Pin Chong, Kevin J. Roe
Platform 74 4:20 p.m.	**INVENTORY OF UNIONIDS IN TWO NATIONAL WILDLIFE REFUGES IN NORTH LOUISIANA.** John L. Harris, Josh H. Seagraves, Timothy Fotinos, Gypsy Hanks	**Platform 78 4:20 p.m.**	**CO-OCCURRENCE AND DISPERSION PATTERN OF MUSSEL SPECIES WITHIN BEDS.** Kathryn Murphy, Caryn Vaughn, Daniel Hornbach **STUDENT SPEAKER*	**Platform 82 4:20 p.m.**	**GENETIC DIVERSITY, POPULATION STRUCTURE, AND COLONIZATION HISTORY OF THE EASTERN PONDMUSSEL, *LIGUMIA NASUTA*, IN THE GREAT LAKES REGION.** Mariah W. Scott*, Todd J. Morris, David T. Zanatta **STUDENT SPEAKER*
Platform 75 4:40 p.m.	**EFFECTS OF CLIMATE, LAND USE AND STREAM HABIAT CHANGES ON APPALACHIAN ELKTOE *(ALASMIDONTA RAVENELIANA)* POPULATIONS IN THE NOLICHUKCY RIVER.** Gary Pandolfi, Jason Mays, Michael M. Gangloff	**Platform 79 4:40 p.m.**	**EVALUATING BURROWING BEHAVIOR WITHIN COMMUNITIES OF FRESHWATER MUSSELS.** Brian C. van Ee, Carla L. Atkinson *STUDENT SPEAKER	**Platform 83 4:40 p.m.**	**CONSERVATION GENETICS OF NORTH AMERICAN *MARGARITIFERA MARGARITIFERA.*** David T. Zanatta, Bernhard Stoeckle, Juergen Geist, Kentaro Inoue, Ralph Kuehn, Annie Paquet, André L. Martel
MIXER AND AUCTION **6:00 – 11:00 pm** **Salons E- H**					

SESSION 19: THREATS I **Wednesday, March 29, 2017 | 8:20 a.m. – 10:00 a.m.** **Salon D** *Moderator: Wendell Haag, US Forest Service, Southern Research Station, Center for Bottomland Hardwoods Research, Frankfort, KY*		**SESSION 20: MUSSEL HABITAT: FROM COMPUTER MODELS TO IN-STREAM APPLICATIONS (SPECIAL) I** **Wednesday, March 29, 2017 | 8:20 a.m. – 10:00 a.m.** **Salon A/B** *Moderator: Heidi Dunn, Ecological Specialists, Inc., O'Fallon, MO*		**SESSION 21: CONSERVATION IV** **Wednesday, March 29, 2017 | 8:20 a.m. – 10:00 a.m.** **Salon C** *Moderator: Jeremy Tiemann, Illinois Natural History Survey Champaign, IL*	
Platform 84 8:20 a.m.	**PRELIMINARY ASSESSMENT OF PARASITES IN ALIEN AND NATIVE FRESHWATER MUSSELS IN EUROPE.** Jouni Taskinen, Wojciech Andrzejewski, Nicoletta Riccardi, Maria Urbanska	**Platform 89 8:20 a.m.**	**GAPS IN CONSERVATION OF FRESHWATER MUSSEL BIODIVERSITY IN EAST TEXAS.** Ashley D. Walters*,Gina M. Cerbie, Madelyn A. Brown, Neil B. Ford, David J. Berg **STUDENT SPEAKER*	**Platform 94 8:20 a.m.**	***UNIO CRASSUS* (PHILIPSSON, 1788), ANOTHER HIGHLY ENDANGERED FRESHWATER MUSSEL SPECIES IN LUXEMBOURG (EUROPE). HOW CAN WE SAVE THE LAST REMAINING POPULATIONS?** Frankie Thielen, Karin Michels, Sonja Heumann, Michel Frisch, Tanja Eybe, Alexandra Arendt
Platform 85 8:40 a.m.	**FACULTATIVE PARASITIC CILIATED PROTOZOA INFLUENCES GLOCHIDIA VIABILITY OF FRESHWATER MUSSELS.** Ryan Prosser, Joseph Salerno, Jim Bennet, Denis Lyne, Patty Gillis	**Platform 91† 8:40 a.m.**	**JOINT SPECIES MODELS REVEAL THE EFFECTS OF ENVIRONMENT ON COMMUNITY ASSEMBLAGE OF FRESHWATER MUSSELS AND FISHES IN EUROPEAN RIVERS.** Kentaro Inoue, Katharina Stoeckl, Juergen Geist	**Platform 95 8:40 a.m.**	**PROVIDING AGENCIES WITH THE SCIENCE REQUIRED FOR MANAGEMENT: A CASE STUDY OF AN IMPERILED FRESHWATER MUSSEL IN NEW MEXICO.** David J. Berg, Debra Hill, Daniel A. Trujillo
Platform 86 9:00 a.m.	**IDENTIFYING RELATIONSHIPS BETWEEN ENVIRONMENTAL STRESSORS AND SPATIAL AND TEMPORAL TRENDS OF FRESHWATER MUSSEL AND FISH ASSEMBLAGES IN THE POWELL RIVER, VIRGINIA.** Serena Ciparis, Susan Lingenfelser	**Platform 92 9:00 a.m.**	**USING HYDROGEOMORPHIC VARIABLES FOR HABITAT MODELING OF UNIONID MUSSEL CONCENTRATIONS IN MISSOURI OZARK RIVERS.** Garth A. Lindner, Kayla Key, Amanda Rosenberger	**Platform 96 9:00 a.m.**	**SCIENTIFICALLY DEFENSIBLE MANAGEMENT OF AN IMPERILED FRESHWATER MUSSEL IN NEW MEXICO; THE CHALLENGES AND TRAJECTORY FOR CONSERVATION OF AN ENDANGERED SPECIES.** Daniel A. Trujillo, David J. Berg, Debra Hill
Platform 87 9:20 a.m.	**WARMING TEMPERATURES LEAD TO RESPIRATORY STRESS AND BROOD EXPULSION BY GRAVID MUSSELS.** Rebecca Tucker, Jim Stoeckel **STUDENT SPEAKER*	**Platform 93 9:20 a.m.**	**A HIERARCHICAL APPROACH TO MUSSEL CONSERVATION: FROM NICHE MODELING TO FIELD MONITORING.** Kayla Key, Garth Lindner, Amanda Rosenberger, and Kristen Bouska **STUDENT SPEAKER*	**Platform 97 9:20 a.m.**	**VOLUNTARY CONSERVATION OF AN IMPERILED FRESHWATER MUSSEL IN SOUTHEASTERN NEW MEXICO.** Debra Hill, David J. Berg, Daniel A. Trujillo
Platform 88 9:40 a.m.	**A FIELD EXPERIMENT TO ASSESS CAUSES OF MUSSEL DECLINES.** Wendell Haag, Jacob Culp, Monte McGregor, Robert Bringolf, James Stoeckel			**Platform 98 9:40 a.m.**	**EFFECTS OF CUMULATIVE SPRING DISCHARGE ON OCCUPANCY AND DETECTION OF FEDERALLY THREATENED SUWANNEE MOCCASINSHELL (*MEDIONIDUS WALKERI*) AND MUSSEL COMMUNITIES IN THE SUWANNEE RIVER BASIN, FLORIDA.** Jordan M. Holcomb, Colin P. Shea, and Nathan A. Johnson
MORNING BREAK 10:00-10:40 am					
†Platform 90 was canceled					

SESSION 22: THREATS II **Wednesday, March 29, 2017 | 10:40 a.m. – 12:20 p.m.** **Salon D** *Moderator: Lyubov Burlakova, Great Lakes Center, Buffalo State College, Buffalo, NY*		**SESSION 23 MUSSEL HABITAT: FROM COMPUTER MODELS TO IN-STREAM APPLICATIONS (SPECIAL) II** **Wednesday, March 29, 2017 | 10:40 a.m. – 12:20 p.m.** **Salon A/B** *Moderator: Heidi Dunn, Ecological Specialists, Inc., O'Fallon, MO*		**SESSION 24: STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES V** **Wednesday, March 29, 2017 | 10:40 a.m. – 12:20 p.m.** **Salon C** *Moderator: Sarah McRae, U.S. Fish and Wildlife Service, Raleigh, NC*	
Platform 99 10:40 a.m.	**ABANDONED BUT SHOULD NOT BE FORGOTTEN: RESACA SUPPORTS INVASIVE APPLE SNAILS (*POMACEA MACULATA*, PERRY, 1810; CAENOGASTROPODA: AMPULLARIIDAE) WITHIN THE LOWER RIO GRANDE VALLEY, TEXAS.** Kathryn E. Perez, Victoria Garcia Gamboa, Caitlin M. Schneider, Romi L. Burks	**Platform 104 10:40 a.m.**	**MODELLING DISTRIBUTIONS OF JUVENILE AND ADULT MUSSELS IN THE UPPER MISSISSIPPI RIVER USING RANDOM FOREST CLASSIFICATION.** Steven J. Zigler, Teresa J. Newton	**Platform 108 10:40 a.m.**	**IMPLEMENTATION OF THE U.S. FISH AND WILDLIFE SERVICE'S SPECIES STATUS ASSESSMENT (SSA) FRAMEWORK FOR TWO FRESHWATER MUSSELS, YELLOW LANCE (*ELLIPTIO LANCEOLATA*) AND ATLANTIC PIGTOE (*FUSCONAIA MASONI*).** Sarah E. McRae
Platform 100 11:00 a.m.	**AMERICA'S NEWEST INVADER? - DISCOVERY OF A THIRD *CORBICULA* IN ILLINOIS.** Jeremy S. Tiemann, Amanda E. Haponski, Sarah A. Douglass, Mark A. Davis, Taehwan Lee, Kevin S. Cummings	**Platform 105 11:00 a.m.**	**FRESHWATER MUSSEL HABITAT CONSTRUCTION/CREATION FOR THE ST. LOUIS DISTRICT.** Heidi L. Dunn, Teresa C. Allen, Brian Johnson	**Platform 109 11:00 a.m.**	**CHANGES IN HOLOCENE CLIMATE AND FRESHWATER MUSSEL SPECIES COMPOSITION AT AN ARCHAEOLOGICAL SITE ON THE TENNESSEE RIVER IN NORTHEAST ALABAMA.** Robert E. Warren, Arthur E. Bogan[2]
Platform 101 11:20 a.m.	**20 YEARS MEASURING LONG-TERM SURVIVAL RATES AND POPULATION PERSISTENCE OF NATIVE MUSSELS COLONIZED BY ZEBRA MUSSELS IN LAKE PEPIN, MISSISSIPPI RIVER.** Rick A. Hart, Mike Davis, Bernard Sietman, Zeb Secrist, James W. Grier, Andrew C. Miller	**Platform 106 11:20 a.m.**	**UPPER MISSISSIPPI RIVER POOL 11 BERTOM AND MCCARTNEY LAKES NATIVE FRESHWATER MUSSEL HABITAT ENHANCEMENT PROJECT – LESSONS LEARNED AND PATH FORWARD.** Dan Kelner	**Platform 110 11:20 a.m.**	**SIGNS OF HOPE FOR THE UPPER COOSA RIVER OF GEORGIA.** Jason M. Wisniewski, Katie Owens
Platform 102 11:40 a.m.	**SPATIAL DISTRIBUTION OF *DREISSENA* SPP. AND THEIR EFFECT ON BENTHOS IN THE LOWER NIAGARA RIVER.** Knut Mehler, Lyubov E. Burlakova, Alexander Y. Karatayev	**Platform 107 11:40 a.m.**	**A MUSSEL COMMUNITY ASSESSMENT TOOL FOR THE UPPER MISSISSIPPI RIVER.** Heidi Dunn, Steve Zigler, Teresa Newton	**Platform 111 11:40 a.m.**	**STATUS ASSESSMENT AND RANKING OF THE CAROLINA HEELSPLITTER POPULATIONS IN THE CATAWBA RIVER BASIN IN SOUTH CAROLINA.** Timothy W. Savidge, Tom E. Dickinson
Platform 103 12:00 p.m.	**INTERACTIONS BETWEEN UNIONIDS AND DREISSENIDS: LESSONS LEARNED.** Lyubov E. Burlakova, Alexander Y. Karatayev			**Platform 112 12:00 p.m.**	**THE BISHOP STEPHEN ELLIOTT MOLLUSK COLLECTION: A PRIVATE COLLECTION OF HISTORICAL SIGNIFICANCE** K. L. Irwin, G. R. Dinkins
BUSINESS LUNCH AND STUDENT AWARDS 12:30-2:30					

SESSION 25: ECOLOGY IV Wednesday, March 29, 2017 | 2:40 p.m. – 4:40 p.m. Salon D *Moderator: Caryn Vaughn, Department of Biology, University of Oklahoma, Norman, OK*		SESSION 26: GENETICS AND PHYLOGENY II / CONSERVATION V Wednesday, March 29, 2017 | 2:40 p.m. – 4:40 p.m. Salon A/B *Moderator: Kevin Roe, Natural Resource Ecology & Management, Iowa State University, Ames, IA*	
Platform 113 2:40 p.m.	**ECOSYSTEM SERVICES PROVIDED BY EUROPEAN FRESHWATER MUSSELS.** Juergen Geist	**Platform 119 2:40 p.m.**	**MULTILOCUS PHYLOGENIES PROVIDE EVIDENCE FOR A CRYPTIC NEW NEOTROPICAL GENUS OF FRESHWATER MUSSEL (MOLLUSCA: BIVALVIA: DREISSENIDAE) FROM CLEARWATER RIVERS OF THE BRAZILIAN AND GUIANAN SHIELDS.** Susan R. Geda, Michael M. Gangloff
Platform 114 3:00 p.m.	**COMPARISON OF SESTON PROCESSING RATES AND POTENTIAL ECOSYSTEM SERVICES OF DIVERSE FRESHWATER AND MARINE BIVALVE SHELLFISH.** Danielle Kreeger, Catherine Gatenby, Jeanette Howard, Kurt Cheng, Josh Moody, Angela Padeletti, Roger Thomas	**Platform 120 3:00 p.m.**	**MITOGENOMICS OF FRESHWATER MUSSELS (BIVALVIA: UNIONIDA): FIRST RESULTS.** Manuel Lopes-Lima, Elsa Froufe, Miguel Fonseca, Han Ming Gan, David C. Aldridge, Ronaldo Sousa, Amílcar Teixeira, Simone Varandas, David T. Zanatta, Alexandra Zieritz, Arthur E. Bogan
Platform 115 3:20 p.m.	**RESTORATION OF AMERICAN EELS TO THE SUSQUEHANNA RIVER WATERSHED: IMPLICATIONS FOR *ELLIPTIO COMPLANATA* POPULATIONS.** Julie L. Devers, Heather S. Galbraith, Carrie J. Blakeslee, Jeffrey Cole, William Lellis, Steve Minkkinen	**Platform 121 3:20 p.m.**	**APPLYING GENOMICS TO ADVANCE OUR UNDERSTANDING OF FRESHWATER MOLLUSKS** Nathan V. Whelan, Paul D. Johnson, Jeffery T. Garner, Kenneth M. Halanych, Brain S. Helms, Ellen E. Strong
Platform 116 3:40 p.m.	**16S METAGENOMIC PROFILING OF FRESHWATER MUSSEL BED MICROBIAL COMMUNITIES REVEALS INFLUENCE ON NITROGEN-CYCLING BACTERIA.** Ellen M. Black, Michael S. Chimenti, Craig L. Just **STUDENT SPEAKER*	**Platform 122 3:40 p.m.**	**PRELIMINARY REPORT ON THE I-74 BRIDGE REPLACEMENT MUSSEL RELOCATION.** David Ford, Kristen Lundh, Emily Grossman, Heidi Dunn, Matthew Hill, Mary Kay Solberg, Felecia Hurley, Terry VanDeWalle, Stacey Parks
Platform 117 4:00 p.m.	**MODULATION OF NEAR-BED HYDRODYNAMICS BY FRESHWATER MUSSELS IN AN EXPERIMENTAL CHANNEL.** Brandon J. Sansom, Joseph F. Atkinson, Sean J. Bennett	**Platform 123 4:00 p.m.**	**PENNDOT HUNTER STATION BRIDGE REPLACEMENT: THE STORY OF THE LARGEST ENDANGERED SPECIES RELOCATION PROJECT IN THE WORLD; A TALE OF TEAMWORK, A TALE OF CONSERVATION AND RECOVERY.** Gregory F. Zimmerman, Autumn Kelly, Philip T. Mathias, Robert Anderson, Jordan Allison, Eric Chapman, Jennifer Kagel, Ryan Schwegman, the Hunter Station Bridge Replacement Mussel Salvage Team (20+ members)
Platform 118 4:20 p.m.	**SHIFTING HOTSPOTS: HOW DO AGGREGATIONS OF MUSSELS AND FISH INTERACT TO INFLUENCE RESOURCE HETEROGENEITY AND FLUXES IN STREAMS?** Caryn C. Vaughn, Keith B. Gido, Thomas B. Parr, Kiza K. Gates, Garrett Hopper, James P. Guinnip, Traci Popejoy, Carla L. Atkinson		
MIXER - MUSIC BY ABBY NORMAL AND THE DETROIT LEAN SALONS E – H 7:00 – 10:00 p.m.			

Thursday, March 30, 2013| 9:00a.m. – 5:00 p.m.			
8:00 a.m. – 5:00 p.m.	**Field Trips** Buses depart from the Marriott Lobby Level Entrance	***Optional Trip I (9:30 a.m. to 5:00 p.m.)*** ***Sightseeing Tour***	***Optional Trip II (9:00 a.m. to 3:00 p.m.)*** ***Restoration in Action***

I Sightseeing Tour (9:30 a.m. to 5:00 p.m.)

Cleveland Aquarium, Great Lakes Brewing Company Tour, and Rock and Roll Hall of Fame. Come see some of the best that Cleveland has to offer! First, check out local and other aquatic ecosystems on display at the Great Cleveland Aquarium via a special behind-the-scenes tour. Next, tour the famous Great Lakes Brewery and restaurant where award-winning beer is crafted using an ecologically sustainable production process. Finally, see and hear the most amazing display of Rock and Roll memorabilia under one giant, prism-shaped roof at the Rock and Roll Hall of Fame! Transportation will be provided from and back to the hotel.

- http://greaterclevelandaquarium.com/
- https://www.greatlakesbrewing.com/
- https://www.rockhall.com/

II Restoration in Action (9:00 a.m. to 3:00 p.m.)

Northeast Ohio Regional Sewer District and Stream Restoration Site Reviews. This tour will be led by Joel Bingham and Neal Hess from EnviroScience and Paul Kovalcik and others from the Northeast Ohio Regional Sewer District (NEORSD). This trip will visit an estimated four sites where habitat restoration and green infrastructure has been used to improve water quality and manage stormwater. Presenters will discuss the key issues surrounding each project including purpose, funding, regulatory basis, and some of the metrics that are being used to gage success. An estimated 1.7 Billion dollars is expected to be invested into the Cleveland/Akron area for stormwater and water quality improvements. Come see what has already been done and what may be on the horizon! Transportation will be provided from and back to the hotel.

- http://www.neorsd.org/stormwater-watersheds.php
- http://enviroscienceinc.com/services/ecological-restoration/

MONDAY MARCH 27, 2017	
7:30 - 8:00 A.M. EAST FOYER	**CONTINENTAL BREAKFAST**
8:00 – 10:00 a.m. SALONS A - D	**WELCOME AND ANNOUNCEMENTS KEYNOTE AND PLENARY SESSION ABSTRACTS**
Keynote Address 8:10 – 8:30 a.m.	**HARMFUL ALGAL BLOOMS AND DEAD ZONES IN LAKE ERIE, THE GREAT LAKES AND AROUND THE WORLD: UNDERSTANDING THE PROBLEMS AND SOLUTIONS.** Dr. Jeffrey Reutter
In the late 1960s Lake Erie was severely polluted. In 1969, the Cuyahoga River in Cleveland, Ohio caught fire and Lake Erie was called a "dead lake" by the media. It became the poster child for pollution problems in this country leading to the formation of USEPA, NOAA, the first earth day, and the Great Lakes Water Quality Agreement. The lake was choked with excessive algal blooms. We solved this problem primarily by improving sewage treatment, which reduced annual phosphorus loading from 29,000 metric tons to our target of 11,000 metric tons, and the lake became the "walleye capital of the world." Walleye harvests in Ohio grew from 112,000 to over 5 million, charter fishing businesses grew from 34 to over 1200, and coastal marine businesses grew from 207 to over 425. It is easy to show how Lake Erie declined annually to 1970, improved steadily from 1975-95, and unfortunately, has been declining since 1995. In 2002 excessive blooms of blue-green algae returned and grew till 2011, a very wet year. The 2011 bloom was 2.5 times worse than any previous bloom and, for the first time, moved into the Central Basin where it covered the water intakes for 2.8 million people. These harmful algal blooms (HABs) are capable of producing extremely dangerous toxins that can be fatal to people and animals. HABs are a global problem. The record wet year of 2011 was followed by a drought year in 2012 that produced only a small HAB, but for the first time a HAB also occurred in the central basin in 2012. A collaboration between NOAA, Ohio Sea Grant/Stone Lab at OSU, Heidelberg University, and the University of Toledo, led to a NOAA model that predicts the severity of Lake Erie Western Basin HABs based on the amount of phosphorus that flows into the Lake from the Maumee River between 1 March and 31 July each year. The bloom of 2013 was not as large as 2011, but larger than 2012, and five blooms occurred in the Central Basin in 2013. For the first time, the 2013 HAB produced toxin levels so high that a water treatment plant serving 2000 people had to shut down, and in early August 2014, the Toledo Water Plant, which serves 400,000 people, was forced to shut down for over 50 hours due to toxin concentrations in the treated drinking water. The bloom of 2015 was the worst ever. This presentation will discuss the causes of the blooms and the remedies and discuss the role of zebra and quagga mussels.	
Plenary: Valuation 8:30 – 9:00 a.m.	**A REVIEW OF FRESHWATER MOLLUSKS AND THE ENDANGERED SPECIES.** Mr. Tom Wilmoth
The Endangered Species Act (ESA) has had a profound effect on the management of the Nation's large river systems. Freshwater mollusks occurring in these river systems are often highly at risk due to their vulnerability to flow changes, water diversions, and pollution. Mollusks, not surprisingly, have been taking center stage in a number of major battles concerning the nation's waterways. This discussion will provide a basic overview of the ESA's main provisions, followed by a closer look at listing decisions, critical habitat designations, and litigation involving mussel populations. We also will explore the effectiveness of the ESA in protecting these vulnerable species and arresting their decline.	

Plenary: Engineering 9:00 – 9:30 a.m.	**ECOSYSTEM ENGINEERS: ROLE OF BIVALVES IN NUTRIENT TRANSFORMATIONS AND RETENTION.** Dr. Timothy Hoellein
As ecosystem engineers, bivalve communities have major effects on the physiochemical template of their environments. Bivalves with dense colonies show high filtration and growth rates, which can change nutrient retention and transformations at large spatial scales. Documenting the role of bivalves on nutrient dynamics requires integration of physiological ecology, biogeochemistry, and population dynamics. Major changes to bivalve abundance and community composition can help reveal animals' role in nutrient processing, including invasive species, restoration of imperiled species, and extirpation of native taxa. I will review our recent research on nitrogen (N) retention and transformation by oysters (*Crassostrea virginica*), clams (*Corbicula fluminea*), and mussels (Unionidae). Studies were conducted mostly in eutrophic ecosystems where understanding the fate N pollution is of high interest. N transformation and retention by individual oysters and Unionid mussels was quantified using streamside, flow-through feeding chambers which generate rates of N filtration, assimilation, production in feces and pseudofeces, and mass of N in soft tissues and shells. We measured the role of oysters, *C. fluminea*, and Unionid mussels on microbial N transformations in sediment including denitrification (i.e., conversion of nitrate to dinitrogen gas), with continuous flow chambers in the lab. Results show bivalve assemblages are critical sites of N transformations including assimilation, excretion, and denitrification. Their capacity for retention and transformation can be sustained in eutrophic habitats despite high N loads. Bivalve communities are one component in the 'toolbox' of policies and methods when developing strategies for management of water quality. In addition, for taxa with ongoing restoration and conservation concerns (e.g., Unionidae and oysters), quantification of their role in the N cycle, especially retention in tissues and denitrification, is needed to support efforts to sustain wild populations.	
Panel Discussion 9:30 – 10:00 am	The purpose of the Panel Discussion is to encourage dialogue between Symposium attendees and those with the "muscle" behind the mollusk. We encourage you to hold your questions, observations, and thoughts on the Plenary topic for the panel that will follow Plenaries on Monday and Tuesday.
Morning Break 10:00 – 10:30 a.m.	

PLATFORM SESSION ABSTRACTS

SESSION 1	Status, Trends, and Monitoring of Molluscan Resources I Monday, March 27, 2017 | 10:30 a.m. – 12:30 p.m.
Platform 1 **10:30 a.m.** **March 27, 2017**	**FRESHWATER MUSSELS (UNIONIDA) OF VIETNAM: DIVERSITY, DISTRIBUTION AND CONSERVATION STATUS.** Arthur E. Bogan[1] and Do Van Tu[2]. [1]NC Museum of Natural Sciences, 11 West Jones St., Raleigh NC 27601. [2]Department of Aquatic Ecology and Environment, Institute of Ecology and Biological Resources (IEBR), Vietnam Academy of Science and Technology (VAS1), 18 Hoang Quoc Viet, Nghia Do, Cau Giay, Hanoi, Vietnam

Vietnam has a high diversity of freshwater mussels in the Indo-Burma area of Southeast Asia. We have made three fieldtrips across most of Vietnam surveying the freshwater mussel fauna. Fifty-nine freshwater mussel species of Unionida (Margaritiferidae and Unionidae) have been recorded from Vietnam. This includes two new undescribed species. Forty-eight of these taxa were assessed in the IUCN Red List 2016 with these taxa falling into the IUCN Categories of Critically Endangered (4 species, 6.8%), Endangered (7 species, 12%), Vulnerable (1 species, 1.7%), Near Threatened (2 species, 3.4%), Least Concern (23 species, 39%), Data Deficient (11 species, 18.6%) and were not evaluated (11 species, 18.6%). Unfortunately, there has been relatively little research on this group in Vietnam. The biology, host fish and anatomy of most of these species are unknown. Under current impacts of human and natural disasters research on diversity and conservation status of freshwater mussels is very urgently needed in order to propose specific conservation measures for these species in Vietnam. If all of Data Deficient and unevaluated taxa are found to be threatened, with around 60 percent of species threatened, this fauna would become one of the most threatened freshwater molluscan faunas.

Platform 2 **10:50 a.m.** **March 27, 2017**	**SURVEY OF THE FRESHWATER MUSSEL FAUNA (BIVALVIA: UNIONIDAE) OF MALAYSIA.** Arthur E. Bogan[1], Khairul Adha A. Rahim[2], Ronaldo Sousa[3], Alexandra Zieritz[4], and Manuel Lopes-Lima[5]. [1] Research Laboratory, North Carolina State Museum of Natural Sciences, MSC 1626, Raleigh, NC 27699-1626, USA., [2] Department of Aquatic Science, Faculty of Resource Science & Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia., [3] CBMA - Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Braga, Portugal., [4] School of Environmental and Geographical Sciences, University of Nottingham Malaysia Campus, Jalan Broga, 43500 Semenyih, Malaysia. [5]CIBIO/InBIO - Research Center in Biodiversity and Genetic Resources, Universidade do Porto, Campus Agrário de Vairão, Rua Padre Armando Quintas, 4485-661 Vairão, Portugal.

Malaysia is part of the island complex including Borneo known as Sundaland. This region is classified as a biodiversity hotspot with an exceptionally high number of endemic species, but facing a major loss of habitat, among other threats. The unionid fauna of Malaysia is very understudied. Our goal after collecting data from literature and museum collections was to assess the modern distribution in mainland Malaysia and the provinces of Sabah and Sarawak, Borneo. We visited 155 sites from 11 major river basins in mainland Malaysia (2014-2015) and 72 sites from 10 river basins across Sabah and Sarawak (2016), using a standard protocol and collected specimens for genetic analyses and environmental data. Ten species of freshwater mussels were found at only 55 of the 155 sites surveyed in Mainland Malaysia. Despite intense surveying in Sabah and Sarawak, we failed to confirm the presence of four of the five native freshwater mussel species previously recorded from the region. We did find one native species in Sarawak *Rectidens lingulatus* (Drouet & Chaper, 1892), now considered a synonym of *Rectidens sumatrensis* (Dunker, 1852). Fifteen populations were found in four Sarawak river basins. *Rectidens sumatrensis* is also found in Peninsular Malaysia and Sumatra, and is not an endemic species in Borneo. *Sinanodonta woodiana* was also present in 15 sites in Sabah and Sarawak and was the most widespread species, being the only freshwater mussel found in Sabah. Four species not found during our survey of Sabah and Sarawak are either extremely rare or possibly extinct.

Platform 3 **11:10 a.m.** **March 27, 2017**	**EARLY WORKERS ON FRESHWATER MUSSELS (BIVALVIA: UNIONIDA) IN SOUTH AMERICA.** Kevin S. Cummings. Illinois Natural History Survey, University of Illinois, Champaign, Illinois, USA**.**

There is a large body of primary literature on the South American freshwater mussel fauna by such prolific authors as Johann Baptist Spix (1781 – 1826), Isaac Lea (1792 – 1886), Alcide d'Orbigny (1802 – 1857), Robert Hermann Schomburgk (1804 – 1865), Louis Hippolyte Hupé (1819? – 1867), Louis Pfeiffer (1804 – 1877), George B. Sowerby II (1812 – 1884), Rodolfo Philippi (1808 – 1904), Heinrich Carl Küster (1807 – 1876), Karl Eduard von Martens (1831 – 1904), Charles Torrey Simpson (1846 – 1932), Hermann von Ihering (1850 – 1930), Fred Baker (1854 – 1938), Arnold Edward Ortmann (1863 – 1927), William Blanchard Marshall (1865 – 1957), Fritz Haas (1886 – 1969), Horace Burrington Baker (1889 – 1971), Juan José Parodiz (1911 – 2007), and Argentino A. Bonetto (1920 – 1998), among others. I will give a brief overview of some of the people that worked, collected and or published on freshwater mussels of the continent highlighting interesting expeditions, important publications, and fun facts of a few of our malacological forefathers.

Platform 4 **11:30 a.m.** **March 27, 2017**	**STATUS OF FRESHWATER MUSSEL POPULATIONS IN CENTRAL EUROPE AND THE NEED FOR SPECIES-SPECIFIC CONSERVATION CONCEPTS.** Katharina Stoeckl and Juergen Geist. Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technical University of Munich, Mühlenweg 22, D-85354 Freising, Germany.

Effective conservation of freshwater mussel populations requires information on their distribution, abundance, and demography in combination with knowledge of habitat quality and host fish availability. Based on a standardized monitoring program of all of these variables, we surveyed 47 streams in the State of Bavaria, Germany, in the years 2012-2016. We focused on the two most critically endangered mussel species in Central Europe, the freshwater pearl mussel (*Margaritifera margaritifera*) and the thick-shelled river mussel (*Unio crassus*). *M. margaritifera* distribution was geographically restricted to and the species was exclusively found in areas with siliceous bedrock geology (25 populations), whereas *U. crassus* had a much wider distribution range covering siliceous as well as carbonate areas (22 populations). Mean population size in *M. margaritifera* has decreased to 3,000 specimens, with only two populations having mussels younger than 50 years. In contrast, mean population size of *U. crassus* was 5,000, and 70% of *U. crassus* populations revealed recent recruitment younger than 6 years. As for the pearl mussel, stream bed properties were identified as the main limiting factor for the lack of recruitment whereas the main threats for *U. crassus* were found to be direct habitat destruction, e.g. by dredging, as well as a lack of suitable host fish. The differences in life histories, life spans and threats for both species suggest that species-specific conservation concepts that set different priorities are required. While habitat restoration in combination with captive breeding are recommended in protecting *M. margaritifera* populations, conservation of *U. crassus* requires placing greater emphasis on public awareness and on fisheries management. Using the example of the Bavarian Coordination office for Freshwater mussel conservation, we present the implementation of applied conservation that also includes collaboration with volunteers.

Platform 5 **11:50 a.m.** **March 27, 2017**	**DECLINE OF NATIVE FRESHWATER MUSSELS WITH EVIDENCE OF LOCALISED REFUGIA FROM ZEBRA MUSSEL INVASION IN THE RIDEAU RIVER, EASTERN ONTARIO.** André L. Martel[1], Noel Alfonso[1], and Jacqueline B. Madill[1]. [1]Malacology Unit, Research and Collections, Canadian Museum of Nature, Ottawa, ON, K1P 6P4, Canada

Museum records for the Rideau River watershed deposited at the Canadian Museum of Nature begin in 1882. The Rideau Canal-Rideau River system is a UNESCO World Heritage site managed by Parks Canada. Historically, the unionid mussel fauna of this drainage basin included 13 species. Since then, urbanization and land development contributed to reduced water quality and habitat degradation, especially near the city of Ottawa. More recently, the arrival of the zebra mussel in 1990 significantly contributed to the steep decline of the unionid fauna across the entire river system. We conducted the first detailed surveys of the native freshwater mussels of the Rideau River from 1998 to 2001, involving time search and quadrat methods. Zebra mussels continued to spread, impacting not only deep-water impounded habitats but also the rich unionid communities in riffle habitats. In 2016, we re-surveyed the same sites to evaluate the effect of the zebra mussel and also documented habitats using underwater imaging. At many sites, unionids had been almost totally extirpated because of zebra mussel fouling. At the Old Slys site, we observed that the abundance of live native freshwater mussels declined by 90% and two of the five species previously documented were not found. However, there is evidence of refugia for unionids. Observed refugia in this study were shallow habitats near or within macrophyte beds with suitable, mixed loose substrates, such as wetlands. Also, many live adult unionids were found in a thick layer of empty zebra mussel shells overlaying soft sediment, which enables deep burrowing, enough to smother zebra mussels. Favourable substrate type and presence of shallow water habitats allow a small but important percentage of unionid mussels to survive. Identifying and protecting refugia areas for unionids along the Rideau River will contribute to their preservation in this *Dreissena*-invaded system.

Platform 6 12:10 p.m. March 27, 2017	**CHANGES IN A COASTAL WETLAND ASSEMBLAGE: SIMPLIFICATION OF THE ST CLAIR DELTA FAUNA.** Todd J. Morris[1], Kelly McNichols-O'Rourke[1], and Clint Jacobs[2]. [1]Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, ON, Canada; [2]Walpole Island Heritage Centre, Walpole Island First Nation, Walpole, ON, Canada.

Since 1999 the Canadian waters of the St Clair delta have been known to possess a rich and diverse freshwater mussel fauna including many species which have since been listed under the Canadian *Species at Risk Act*. As these waters are found in the relatively undisturbed wetlands of Walpole Island First Nation it was hoped that they would act as refuge for many species from the impacts of dreissenids and other pollutants. In 2003, Environment Canada established a network of index monitoring sites within this area and these sites were resampled by Fisheries and Oceans Canada in 2011 and again in 2016 to investigate the status of this refuge. Sites were sampled by snorkelling along predefined transects until a mussel was detected. Once detected, the location was marked and a circular plot (65 m^2) was searched with the location of the animal at the centre of the plot. All animals were collected, identified, measured and all dreissenid mussels were enumerated and removed. Each transect was searched until 10 plots were assessed or until the transect reached the shore. Dreissenid burden (# of dreissend mussels/unionid) has declined steadily over the study period at all sites while unionid density (#/m^2) within the circular plots initially declined between 2003 and 2011 but has rebounded in 2016 to equal or exceed 2003 levels at most sites. However, unionids have become more patchy with the average number of plots/transect declining from 26 in 2003 to only 14 2016 resulting in an overall reduction in the number of unionids found within the study area from 814 in 2003 to 674 in 2016 (18% decline). Although overall species richness has remained relatively stable between 2003 (19 species) and 2016 (18 species) there has been a shift in dominance with *Lampsilis siliquoidea* representing 66% of all individuals in 2016 compared with only 33% in 2003. Four of the seven species at risk found in 2003 were not detected in 2016 calling into question the potential for the delta to act as a ongoing refuge for many species. Todd.Morris@dfo-mpo.gc.ca

PLATFORM SESSION ABSTRACTS

SESSION 2	Contaminants & Ecotoxicology I Monday, March 27, 2017 | 10:30 a.m. – 12:30 p.m.
Platform 7 **10:30 a.m.** **March 27, 2017**	**IS JUVENILE MUSSEL CHEMICAL SENSITIVITY INFLUENCED BY PROPAGATION METHOD AND AGE? A COMPARISON OF *IN VITRO* AND *IN VIVO* PROPAGATED JUVENILES.** Anakela Popp[1]*, W. Gregory Cope[1], Monte McGregor[2], Leroy Koch[3], Thomas J. Kwak[4], Tom Augspurger[5], and Jay F. Levine[6]. [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]U.S. Fish and Wildlife Service, Frankfort, KY. [4]U.S. Geological Survey, NC Cooperative Fish and Wildlife Research Unit, Raleigh, NC. [5]U.S. Fish and Wildlife Service, Raleigh, NC. [6]North Carolina State University, Department of Marine, Earth and Atmospheric Sciences, Raleigh, NC. **STUDENT SPEAKER*
Identifying and mitigating chemical stressors is important to freshwater mussel conservation, as is assessing mussel-specific sensitivity to pollutants to establish water quality criteria. The newly transformed juvenile life stage is sensitive to certain toxicants and is often used in toxicity testing. Thus, there is a need to transform mussel larvae (glochidia) into juveniles within a laboratory setting. Over the past several decades, host-fish (*in vivo*) propagation techniques have significantly advanced, as have long-term growth and maintenance of propagated mussels. Recently, *in vitro* culture methods have made laboratory rearing of juveniles more efficient and cost-effective. However, ASTM International cautions against using *in vitro* propagated juveniles in toxicity tests unless their relative chemical sensitivity to *in vivo* juveniles is described. The objectives of this study were to evaluate the relative sensitivity of juvenile mussels from both propagation methods to selected chemical toxicants and at multiple ages post-transformation. We conducted 96-hour acute toxicity tests according to ASTM International guidelines with three species (*Lampsilis cardium*, *L. abrupta*, and *Utterbackia imbecillis*) and six chemicals: chloride, nickel, ammonia, copper, and aquatic herbicides Clearigate and Nautique. We calculated the median effective concentration (EC50) for each species-chemical exposure, comparing the EC50s between *in vitro* and *in vivo* juveniles. Statistically significant differences in EC50 between both propagation types were observed in 8 of 17 trials, and *in vitro* juveniles were more sensitive in 7 of the 8 observed differences. All statistically significant differences were within the variation for between-laboratory juvenile mussel EC50 comparisons for a given chemical reported in a recently published evaluation of results from mussel toxicity tests (a factor of 3.6). Additionally, age of juvenile (0 to 22d post-transformation) did not influence relative chemical sensitivity. This study demonstrates that both fish-transformed and *in vitro* transformed juveniles may be appropriate for use in standardized toxicity testing. apopp@ncsu.edu	
Platform 8 **10:50 a.m.** **March 27, 2017**	**EFFECTS OF HARDNESS AND ION MIXTURES ON MAJOR ION TOXICITY TO FRESHWATER MUSSEL GLOCHIDIA.** Robert B. Bringolf[1], Robert L. Ratajczak[1], Ian McIvor[2], Anthony Knafala[2], and James A. Stoeckel[3]. [1]University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA 30602; [2]Equilibrium Environmental, Inc., Calgary, AB T2T1H3; [3]Auburn University, School of Fisheries, Aquaculture and Aquatic Sciences, Auburn, AL 36849.
A variety of anthropogenic activities result in increases of major ions in freshwater and pose a significant risk to aquatic communities including freshwater mussels. Some information exists on the toxicity of NaCl to early life stages of mussels but only a few studies to date have examined the toxicity of ion mixtures common in natural aquatic environments or effects of hardness on major ion toxicity in mussels. Therefore, the primary objectives of this work were to: 1) determine the relationship between water hardness and acute ion toxicity to glochidia, and 2) establish acute toxicological data and evaluate and evaluate relationships for major ion mixtures. We assessed the role of water hardness in acute toxicity of NaCl to glochidia of three widespread North American species: *Lampsilis siliquoidea, L. fasciola,* and *Anodonta suborbiculata.* In the next phase we determined acute toxicity of *L. siliquoidea* glochidia exposed singly to Na_2SO_4, $NaHCO_3$, $MgCl_2$, $MgSO_4$, $CaCl_2$, $CaSO_4$, and KCl. Following the single salt toxicity tests we conducted binary mixture testing of the salts based on a toxic unit (TU) approach across a range of mixture ratios to evaluate the potential for additive, synergistic or protective effects. Results of this work advance understanding of the relative risks of major ions and common ion mixtures to freshwater mussels and inform derivation of water quality standards and criteria to protect mussel populations.	

Platform 9 **11:10 a.m.** **March 27, 2017**	**BIOACCUMULATION OF METALS IN JUVENILE MUSSELS EXPOSED TO AMBIENT STREAM CONDITIONS.** Jacob Culp[1], Wendell Haag[2], Monte McGregor[3], and Garrett Stillings[1]. . [1]Kentucky Division of Water, Frankfort, KY 40601; [2]US Forest Service, Southern Research Station, Center for Bottomland Hardwoods Research, Frankfort, KY 40601; [3]Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY 40601.

Many studies have demonstrated the negative effects (both chronic and acute) of metals exposure on freshwater mussels. We placed laboratory-reared juvenile mussels in silos and sediment cages in 23 streams in Kentucky and measured body burdens of 16 metals after a 12-week exposure period. A related component of this study found inhibited juvenile growth in streams that have experienced dramatic mussel declines, but higher growth in streams that continue to support mussels; reduced growth was associated with higher levels of nitrates/nitrites, pesticides, and barium in stream water. We detected 12 metals in mussel tissues from all sites, and juvenile growth was negatively associated with body burdens of each metal. Reduced growth was most strongly associated with high body burdens of chromium, copper, and zinc ($R^2 > 0.69$). Despite these relationships, reduced growth was not associated with high levels of metals in stream water. Furthermore, we found no significant difference in body burdens between juveniles housed in silos and those housed in sediment cages, even though growth was significantly higher in silos. These results show that bioaccumulation of metals by mussels is a complex process that may influence, or be influenced by, other physiological processes such as growth.

Platform 10 **11:30 a.m.** **March 27, 2017**	**EFFECTS OF CHLORIDE EXPOSURE ON THE FEDERALLY ENDANGERED NORTHERN RIFFLESHELL MUSSEL.** H.S. Galbraith[1], C.J. Blakeslee[1], J.C.Cole[1], K.A. Patnode[2], L. Latanzi[2], R.M. Anderson[2], and S.A. Weaver[3]. [1]U.S. Geological Survey, Leetown Science Center, Northern Appalachian Research Laboratory, Wellsboro, PA; [2]U.S. Fish and Wildlife Service, PA Field Office, State College, PA; [3]University of Alaska Fairbanks, Fairbanks, AK.

An emerging threat to freshwater ecosystems is increased chloride (Cl^-) concentrations due to a variety of factors including climate change, land-use change and development, agricultural practices, road de-icing, and brines released from fossil fuel extraction techniques. While there has been recent concern over the potential impacts of salinization on freshwater ecosystems and the species inhabiting them, most studies have focused on levels of Cl^- that are acutely toxic to adult organisms (*e.g.*, typical LC50 studies). Fewer studies have addressed long term exposure to Cl^- using sublethal indicators of exposure to sub-adult organisms. We chose to assess Cl^- toxicity to native freshwater mussels because of their declining status and general sensitivity to aquatic contaminants. We assessed the effects of acute (2-3000 ppm) and chronic (2-1000 ppm) Cl^- exposure on survival and growth in juvenile Northern Riffleshell and Fatmucket and on adult gravid female Northern Riffleshell. Our results suggest that low levels of chloride are lethal to juvenile mussels, but that mortality was size-specific. Gravid females were less sensitive to Cl^- induced mortality, but effects of Cl^- exposure on glochidia warrants further investigation. These studies suggest that Cl^- differentially impacts mussels at various life stages. Understanding the acute and chronic effects across life stages is crucial to model and predict population and ecosystem-level effects, establish threshold levels for species of concern, and guide the development of appropriate regulations and best management practices.
hgalbraith@usgs.gov

Platform 11 **11:50 a.m.** **March 27, 2017**	**ASSESSING SALINITY TOXICITY OF *POPENAIAS POPEII* (TEXAS HORNSHELL) FROM THE RIO GRANDE, TEXAS.** Michael A. Hart[1], Charles R. Randklev[1]. [1]Institute of Renewable Natural Resources Texas A&M University 17360 Coit Rd. Dallas, TX 75252

Popenaias popeii, Texas hornshell, is endemic to the Rio Grande drainage, in Texas and New Mexico, and to Mexico in select coastal streams. Currently, only four populations persist in the United States and its status within Mexico remains unknown. In 2016, USFWS proposed Texas hornshell for listing as Endangered under the ESA. A number of factors have been implicated in the decline of this species including degraded water quality due to changes in land use, river impoundment, and ground water pumping, but none of these stressors have been explicitly tested. In particular, salinization of the Rio Grande and its tributaries has long been a concern due to the underlying geology, the effects of which have been exacerbated by agricultural practices, natural gas extraction, and river impoundments. In general, unionid mussels are considered sensitive to even low levels of salinity so increased salinization could be a major contributing factor to the decline of Texas hornshell in the Rio Grande. The objective of this study was to determine the effects of various concentrations of salinity on survival of adult mussels of Texas hornshell. We performed acute and chronic toxicity tests at various salinity concentrations for up to 10 days. We found that mussels exposed to concentrations above 4 ppt showed significant mortality, while concentrations below this showed no mortality. Our results demonstrate that Texas hornshell is tolerant of salinization compared to other unionid mussel species. However, large segments of the Pecos and parts of the Rio Grande are near or exceed 4 ppt, which indicates that these reaches are becoming unsuitable and populations within them at risk.

Platform 12 12:10 p.m. March 27, 2017	**USE OF PARTIAL LIFECYCLE TESTS TO DETERMINE EFFECTS OF NITRATE AND AN ESTROGEN ON FATMUCKET (*LAMPSILIS SILIQUOIDEA*).** Adrian P. Moore[1], Robert B. Bringolf[1], and M. Christopher Barnhart[2]. [1]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602; [2]Department of Biology, Missouri State University, Springfield, MO 65897. **STUDENT SPEAKER*

Water quality and contaminants have been frequently identified as critical stressors for freshwater mussels, many species of which are highly imperiled throughout North America and the world. Nutrient pollution, specifically nitrate, is one of the most prevalent causes of water quality degradation globally, with increasing anthropogenic input from agricultural runoff, municipal wastewater, and industrial waste. Nitrate pollution often co-occurs with known endocrine disrupting compounds such as hormones, pointing to the need to understand how these compounds may be interacting to affect wildlife. The potential effects of nitrate and hormones on freshwater mussels are largely unknown, particularly during the parasitic stage of the freshwater mussel lifecycle during which metamorphosis from larvae to juvenile occurs on host fish. Therefore, we investigated the effects of nitrate singly and in combination with a model estrogen on freshwater mussel glochidia viability, attachment success on host fish, and metamorphosis success. In the first experiment we exposed Fatmucket (*Lampsilis siliquoidea)* glochidia for 24 hours to environmentally relevant nitrate concentrations (0, 50, 250 mg/L NO_3) alone and in mixture with an environmentally relevant concentration of ethynylestradiol (EE2; 5 ng/L) before inoculation on their primary host, Largemouth Bass (*Micropterus salmoides*). Nitrate exposure altered glochidia attachment, metamorphosis success, and the number of juveniles produced, while EE2 had no measurable effects. In a separate experiment, we exposed brooding female Fatmucket to a range of nitrate concentrations (0, 50, 100, 150, 200, 250 mg/L) for 25 days and monitored the same suite of endpoints to determine the effects of nitrate when glochidia are exposed in the marsupial gills. Results of these studies are important for improving understanding of the hazards of these common contaminants to freshwater mussels at the critical stages of brooding and metamorphosis and to better define the role of water quality in assessing habitat suitability for mussel conservation efforts. amparr@uga.edu

PLATFORM SESSION ABSTRACTS

SESSION 3	Conservation I Monday, March 27, 2017 | 10:30 a.m. – 12:30 p.m.
Platform 13 10:30 a.m. March 27, 2017	**BASELINE QUALITATIVE AND QUANTITATIVE MUSSEL SURVEYS ASSOCIATED WITH DAM REMOVALS IN THE MILL RIVER WATERSHED, MASSACHUSETTS.** Alan D. Christian. School for the Environment, University of Massachusetts Boston, Boston, MA 02125.

The Taunton River, a ~1,295 km^2 watershed in Southeastern Massachusetts, hosts one of the largest river herring runs in New England and was designated Wild and Scenic in 2009. The main stem of the Taunton River is free-flowing, but many tributaries are blocked by obsolete dams that impact river processes and habitat. The Mill River Restoration Partnership, a collaboration of government agencies, non-profit organizations, and others, is working to remove the dams along the one of the Taunton River Tributaries. Since 2012, two dams have been removed along the Mill River, and a fish-way has been installed at a third dam. One dam remains to be removed. The Partnership is dedicated to monitoring the impacts of these dam removals on populations and habitat of fish, mussels, and other invertebrates. The goals of this project are to assess the effects of dam removals on the freshwater macroinvertebrate assemblages, freshwater mussel assemblages, and stream habitat in the Mill River Watershed. In particular, the effects on *A. implicata* (Alewife floater), *L. nasuta* (Eastern Pondmussel), and *L. ochracea* (Tidewater Mucket) will be documented. In order to achieve these goals, we had two freshwater mussel related objectives: 1) conduct a qualitative freshwater mussel survey, 2) conduct quantitative mussel surveys at 7 stations associated with upstream (n=2) and downstream (n=2) reference reaches and dam removal (n=3) reaches. The summer 2015 qualitative mussel survey resulted in surveying ~17 km of reaches in the Canoe, Snake, and Mill rivers and was conducted at 77 qualitative sampling stations resulting in the observation of 5 species of mussels represented by 2,942 individuals over a combined active search time of 1,756 minutes. The relative abundance was *E. complinata* (89%), *L. radiata* (10%), *A. implicata* (0.5%), the Massachusetts Special Concern *L. nasuta* (0.4%), and *P. cataracta* (<0.1%). Overall, the Massachusetts Special Concern *L. nasuta* was observed at 6 stations represented by a total of 11 individuals. Meanwhile, the target species *A. implicata* was observed at nine stations and represented by a total of 16 individuals. The summer 2016 quantitative sampling and population estimates also will be presented.

Platform 14 10:50 a.m. March 27, 2017	**MODELING THE VARIABLE EFFECTS OF LOW-HEAD DAMS ON FRESHWATER MUSSEL ASSEMBLAGES.** Tara M. Early[1], Michael M. Gangloff[2], and Christpher S. Thaxton[3]. [1]Department of Environmental Sciences, Appalachian State University, Boone, NC 28607; [2]Bepartment of Biology, Appalachian State University, Boone, NC 28607 **STUDENT SPEAKER*

The widespread impounding of lotic ecosystems is commonly associated with dramatic ecological effects including changes to temperature, oxygen and flow regimes, changes to the physical structure of the river and population fragmentation. However, the majority of prior research describing these negative effects was conducted in large streams with large hydroelectric dams. In contrast, recent research suggests that the effects of intact low-head (<10 m) dams vary widely across taxa and may improve habitat conditions for some taxa, including freshwater mussels. The focus of this study was to examine why high-density mussel aggregations are present downstream from some dams but not others. We compiled mussel survey data from dams with mussel data from tailrace reaches as well as reference reaches up-and-downstream. We computed response ratios to examine the effect of individual dams on mussel assemblages and used these standardized data as our dependent variable in all analyses. We obtained dam meta-data (e.g., structural and hydraulic height, year built, length, catchment area, stream order, volume, elevation) from public databases or field measurements, and used correlations and multivariate regression analyses to identify dam attributes that were most strongly associated with this phenomenon. We found that the year a dam was built was the best predictor of increased tailrace mussel abundance suggesting that mussel recovery following dam construction may be extremely slow. Further, although the trend was not significant, forest cover exhibited a negative correlation with mussel abundance suggesting that small dams may primarily provide an oasis for mussels (and other mollusks) in more impacted watersheds. Dam removals are prioritized based on cost and perceived benefits to at-risk species. The results of this study may help inform the site selection process by identifying and de-prioritizing dams that potentially benefit mussel populations and ensuring that scarce restoration dollars maximize benefits to all at-risk taxa.
earlytm@appstate.edu

Platform 15 **11:10 a.m.** **March 27, 2017**	**STRANDED FRESHWATER MUSSELS IN THE GREEN RIVER, KENTUCKY, FOLLOWING FAILURE OF LOCK & DAM 6.** William Cody Fleece[1], James Kiser[2], and Ken Kerns[3]. [1]Stantec Consulting, Cincinnati, Ohio 45241; [2] Stantec Consulting, Louisville, Kentucky 40223, [3] Mammoth Cave National Park, Mammoth Cave, Kentucky 42259.

On November 25, 2016, Green River Lock & Dam 6 failed resulting in a loss pool elevation of approximately eight feet in a matter of hours. Issues with the integrity of the dam were known and efforts to remove the dam were in progress. The change in pool elevation extended from the dam (River Mile 181.7) to at least River Mile 197. The rapid change in water surface elevation exceeded the ability of many freshwater mussels to move to lower elevations leaving them stranded. Reconnaissance surveys of the dam pool were undertaken on November 29, 2016 and approximately 100 animals were placed back in the water. A more intensive effort to rescue stranded mussels began on December 1, 2016 and continued through to the 2nd. Nearly 800 mussels comprised of 24 species were rescued including one live sheepnose (*Plethobasus cyphyus*), a federally endangered species. Subsequent efforts, not presented here, collected nearly 2,000 additional animals under a lower flow condition on December 12th and 13th. This presentation will review information developed during engineering feasibility studies for the dam demolition including bathymetric survey data and hydraulic models that were used to characterize anticipated changes to the dam pool. Finally, we compare data collected during the rescue to historic surveys in the dam pool, to data from a nearby riverine survey, and to data from prior mussel rescues associated with dam removals. Our work on this project and others suggests that special status taxa can and do reside within dam pools and that these resources should be considered as part of demolition planning efforts. Further, in circumstances where high quality mussel resources exist, planning for unanticipated dam breaches or failures may be warranted. Cody.Fleece@stantec.com

Platform 16 **11:30 a.m.** **March 27, 2017**	**HABITAT USE AND TRANSLOCATION OF RARE MUSSELS PRIOR TO DAM REMOVAL.** Peter D. Hazelton. Massachusetts Division of Fisheries & Wildlife, Natural Heritage & Endangered Species Program, Westborough, MA. 01581

Literature surrounding dam removals in habitat of Unionoida reflects conflicting opinions to the benefit of dam removals to these taxa. Nevertheless, removal of small mill dams in New England is gaining traction as an important conservation and habitat restoration tool. The Millie Turner Dam on the Nissitissit River (Pepperell, MA) was removed in September 2015 because of dam safety concerns, to increase flood resiliency, and to restore stream connectivity and fish passage. The dam presence separated two populations of the state endangered *Alasmidonta varicosa* (Brook Floater), and three other species of conservation concern: *Strophitus undulatus* (Creeper), *Alasmidonta undulata* (Triangle Floater), *Margaritifera* (Eastern Pearlshell). Prior to dam removal, Massachusetts Division of Fisheries and Wildlife (MassWildlife) used a combination of qualitative, semi-quantitative, and microhabitat analysis at seven sites downstream of the dam, within the influence of the impoundment, and upstream of the impoundment to record population, microhabitat use and habitat-availability baseline conditions. *S.undulatus* and *A.undulata* were the rarest species in the system, not found at all sites, and therefore comparison across sites is difficult. Habitat availability differed slightly among sites, but habitat use of *M. margaritifera* and *A. varicosa* did not differ significantly from habitat available at sites. In general, rare mussels were more abundant in sites at the upper reaches of the impoundment and at upstream reference sites. Prior to, and during the dam removal, more than 200 individuals of target species were translocated to refuge sites upstream of the impoundment. Recapture rates of relocated mussels at 1-yr follow-up surveys will also be presented. Long-term monitoring schedule is planned to assess changes to target mussel populations, and stream habitat following dam removal to further inform MassWildlife management practices for freshwater mussels during dam removal.

Platform 17 **11:50 a.m.** **March 27, 2017**	**DAM REMOVAL AND FRESHWATER MUSSELS: GUIDANCE FOR RESTORATION, CASE STUDIES, AND GAPS IN KNOWLEDGE.** Erin S. McCombs American Rivers, 29 N. Market St., Ste 603A, Asheville, NC 28801.

Dam removal is gaining momentum as a restoration tool to increase aquatic connectivity, public safety, and recreational opportunities. With limited resources and thousands of small and medium sized dams to prioritize for removal, information to guide the process is of principal importance. Freshwater mussels are an imperiled group of aquatic organisms found across the country frequently found below small dams in high richness and density. This talk will provide guidance to resource managers on the best practices for prioritizing and removing dams where freshwater mussels are present and offer case studies from completed projects in North Carolina as well as elsewhere in the Southeast, Northeast, and Midwest. The first step when approaching a dam for removal is to determine if the project will achieve effective restoration, ideally eliminating the root cause of stream impairment. While large information gaps in understanding dam removal effects on freshwater mussel populations exist, case studies have shown that adverse short term impacts to freshwater mussels can be reduced with proper planning, timing, and removal techniques. Management options to address the presence of freshwater mussels at a dam removal may include sediment management, mussel relocation, and equipment location management. Additionally, a need remains for collaboration between resource managers and academics to get a better grasp of the complex ecological impacts of dam removal. emccombs@americanrivers.org

Platform 18 12:10 p.m. March 27, 2017	**FRESHWATER MUSSEL RECOLONIZATION UPSTREAM OF A DAM AFTER INSTALLATION OF A FISH LADDER.** Jennifer E. Price, Chris B. Eads, and Jay F. Levine. Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, 2800 Faucette Drive, Raleigh, NC 27607.

In 2007, movement of fish across a dam on the Broad River in Columbia, SC was made possible for the first time since 1895 through the construction of a fish ladder. Mussel inventories in 2007 documented five species below this dam that were not found in the 30 mile stretch of river between this dam and the next dam upstream. This 30 mile stretch contained excellent habitat for mussels and high densities of a few common species. In 2016, after nine years of fish passage, an inventory of this 30 mile stretch documented three of the five species previously found only below the dam. A wide range of sizes of *Elliptio roanokensis* and *Elliptio congaraea*, formerly found only downstream of the dam, were documented in moderate abundance at several above dam sites, indicating that the fish passage had probably facilitated recolonization. Successful hosts for *E. roanokensis* include gizzard shad *Dorosoma cepedanium* and blueback herring *Alosa aestivalis.* Gizzard shad were found moving through the fish passage each year in high abundance. We have tested 21 fish species as potential hosts for *E. congarea* but have not yet located a successful host. Additional trials are planned for 2017. Only eight individuals of the third mussel species, *Lampsilis cariosa*, were found above the dam. Seven out of eight individuals were large and likely older than 9 years of age, and all were found at sites not previously inventoried. Therefore, it is likely that they were there before the fish passage became operational. Lower rates of fish passage usage by known hosts for *L. cariosa*, and two other species found only below the dam, *Ligumia nasuta* and *Lampsilis radiata,* is likely responsible for the lack of significant recent recruitment above the dam.
jenniferjohnsonprice@gmail.com

PLATFORM SESSION ABSTRACTS

SESSION 4	Propagation I Monday, March 27, 2017 | 2:00 p.m. – 3:20 p.m.
Platform 19 2:00 pm March 27, 2017	**RECENT CHANGES AND IMPROVEMENTS IN FRESHWATER MUSSEL CULTURE AT GENOA NATIONAL FISH HATCHERY (NFH).** Nathan Eckert[1] and Megan Bradley[1]. [1] Genoa National Fish Hatchery, S5631 State Hwy 35, Genoa, 54632 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. For the Higgins' eye pearlymussel culture was accomplished either by mussel cages or by free release. As the program has grown techniques have been altered to expand the list of propagated species. This has necessitated partnering with surrounding agencies to acquire unique host fish, such as flathead catfish, freshwater drum, shortnose gar and mudpuppies. Minor alterations have been made to the cage culture program, but the largest changes have come in the use and expansion of intensive culture techniques. The streamside rearing trailer has proven effective in the production of young of the year mussels as well as finishing culture for yearling mussels prior to release. The intensive culture program at Genoa NFH has undergone a shift from the mucket bucket to the sediment tank. Results for this technique were very promising in 2016. A pulse flow system is also being developed to test that new technique for its viability on station. The increase in sub-adult production at Genoa NFH has also increased the need for sub-adult finishing culture. Techniques such as cages, black pans, floating baskets and SUPSY's have been tested with varying levels of success. Finally, a mutually beneficial partnership has been established with the National Mississippi River Museum and Aquarium to care for sub-adult mussels in SUPSY's while also fostering environmental education for area high school students.
Nathan_Eckert@fws.gov

Platform 20 2:20 pm March 27, 2017	**A STRATEGY FOR ESTIMATING THE COST OF MUSSELS PRODUCED AND CULTURED AT GENOA NATIONAL FISH HATCHERY.** Megan E. Bradley, Nathan L. Eckert and Doug B. Aloisi. Genoa National Fish Hatchery, U.S. Fish and Wildlife Service, South 5631 State Hwy 35, Genoa, WI 54632.

The Genoa National Fish Hatchery (GNFH) has been involved in the culture of freshwater mussels in the Upper Mississippi River Basin since efforts began in 2000. The program has expanded from working with a single species, using a single technique, to working with as many as 18 species in as many 6 locations, and the techniques used have evolved and been made to suit the culture location or species specific needs. In the beginning, determining the cost of the producing disease free host fish, and several million *Lampsilis higginsii* juvenile transformers released at 2 months was relatively simple, but it has grown into a complex tangle incorporating the difficulty of collecting a species, propagation and culture techniques. This challenge was met in 2016 when the hatchery was called on to estimate the costs of providing nearly twenty species of freshwater mussels for a project. To prevent the continual re-creation of the wheel and to represent the true cost of producing mussels, an invoicing method was developed, incorporating the total cost to produce each species including personnel time, infrastructure maintenance, administration, and replacement costs. Due to the nature of mussel culture, the cost of an individual mussel isn't provided, rather the effort to produce batches of mussels, defined by the average number produced of a species at GNFH, are the baseline. This relatively simple structure provides the foundation for estimating the actual replacement cost of mussels, and reducing the chance of subsidizing companies that cause environmental damage on the backs of the resource they damage.

Platform 21 **2:40 pm** **March 27, 2017**	**USE OF SEROTONIN TO INDUCE RELEASE OF GLOCHIDIA BY CONGLUTINATE-PRODUCING FRESHWATER MUSSELS.** Chris B. Eads[1], Tom Fox[2], Rachael Hoch[3], Nathan L. Eckert[4], Jay F. Levine[1]. [1]Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, 2800 Faucette Drive, Raleigh, NC 27607, [2]North Carolina Wildlife Resource Commission, 2430 Turner Rd, Mebane, NC 27302, [3]Marion Conservation Aquaculture Center, 645 Fish Hatchery Rd, Marion, NC 28752, [4]Genoa National Fish Hatchery, S 5631 State Hwy 35, Genoa, WI 54632.
Propagation of some freshwater mussel species is often done by first using a water-filled syringe to puncture the gravid female's marsupia and flush out its larvae. Unfortunately, this technique can be especially destructive to gill tissue of species that release conglutinates or mucous masses of glochidia. Chemically inducing glochidial release is an alternative for these species that could preserve gill integrity while allowing for larval collection in a timely manner. We exposed gravid *Strophitus undulatus* to three concentrations (20, 40, and 100 mg/L) of serotonin and a fresh water control (n = 5) and exposed gravid *Ptychobranchus subtentum* to these same treatments as well as to three concentrations (0.5, 2, and 5 mg/L) of fluoxetine (n = 6). Conglutinates were counted at 1, 3, 5, 8, 12, and 24 hours and assessed for viability. The lowest two serotonin concentrations used provided the quickest release of conglutinates by both species with maximum glochidial viability. During exposure to both chemicals, adult mussels produced excess mucous and exhibited significant foot swelling; however, these symptoms subsided after 24 hours in fresh water. Expelled *P. subtentum* glochidia were subsequently used to infect host fish and successfully produce juvenile mussels while exposed adults were captively held for 7 months with no mortality differences between treatments. Since that experiment, further trials have led us to a standard serotonin exposure of 10 mg/L for 2-3 hours. With this reduced exposure, we have observed reduced foot swelling and stress-related mucous production while maintaining glochidial release of a large majority of broods within 24 hours. Serotonin has been used successfully on three *Alasmidonta* spp. that produce mucous masses of glochidia as well as on the conglutinate-producing *Lasmigona decorata*. Individual females have been exposed up to three consecutive years with no apparent lasting effects on the adults or on larval metamorphosis. Chris_Eads@ncsu.edu	
Platform 22 **3:00** **March 27, 2017**	**IN VITRO RESEARCH AT THE COLUMBUS ZOO & AQUARIUM'S FRESHWATER MUSSEL CONSERVATION AND RESEARCH FACILITY.** Jacqualyn Halmbacher. The Ohio State University, Columbus Zoo & Aquarium, Ohio Division of Wildlife 6000 Harriot Dr. Powell, OH 43065
Since 2002, the Columbus Zoo & Aquarium's Freshwater Mussel Research and Conservation Facility has been dedicated to reintroducing mussel populations back into Ohio's rivers. The success experienced by this facility has resulted in the release of tens of thousands of mussels in Ohio via propagation and reintroduction; receiving accolades such as "The North American Conservation Award" in 2011. Recently, the facility has experienced a significantly higher degree of success in propagating freshwater mussels by implementing a cell culture technique known as *in vitro*. The Columbus Zoo & Aquarium's Freshwater Mussel Research and Conservation Facility is among a handful of institutions across the United States successfully transforming juvenile mussels with this innovative technique. *In vitro* offers an alternative: eliminating host fish from the equation. The protocol allows thousands of juveniles to be cultured in one petri dish. This presentation will give insight into the *in vitro* research conducted at the Columbus Zoo & Aquarium's facility partnered with The Ohio State University, Ohio Division of Wildlife and U.S Fish and Wildlife Service. halmbacher.2@osu.edu	

PLATFORM SESSION ABSTRACTS

SESSION 5	Contaminants and Ecotoxicology II Monday, March 27, 2017 | 2:00 p.m. – 3:20 p.m.
Platform 23 **2:00 pm** **March 27, 2017**	**ASSESSMENT OF THE TOXICITY OF AN ENVIRONMENTALLY RELEVANT MIXTURE OF MAJOR IONS AND THE TRACE ELEMENT NICKEL ON JUVENILE RAINBOW (*VILLOSA IRIS*) AND OYSTER (*EPIOBLASMA CAPSAEFORMIS*) MUSSELS.PROPAGATED JUVENILES.** A. T. Phipps[1], S. Ciparis[2], M. J. Keefe[1] , C.E. Zipper[1], J. W. Jones[2]. [1]Deparment of Fish and Wildlife Conservation, Virginia Tech University, Blacksburg, VA. [2]United States Fish and Wildlife Service, Blacksburg, VA

The Powell River in Virginia and Tennessee, USA supports diverse freshwater mussel assemblages. Coal mining occurs in the watershed. Throughout the river's extent major ion and trace element concentrations are elevated and mussels have been extirpated or are declining. We conducted a laboratory study to assess the effects of major ions and the trace element nickel (Ni) on growth and survival of juvenile mussels, including one common (*Villosa iris)* and one endangered (*Epioblasma capsaeformis)* species. Mussels were exposed to environmentally relevant concentrations of major ions and Ni, to assess the combined toxicity and the potential interaction of Ni with HCO_3(-). Mussels were exposed to diluted pond water alone (control), with Ni only (Ni-control), and with environmentally relevant major ion mixtures with and without Ni for 70 days. Two treatments were tested. The treatment first mimicked low-flow concentrations of Ca(2+), Mg(2+), K(+), HCO(-) and SO_4(2-) in the Powell River at a total ion concentration of 942 mg/L. The second treatment combined the first treatment mixture with an environmentally relevant concentration of Ni (14 µg/L). Mussel survival differed significantly between species, as mean survival was 84.2% for *E. capsaeformis* and 92.7%. for *V. iris* There were no significant differences in overall survival between treatments and controls for either species. Total growth showed little variation and was not significantly different between treatments and controls. Results suggest that major ion chronic toxicity alone or in combination with Ni is not the primary source of toxicity for juvenile mussels in the Powell River. The results also suggest that HCO_3(-) does not increase the toxicity of Ni in this system.
andrew08@vt.edu

Platform 24 **2:20 pm** **March 27, 2017**	**OPTIMIZATION OF CLEARANCE RATE AS AN EFFECT ENDPOINT IN TOXICITY TESTING WITH FRESHWATER MUSSELS.** Joseph Salerno[1], Jim Bennett[2], Patricia Gillis[2], Paul Sibley[1], and Ryan Prosser[2]. [1]School of Environmental Sciences, University of Guelph, Guelph, ON, Canada; [2]Aquatic Contaminants Research Division, Environment and Climate Change Canada, Burlington, ON. **STUDENT SPEAKER*

Freshwater mussels play an integral role in aquatic ecosystems by assisting in nutrient cycling, energy transfer, habitat structure, and water quality. Populations of freshwater mussels can significantly impact water quality by filtering out particulates such as algae, zooplankton, bacteria, and detritus from the water column which can lower ammonia, nitrate, phosphorus, and dissolved organic carbon concentrations in aquatic systems. When investigating the potential risks that waterborne contaminants pose to freshwater mussels it is important to assess ecologically relevant sub-lethal endpoints since these organisms will most likely be exposed to low environmental concentrations of contaminants in aquatic systems. Therefore this study examined how to optimize our current method of quantifying the ability of mussels to filter algae from solution after being employed in toxicity tests. For the purposes of a toxicity test endpoint, clearance rate is defined as the amount of algal cells that an individual mussel can remove from the overlying water by filtration. We examined three methods for determining clearance rate of mussels; spectrophotometry, flow cytometry, and direct microscopic examination using a hemocytometer. Experimental vessels were set up with juvenile or adult fatmucket mussels (*Lampsilis siliquoidea*) a minimum of 15-24 hours before adding an average of 2.7E7 algal cells/mL, a mixture of *Nannochloropsis* (Instant Algae®166) and Shellfish Diet (Reed Mariculture, Campbell, CA, USA), to the treatments at time 0. Mussels were left to feed for 24, 36, and 48 h. To account for algal settling in the test vessels, control vessels containing only the added average 2.7E7 algal cells/L and no mussels were run in parallel. For each test period the algal cell densities were significantly different ($p<0.05$) between the initiation and completion of the test period. The cell density in each replicate remained above the detection limit for the three methods examined (spectrophotometry, microscopic examination, and flow cytometry). When comparing the average percent difference in algal cells between test initiation and completion with the spectrophotometer and hemocytometer, the 24 h time point had the lowest percent difference (25.34%, ±20.76) compared to the 36 h and 48 h time point, which were similar (79.96%, ±1.88 and 78.33, ±4.17, respectively). Following optimization of the measurement of clearance rate, a 7-d exposure with a reference toxicant was performed in order to assess the effectiveness of the recommended 36 h clearance rate method.

Platform 25 **2:40 pm** **March 27, 2017**	**USING SURVIVAL AND GROWTH OF JUVENILE MUSSELS TO IDENTIFY SOURCES OF WATER QUALITY DEGRADATION.** Lesley Sneed[1], Wendell Haag[2], Jacob Culp[3], Monte McGregor[4], Robert Durborow[5]. [1]Kentucky State University, Aquaculture Research Center, Frankfort, KY 40601. [2]US Forest Service, Southern Research Station, Center for Bottomland Hardwoods Research, Frankfort, KY 40601; [3]Kentucky Division of Water, Frankfort, KY 40601; [4]Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY 40601; . [5]Kentucky State University, Land Grant Program, Frankfort, KY 40601. **STUDENT SPEAKER*
Freshwater mussels have declined in many streams that have no obvious, point-source impacts. We used *in situ* exposures of captively propagated juvenile mussels to attempt to identify sources of water quality degradation in the Nolin River and Horse Lick Creek watersheds in Kentucky, both of which have lost nearly their entire mussel faunas in the last 30 years for unknown reasons. A previous study showed that juvenile mussel growth was inhibited in both watersheds compared with reference streams that continue to support healthy mussel faunas. We placed juvenile mussels (mean length at deployment = 5.0 mm) in concrete holding chambers (silos) at nine sites in the Nolin River watershed and 12 sites in the Horse Lick Creek watershed. In both watersheds, we placed silos near the mouths of most major tributaries in May and retrieved them in September after a 12-week exposure period. We also placed juvenile mussels in five reference streams during the same period. We collected monthly water quality samples and sediment samples for characterization of bacterial and diatom assemblages at each site. Survival was high at all sites in both watersheds, but all sites exhibited evidence of growth inhibition. Mean growth during the exposure period was 0.3 mm (range = -0.7-1.6) in the Nolin River watershed and 0 (range = -1.1-0.9) in Horse Lick Creek; in contrast, mussels in reference streams grew an average of 3.8 mm (range = 3.2-4.8). Growth inhibition at all sites suggests watershed-wide water quality degradation perhaps via groundwater. Bacterial and diatom assemblages showed no obvious differences among sites, and the cause of growth inhibition remains unclear.	
Platform 26 **3:00** **March 27, 2017**	**COMBINED EFFECTS OF MERCURY CONTAMINATION AND THERMAL STRESS ON FRESHWATER MUSSELS AND ECOSYSTEM FUNCTION.** Brent N. Tweedy[1,2], Caryn C. Vaughn[1,2]. [1]Department of Biology, University of Oklahoma, Norman, OK 73019; [2]Oklahoma Biological Survey, Norman, OK 73019.
Modern freshwater ecosystems face an ever-growing array of threats and stressors. Among the most widespread are mercury (Hg) contamination, impoundment and flow alterations, and global climate change (GCC). Hg emitted from anthropogenic sources is converted into toxic methylmercury in aquatic ecosystems where it biomagnifies in the food web, threatening wildlife and humans. Impoundment, reduced in-stream flow, and GCC can contribute to increased thermal stress in many freshwater ecosystems. Freshwater mussels are important drivers of ecosystem function in many freshwater systems, thus declines in the abundance and health of mussel populations can result in ecosystem function losses. Mercury contamination and thermal stress are two widespread stressors with the potential to negatively affect freshwater mussel abundance and function. We conducted two experiments to test the combined effects of Hg and thermal stress on mussel physiology and their contributions to ecosystem function. A laboratory experiment examining the effects of Hg and thermal stress alone and in combination found decreased respiration in *Amblema plicata* under both stressors and lower water clearance rates in *Actinonaias ligamentina* exposed to increased temperature. High mortality was observed in *A. ligamentina* exposed to both stressors. This study was followed-up with a mesocosm experiment examining the effects of both stressors on freshwater communities with and without mussels. Increased mussel mortality was observed across three species in double stressor treatments for multiple species. Because freshwater mussels contribute significantly to the diversity and functioning of numerous rivers and streams across North America (including food web structure) these findings have important ramifications for management and conservation of these already stressed and imperiled ecosystems. brent.tweedy@ou.edu	

PLATFORM SESSION ABSTRACTS

SESSION 6	Conservation II Monday, March 27, 2017 | 2:00 p.m. – 3:20 p.m.
Platform 27 **2:00 pm** **March 27, 2017**	**DAM REMOVALS ON THE WEST FORK RIVER: A CASE STUDY IN OVERCOMING OBSTACLES TO HABITAT RESTORATION.** Barb Douglas[1], John Schmidt[1], Nick Millet[1], Callie McMunigal[2], Sarah Veselka[3]. [1]United States Fish and Wildlife Service, West Virginia Field Office, Elkins, WV 26241.[2]United States Fish and Wildlife Service, Appalachian Fish and Wildlife Conservation Office, White Sulphur Springs, WV 24986, [3]AllStar Ecology, LLC., Fairmont, WV 26554.
The West Fork River was historically one of the more diverse freshwater mussel streams in West Virginia, supporting over 25 species including five species that are now considered federally threatened or endangered. However, the construction of a series of low-head dams during the early 1900's coupled with water quality degradation, led to the decline of mussels in the watershed. Only 11 native freshwater mussel species, including one federally listed species, the snuffbox (*Epioblasma triquetra*), have been documented in the river in the past 30 years. In the early 2000's, the dam owners and other partners began working together to remove three of the dams that had become obsolete and were a danger to human lives. These dams were successfully removed in 2016. Over the course of this effort, we encountered a number of obstacles that impeded completion of the project including opposition from citizens, potential lawsuits based on obscure statutes concerning whether an impounded river is a legal fence, watershed groups attempting to acquire and keep the dams, regulatory requirements, decades of trash accumulation, collapses of poorly constructed roads, vandalism, logistical complications, and other unexpected issues. These issues were overcome though extensive public outreach and the cooperative efforts of a diverse group of partners. This case study will highlight some of the lessons learned and the issues to consider when planning large-scale habitat restoration efforts.	
Platform 28 **2:20 pm** **March 27, 2017**	**REMOVAL OF THREE LOW-HEAD DAMS ON THE WEST FORK RIVER – FRESHWATER MUSSEL IMPLICATIONS.** Sarah Veselka[1], Janet Clayton[2], Barb Douglas[3], Brian Carlson[1], John Schmidt[3], Nick Millett[3], and Callie McMunigal[4]; [1]AllStar Ecology, LLC., Fairmont, WV 26554, [2]West Virginia Division of Natural Resources, Elkins, WV 26241, [3]United States Fish and Wildlife Service, West Virginia Field Office, Elkins, WV 26241, [4]United States Fish and Wildlife Service, Appalachian Fish and Wildlife Conservation Office, White Sulphur Springs, WV 24986
In 2016, the USFWS and numerous partners removed three low-head dams (West Milford Dam, Highland Dam, and Two Lick Dam) on the West Fork River in Harrison County, West Virginia. The West Fork is known to support the federally endangered snuffbox mussel (*Epioblasma triquetra*). Initial surveys conducted by the WVDNR observed the first live *E. triquetra* in the West Fork River in recent history. Additional pre-removal mussel surveys were conducted within 100m downstream of each dam and additional spot dives upstream. Over one hundred live mussels of eight species were collected and identified during the pre-removal survey efforts. Relic *E. triquetra* were observed; however, no additional live threatened or endangered mussel species were located. During dam removal and dewatering, malacologists and volunteers used canoes and "grabbers" to collect stranded mussels along the banks of the West Fork resulting in the relocation of 1,476 mussels of eight species. The removal of the three dams connected 35 river miles which had been segmented for almost a century and returned approximately 12.5 miles of lentic habitat back to lotic habitat. These habitat improvements will likely benefit freshwater mussel communities of the West Fork through improved sediment transport, increased riffle habitat, and free movement of host fish. No active restoration is planned at this time but will most likely occur sometime in the future and involve translocations of adult mussels as they become available.	

Platform 29 **2:40 pm** **March 27, 2017**	**AQUATIC FAUNA RESTORATION IN CHEOAH RIVER, WESTERN NORTH CAROLINA.** Steve Fraley[1], T.R. Russ[2], Rachael Hoch[2], and Wendell Pennington[3]. [1]North Carolina Wildlife Resource Commission, 20830 Waynesville, NC 28786; [2]North Carolina Wildlife Resource Commission,645 Fish Hatchery Rd., Marion, NC 28752; [3]Pennington & Associates, Inc., 161 McGee Lane, Cookeville, TN 38501

A nine-mile reach of the Cheoah River, a regulated river recently improved by FERC mandated flow and substrate restoration, is the focus of efforts to augment an existing relict population of the federal endangered *Alasmidonta raveneliana* and to reintroduce NC state listed *A. viridis*, *Lampsilis fasciola,* and *Villosa iris*, as well as the federal threatened *Erimonax monachus* and other native fishes. Improvements in water and habitat quality can restore suitable habitat for freshwater fauna; however, barriers may exist to natural colonization where species are extirpated or demographics of relict populations may be less than ideal for population recovery. Assisted recovery via augmentation and reintroduction can help surmount those barriers. The Cheoah River situation offers unique opportunities for restoration and relative long-term persistence of rare species that are vulnerable at other locales in NC. A combination of translocation and captive propagation provide animals for restoration. *A. raveneliana* had never been cultured in captivity prior to these efforts and innovative techniques were developed to successfully produce them in sufficient numbers. Since 2012, over 4,700 propagated *A. raveneliana* have been released and an additional 97 adults were translocated; and, over 1500 *A. viridis*, 20,000 *L. fasciola*, and 15,000 *V, iris* were also propagated and released. Since 2009, seven cohorts of captively propagated *E. monachus* yearling fry were reared and released, totaling approximately 2,900, with an additional 205 adults translocated. Assessment surveys performed in 2016 show positive results with all species surviving, growing, showing evidence of reproduction and recruitment, and expansion of occupied range.

Platform 30 **3:00 p.m.** **March 27, 2017**	**DEVELOPMENT OF RESTORATION CRITERIA FOR FRESHWATER MUSSEL SPECIES IN GREATEST CONSERVATION NEED IN ILLINOIS.** Sarah A. Douglass[1], Alison P. Stodola[1], and Scott J. Chiavacci[2]. [1]Illinois Natural History Survey, Prairie Research Institute at the University of Illinois Urbana-Champaign, Champaign, IL 61820. [2]U.S. Geological Survey, Science and Decisions Center, Reston, VA 20192.

Biologists in Illinois recently conducted a comprehensive statewide survey in a project entitled “Investigating Mussel Communities in Wadeable Illinois Streams”. The survey results provided needed information for reevaluating mussel species for listing as species in greatest conservation need (SGCN) and updating the statuses, distributions, and stresses to the mussel SGCN for a revision of Illinois’ State Wildlife Action Plan. In addition, action items were established for inclusion in the Streams Campaign. Historical, pre-settlement unionid distributions were established in a follow-up project entitled “Defining Expectations for Mussel Communities in Illinois Streams,” in which distribution maps and modeled expectations were provided to guide conservation of SGCN species. With knowledge from these projects, the state of Illinois is poised to make informed restoration decisions for imperiled or rare unionids. Recently, we began a project that will provide a detailed investigation into restoration options for specific mussel SGCN using a Bayesian Belief Network. We chose two species, Ellipse *Venustaconcha ellipsiformis* (SGCN) and Spike *Elliptio dilatata* (state threatened), in a focal region called the Chicago Wilderness Region that includes portions of 18 counties in northeast Illinois. While an ideal situation for re-establishment of freshwater mussels would exist in the form of natural recolonization, research indicates that this process is unlikely to occur in certain situations (e.g., critically small populations) or may take many years to occur in optimal situations (e.g., unimpounded waterways). Current models of Ellipse and Spike presence reveal a number of species-specific threats and reasons for declines throughout the Chicago Wilderness Region, and we are investigating specific reaches that may need assistance for reestablishment of these species. This project will inform managers of optimal restoration options for a specific scenario and will be an initial step to provide guidance to state entities on the direction of restoration efforts for mussels in wadeable streams.

PLATFORM SESSION ABSTRACTS

SESSION 7	Propagation II Monday, March 27, 2017 3:40 – 5:00 p.m.
Platform 31 3:40 pm March 27, 2017	**PROPAGATION AND JUVENILE MUSSEL CULTURE AT THE CUMBERLAND RIVER AQUATIC CENTER.** Dan Hua[1], Dave McKinney[1], David Sims[1], Don Hubbs[1], and Kou Peng[2]. [1]Cumberland River Aquatic Center, Tennessee Wildlife Resources Agency, Gallatin, TN 37066; [2] Department of Bioscience, Nanchang University, Nanchang, Jiangxi, China 330038.

Approximately, 43.3% of freshwater mussels in North America have been found in Tennessee. Of those, 14 species are presumed extinct, and 48 species are listed federally endangered, and populations of most remaining species are still declining. Hence, propagation and culture of freshwater mussels for the purpose of recovery of those endangered species were initiated at The Cumberland River Aquatic Center (C-RAC), Tennessee Wildlife Resources Agency, located at Gallatin, TN in August 2015. Six species of juvenile mussels were produced including 5 federally endangered species, pale lilliput (*Toxolasma cylindrellus*), Duck River dartersnapper (*Epioblasma ahlstedti*), fanshell (*Cyprogenia stegaria*), birdwing pearlymussel (*Lemiox rimosus*), snuffbox (*Epioblasma triquetra*) and one common species, wavy-rayed Lampmussel (*Lampsilis fasciola*) during the past year. Currently, *T. cylindrellus* is facing extremely high risk of extinction in the wild. In June 2016, 3,878 juvenile mussels of *T. cylindrellus* were successfully propagated at C-RAC and 3,876 juveniles of this species are being grown out as of December 2016. The survival rate of this species has remained approximately 100% during the past 5 months. Additionally, the effect of temperature on the duration of juvenile transformation of *L. fasciola* was tested from Nov. 2015 to May 2016. Results indicated that the glochidia transformation was impacted by actual temperature instead of accumulated temperature. The juvenile mussel culture and endangered species restoration are promising at C-RAC.

Platform 32 4:00 pm March 27, 2017	**CURRENT STATUS OF REINTRODUCTION EFFORTS FOR THREE FEDERALLY ENDANGERED FRESHWATER MUSSELS IN ALABAMA, MISSISSIPPI, AND TENNESSEE.** Paul D. Johnson[1], Todd B. Fobian[1], Michael L. Buntin[1], Jesse T. Holifield[1] Thomas A. Tarpley[1], and Jeffrey T. Garner[2]. [1]Alabama Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, Alabama, [2]Alabama Department of Conservation and Natural Resources, Florence, Alabama.

Recent mussel recovery efforts have focused on establishing new populations for critically imperiled mussels with emphasis on *Epioblasma penita* (Southern Combshell), *Toxolasma cylindrellus* (Pale Lilliput), and *Lampsilis virescens* (Alabama Lampmussel). These efforts have been carried out by ADCNR-AABC partnering with TN (TWRA) and MS (MSDWF&P). Remaining in ≈24 km of the Buttahatchee River near the AL-MS state line, *E. penita* historically occupied much of the Mobile River Basin. AABC recovery efforts have focused on host fish identification and reintroductions into the Cahaba River, Bibb Co., AL and Bull Mountain Creek, Itawamba Co., MS. Four releases have been completed, 3 in the Cahaba River (287 individuals) and 1 in Bull Mountain Creek (205). Propagated *E. penita* juveniles were produced from 15 different females and a captive Ark Population has been established. Tennessee River Basin endemics *T. cylindrellus* and *L. virescens* occupy ≈20 and 53 km of the Paint Rock River, Jackson Co., AL, respectively. Historical distribution of *T. cylindrellus* was the middle and lower Tennessee River Basin downstream of Chattanooga, TN. *Lampsilis virescens* was found throughout the Tennessee River and major tributaries just above Knoxville, TN to Muscle Shoals, AL. *Toxolasma cylindrellus* reintroductions targeted the Duck River, Marshall and Maury Co., TN with 4 releases in 3 years totaling 1,700 individuals. Propagated *T. cylindrellus* juveniles were produced from 29 females. *Lampsilis virescens* were reintroduced into Bear Creek, Colbert Co., AL (5,152), Elk River, Lincoln and Giles Co., TN (5,042), Sequatchie River, Marion Co., TN (1,800) and Tennessee River, Lauderdale Co., AL (92) in 6, 3, and single releases respectively. Propagated *L. virescens* juveniles were produced from 9 female brooders. Reintroduction sites were selected through regional plans produced by multiple state and federal resource agencies. Follow-up monitoring verified persistence and growth at all sites except the Sequatchie River, *L. virescens*. paul.johnson@dcnr.alabama.gov

Platform 33 **4:20 pm** **March 27, 2017**	**PROPAGATION AND CULTURE AT VIRGINIA FISHERIES AND AQUATIC WILDFLIFE CENTER.** Amy Maynard, Rachel Mair, Brian Watson, Michael Odom, Ben Davis

Virginia Fisheries and Aquatic Wildlife Center (VFAWC) is a cooperative freshwater mussel propagation facility. Together, the United States Fish and Wildlife Service and the Virginia Department of Game and Inland Fisheries have produced 12 species of freshwater mussel from the Atlantic Slope since 2008 and have released 201,948 mussels since 2010. VFAWC was founded in 2007 as a freshwater mussel grow-out facility, but quickly expanded as plans to build a mussel propagation facility on-site ensued. VFAWC is located at Harrison Lake National Fish Hatchery and Harrison Lake provides the facility with water for indoor and pond culture of the mussels. Newly metamorphosed juveniles are currently reared in mucket-buckets and static sediment systems. Juveniles exceeding 0.5-1.0mm are reared in larger recirculating and flow-through systems, as well as floating baskets. During the 2016 propagation season, 1,129,195 juvenile mussels of 6 species, including 1 Federal Endangered species *Pleurobema collina* (James spinymussel) and 1 State Threatened species, *Lasmigona subviridis* (Green Floater), were produced. Four others include species that are listed as Species of Greatest Conservation Need in the Virginia Wildlife Action Plan (WAP). We were able to accommodate approximately 637,305 newly metamorphosed individuals within indoor culture systems and 13.8% survived to winter. The remaining 491,890 were placed in floating baskets on ponds. This season, we released 24,003 mussels of 6 mussel species into the Rappahannock, Nottoway, and Meherrin rivers in Virginia.

Platform 34 **4:40 p.m.** **March 27, 2017**	**EVALUATING THE USEFULNESS OF COMMERCIALLY AVAILABLE PROBIOTICS IN THE DIETS OF JUVENILE FRESHWATER MUSSELS.** Andrew T. McDonald, David Cravens, Fritz E. Vorisek, Travis Bailey, Adam C. Shepard, Monte A. McGregor. Center for Mollusk Conservation, KY Dept. of Fish and Wildlife Resources, Frankfort, KY 40601

CANCELED

In response to the decline of freshwater mussel populations across North America, many states and universities are propagating and rearing species for re-introduction or augmentation of wild populations. While there is some understanding that bacteria serve an important role in the diets of these animals, there has been limited research in this area. Few studies have been done that have introduced bacteria into the diets of [illegible] in a controlled aquaculture setting. The objective of this study was to determine the growth and survival of juvenile mussels in algae diets with additions of three probiotic bacterial formulations (Clear-Flo® 1002, 1006 and 1008, Alken-Murray Corporation). Each probiotic contains a different ratio of gram-positive to gram-negative bacteria, which is representative of natural bacterial assemblages found in mussel populations. These formulations may be suitable as mussel diet supplements. We tested growth and survival of 7 mo. old plain pocketbooks, *Lampsilis cardium*, for one month, by daily adding each of the three probiotics to the regular multi-algal diet used at the CMC. The Clear-Flo® 1006 treatment produced significantly lower survival than the other probiotics, while Clear-Flo® 1002 had significantly better growth than the other probiotics. These results indicate that the addition of Clear-Flo® 1002 may be beneficial to the diet of freshwater mussels, while the 1006 formulation should be avoided for *L. cardium*.

PLATFORM SESSION ABSTRACTS

SESSION 8	STATUS, TRENDS, AND MONITORING OF MOLLUSCAN RESOURCES II Monday, March 27, 2017 3:40 – 5:00 p.m.
Platform 35 **3:40 p.m.** **March 27, 2017**	**FRESHWATER MUSSELS OF THE HIWASSEE RIVER (APALACHIA CUTOFF) IN POLK COUNTY, TENNESSEE - AN ISOLATED AND TENUOUS COMMUNITY.** Steven A Ahlstedt [1], Charles S. Howard[2], Matthew P. Reed[2], [3]James Herrig.[1]Norris, TN; [2]Tennessee Valley Authority, Knoxville, TN. [3]Cherokee National Forest, Cleveland, TN.

Apalachia Dam (Cherokee County, NC) and its powerhouse (~20 km downstream in Polk County, TN) were constructed on the Hiwassee River in 1943. Nearly all river discharge circumvents the upper dam tailwater(= "Cutoff") such that flows in the Cutoff are generally limited to small dam releases, dam leakage, spillage during high rainfall events, limited tributary inflow, and backflow from the powerhouse discharge. Consequently, the Cutoff typically has stagnant conditions during summer and fall and now resembles a smaller stream channel that is highly braided and clogged with sediment, organic flocculent, and woody debris. Between November 2015 and March 2016, nearly all discharge was released through the Cutoff instead of the powerhouse to facilitate repairs. Sustained discharge and high rainfall resulted in a record discharge period through the Cutoff. This study monitored potential effects of sustained high flows on mussels and habitat in the Cutoff. At least 36 mussel species are reported historically from the Hiwassee River below the dam. Numerous train derailments (sulfuric acid spills), cold-water releases, and impoundments have nearly eliminated the mussels downstream from the Powerhouse. Since the mid-1980s, approximately 15 mussel species are documented in the Cutoff, including single-specimen records and three federally listed species (golden riffleshell [*Epioblasma florentina aureola*], slabside pearlymussel [*Pleuronia dolabelloides*], and Cumberland bean [*Villosa trabalis*]). Golden riffleshell may be extirpated, and slabside pearlymussel is extremely rare. Cumberland bean and Tennessee clubshell (*Pleurobema oviforme*) populations are some of the largest known range-wide. Catch rates among sites and years vary considerably. Habitat is most productive immediately upstream of the powerhouse, where Cumberland bean and Tennessee clubshell are most abundant. Following the high-flow event of 2015-16, monitoring sites were cleared of most fine sediment and debris accumulation, but habitat and mussel abundance (including rare species and juveniles) did not appear to be diminished. bigshelldaddy@bellsouth.net

Platform 36 **4:00 pm** **March 27, 2017**	**POPULATION DISTRIBUTION ANALYSIS OF THE ALABAMA SPIKE (*ELLIPTIO ARCA*) IN THE MOBILE RIVER BASIN.** Daniel Mason[1]*, Michael M. Gangloff[1]. [1]Appalachian State University, Boone, NC 28608. **STUDENT SPEAKER*

The Mobile River Basin (MRB) is a global hotspot for freshwater mollusk diversity. However, many MRB mollusks are imperiled and the USFWS is currently evaluating 10 MRB species for listing under the Endangered Species Act. I examined changes in the range of the petitioned species *Elliptio arca* in the MRB over the past 35 years. I used historical data and conducted additional mussel surveys to determine if *E. arca* was present at historically occupied sites across the MRB. In 2016 I surveyed mussels at 74 sites that supported *E. arca* within the last 20 y. I mapped 396 *E. arca* records at the HUC-12 scale in three temporal categories: 1980-1992, 1993-2004 and 2005-2016 and calculated the network distances between each HUC before testing for differences among categories. I detected *E. arca* at only 21 of 74 historically-occupied sites. *Elliptio arca* populations appear to be isolated and small except in the Sipsey, Buttahatchee Rivers and the upper Tallapoosa River Drainage, where CPUE was relatively high. In the past 35 years, this species seems to have undergone a dramatic reduction in extent of occurrence and numerous populations appear to be smaller or more isolated. *Elliptio arca* is rare in the Black Warrior and Cahaba drainages and may be extirpated from these systems. It is also uncommon in the Coosa Drainage. Changes in the extent of occurrence and the low rates at which it was detected suggests that *E. arca* has undergone precipitous population declines. Additional surveys are needed to further explore these trends and ongoing work will investigate the population genetics of *E. arca* in the MRB.

Platform 37 **4:20 pm** **March 27, 2017**	**POPULATION STATUS AND DEMOGRAPHICS OF THE DWARF WEDGEMUSSEL IN THE DELAWARE RIVER BASIN: PERSPECTIVES ON SPECIES RECOVERY.** J.C. Cole[1], H.S. Galbraith[1], C.J. Blakeslee[1], B.S. White[1], and W.A. Lellis[2]. [1] U.S. Geological Survey, Leetown Science Center, Northern Appalachian Research Laboratory, Wellsboro, PA. [2] U.S. Geological Survey, Ecosystems Mission Area, Reston VA.

The dwarf wedgemussel *(Alasmidonta heterodon)* is a federally endangered species first listed in 1990. It is a small, sexually dimorphic, Atlantic Slope species with historic distributions ranging from New Brunswick to North Carolina. Remaining populations are small in size and often physically and genetically isolated. Populations in the Delaware River mainstem were first identified in 2000 by USGS, and subsequent surveys have identified other new populations and assessed a known Neversink River population in the upper Delaware River basin. Our research conducted over the last 16 years has aimed to understand the status of these populations and their significance to the range-wide recovery of the species. We performed qualitative surveys along 457 km of river throughout the basin to document new populations and completed quantitative surveys at 59 qualitatively surveyed sites to generate population estimates. We surveyed 25,880 0.25m^2 quadrats in these systems to determine a mean population estimate of 14,432 with 95% confidence limits of 7,961 to 26,161. We will discuss these population estimates along with information on demographics including size, age, and sex ratio. Our results suggest that Delaware River Basin populations rank high in overall abundance compared to other known populations, surpassed only by the Upper Connecticut River mainstem populations. However, our data indicate declines in historically abundant Delaware Basin populations following major flooding in the mid-2000's. Future survey and monitoring efforts are needed to better assess trends in population status through time. Additional surveys or application of eDNA techniques could also be useful in identifying additional populations in un-surveyed rivers within the basin.

Platform 38 **4:40 p.m.** **March 27, 2017**	**LONG TERM MONITORING OF *PLEUROBEMA COLLINA* ON SOUTH FORK POTTS CREEK, MONROE COUNTY, WEST VIRGINIA.** Michael E. Everhart, Janet L. Clayton. West Virginia Division of Natural Resources, Elkins, WV 26241.

West Virginia has only one known population of the federally endangered *Pleurobema collina*. Located in Monroe County on the southeastern edge of West Virginia, South Fork Potts Creek is a headwater tributary of the James River Watershed. Since *P. collina* was first observed here in the 1980's several Qualitative Timed Search (QTS) surveys, conducted approximately every five years, have been conducted to assess its abundance and distribution along nearly seven kilometers of the stream. The entire reach is located on private properties and has historically been impacted by cattle and muskrat predation. Surveyors have used QTS techniques to locate, measure and identify *P. collina* and the only other mussel species known to occur within the survey reach, *Strophitus undulatus.* In 2015, restoration activities began on the section of stream that supports the best known population of *P. Collina* in the state. Fencing and rock ford crossings were installed to prevent cattle from entering the stream except for controlled flash grazing. In 2016 the West Virginia Division of Natural Resources took over as the lead investigator for survey activities and conducted QTS surveys along most of the historic reach. Data were compared to previous survey events. A mark/recapture area was planned for 2016 to provide quantitative data but small mussel concentrations were scattered and found in areas where the substrate was compacted. Establishing a mark/recapture area could have adversely impacted the substrate in these more stable areas. While areas of *P. collina* concentrations have remained consistent over the decades, numbers of animals have ranged from a low of 31 animals in 2011 to a high of 339 in 2006. While it appears *P. collina* populations are stable, further restoration activities need to be considered for the species to obtain its maximum potential. Monitoring is planned to continue at five year intervals.
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PLATFORM SESSION ABSTRACTS

SESSION 9	CONSERVATION III Monday, March 27, 2017 3:40 – 5:00 p.m.
Platform 39 **3:40 p.m.** **March 27, 2017**	**DISTRIBUTION OF WAVYRAYED LAMPMUSSEL (*LAMPSILIS FASCIOLA*) IN THE LOWER SPEED RIVER, ONTARIO.** Courtney Beneteau. PARSONS, 1069 Wellington Road South, Suite 214, London, Ontario, Canada, N6E 2H6.

Ontario has the greatest diversity of freshwater mussel species in Canada, with 41 species known to occur in the province's watersheds. Due to distribution changes and potential lack of research, native mussel species are occasionally discovered in previously unknown ranges. For example, in 2012, Wavyrayed Lampmussel (*Lampsilis fasciola*) was discovered in the Speed River in Cambridge, Ontario during an environmental assessment for the expansion of four highway bridges over the river. Wavyrayed Lampmussel is a Species at Risk (SAR) in Ontario and the project required formation of an overall benefit plan in accordance with the province's *Endangered Species Act*, because the bridge expansion would impact the species' habitat. As part of the overall benefit plan, a semi-quantitative survey of Wavyrayed Lampmussel in the lower Speed River was conducted in the summer of 2016. Six survey sites measuring 1,500 m^2 were selected and surveys were conducted in 96 randomly placed 1 m^2 quadrats. All mussels found at each survey site were identified and geotagged, while SAR mussels were measured and photographed. Based on this data, we were able to estimate the population size, density, and to relative abundance of Wavyrayed Lampmussel. In addition, an index of spatial association was calculated to quantify the spatial distributions of mussels at each site. Data pertaining to water quantity and quality, depth, substrate, and aquatic vegetation cover were also documented at each site. The mussel community compositions at each site and spatial association of mussels was then compared to various habitat characteristics. Spatial association varied between sites and between species, with some sites and species exhibiting high clustering and others exhibiting no significant clustering. It is hypothesized that these variations are related to differing habitat characteristics, particularly substrate type and water depth.

Platform 40 **4:00 pm** **March 27, 2017**	**ENDANGERED SPECIES RESTORATION IN WEST VIRGINIA.** Janet L. Clayton[1] and Patricia A. Morrison[2]. [1]West Virginia Division of Natural Resources, Elkins, WV 26241; U. S. Fish and Wildlife Service, Williamstown, WV 26187

West Virginia has been working with cooperating agencies in the restoration of federally listed species since 2006. Although not listed at the time, early efforts began with the translocation of *Villosa fabalis* from the Allegheny River, Pennsylvania in cooperation with the Pennsylvania Fish and Boat Commission and the U. S. Fish and Wildlife Service. The first listed species translocated was *Cyprogenia stegaria* from the Licking River in Kentucky in 2010. Small pilot populations were established on the Kanawha and Ohio rivers. In 2016 a new area was established at Ohio Rivermile 284. In 2012 the first augmentation of *Epioblasma torulosa rangiana* occurred on the Elk River at Queen Shoals, with additional individuals in 2013 and 2014 including *V. fabalis*. In 2013 we began widespread restoration efforts for *E. t. rangiana* and *Pleurobema clava* salvaged from the Hunter Station Bridge in Pennsylvania by Enviroscience, Inc. Pilot sites were first established to ensure no acute mortality issues. Additional translocations followed. To date, including the Elk River, nearly 11,000 *E. t. rangiana* and over 24,000 *P. clava* have been translocated into nine sites. Major restoration efforts have occurred in the Belleville Pool of the Ohio River following a large mussel kill. Two federally listed species, *Cyprogenia stegaria* and *Lampsilis abrupta*, were known to occur in the area, and the listing of *Plethobasus cyphyus* increased number of listed species to three. The first stocking of listed species occurred in 2013 with the addition of 400 propagated *L. abrupta* juveniles from Tennessee Tech and White Sulphur Springs National Fish Hatchery. To date, a total of nearly 1600 tagged juveniles have been stocked at three locations.

Platform 41 **4:20 pm** **March 27, 2017**	**HOW THE USE OF SUBMERSIBLE UPWELLING SYSTEMS ARE SPREADING THE CONSERVATION BIOLOGY MESSAGE TO IOWA AND WISCONSIN HIGH SCHOOL STUDENTS.** Jared McGovern[1], Mikaela Foust[1], and Megan Bradley[2]. [1]National Mississippi River Museum and Aquarium, 350 E. 3rd St. Dubuque, IA 52001. [2]Genoa National Fish Hatchery, S5631 State Hwy 35, Genoa, WI 54632.

As partners, the National Mississippi River Museum and Aquarium and the Genoa National Fish Hatchery have devised a way to effectively engage our students, and our community in a hopeful conservation message by flexing our mussels. We provide students and educators the opportunity to work with endangered mussels through a captive propagation program. Students and educators engage with yearling mussels living in Submersible UPwelling SYstems (SUPSY) to finish their growth prior to stocking. These systems are simple but effective. Two, 2 gallon buckets, with a short PVC chimney, some airline, rope, zip ties, a brick, and a compressor is all it takes to create a suitable growth environment with fresh water upwelling through the mesh that has replaced the bottom of each bucket. Every two weeks from May through October museum visitors directly partake in this conservation project by measuring a 10% sample of the mussels from each bucket, and testing various water quality parameters. Students are engaged in collecting and analyzing growth and survival data as well as removing zebra mussels while learning about the negative impacts of invasive species. Through freshwater mussels, we are engaging people in the culture, conservation, and history of our Rivers.
Join us and discover how students are partaking in projects aimed at saving species from extinction, and how we are introducing students to the role Zoos and Aquariums play in a much larger conservation effort. jmcgovern@rivermuseum.com

Platform 42 **4:40 p.m.** **March 27, 2017**	**USING CREATIVE NONFICTION TO COMMUNICATE SCIENCE IN IMMERSION: THE SCIENCE AND MYSTERY OF FRESHWATER MUSSELS.** Abbie Gascho Landis

Native freshwater mussels captivate many scientists, but mussels' virtues and plight can be difficult to communicate to the general public. Although mussels are distributed globally and can occur in rich density, they are hidden below water, and exist beneath most peoples' radar. To appreciate mussels, we first have to recognize them, becoming aware of life at river bottom. Detailed descriptions of the mussel species diversity and their life strategies can bog down in particulars, but telling generalized stories threatens to lose the details that lend accuracy and reveal mussels' complexities. Also, describing the endangerment of mussels and their rivers can be perceived as depressing or moralizing. Writing creatively is one approach to increasing public appreciation of mussels that merits discussion, and the process of researching and writing *Immersion: The Science and Mystery of Freshwater Mussels* can offer some insights, alongside excerpts from the book. In turns joyful and sobering, *Immersion* is an introduction to mussel science and an invitation to see rivers from a mussel's perspective, a celebration of the wild lives visible to those who learn to search. Communicating science—including mussel science—in ways that engage broad audiences will be pivotal to the future of mussels, freshwater ecosystems, and humans.

TUESDAY MARCH 28, 2017	
7:30 - 8:15 A.M. EAST FOYER	**CONTINENTAL BREAKFAST**
8:15 – 10:00 a.m. SALONS A - D	**WELCOME AND ANNOUNCEMENTS PLENARY SESSION ABSTRACTS**
Plenary: Ecosystems 8:30 – 9:00 a.m.	**WHAT ARE FRESHWATER MUSSELS WORTH?** Dr. David Strayer
Historically, little thought was given to the value of freshwater mussels when people made decisions that affected these animals and their habitats. The advent of the ecosystem services framework has raised the question of what freshwater mussels really are worth, and how much weight they should be given in environmental decision-making. I will briefly review several approaches that might be used to value freshwater mussels, review progress towards providing quantitative estimates of those values, and discuss problems with these valuation approaches. Despite uncertainty about the precise value of freshwater mussels, it is clear that they have substantial value to humans, which should be taken into account in environmental decision-making.	
Plenary: Practice 9:00 – 9:30 a.m.	**ADVANCES IN FRESHWATER MOLLUSK RESEARCH: PERSPECTIVES ON PRACTICE, REGULATION, AND EMERGING NEEDS.** Dr. Gregory Cope
The study of 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 understanding the biology, ecology, control, and adverse consequences of dreissenid mussels, technology to propagate and reintroduce mussels, techniques to translocate adult mussels, contaminant monitoring, in situ caging studies, assemblage surveys, laboratory toxicity testing, the mechanistic understanding of physiological and biochemical effects of pollutants, taxonomy, and genetics. Although these advances have clearly propelled the science forward, many of the challenges faced today remain similar to those from several decades ago; those include understanding quality habitat, host fish distribution and interactions with mussels, and the various sensitivities to water and sediment conditions for the many species of mussels and snails. Today, there are many new and emerging issues and problems to resolve, and these will likely require a new paradigm for research, involving multi-disciplinary collaborations and alternative funding strategies. Some of the large and seemingly intractable issues of today include the effects of climate change, unexplained die-offs and enigmatic declines, the influence of microbes (e.g., bacteria and viruses) and the internal and external microbiome on the health, well-being and functional roles of mussel and snails in the ecosystem. Understanding and communicating the ecosystem services provided by these two faunal groups will likely be central to their conservation, especially in an era of perceived decreased value, use and overall belief in science. Training our future generations of researchers, natural resource managers, and conservation leaders is of utmost importance. Putting our research into practice or into regulation is never easy, or rapid, but those are the gains for which we need to strive.	
Panel Discussion 9:30 – 10:00 am	The purpose of the Panel Discussion is to encourage dialogue between Symposium attendees and those with the "muscle" behind the mollusk. We encourage you to hold your questions, observations, and thoughts on the Plenary topic for the panel that will follow Plenaries on Monday and Tuesday.
Morning Break 10:00 – 10:30 a.m.	

PLATFORM SESSION ABSTRACTS

SESSION 10	Life History Tuesday, March 28, 2017 | 10:30 a.m. – 12:30 p.m.
Platform 43 **10:30 a.m.** **March 28, 2017**	**SYNCHRONIZATION OF REPRODUCTION BY TEMPERATURE IN DEERTOE MUSSEL (*TRUNCILLA TRUNCATA*).** Kendell Loyd[1]*, Chris Barnhart[1], Bernard Seitman[2], and Mike Davis[2]. [1]Department of Biology, Missouri State University, Springfield, MO 65897; Minnesota Department of Natural Resources, 2109 North Lakeshore Drive, Lake City, MN 55041. **STUDENT SPEAKER*

Mating in freshwater mussels occurs when males release aggregates of sperm (spermatozeugmata) that drift downstream and are filtered from the water by females. Fertilization presumably occurs in the water passages of the female gills as the eggs are deposited into the marsupial demibranchs. Sperm have limited lifespan in water and there is no evidence for sperm storage in females. Consequently, the synchronization of male and female spawning is vital for successful reproduction. The mechanism of this synchronization is poorly understood. Spawning may be synchronized by environmental factors such as temperature and possibly by chemical communication between upstream and downstream individuals. We investigated Deertoe Mussel (*Truncilla truncata* from the Minnesota River) which spawns in early spring. A previous study indicated that male spawning is triggered by rising temperature. We hypothesized that females might spawn in response to the presence of spermatozeugmata. Mussels were exposed to controlled temperature changes with and without the presence of conspecifics. Spawning of both males and females was delayed indefinitely (up to 1 year) at 10C and triggered by as little as 1-2 hours at or above 13 C. Results were similar whether mussels were isolated, held in groups of males only, females only, or males and females together. Likewise, the presence of spermatozeugmata in the water had no evident effect on timing of male or female spawning. These results indicate that chemical communication is not a factor in synchronicity of spawning in this species. Sperm were found to activate in the presence of eggs, as well as by addition of sodium chloride or calcium chloride. It is possible that the egg interacts chemically with the sperm by triggering sodium-channel and calcium-channel proteins.

Platform 44 **10:50 a.m.** **March 28, 2017**	**REPRODUCTIVE LIFE HISTORY AND HOST FISH SELECTIVITY OF *FUSCONAIA MITCHELLI* AND *QUADRULA PETRINA*.** Jack F. Dudding[1], Clint Robertson[2], Charles R. Randklev[3]. [1]Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843; [2]Texas Parks and Wildlife, Inland Fisheries Division, San Marcos, Texas 78667; [3]Institute of Renewable Natural Resources, Texas A&M University, College Station, TX 77843. **STUDENT SPEAKER*

Freshwater unionid mussels are amongst the most imperiled species in North America. *Fusconaia mitchelli* (false spike) and *Quadrula petrina* (Texas pimpleback) are rare mussel species endemic to central Texas rivers and both are likely to become listed under the Endangered Species Act. Currently, little is known about the life history and reproductive biology of these species, which is likely to hamper conservation efforts for both species. To address these knowledge gaps, my proposed thesis research will examine early reproductive life history and host fish associations for *F. mitchelli* and *Q. petrina* in the lower Guadalupe River, which harbors significant populations for each species. I plan to monitor the gametogenic cycle throughout the year for both species to quantify seasonal timing of gamete production, spawning, and brooding. Fecundity will be assessed via gill excision and related to size and age to determine if fecundity is age/size dependent and whether there is evidence of reproductive senescence. Age of maturation and growth rates will be determined by shell thin-sectioning. Host fish associations and glochidia selectivity will be determined through laboratory host fish trials. Congeners of *F. mitchelli* in *Fusconaia* typically utilize cyprinid fishes as primary hosts, while congeners of *Q. petrina* in the pustulosa group of *Quadrula* primarily use ictalurid fishes as hosts. The ecological importance of hosts identified in the laboratory will be determined by: calculating the relative abundance of laboratory identified hosts in and around mussel habitat; determining glochidia infestation rates in situ; and prevalence of natural host infestation.

Platform 45 **11:10 a.m.** **March 28, 2017**	**THE EFFECT OF *GEOBACTER SULFURREDUCENS* ON JUVENILE *LAMPSILIS RADIATA* GROWTH AND SURVIVAL.** Stephanie P. Gill[124], David Perkins[26], and Derek Lovley[351]Department of Environmental Conservation, University of Massachusetts Amherst; [2]U.S. Fish and Wildlife Service, Richard Cronin Aquatic Resource Center; [3]Department of Microbiology, University of Massachusetts Amherst. **STUDENT SPEAKER*

Bacteria are some of the most extensive and important organisms on Earth, living in relatively high densities within the aquatic ecosystem, yet their influence on juvenile freshwater mussel growth and survival is largely unknown. In the wild, bacteria, and other microbes, are important food sources for freshwater mussels, however most aquaculture facilities propagate mussels with an algae-based diet. The objective of this study is to determine the importance of bacteria in the diet of juvenile *Lampsilis radiata* by measuring growth and survival rates over a period of 4-6 weeks. Freshwater mussels have the ability to selectively digest food, preferring organisms that are small, not too spherical or spiny, and that have a negative electrostatic charge. Genetic sequencing of gut bacteria from wild mussels using the 16S Diversity tool in Geneious© 2005 revealed an array of genera, with *Geobacter* appearing in a majority of them. A comparison of the size, shape, and electrostatic charge of various *Geobacter* species resulted in selection of *Geobacter sulfurreducens* as an experimental food source. Downwelling rearing chambers containing 500 juvenile *Lampsilis radiata* (Bivalvia:Unionidae) mussels were assembled. Differences in mussel survival and growth were tested amongst four diets: bacteria at a high density, bacteria at a low density, Instant Algae® feed (Instant Algae® Shellfish Diet 1800™, and Nanno 3600™, Reed Mariculture, Campbell, CA, USA) and a mixture of bacteria with Instant Algae® feed. The results of this study will provide a better understanding of the importance of bacteria as a food source for early juvenile *Lampsilis radiata*, and whether the high mortality often observed in juvenile mussels can be reduced through dietary changes. spgill@umass.edu

Platform 46 **11:30 a.m.** **March 28, 2017**	**LOOKS CAN BE DECEIVING: IDENTIFICATION OF SEXUAL DIMORPHISM OF *LAMPSILIS TERES.*** Megan C. Hess[1], Wayne P. Hall[1], Eric T. Tsakiris[1], Michael Hart[1], Kentaro Inoue[1], Clint Robertson[2], Charles R. Randklev[1]. [1]Institute of Renewable Natural Resources, Texas A&M University, College Station, TX 77843; [2]Texas Parks and Wildlife, Inland Fisheries Division, San Marcos, Texas 78667.

Determining sex ratio of natural populations is important for characterizing demographic structure and evaluating population dynamics. Misidentification of sex potentially biases population estimates, which could have long-term negative conservation implications. For unionid mussels, recent research has demonstrated that species misidentification is common and may be prevalent depending on species and surveyor experience, but less attention has been given to assessing the reliability of sex identification on the basis of shell morphology. To evaluate the prevalence of misidentification of sex, we conducted an identification exercise for *Lampsilis teres* (yellow sandshell), a species considered sexually dimorphic and found throughout the Mississippi River and Gulf basins. We used a two-pronged approach; first, we asked researchers with varying degrees of experience to correctly identify sex of *L. teres* shells taken from live individuals (sex of these specimens was validated beforehand by extracting and examining male (sperm) or female (eggs) gametes from gonad tissue). Secondly, we used three morphometric methods (traditional, geometric, and Fourier morphometrics) to investigate whether or not the sex of *L. teres* can be identified statistically. We found misidentification rates of sex were relatively high, particularly for inexperienced researchers, and two of the three morphometric methods (geometric and Fourier) correctly identified sex. Our results provide the first benchmark of sex identification accuracy for mussels as we show that misidentification of sex can occur. As a result, this type of bias should be considered if sex data is used to guide management efforts. Our study also provides additional support for the need of mussel identification workshops, national and regional, to teach species and sex identification skills.

Platform 47 11:50 a.m. March 28, 2017	**GLOCHIDIAL DEVELOPMENT OF THE FRESHWATER SWAN MUSSEL (*ANODONTA CYGNEA*, LINNAEUS 1758) ON NATIVE AND INVASIVE FISH SPECIES.** Verena Huber, Juergen Geist. Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technical University of Munich, Mühlenweg 22, D-85354 Freising, Germany. **STUDENT SPEAKER*

The bivalve *Anodonta cygnea* is an important ecosystem engineer in European freshwater systems, but most populations are in decline. Like all other species of the order Unionoida, the larvae of *A. cygnea* have an obligate parasitic phase on a suitable host fish. For conservation and fisheries management, information on the complex life cycle of *A. cygnea* is important, but the host suitability of most co-occurring fish species has not yet been tested. In this study, ten different fish species, including eight native and two non-native species from four different families, were simultaneously infested with the glochidia of *A. cygnea* in a standardized laboratory experiment. The hypothesis that *Anodonta cygnea* can be considered a host generalist was confirmed in this study, since nine out of the ten tested fish species were suitable hosts, with different body parts of hosts being infested with glochidia. Hosts were classed into "good hosts" (*Perca fluviatilis*, *Leuciscus idus*, *Salmo trutta*, *Gasterosteus aculeatus*, *Ctenopharyngodon idella*), "poor hosts" (*Leucaspius delineatus*, *Gobio*, *Rutilus rutilus*, *Pseudorasbora parva*) and "no hosts" (*Rhodeus amarus*), due to differences in infestation rates as well as metamorphosis success. Surprisingly, two non-native fish species (*Ctenopharyngodon idella* and *Pseudorasbora parva*) were identified as suitable hosts for *A. cygnea*. The duration of the larval development differed strongly between the single host fish species concerning success of juvenile mussel excystment and duration of metamorphosis, as well as timing and synchronization in juvenile mussel drop-off. The results of this study provide evidence that the common generalization that non-native species are always a threat to native mussel populations does not hold true. The great variation in larval development on different hosts suggests that fisheries management is also important in freshwater mussel species that are considered host generalists. geist@wzw.tum.de

PLATFORM SESSION ABSTRACTS

SESSION 11	Methods Tuesday, March 28, 2017 | 10:30 a.m. – 12:30 p.m.
Platform 48 **10:30 a.m.** **March 28, 2017**	**UNDERWATER VIDEO IS AN EFFECTIVE TOOL TO REVEAL DREISSENA SPATIAL DISTRIBUTION.** Alexander Karatayev[1], Lyubov Burlakova[1], Knut Mehler[1], Vadim Karatayev[2], Thomas Nalepa[3], Ashley Elgin[4], and Elizabeth Hinchey[5]. [1]Great Lakes Center, Buffalo State College, 1300 Elmwood Ave, Buffalo, NY 14222; [2]Department of Environmental Science and Policy, University of California, Davis, CA; [3]Water Center, Graham Sustainability Institute, University of Michigan, Ann Arbor, MI 48104; [4]National Oceanic and Atmospheric Administration Great Lakes Environmental Research Laboratory, Muskegon, MI 49441; [5]United States Environmental Protection Agency, Great Lakes National Program Office, Chicago, IL, 60604

Almost every study of dreissenids (zebra and quagga mussels) in the Great Lakes has relied on bottom grabs to characterize mussel presence and biomass, but until now, the scale at which mussel cover of the lake bed varies has largely been unknown. We developed a novel method, which analyses video footage recorded from a GoPro camera on a towed benthic sled, to estimate dreissenid cover and biomass over relatively large areas of the lake bed compared to using traditional sampling methods. Across 43 sites sampled in Lake Michigan in 2015, we compared quagga mussel cover and biomass estimates based on three replicate PONAR grabs vs. 500 m-long video transects. Overall, PONAR samples yielded very high variability in estimates of quagga mussel presence at a given site, especially at sites with low to moderate mussel cover, because mussel cover heterogeneity typically occurs at spatial scales much larger than the sample size collected by replicate bottom grabs. We hypothesize that the physical and biological drivers of dreissenid distribution follow the intermediate disturbance hypothesis. In the shallow littoral zone, quagga mussels have an abundant food supply but are limited by wave activity and therefore can only form large aggregations on hard substrates with almost no mussels found on soft and unconsolidated sediments, resulting in high heterogeneity in their distribution. In contrast, in the deep stable profundal zone with no wave action, mussels are food limited and will form small, evenly spaced aggregations on silty substrates, which is likely driven by competition for food and results in low heterogeneity in distribution. The highest *Dreissena* densities will therefore be observed in the intermediate depth zone, where particle deposition is highest and wave activity does not reach the bottom.

Platform 49 **10:50 a.m.** **March 28, 2017**	**EVALUATION OF COSTS ASSOCIATED WITH ADHESION OF PIT TAGS TO FRESHWATER MUSSELS USING TWO COMMONLY EMPLOYED ADHESIVES.** Matthew J. Ashton[1] and Jeremy S. Tiemann[2]. [1]Maryland Biological Stream Survey, Maryland Department of Natural Resources, 580 Taylor Ave., C-2, Annapolis, MD. [2]Illinois Natural History Survey, University of Illinois at Urbana-Champaign, 1816 S. Oak St., Champaign, IL.

Despite the increasing use of PIT tags in freshwater mussel research and conservation, there has been no evaluation of the trade-offs in material cost and effort between two commonly implemented adhesive types. These factors could be important to consider when developing a conservation plan or study design if tag retention rates do not vary by adhesive, the effects of handling are large, or resources are limited. We modeled and evaluated how cost and effort function over a range of sample sizes using field data from the relocation of 3,820 Northern Riffleshell and Clubshell in Illinois and 2,345 Eastern Elliptio in Maryland. While both relocations used externally affixed 12.5 mm, 134.2 kHz PIT tags Illinois researchers used an underwater epoxy resin, whereas Maryland researchers selected a surface insensitive gel cyanoacrylate. We determined total cost-per-tag (CPTE) after parameterizing the cost of each adhesive, quantity of adhesive consumed, time needed to apply adhesive, and time engaged with mussels to cure the adhesive. Based on a comparison of material costs and staff time expended to affix, encapsulate, and cure PIT tags in adhesive to mussels, cyanoacrylate was less costly than epoxy on a per mussel basis. Absolute differences in CPTE are small when the number of mussels tagged is low, but increase by almost $\$6 \cdot \text{mussel}^{-1}$. A primary goal in relocation projects is reduced stress from aerial exposure. Using underwater epoxy can negate this goal and increase costs as it requires approximately five times more handling effort than cyanoacrylate. Nevertheless, epoxy may still be an appropriate choice of adhesive when the number of study animals is low (e.g., <100 mussels). Further study is warranted to understand how our results may vary by adhesive brand, application rate, staffing level, and other factors.

Platform 50 **11:10 a.m.** **March 28, 2017**	**AUTOMATED MUSSEL DETECTION USING MOBILE PHONE MICROSCOPY AND MICROFLUIDIC TECHNIQUES.** David Perkins[1], Aftab Usmani[2], Dan Holcomb[2]. [1]U.S. Fish & Wildlife Service, Richard Cronin Aquatic Resource Center, Sunderland, MA 01375; [2]University of Massachusetts, Department of Electrical and Computer Engineering, Amherst, MA 01003

CANCELED

Because of their small size, observation of juvenile freshwater mussels has traditionally relied up magnification tools such as microscopes and stereoscopes. As such, enumeration tends to be a tedious and time-consuming manual task. Our project aimed at automating the process of counting and measuring the length of juvenile mussels. We designed a microfluidic device through which water containing juvenile mussels was input with a syringe or syringe pump. PDMS (polydimethylsiloxane) was the material chosen for microfluidic device because it's ideal for optical detection, easy to mold and harmless to living organism. The water flow was then captured by an imaging device, in this case a cell phone, which was placed behind an objective lens and pointed at the microfluidic channel. A cradle to hold the cell phone and microfluidic device was designed and fabricated with a 3-D printer. Finally, the captured video was processed with custom mussel-recognition software that enumerated, as well as measured the length of each mussel. Initial trials demonstrated successful counting and measuring. System testing is underway to examine flow rates, mussel densities, and validation that processing does not injure mussels.

Platform 51 **11:30 a.m.** **March 28, 2017**	**EXPLORING THE POTENTIALITY OF UNDERWATER DRONES FOR FRESHWATER MUSSELS SURVEY.** Nicoletta Riccardi[1], Manuel Lopes-Lima[2,3,4], Davide Morea[5], Giannandrea Carpanzano[5], Angela Boggero[1]. 1 Institute of Ecosystem Study, National Research Council, 28922 Verbania-Pallanza, Italy,; 2 CIIMAR/CIMAR — Interdisciplinary Centre of Marine and Environmental Research, University of Porto, Terminal de Cruzeiros do Porto de Leixões, Avenida General Norton de Matos, S/N, P 4450-208 Matosinhos, Portugal, 3 CIBIO/InBIO - Research Center in Biodiversity and Genetic Resources, Universidade do Porto, Campus Agrário de Vairão, Rua Padre Armando Quintas, 4485-661 Vairão, Portugal; 4 IUCN SSC Mollusc Specialist Group, c/o IUCN, David Attenborough Building, Pembroke St., Cambridge, England. 5 Professione droni Srls Via Amico Canobio, 4/6, 28100 Novara Italy, info@professionedroni.it

Without population trends of species, it is hard to assess the effects of pressures or the risk of extinction of species. However, monitoring the state of the populations of many taxa is hampered by the difficulties and the costs of surveys. This is the case of freshwater mussels that are declining rapidly due to habitat degradation worldwide. Driven by rising conservation concerns, the study of these taxa increased over the past few decades, but their conservation still faces several challenges. Foremost, acquiring the basic information (distribution, habitat preferences) crucial to freshwater mussels' conservation is impeded by inadequate funding. Potentially exacerbating this problem is the difficulty to survey freshwater mussels, because they are often rare, spatially clustered, and difficult to detect. In addition, mussel surveys are often hampered by restrictive environmental conditions, such as high water level, strong current, or high turbidity. As in a vicious circle, these constraints may dramatically increase the survey costs, exacerbating the problem of allocating (highly limited) funds. To escape this bottleneck we started exploring the potentiality of using underwater drones, which are being developed for our specific tasks, by a recently created start-up company. The use of drones is becoming increasingly popular in ecological research because of their versatile use in data capture. Drones are a beneficial tool not only for economical and safety reasons, but also for obtaining data that cannot be accessed otherwise. However, to date its use for research, monitoring and conservation have focused on aerial drones, surprisingly neglecting the underwater drones. We started to assessing the efficiency of the drone in locating and counting mussels, and exploring the limits for field application under gradients of environmental limitations, such as water turbidity, water depth, current velocity, slope of the bank, and substrate composition. n.riccardi@ise.cnr.it

Platform 52 **11:50 a.m.** **March 28, 2017**	**INVESTIGATING SOURCES OF BIAS IN FRESHWATER MUSSEL SAMPLING METHODS IN THE MERAMEC RIVER BASIN, MISSOURI.** Matthew C. Schrum[1], Amanda E. Rosenberger[2], and Stephen McMurray[3].[1]Missouri Cooperative Fish and Wildlife Research Unit, School of Natural Resources, University of Missouri, Columbia Missouri; [2] U.S. Geological Survey Missouri Cooperative Fish and Wildlife Research Unit, School of Natural Resources, University of Missouri, Columbia Missouri; [3] Missouri Department of Conservation, Columbia Missouri *STUDENT SPEAKER
Freshwater mussels are among the most threatened aquatic fauna in North America. Given the need for continued monitoring of threatened populations, an evaluation of the effectiveness of metrics from visually-based sampling methods is an essential step in assessing populations of these mollusks. We surveyed 14 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 m² quadrats. We excavated substrate at each .25 m² quadrat to determine baseline abundances for each species. When direct estimation of sampling efficiency is not possible, as is the case with timed visual searches and strip transects, investigation of method covariance, and the habitat mediated bias associated with those methods allows calibration of CPUE and density estimate for those visual methods. We compare the results of abundance estimates of each of the visual methods with the robust estimates based on excavated quadrat samples. Sampling effectiveness of visual-based methods were calculated and used to determine if visual techniques provide reasonable approximation of overall mussel abundances and investigated factors that influenced their effectiveness. These results will be used to produce sampling protocols for freshwater mussels for the state of Missouri.	
Platform 53 **12:10 p.m.** **March 28, 2017**	**APPROACHES FOR ESTIMATING ABUNDANCE OF FRESHWATER MUSSELS IN AN ATLANTIC COASTAL RIVER, AND IMPLICATIONS FOR ASSESSING NATURAL CAPITAL.** Barbara St. John White[1], Daniel E. Spooner[1], William A. Lellis[2], Jeffrey C. Cole[1], and Donald R. Hamilton[3]. [1]U.S. Geological Survey, Leetown Science, Center Northern Appalachian Research Laboratory, 176 Straight Run Road, Wellsboro, PA 16901. [2]U.S. Geological Survey, Ecosystems Mission Area, 12201 Sunrise Valley Drive, MS-300, Reston, VA 20192. [3]National Park Service, Upper Delaware Scenic and Recreational River, 274 River Road, Beach Lake, PA 18405
Effective and efficient assessment of freshwater mussel distribution and abundance is critical to understanding ecosystem function and services provided by mussels, and important in mussel conservation. Qualitative mussel surveys are often fast and relatively inexpensive, but only provide information on relative abundance (e.g., catch-per-unit-effort, CPUE) and do not provide needed information on mussel density (number/m²) and thereby abundance. Alternatively, quantitative surveys yield information on mussel density, but can be time-consuming, expensive (in labor), and disruptive to existing mussel populations. Models predicting mussel density using qualitative survey results would be an ideal way to maximize the results of mussel surveys efforts. We characterized relative abundance of mussels using timed search surveys across 198 kilometers of the Delaware River, a mid-sized river in the mid-Atlantic region. We generated estimates of density and abundance for the common eastern elliptio mussel (*Elliptio complanata*) and tested the utility of several models in predicting mussel density from CPUE data including a categorical model, as well as simple linear, piecewise linear and polynomial regression models. Models were generally comparable in their predictive power ($R^2 \geq 0.83$) but varied in predicted population size, which ranged from 230 (piecewise linear model) to 275 (simple linear) million eastern elliptio mussels for the full survey area. These results translate to approximately 1.2 – 1.4 million eastern elliptio per river kilometer within the survey area. The authors discuss the relative costs and benefits of the various models and in using a qualitative-quantitative integrated modelling approach to estimate overall mussel abundance. bwhite@usgs.gov	

PLATFORM SESSION ABSTRACTS

SESSION 12	Ecology I Tuesday, March 28, 2017 | 10:30 a.m. – 12:30 p.m.
Platform 54 **10:30 a.m.** **March 28, 2017**	**LATITUDINAL VARIATION IN *AMBLEMA PLICATA* SIZE AND GROWTH CHARACTERISTICS IN NORTH AMERICA.** Traci Popejoy and Caryn C. Vaughn. Oklahoma Biological Survey, Department of Biology, and Ecology and Evolutionary Biology Graduate Program, University of Oklahoma, Norman, OK 73019

Size and growth rates are important characteristics for evaluating mussel population health and age estimates. Understanding how these growth characteristics vary across space, specifically a latitudinal gradient, has implications for how freshwater mussel populations respond to climate change. Bergmann's rule states that as latitude increases, organisms get larger. While *Margaritifera margaritifera*, a cold-water specialist, follows Bergmann's rule, *Amblema plicata*, a habitat generalist that exhibits considerable variation in its growth characteristics, has not yet been evaluated for this pattern. We are evaluating the variability of *A. plicata* size and growth rate across a latitudinal gradient spanning south Texas to Minnesota to see if *A. plicata* follows Bergmann's rule. To test this, we are thin-sectioning recently dead shells from multiple rivers across the United States to access growth annuli. From these annuli, we can calculate and compare size-at-age values and von Bertanlanfy's K (growth rate). We will then evaluate how water temperature, river velocity, and land-use influences these growth characteristics. Our preliminary data show that *A. plicata* occurring in higher latitudes are larger, meaning they follow Bergmann's Rule. This study informs conservation efforts by describing the variability of growth characteristics between rivers in North America and evaluating possible mechanisms of this variability and assists conservation biologists by identifying which abiotic factors influence freshwater mussel growth. tracipopejoy@ou.edu

Platform 55 **10:50 a.m.** **March 28, 2017**	**SPATIAL MODELS TO UNDERSTAND SPECIES DITRIBUTIONS AND NUTRIENT SEQUESTRATION AND FLUXES PROVIDED BY SPECIES-RICH COMMUNITIES.** Carla L. Atkinson and Brian C. van Ee. Department of Biological Sciences, University of Alabama, Tuscaloosa, Alabama 35487

Animal aggregations can lead to localized patches (hotspots) of nutrient regeneration and material flux in streams. Yet, the abiotic characteristics that lead to these hotspots and the spatial structure of these hotspots in relation to species-specific preferences remain a mystery. Historically, unionid mussels dominated benthic biomass in many riverine ecosystems, but have undergone extensive population declines. We examined reach-scale physical attributes of sites encompassing a gradient of mussel densities, evaluated quadrat-scale variables resulting in variability in species distributions at finer spatial scales, and the role various species play in nutrient sequestration and regeneration. Here, we measured excretion rates (nitrogen [N] and phosphorus [P]), biodeposition rates (carbon [C], N, P) and body tissue composition (C, N, P) of several mussel species. Our nutrient data were combined with spatially-explicit randomized quadrat sampling incorporating multiple abiotic variables (e.g., channel roughness, velocity) and density and biomass of mussels across 12 reaches in the Sipsey River, Alabama. We sampled 1,218 quadrats and measured the length of each individual (~9,500 individuals), measured tissue composition of 11 species (190 individuals), and conducted excretion and biodeposition rate measurements on 10 species (178 individuals). Using geostatistical analyses tools, species distributions were mapped at specific river reaches and we quantified and mapped species' roles in recycling and storing nutrients. We used these estimates to examine reach- and fine-scale nutrient recycling and storage by mussel communities and the role various species play in determining hotspots of N and P sequestration and flux. Our results demonstrate that freshwater mussels can be important to nutrient dynamics through nutrient regeneration and the creation of storage hotspots, but their significance varies with mussel patchiness, species composition, and abiotic context. In future work, we aim to examine the indirect effects of mussels on nutrient cycling through measurements of anammox production, denitrification rates, and nitrification rates.

Platform 56 11:10 a.m. March 28, 2017	**GOING WITH THE FLOW: EVIDENCE FOR ADVECTIVE DISPERSAL OF ADULT UNIONIDS FROM A CASE STUDY ON THE RIO GRANDE AND INSIGHTS FOR CONSERVATION.** Vadim A. Karatayev[1], Lyubov E. Burlakova[2], Alexander Y. Karatayev[2], Tom Miller[3], and Luojun Yang[1]. [1]Department of Environmental Science and Policy, University of California, Davis, CA 95616; [2]Great Lakes Center, Buffalo State College, Buffalo NY 14222; [3]Environmental Science Center, Laredo Community College, Laredo, TX 78040

Most freshwater mussels have experienced strong fragmentation and thinning of their historic ranges, and over half of North America's ~300 unionid species are vulnerable to extinction. Understanding the factors regulating the population dynamics of these long-lived animals is critical to their successful conservation and recovery. During an intensive study of the Texas state endangered *Popenaias popeii* in the Rio Grande in Texas we found both large long-term changes in their distribution and year-to-year changes in local abundance and population structure. Over the last 100 years the total length of the rivers populated by *P. popeii* has declined by 75%, and the total Texas hornshell population size has declined by 72%. Analysis of 4-years of mark-recapture data estimated 16-51% of marked adults permanently leaving the local population each year via advective dispersal, with similar rates of immigration from upstream balancing changes in local abundance. This is the first conclusive evidence that discharge pulses can drive strong, downstream migration events between habitats in unionid mussels, previously thought to have largely or exclusively sessile adult stages. Using a spatially structured, mechanistic population model we show that even low rates of advective dispersal in adults may reduce the rate of recovery or accelerate extinction for mussel populations persisting in highly fragmented, heavily constricted, or frequently disturbed habitats. We illustrate these ideas with specific examples of how damming and organic pollution on the Rio Grande have fragmented this largest extant *P. popeii* population. These results highlight the need for system-wide conservation efforts, of both unionid habitats and their associated fish hosts.

Platform 57 11:30 a.m. March 28, 2017	**TO GO WITH THE FLOW? HOW STREAM DISCHARGE INFLUENCES MUSSEL SURVIVAL AND PERSISTENCE.** Alison P. Stodola[1], Scott J. Chiavacci[2], Kirk W. Stodola[1], and Jeremy S. Tiemann[1]. [1]Illinois Natural History Survey, Prairie Research Institute, University of Illinois, Champaign, Illinois 61820; [2]United States Geological Survey, Reston, Virginia 20192.

Freshwater mussels are often described as flow dependent. However, stream discharge is subject to stochastic variation, which is sometimes seen in extreme forms of flooding or persistent drought. Under changing climates and altered landscapes, variability in flow may be increasing. Little is known about the true effect of such events on freshwater mussel persistence or survival, let alone how mussels are influenced by moderate variation over time. Two projects in Illinois have revealed that flow conditions are linked to declines in persistence and survival of freshwater mussels. In one study, we investigated the primary factors influencing mussel presence in an urban landscape, with special emphasis on Ellipse (*Venustaconcha ellipsiformis*) and Spike (*Elliptio dilatata*). Our analyses indicated that low flow duration and/or number of high pulse flows were important predictors of species' persistence. Further, the negative impact of pollutant dischargers in the watershed on Ellipse presence was exacerbated during periods of low flow. In another study, we used a mark-recapture approach to estimate survival of 4000 individually marked Clubshell (*Pleurobema clava*) and Northern Riffleshell (*Epioblasma rangiana*) translocated to the Salt Fork and Middle Fork Vermilion rivers. We found that survival of both species during a five-year period declined by nearly 2 times following a high flow event. Furthermore, survival differed between species, with Clubshell nearly five times more likely to survive compared to Northern Riffleshell. Northern Riffleshell are more prone to be at the substrate surface, which might have led them to be more susceptible to being dislodged following periods of exceptional flow. Understanding the role of flow on survival and persistence of mussels remains a monumental challenge for freshwater mussel conservation, as each species may respond uniquely to variations in flow rates, and low flow events may compound impacts like temperature or dilution rates of pollutants.

Platform 58 **11:50 a.m.** **March 28, 2017**	**GOING WITH THE FLOW: BEHAVIORAL RESPONSES OF ENDANGERED MUSSELS TO REDUCTIONS IN FLOW.** Kendall R. Moles[1] and James B. Layzer[2]. [1]Arkansas Game and Fish Commission, 2 Natural Resources Drive, Little Rock, AR 72205. [2]Tennessee Technological University, Box 5114, Cookeville, TN 38505.
Behavioral responses of mussels to reductions in streamflow are poorly understood. Mussels are primarily thought of as sessile organisms typically exhibiting little to no movement during their life span. To better understand this aspect of mussel ecology, a series of flume trials were conducted to determine the behavioral responses of mussels to reductions in streamflow. A hydraulic flume was used to mimic decreasing streamflow conditions to identify the level of flow and determine the behavioral responses of 18 mussel species, including 10 federally listed mussel species. Mussels exhibited the greatest response when water levels were reduced to a depth of 5 cm. Most mussels exhibited one of two responses to deal with reductions in flow, by either burrowing into or moving laterally across the substrate. Although responses were consistent within species the magnitude of movement differed between males and females in some species with males moving greater distances than females. Additionally, brooding had an effect on response with non-gravid females moving faster than gravid females. These behavioral responses represent two distinct strategies mussels use for coping with their unstable lotic environment.	
Platform 59 **12:10 p.m.** **March 28, 2017**	**DUCK MUSSELS *ANODONTA ANATINA* FILTER *DIPLOSTOMUM* EYE FLUKE LARVAE AND REDUCE FLUKE INFECTION IN RAINBOW TROUT.** Jouni Taskinen[1], Mikhail Gopko[2] and Katya Mironova[2]. [1]Department of Biological and Environmental Science, University of Jyväskylä, P.O. Box 32, FI-40014 Jyväskylä, Finland; [2]A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences. 33 Leninskii Prospekt, 119071 Moscow, Russia
Ecosystem services provided by freshwater mussels stem from their filtering and burrowing activities. Mussels filter phytoplankton, bacteria and detritus from the water column and biodeposit a remarkable part of these materials to bottom. Mussels decrease chloriphyll-*a* content and clear the water. Bioturbation of sediments through mussel movements increases sediment water and oxygen content. Mussels link multiple trophic levels in river ecosystems. It has been recently suggested that freshwater mussels could filter infective stages of parasites and pathogens. We studied if the duck mussel, *Anodonta anatina*, can filter cercarial larvae of the trematode parasite *Diplostomum pseudospathaceum* which infect eyes of fish. Presence of *A. anatina* caused a 4-fold decrease in the concentration of cercariae in 4-h incubation as compared to control containers without mussel. A 3-h infection experiment with parasite cercariae revealed that the numbers of parasites in rainbow trout were three quarters of that in control containers with an empty mussel shell. Thus, our results indicate that *A. anatina* can eliminate cercariae and reduce the eye fluke infection in fish. This suggests that freshwater mussels may modify host-parasite relationships in aquatic ecosystems. Furthermore, our results suggest that mussels can potentially mitigate problems caused by eye flukes for fisheries and fish farming. jouni.k.taskinen@jyu	

PLATFORM SESSION ABSTRACTS

SESSION 13	Status, Trends, and Monitoring of Molluscan Resources II Tuesday, March 28, 2017 | 2:00 – 3:20 p.m.
Platform 60 **2:00 p.m.** **March 28, 2017**	**ASSESSING THE CONSERVATION STATUS OF FRESHWATER MUSSELS IN THE RIO GRANDE DRAINAGE, TEXAS.** Charles Randklev[1], Michael Hart[1], and Tom Miller[2]. [1]Institute of Renewable Natural Resources, Texas A&M University, Dallas, TX. [2]Lamar Bruni Vergara Environmental Science Center, Laredo Community College. Laredo, TX.

The Rio Grande drainage, in Texas, harbors three unionid mussel species (*Popenaias popeii*, Texas hornshell; *Potamilus metnecktayi*, Salina mucket; and *Truncilla cognata*, Mexican fawnsfoot) proposed for listing under the Endangered Species Act. Due to the remoteness of this river system and historical lack of interest in freshwater mussels, the Rio Grande and tributaries have not been surveyed using a sampling design that accounts for variability in detection, which is problematic because false-negatives can incorrectly suggest extirpation and range reductions. The objective of this study was to use an occupancy-modeling approach to assess the occurrence of rare and common mussel species and factors that affect their detection at ~115 sites along ~ 800 river kilometers of the Rio Grande in Texas. In total, we collected 2,632 live mussels of 10 species, including the 3 species presently considered for listing under the ESA. We found several hotspots of mussel species richness and abundance along the Rio Grande and in adjacent tributaries. Detection probabilities varied considerably and were influenced by survey experience, mesohabitat and proximity to upstream dams and urban areas. Our results provide important information that will likely aide in the conservation and management of mussel species in one of the most endangered river systems in North America and confirms the usefulness of occupancy-modeling to assess the distribution, habitat relationships and anthropogenic stressors of unionid mussels.

Platform 61 **2:20 p.m.** **March 28, 2017**	**DISTRIBUTION AND ECOLOGY OF SIX STATE THREATENED MUSSEL SPECIES OF EAST TEXAS.** Neil B. Ford[1], Andrew R. Glen[1], Jared Dickson[1], Lance Williams[1], Marsha Williams[1], John Placyk[1] Harmonie Hawley[2] and Josh Banta[1]. [1] Department of Biology, [2]Department of Civil Engineering, University of Texas at Tyler, Tyler, Texas 75703.

We used predicted distribution maps to identify sites of highly suitable habitat for six state listed species of East Texas Mussels. These maps were used to determine field locations to examine population level information for each species, including information about population size, age distribution, and recruitment at sites of greatest abundance. We recorded 1853 live and 243 recently dead mussels of 22 species in the Angelina River and Attoyac Bayou, 10,122 live and 972 dead mussels of 28 species from the Neches River, 460 live and 294 dead mussels of 19 species from the Cypress Creek basin, 2215 live and 1139 dead mussels of 19 species from the Sabine, 940 live and 95 dead mussels of 21 species from the Sulphur River, and 1124 live and 679 dead mussels of 16 species in the Trinity River. We found all 6 species of mussels listed as state-threatened. In 7 locations with high abundances mark-recapture was conducted on Texas, Triangle and Louisiana pigtoes. The Texas Pigtoe, *Fusconaia askewi*, appears stable but is difficult to separate visually from the rare Triangle Pigtoe, *F. lananensis*, which appears to only occur in the Attoyac Bayou and lower Neches River. Texas Pigtoes in areas of high abundance had densities of 2.2 to 3.5 per m^2. The distribution of the Southern Hickorynut, *Obovaria arkansasensis* is restricted to only a very limited reach on the Neches River. The Louisiana Pigtoe, *Pleurobema riddelliii* was only doing well in the upper Neches River. In sites of high abundance they had densities of 1 to 2 per m^2. The Sandbank Pocketbook*, Lampsilis satura* and the Texas Heelsplitter, *Potamilus amphichaenus*, are rare everywhere and primarily found only in the Neches and Sabine Rivers. Sandbank Pocketbooks had densities less than .03 per m^2 and Texas Heelsplitters less than .01 per m^2.

Platform 62 **2:40 p.m.** **March 28, 2017**	**COMPREHENSIVE ILLUSTRATED CATALOGUE OF PRIMARY TYPES OF THE PLEUROCERIDAE.** Jeffrey T. Garner[1], Ellen E. Strong[2], Arthur E. Bogan[3], Thomas A. Tarpley[4], and Paul D. Johnson[4]. [1]Alabama Department of Conservation and Natural Resources (ADCNR), Florence, AL; [2]National Museum of Natural History, Department of Invertebrate Zoology, Washington, DC; [3]North Carolina State Museum of Natural Sciences, Raleigh, NC; [4]ADCNR, Alabama Aquatic Biodiversity Center, Marion, AL.

One of the most challenging freshwater snail families is the Pleuroceridae. The second most speciose gastropod family in North America and one of its most imperiled, taxonomic issues have hampered study of the group and precluded protection of worthy constituents. The problems result from an excess of names applied to members of the family, mostly by 19th century workers. Intraspecific shell morphology is highly variable among and within pleurocerid populations and many species were described multiple times, based on minor differences among individuals. A stable and accurate classification is necessary for clear communication, and must be based on application of the International Code of Zoological Nomenclature (ICZN). The critical first step is compilation of information about the type material, which is housed in scattered museums in North America and Europe. A decade ago we began the task of documenting pleurocerid type material with the aim of compiling a comprehensive illustrated catalogue of primary type specimens. A total of 847 available names has been identified for the Pleuroceridae and North American Semisulcospiridae; the latter are included in the catalogue as they were considered part of the Pleuroceridae until recently. An additional 47 names represent *nomina nuda* and junior homonyms. Four species-group names were deemed to belong to other families. Of the 847 available names, 661 primary types have been located and photographed. From among these, 142 lectotypes will be designated. Another 54 possible type lots remain to be assessed.

Platform 63 **3:00 p.m.** **March 28, 2017**	**FILLING THE GAPS: THE IMPORTANCE OF DENSE GEOGRAPHIC SAMPLING FOR ASSESSING THE DIVERSITY OF WESTERN NORTH AMERICAN *JUGA* (GASTROPODA, SEMISULCOSPIRIDAE).** Ellen E. Strong[1] and Nathan V. Whelan[2]. [1]Smithsonian Institution, National Museum of Natural History, Washington DC, 20560; [2]U.S. Fish and Wildlife Service, Warm Springs Fish Technology Center, Warm Springs, GA 31830.

Juga is a genus of freshwater gastropod distributed in Pacific and Interior drainages of the Pacific Northwest from northern Washington to central California. They are found in a diversity of habitats including, springs, spring runs, creeks and large rivers to ponds and lakes. As with other freshwater gastropods, their taxonomy has relied heavily on features of the shell, with 11 species currently relegated to three extant subgenera established on the basis of early teleoconch shell sculpture. However, the extent that similarity in shell morphology is an accurate reflection of phylogenetic affinity is unknown. In addition, the diversity of *Juga* has not been robustly explored using molecular methods. Thus, it remains unclear whether there may be few, highly variable, widespread species, or conversely, numerous narrow-range endemics, and if the currently recognized subgenera are monophyletic. Consequently, a multilocus mitochondrial (COI, 16S) and nuclear gene (ITS1) dataset was assembled for ~100 populations collected from across their range. Each partition was analyzed separately, and in the absence of significant incongruence, a concatenated dataset was analyzed using Bayesian inference. The biogeographic pattern comprised a mixture of widespread, highly variable species and narrow range endemics, with one species recovered at a single location. Most populations were found to comprise a single species, with two species co-occurring at less than five locations. Features of teleoconch sculpture that are considered significant in subgeneric classification were found to be variable in some species. Overall diversity was found to be lower than presently recognized, requiring the synonymy of several species. Of several distinct morphotypes thought to represent potentially new species of *Juga*, the majority are conspecific with species currently recognized or already have a name from among the historical list of synonyms.

PLATFORM SESSION ABSTRACTS

SESSION 14	Ecology II Tuesday, March 28, 2017 | 2:00 – 3:20 p.m.
Platform 64 **2:00 p.m.** **March 28, 2017**	**ASSESMENT OF MULTIPLE APPROACHES USING THE ELECTRON TRANSPORT SYSTEM (ETS) ASSAY TO COMPARE THERMAL TOLERANCE OF UNIONID MUSSELS.** Lindsay M White and James A. Stoeckel. Department of Fisheries, Aquaculture, and Aquatic Science, Auburn University, Auburn, AL 36849 **STUDENT SPEAKER*

Respirometry has been used to estimate organismal responses to environmental stressors (e.g. temperature, dissolved oxygen, etc.) that can impact metabolism, growth, and reproduction. Alternatively, the electron transport system (ETS) assay quantifies the activity of ETS enzymatic complexes and is a tool for investigating thermal performance related to respiration at the cellular level. Thermal performance curves reveal the temperature thresholds beyond which enzyme activity stops increasing and begins to decrease with increasing temperature – indicating the onset of thermal stress at the enzymatic level. We acclimated two mussel species (*Lampsilis teres* and *Villosa lienosa*) to five temperatures (range = 15 – 33°C; 5 individuals/temperature/species) and then removed two small tissue plugs for ETS analysis. In this approach, quantity and quality of enzymes produced by mussels may have differed among temperatures during the two-week acclimation period. We subsequently acclimated ten mussels of each species to a single temperature (20°C), removed ten tissue plugs from each mussel, then assayed plugs from each mussel across all five temperatures. In this approach, quantity and quality of enzymes produced by each mussel was held constant across temperatures. Finally, we held individuals of each species in a stream and collected tissue plugs throughout the year during changes in ambient temperature. All three approaches consistently identified *L. teres* as the most thermally sensitive species. Comparison of the first two approaches indicated that enzyme quality and quantity change during chronic exposure to warm temperatures. The first approach likely gives a more accurate estimate of optimal temperatures at the enzymatic level. However, the second approach can be used to assess differences in relative tolerance among species if numbers of experimental mussels are limited and acclimation to multiple temperatures is not practical. The ETS assay is a promising approach to assess thermal tolerance of mussel species in both laboratory and field studies. lmw0063@auburn.edu

Platform 65 **2:20 p.m.** **March 28, 2017**	**USE OF THE ELECTRON TRANSPORT SYSTEM (ETS) ASSAY TO TEST FOR DIFFERENCES IN THERMAL TOLERANCE OF EIGHT MUSSEL SPECIES IN THE SIPSEY RIVER, ALABAMA.** Hisham A. Abdelrahman[1], Lindsay White[1], Carla L. Atkinson[2], Troy Farmer[1] and James A. Stoeckel[1]. [1]School of Fisheries, Aquaculture, and Aquatic Sciences, Auburn University, 203 Swingle Hall, Auburn, AL 36849, USA); [2]Department of Biological Sciences, University of Alabama, Tuscaloosa, AL 35847

Temperature has a major impact on the physiological processes of freshwater invertebrates. Assays that assess variation in sensitivity of respiratory enzymes to heat stress should be particularly useful in assessing the potential of local populations to adapt to warming temperatures. The ETS assay quantifies the activity of enzymatic complexes involved in the electron transport system. Thermal performance curves reveal the temperature thresholds beyond which enzyme activity stops increasing and begins to decrease with increasing temperature – indicating the onset of thermal stress at the enzymatic level. Native freshwater mussels (Bivalvia: Unionidae) are a diverse but imperiled fauna. Recent studies suggest many species may already be living near their upper thermal limits. The Sipsey River supports one of most intact biological communities in the region, making it an ideal site to assess intra and interspecific variation in thermal tolerance among co-existing species. The objectives of this study were to compare thermal tolerance among species at the enzymatic level, and assess the degree of variation within species. Five mussels from each of eight species (*Amblema plicata*, *Elliptio arca*, *Fusconaia cerina*, *Lampsilis ornate*, *Obovaria unicolor*, *Pleurobema decisum*, *Quadrula asperata*, and *Quadrula verrucosa*) were collected and 12 tissue plugs biopsied from the foot of each individual. ETS activity was assessed at seven temperatures, and optimal enzymatic temperature was determined. Preliminary analysis of thermal performance curves indicate high intraspecific and low interspecific variation in the relationship between ETS enzyme activity and temperature. This suggests that the Sipsey populations possess enzymatic variability that facilitates adaptation to changing temperatures. There was no indication that specific species were more thermally tolerant than others, in part due to the high variation within species. We are currently conducting experiments to validate preliminary findings and assess the usefulness of this assay as a measure of thermal tolerance and adaptability of mussel species. hisham@auburn.edu

Platform 66 **2:40 p.m.** **March 28, 2017**	**UPPER THERMAL LIMITS OF FRESHWATER MUSSELS (BIVALVIA, UNIONOIDA) IN RAMPED TEMPERATURE EXPOSURES.** Kathryn C. Martin, M. Christopher Barnhart. Department of Biology, Missouri State University, Springfield, MO 65804.

The purpose of this study was to determine the upper thermal limits of three species of juvenile freshwater mussels during ramped temperature excursions lasting 16 hours. Temperature was increased linearly from baseline during 6 h, held at peak temperature for 2 h, and then decreased to baseline during 8 h. Similar temperature changes occur in the field as a result of solar heating. The peak temperature fatal to half of the exposed population (LT50) was tested with respect to species, population, age, and seasonal acclimation. Mortality was monitored for 2 weeks after a single 16-h excursion. The smallest size classes were tested in a thermal cycler instrument, a novel application for testing mussels. LT50s for juveniles less than 3 weeks old were similar within 2-3°C compared to juveniles 1-2 years older. LT50s for peak temperature in summer-acclimated mussels were 33.2, 39.1, and 38.9°C for Western pearlshell, Fatmucket, and Washboard juveniles less than 3 weeks old compared to LT50s of 36.1 and 40.8°C for Fatmucket and Washboard 1-2 years of age. These results are several degrees higher than previously reported for continuous temperature exposures lasting 1- several days. LT50s for summer acclimated Washboard and Fatmucket immersed in water were 2-3°C higher than for those emersed in damp sand. LT50s for winter acclimated Washboard and Fatmucket immersed in water were 1°C lower than those emersed in damp sand. Winter acclimated Washboard had LT50s 2-4°C lower than summer acclimated animals. These data can be used to predict the impacts on threatened mussel species of anthropogenic factors that alter peak daily temperatures, including flow alteration, thermal pollution and climate change. kathryn6@missouristate.edu

Platform 67 **3:00 p.m.** **March 28, 2017**	**A WEIGHT OF EVIDENCE APPROACH FOR DEFINING THERMAL TOLERANCE IN A FEDERALLY ENDANGERED SPECIES.** C.J. Blakeslee[1], H.S. Galbraith[1], and W.A. Lellis[2]; [1]U.S. Geological Survey, Leetown Science Center, Northern Appalachian Research Laboratory, Wellsboro, PA; [2]U.S. Geological Survey, Ecosystems Mission Area, Reston, VA

Special consideration for the ecological needs of rare and endangered native freshwater mussels is needed when managing rivers to support these species. The Delaware River basin (USA) is thought to house the second largest remaining populations of the federally endangered dwarf wedgemussel, *Alasmidonta heterodon.* State and federal management agencies have expressed growing interest in how changes in thermal regimes, whether from flow management practices or climate change, affect *A. heterodon* within this system. Gathering information on the thermal biology of freshwater mussels, especially rare and threatened species can be challenging: meaningful and sensitive metrics to assess thermal stress in mussels are still under development. While information is needed on physiological thermal limits for dwarf wedgemussel, an understanding of optimal thermal conditions for this species and consideration of its host fish requirements are also critical. We present a series of laboratory studies involving *A. heterodon*, several co-occurring mussel species, and tessellated darter and slimy sculpin (two of *A. heterodon's* documented host fish) to fill the data gap on the thermal biology of this species. Temperature preference, thermal tolerance, and physiological response to temperature were investigated. Given that *A. heterodon* is endangered, there are limited individuals available for testing, limiting the statistical power in data analysis. The authors use a weight of evidence approach, utilizing cumulative results from multiple experimental assessments, to define thermal limits and optimal conditions for dwarf wedgemussel, put these results in context with co-occurring species, and discuss the utility of this approach when working with rare, threatened, or endangered species.

PLATFORM SESSION ABSTRACTS

SESSION 15	Environmental DNA Tuesday, March 28, 2017 | 2:00 – 3:20 p.m.
Platform 68 **2:00 p.m.** **March 28, 2017**	**ENVIRONMENTAL DNA AS A MONITORING TOOL FOR FRESHWATER MUSSELS: A SUBSTITUTE FOR CLASSICAL SURVEYS?** Bernhard Stoeckle[1], Ralph Kuehn[2] and Juergen Geist[1]. [1]Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technical University of Munich, D-85354 Freising, Germany; [2]Unit of Molecular Zoology, Chair of Zoology, Department of Ecology and Ecosystem Management, Technical University of Munich, D-85354 Freising, Germany.

Knowledge of species distribution is an important prerequisite for conservation and management of freshwater mussels. Conventional monitoring surveys can be time-consuming, costly and are not always reliable since individuals can be overlooked. Environmental DNA (eDNA) monitoring has only recently emerged as an effective tool to discover the presence of target species via detecting the DNA that they release into the environment. The objective of this study was to establish a species-specific PCR-based eDNA marker system to detect endangered freshwater pearl mussel (*Margaritifera margaritifera*) in defined laboratory standards as well as in its natural habitat, and to critically assess the advantages and disadvantages of this molecular detection system compared to classical survey work. The detection sensitivity of the PCR system was verified under laboratory conditions and tested on water samples of twelve well-monitored streams with population sizes of *M. margaritifera* ranging from 100 to 20,000 individuals, as well in streams with extinct populations where false positive results may occur as a result of the release of DNA from dead shells. The newly established eDNA-PCR system proved to be highly sensitive and capable of detecting target species DNA down to 10 fg/µl in laboratory experiments. In the natural stream habitat, DNA of *M. margaritifera* was consistently detected in water samples collected directly downstream (25 m) of living pearl mussel populations. The eDNA detection at distances greater than 500 m downstream of these populations was unreliable, possibly due to DNA degradation, binding of eDNA to particulate matter, or dilution processes. eDNA was also detected downstream one already extinct population, most likely resulting from overlooked specimens or the release of DNA from dead shells. Concerning conservation efforts of freshwater mussels, the eDNA approach proposed herein may be helpful in initial screenings of streams that are otherwise difficult to monitor, or in the detection of buried juvenile mussels without disturbing their habitat. However, it has to follow the same standards as analyses of ancient DNA and clearly cannot replace classical monitoring outcomes such as population demography data, making it only a supplementary tool useful in specific situations. bernhard.stoeckle@tum.de

Platform 69 **2:20 p.m.** **March 28, 2017**	**ENVIRONMENTAL DNA: AN EFFICIENT, NON-INVASIVE APPROACH FOR MONITORING THREATENED AND ENDANGERED MUSSEL DISTRIBUTIONS.** Eric R. Waits[1], Amy Bergdale[2], Matthew Ashton[3], Kathleen A. Patnode[4], Janet L. Clayton[5], and Lucas M. Smith[1]. [1]United States Environmental Protection Agency, Office of Research and Development, Cincinnati, OH 45268; [2]United States Environmental Protection Agency, Region 3, Wheeling, WV 26003; [3]Maryland Department of Natural Resources, Annapolis, MD 21401; [4]United States Fish and Wildlife Service, State College, PA 16801; and [5]West Virginia Division of Natural Resources, Elkins, WV 26241.

There is an urgent need for data-driven prioritization of conservation actions, which rely heavily on reliable, rapid, cost-effective monitoring of ecosystem biological structure through time and space. Traditional biomonitoring approaches are labor intensive, require significant resources, and are often invasive or destructive by nature. Taxonomic identification of species based on DNA present in environmental samples (environmental DNA, or "eDNA") may offer a sustainable solution to the limitations of traditional biomonitoring. Extra-organismal genetic material is continuously deposited into the environment in the form of excrement, saliva, urine, mucus, gametes, sloughed skin cells, or rotting carcass. The component DNA can be readily obtained from easy-to-collect environmental samples (e.g., water, soil) instead of thru capture, handling, or sacrifice of whole organisms. Because each organism's DNA contains a unique genetic code, eDNA can be used for precise taxonomic identification. In order to evaluate the utility of eDNA surveillance for detecting mussel Species of Greatest Conservation Need (SGCN), we developed species-specific eDNA markers targeting Dwarf Wedgemussel (*Alasmidonta heterodon*), Northern riffleshell (*Epioblasma torulosa rangiana*), and the Snuffbox mussel (*Epioblasma triquetra*). We tested our eDNA methodology on water and sediment samples collected (2014-2016) at numerous locations within the Chesapeake Bay and Ohio River drainages, including locations of known target species occupancy for validation. Results of our eDNA assays indicate eDNA-surveillance is extremely effective in determining species occupancy; and potentially relative abundance among populations. Continued advancements in eDNA technology will provide natural resource managers with the ability to readily verify species persistence from extant populations and existence from populations of questionable status, significantly improving our ability to conserve and recover rare freshwater mussel species. *Although this research was approved for presentation, it does not necessarily reflect Agency views.*

Platform 70 **2:40 p.m.** **March 28, 2017**	**A NOVEL WATER COLLECTION TECHNIQUE FOR ENVIRONMENTAL DNA STUDIES OF FRESHWATER MUSSELS.** Caitlin Byrne[1], Mike Brittsan[2], Kody Kuehnl[3], Barb Wolfe[4], Doug Warmolts[2], and G. Thomas Watters[1]. [1]Department of Evolution, Ecology, and Organismal Biology, The Ohio State University;[2] Columbus Zoo and Aquarium; [3] Department of Science and Mathematics at Franklin University; [4] Morris Animal Foundation

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Recently, techniques have been developed to detect the presence of hard to detect or rare aquatic species by identifying their DNA in the environment (eDNA). Water samples are collected and analyzed to determine the presence of a species by the isolation of its DNA from the sample. In recent years, several different methods have been utilized to determine the most efficient way to collect eDNA samples. For this study, we focused on the viability of different water collection techniques in order to increase the probability of detecting a federally endangered mussel, Northern Riffleshell, at a site known to harbor that species. We compared the more traditional method of collecting eDNA using bottles contain various volumes of water to a new method of placing filter bags in the river for a predetermined amount of time. All samples were processed using the same extraction and PCR protocols. Samples collected in bottles, regardless of the volume used, were negative for Northern Riffleshell DNA. However, seven of eight filter bag samples positively amplified the target species DNA. These results indicate as the volume of water that flows through the bag is much greater than that captured in bottles, probability of successful detection of rare species is greatly increased.

Platform 71 **3:00 p.m.** **March 28, 2017**	**DETECTION OF FOUR FRESHWATER MUSSEL SPECIES AT RISK (UNIONIDAE) FROM ENVIRONMENTAL DNA (eDNA) AT ESTABLISHED MONITORING SITES.** Charise A. Currier[1]*, Todd J. Morris[2], Chris C. Wilson[3], Joanna Freeland[4]. [1]Environmental and Life Sciences, Trent University, Peterborough, ON, K9L 0G2; [2]Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, L7S 1A1 [3]Ontario Ministry of Natural Resources and Forestry, Peterborough, ON, K9L 1Z8 **STUDENT SPEAKER*

Environmental DNA (eDNA) detection is a growing field that uses species-specific markers to screen DNA from bulk samples, such as water, to infer species presence. eDNA is particularly effective for the detection of rare species, including species at risk, due to its high sensitivity and low cost. This study involved the development and validation of species-specific markers for four freshwater pearly mussels (Unionidae). The markers were then used to detect target species DNA from water samples collected at intensively-sampled mussel monitoring sites throughout southern Ontario. Using a paired sampling design, eDNA-derived species detections were compared with quadrat species detections to assess the efficacy and sensitivity of the designed markers relative to traditional sampling. Target species were detected using eDNA at all sites where they had previously been detected by quadrat sampling, and a single species was detected at two additional sites using eDNA. This paired design demonstrated that eDNA detection was at least as sensitive as quadrat sampling and that high species specificity can be achieved even when designing against many sympatric unionids. Other analyses using eDNA data revealed no difference in detection probability based on sampling depth within the water column and a correlation between signal strength and mussel density. Detection failures can impede species conservation efforts and occupancy estimates; the high sensitivity of eDNA sampling could improve our knowledge of species distributions and population status through increased sampling sensitivity and sampling coverage. charisecurrier@trentu.ca

PLATFORM SESSION ABSTRACTS

SESSION 16	Status, Trends, and Monitoring of Molluscan Resources IV Tuesday, March 28, 2017 | 3:40 – 5:00 p.m.
Platform 72 **3:40 p.m.** **March 28, 2017**	**COMMUNITY CHANGES IN A FRESHWATER MUSSEL BED FROM 2005 TO 2016 IN THE GREEN RIVER, KENTUCKY.** Monte A. McGregor, Adam C. Shepard, Travis Bailey, Andrew T. McDonald, Fritz E. Vorisek, David Cravens, and Julieann M. Jacobs. Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort Kentucky, 40601.

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 summer 2005, 2010, and 2016. We determined species presence, abundance, and distribution patterns for all species. We collected 33 species (3,137 individuals) for all three events. The most dominant species in all three events was the mucket, *Actinonaias ligamentina* (32% to 49% of the total abundance). Mucket densities ranged from 3.95 (2005), 3.62 (2010) to 4.47/m^2 (2016). Other abundant species were the spike, *Elliptio dilatata* (4.7 - 31%), purple wartyback, *Cyclonaias tuberculata* (5.8-6.8%), threeridge, *Amblema plicata* (2.9-10%), round pigtoe, *Pleurobema sintoxia* (1.4-4.7%), and the longsolid, *Fusconaia subrotunda* (2.8-4.9%), collectively 75-80% of the individuals. Mean densities by species ranged from 0.01 to 4.47/m^2 and 15 species were rare in 2005 (2 T&E), 14 were rare in 2010 (1 T&E), and 16 were rare in 2016 (3 T&E). Mussels were considered rare if densities were less than 0.1/m^2. Average mussel density for all years ranged from 8.04 to 14.10/m^2 and with maximum densities/m^2 ranging from 30 to 53/m^2. Three endangered species, the fanshell, *Cyprogenia stegaria*, sheepnose, *Plethobasus cyphyus*, and rough pigtoe, *Pleurobema plenum*, were detected at densities from 0.2-0.6/m^2 (fanshell) and 0.0-0.02/m^2 (sheepnose and rough pigtoe). In 2005 only 1 species was present at densities > 0.5/m^2, compared to 4 species in 2010, and 6 species in 2016. monte.mcgregor@ky.gov

Platform 73 **4:00 p.m.** **March 28, 2017**	**NEW DISTRIBUTIONAL RECORDS FOR THE SPECTACLECASE MUSSEL FROM THE OUACHITA RIVER IN ARKANSAS.** William R. Posey II, Kendall R. Moles, and Kelly J. Irwin. Arkansas Game and Fish Commission, 2 Natural Resources Drive, Little Rock, AR 72205

The Spectaclecase Mussel *Cumberlandia monodonta* (Say, 1829) was listed as a federally endangered species in March 2012. This species historically occurred in 44 rivers within the Mississippi River Basin, but known populations have been reduced to 20 rivers, a 55% decline. Of the 20 extant rivers, six have records based on only one or two individuals. The most robust populations persist in the St. Croix River of Minnesota and Wisconsin and the Gasconade and Meremac rivers in Missouri. Prior to 2012, the known distribution for *C. monodonta* in Arkansas was from scattered records in the Ouachita (n=4) and Mulberry (n=1) rivers. The Ouachita River records were based on three live individuals collected within a 56 km reach between Tates Bluff and Camden and one relic shell from above Lake Ouachita. The Mulberry River has yielded one live individual. We conducted surveys for the species in 93 river km of the Ouachita River in 2012 and 2013 and discovered seven (7) new populations, from Arkadelphia to Camden. The number of individuals encountered at each of these new sites ranged from a few to hundreds of individuals. Intensive systematic sampling has been initiated to delineate suitable habitat, determine demographics, and estimate population size at each site. Preliminary results indicate robust populations with consistent recruitment at several sites.

Platform 74 **4:20 p.m.** **March 28, 2017**	**INVENTORY OF UNIONIDS IN TWO NATIONAL WILDLIFE REFUGES IN NORTH LOUISIANA.** John L. Harris[1], Josh H. Seagraves[2], Timothy Fotinos[3], Gypsy Hanks[4]. [1]Welch/Harris, Inc., Scott, AR 72142, [2]Benton, AR 72019, [3]U.S. Fish and Wildlife Service, Inventory and Monitoring Program, Bossier City, LA 71112, [4]U.S. Fish and Wildlife Service, North Louisiana Refuges Complex, Farmerville, LA 71241.

D'Arbonne National Wildlife Refuge (NWR) was established in 1975 and consists of 17,419 acres purchased by the U.S. Army Corps of Engineers to mitigate for the Ouachita and Black Rivers Louisiana and Arkansas Nine-Foot Navigation Project. D'Arbonne NWR is bisected by 13 stream miles of Bayou D'Arbonne and is managed for the protection of bottomland hardwood forest, migratory birds, and threatened and endangered species. The Upper Ouachita NWR was established in 1978 and consists of 54,196 acres purchased with Migratory Bird stamp monies and Land and Water Conservation funds to provide habitat for migratory birds and to protect wetlands. Approximately 18.1 miles of the Ouachita River bisect the refuge and an additional 3.7 river miles is closely associated with one side of the refuge. Bayou D'Arbonne and the Ouachita River within the refuges are components of the Louisiana Natural and Scenic Rivers System, and both have been hydrologically affected by dams upstream and downstream. None of the streams within either refuge have been systematically surveyed for mussels. The objectives of this study were to document which freshwater mussel species inhabit the refuges, determine a rough estimate of abundance, and locate and map the mussel assemblages (beds) in Bayou D'Arbonne and the Ouachita River. During September through November 2016, surveys for 7 stream miles of Bayou D'Arbonne and 21.8 river miles of the Ouachita River were conducted by diving using timed searches. Three field days were spent examining 31 sites on Bayou D'Arbonne yielding 10 unionid species that were present in low numbers. Ten field days were utilized to examine 157 dive sites on the Ouachita River revealing 29 unionid taxa and numerous expansive, high-density mussel assemblages.

Platform 75 **4:40 p.m.** **March 28, 2017**	**EFFECTS OF CLIMATE, LAND USE AND STREAM HABIAT CHANGES ON APPALACHIAN ELKTOE *(ALASMIDONTA RAVENELIANA*) POPULATIONS IN THE NOLICHUKCY RIVER.** Gary Pandolfi[1,3], Jason Mays[2] and Michael M. Gangloff[3]. [1]U.S. Fish and Wildlife Service Ecological Service Field Office 10711 Burnet Road, Suite 200 Austin, TX 78758. [2]U.S. Fish and Wildlife Service Ecological Services Field Office 160 Zillicoa Street Asheville, NC 28801. [3]Appalachian State University Biology Department 572 Rivers Street Boone, NC 28608

Although effects of recent human population growth and concurrent urbanization of stream catchments across much of the southeastern USA are well-documented, relatively few studies have examined how landuse change, including ex-urban development, influence habitats of sensitive mountain stream biota. The Appalachian elktoe (*Alasmidonta raveneliana*) is endemic to upper Tennessee River drainage streams draining the Blue Ridge Physiographic Province in North Carolina and Tennessee. Populations of this federally-endangered mussel have declined across parts of its highly-restricted range during the past three decades, but few parsimonious mechanisms have been proposed to explain its near complete extirpation from several former strongholds. Research suggests that Appalachian elktoe are extremely sensitive to subtle environmental changes. Further, Appalachian elktoe appear to be a headwater specialist and occur near what appears to be the upstream limits for bivalves in many Blue Ridge streams. The Nolichucky River Drainage supports Appalachian elktoe populations that vary in abundance by several orders of magnitude (range: 1-217 mussels per site). They were likely present historically at all of our study sites, Appalachian elktoe were only detected at 12 of 25 sites surveyed. Models found that Appalachian elktoe populations were more likely to be detected at sites with more forested watersheds and intact riparian zones as well as sites with relatively coarse substrates compared to sites located in watersheds with less forest cover and more instream fine sediments. Though there were few significant relationships between forest cover and in-stream physical habitat parameters these data along with reasonably-well documented and fairly dramatic shifts in the range and abundance of this mussel suggest that it is capable of undergoing both rapid population increases as well as declines. Conservation of Appalachian elktoe populations in the Nolichucky watershed should focus on protecting forest cover in occupied watersheds and mitigating impacts to riparian zones that may increase sedimentation. gary_pandolfi@fws.gov

PLATFORM SESSION ABSTRACTS

SESSION 17	Ecology III Tuesday, March 28, 2017 | 3:40 – 5:00 p.m.
Platform 76 **3:40 p.m.** **March 28, 2017**	**DETERMINING THERMAL TOLERANCES OF FRESHWATER MUSSELS IN TEXAS.** Jennifer N. Morton[1], Clint Robertson[2], and Charles R. Randklev[1]. [1]Department of Wildlife and Fisheries Science, Texas A&M University, College Station, TX 77843; [2]Texas Parks and Wildlife, Inland Fisheries Division, San Marcos, Texas 78667. **STUDENT SPEAKER*

Freshwater mussels are among the most imperiled groups of aquatic organisms in North America largely due to anthropogenic impacts, such as altered temperature regimes. Detailed knowledge on lethal temperatures for freshwater mussels has been limited to only 14 species, which is less than 5% of the species known to occur in North America, and nothing is known about thermal tolerances of Texas mussel species. This lack of information is problematic because climate change coupled with increasing human water demand is expected to increase the frequency and intensity of droughts in Texas, which may negatively impact threatened mussel populations. To determine the effects of elevated water temperature on Texas mussels, we tested the upper thermal temperature tolerances of 3 freshwater mussel species (*Fusconaia mitchelli*, *Cyrtonaias tampicoensis,* and *Amblema plicata*). Behavioral response and survival were monitored for mussels acclimated to 3 temperatures (23, 27, or 30°C) across a range of experimental temperatures (26°C-45°C) during acute 96-h laboratory experiments. Preliminary results indicate that *F. mitchelli* and *C. tampicoensis* have lower LT50s (the temperature that causes mortality in 50% of the population) and thus are more thermally sensitive, while *A. plicata* is more thermally tolerant. These results indicate that *F. mitchelli* and *C. tampicoensis* might be at risk from elevated water temperatures, especially during drought. To mitigate the impact, agencies responsible for managing freshwater resources should consider thermal tolerances of mussels when making and implementing environmental flow recommendations. jennifer.morton@ag.tamu.edu

Platform 77 **4:00 p.m.** **March 28, 2017**	**THE RELATIONSHIP BETWEEN MESOHABITAT STRUCTURE AND MUSSEL COMMUNITIES IN EAST TEXAS RIVERS.** Andrew R. Glen[1], Lance Williams[1], and Neil B. Ford[1]. [1] Department of Biology, University of Texas at Tyler, Tyler, Texas 75703 **STUDENT SPEAKER*

North America is home to 302 unionoid species, with approximately 53 occurring in Texas, and they are considered the second most imperiled group of organisms. Several hypotheses have been proposed to explain the spatial distribution of mussels within a stream reach, but only certain hydraulic characteristics appear to be correlated with their distribution. Emerging evidence indicates that freshwater mussels may use flow refugia to remain embedded during high flow events. As the use of hydraulic variables to characterize mussel habitat becomes more widespread, it may be useful to implement sampling that captures these measures. One option may be a Basin Visual Estimation Technique (BVET) that utilizes classification by riffles, pools, and runs. We sampled populations of freshwater mussels using this three-tiered sampling scheme in order to investigate habitat associations. We sampled 31 sites along the upper Neches River in Texas through excavating 0.25m2 quadrats for mussels and the collection of site specific environmental data at the same location. Three-way log-linear contingency tables were developed and analyzed using a $\chi 2$ test to elucidate if associations between species, environmental characteristics, and mesohabitats were occurring. The results suggest that numerous species do associate with mesohabitats and are associated with certain environmental characteristics and areas of low shear stress. For example, the Louisiana Pigtoe (Pleurobema riddellii) was found to associate with run habitats that contain gravel substrate as the subdominant substrate. We feel that implementing sampling protocols that use classification by mesohabitats may help managers determine habitat associations for a wide array of freshwater mussels. Aglen@patriots.uttyler.edu

Platform 78 **4:20 p.m.** **March 28, 2017**	**CO-OCCURRENCE AND DISPERSION PATTERN OF MUSSEL SPECIES WITHIN BEDS.** Kathryn Murphy[1], Caryn Vaughn[1], Daniel Hornbach[2]. [1]Oklahoma Biological Survey and Department of Biology, University of Oklahoma, Norman, OK 73019. [2]Department of Biology, Macalester College, St. Paul, Minnesota 55105 **STUDENT SPEAKER*
To aid in the conservation of freshwater mussels (Bivalvia, Unionidae), a better understanding of mussel bed formation and composition is needed. Facilitation, a positive interaction between species that results in a benefit to both parties, is often an important mechanism underlying the organization of sessile organisms. We hypothesized that facilitation between sessile mussel species may be an underlying mechanism of mussel bed formation. To test this hypothesis, we semi-quantitatively sampled 42 mussel beds and quantitatively sampled 12 large mussel beds in the Little River in southeastern Oklahoma. We also obtained quantitative survey data from an additional 9 beds in east central Minnesota. We are analyzing these data to look for patterns of co-occurrence and association that might indicate underlying species interactions. These analyses include checkerboard scores, which determines how random species are distributed using a presence-absence matrix, as well as how nested the species are within the river.	
Platform 79 **4:40 p.m.** **March 28, 2017**	**EVALUATING BURROWING BEHAVIOR WITHIN COMMUNITIES OF FRESHWATER MUSSELS.** Brian C. van Ee and Carla L. Atkinson. Department of Biological Sciences, University of Alabama, Tuscaloosa, AL 35487. **STUDENT SPEAKER*
Freshwater mussels (family Unionidae) have been previously demonstrated to fill integral functional roles within many stream ecosystems. By exhibiting bottom-up controls on stream communities through increased nutrient sequestration in channel sediments, unionids enhance benthic productivity and biodiversity. Freshwater mussels accomplish this by filter-feeding from channel water and excreting waste products that frequently become trapped in the benthos, creating nutrient hotspots and habitat heterogeneity. While many unionids seem to primarily inhabit the interface between channel water and benthic sediments, a significant portion of the community can be completely buried within the sediment. Our objective was to quantify the proportion of the unionid community at the water-sediment interface vs. those that were completely buried, as well as determine potential drivers behind this behavior. We conducted quantitative surveys at 14 sites, collecting species and length information on mussels at the surface of the sediment and buried in the sediment, and an array of environmental variables (e.g. water velocity, sediment type, pore water chemistry, hyporheic connectivity). There appear to be significant relationships between burying behavior and life stage, with smaller individuals being much more likely to be found completely buried. Burying behavior also varied significantly between species, some are found most often at the surface while other species are most often buried. Further work needs to be done to clarify the underlying drivers for this behavior, though from our findings the most likely explanation would be shelter from dislodgement. Understanding burrowing behavior is vital to understanding the ecological role of unionids, as well as improving methods for detection and conservation.	

PLATFORM SESSION ABSTRACTS

SESSION 18	Genetics and Phylogeny I Tuesday, March 28, 2017 | 3:40 – 5:00 p.m.
Platform 80 **3:40 p.m.** **March 28, 2017**	**INVESTIGATION OF GENE EXPRESSION IN WILD AND CAPTIVE FRESHWATER MUSSELS.** Ieva Roznere[1], Brandon T. Sinn[2], Marymegan Daly[1], and G. Thomas Watters[1]. [1]Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, OH 43210; [2]New York Botanical Garden, Bronx, NY 10458.

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 the current study is to investigate whether the stress of relocation into captivity affects gene expression in adult freshwater mussels using next generation sequencing methods. Individuals of the species *Pyganodon grandis* were collected from the Muskingum River in Washington Co., OH, in September 2014 and brought into captivity inside the Freshwater Mussel Conservation and Research Center in Powell, OH. Gill tissue samples (<30 mg) were collected in August 2015 from eight mussels relocated into captivity and eight undisturbed mussels in the Muskingum River. RNA was extracted using an RNeasy Kit (Qiagen) and all samples had a R.I.N. value of at least 7.5. Sequencing was done using 100 bp paired-end reads on the Illumina HiSeq 2000 and *de novo* assembly of reads was performed using Trinity. Differential gene expression between undisturbed and captive mussels will further our understanding of the physiological effects of relocation into captivity. Focus will be given on the potential of transcriptomics to improve freshwater mussel conservation techniques.

Platform 81 **4:00 p.m.** **March 28, 2017**	**ASSESSING THE CONTRIBUTIONS OF SPERM AND GLOCHIDIA TO GENE FLOW IN FRESHWATER MUSSELS (BIVALVIA: UNIONIDAE).** Jer Pin Chong[1] and Kevin J. Roe[2]. [1]Department of Biological Sciences, 845 West Taylor Street, (MC 066) Chicago, IL 60607-7104; [2]Department of Natural Resource Ecology and Management, Iowa State University, 339 Science II, Ames, Iowa, USA 50011

Gene flow among populations can occur at different life stages through dispersal of gametes, zygotes, and adult progeny. Contributions to gene flow from different life stages are an under-studied research topic in animals that lack internal fertilization. We present an approach, first utilized in to estimate pollen-mediated gene flow in plants, to estimate gamete-mediated gene flow (sperm dispersal) relative to zygote-mediated gene flow (glochidia dispersal) in freshwater mussels. Using both maternally inherited and nuclear genetic markers, we tested our approach using multiple populations of three freshwater mussel species *Leptodea leptodon*, *Le. fragilis*, and *Lampsilis abrupta*. Our results indicate that in many of the comparisons in these three species, sperm gene flow is equal to or exceeded glochidia gene flow. In particular, sperm gene flow seems to dominate glochidia gene flow between populations that were separated by greater distances. Glochidia gene flow did exceed sperm gene flow for populations that were separated by shorter distances. For conservation management purposes, i.e., to determine where to establish newly translocated populations in a river to maintain sufficient gene flow with the extant populations, it would be crucial to include estimates of both sperm and larval gene flow to overall estimates of gene flow among populations. We hope that our study serves the purpose of initiating additional studies investigating the contributions of sperm gene flow in maintaining population connectivity in aquatic animals.

Platform 82 **4:20 p.m.** **March 28, 2017**	**GENETIC DIVERSITY, POPULATION STRUCTURE, AND COLONIZATION HISTORY OF THE EASTERN PONDMUSSEL, *LIGUMIA NASUTA*, IN THE GREAT LAKES REGION.** Mariah W. Scott[1]*, Todd J. Morris[2], David T. Zanatta[3]. [1,3] Central Michigan University, [2]Fisheries and Oceans Canada **STUDENT SPEAKER*

The freshwater mussel *Ligumia nasuta* has an expansive distribution from the Atlantic slope to the Great Lakes regions of eastern North America. *Ligumia nasuta* dispersed into the Great Lakes region, following the retreat of Wisconsinan glaciation. While many of the known populations appear to have followed natural colonization routes (e.g., via stream capture events or natural host fish dispersal), some in northern Michigan and western New York are hypothesized to be the result of anthropogenic introductions (e.g., stocking host fish). Over the last few decades, this species has declined in abundance and distribution, resulting from infestation by invasive dreissenid mussels and changes in habitat. As a result, the species is considered imperiled across large portions of its distribution, especially in the Great Lakes region. In this study, the genetic diversity and structure of the remnant populations in the Great Lakes region were assessed using newly developed microsatellite DNA loci for *L. nasuta*. The understanding of the genetic diversity and structure of remaining populations can inform future management projects, examine the colonization history of the species, and determine if the remnant populations have experienced a genetic bottleneck or founder effect. Emphasizing the Great Lakes region, samples from 57 sites in 24 sampled waterbodies across the range of *L. nasuta* (n=429) were included. Across the distribution of *L. nasuta*, genetic diversity indices were calculated, the significance of genetic differentiation within and among sampling locations was tested, and the pattern of population structure was estimated. Mantel tests of isolation by water, road, and Euclidean distances between populations were used to assess the likelihood of natural or anthropogenic colonization history. Also, analyses of genetic diversity were used to test if past genetic bottlenecks or strong founder effects had occurred. This study deepens our understanding of the genetic past and present of this imperiled species. scott2mw@cmich.edu

Platform 83 **4:40 p.m.** **March 28, 2017**	**CONSERVATION GENETICS OF NORTH AMERICAN *MARGARITIFERA MARGARITIFERA.*** David T. Zanatta[1], Bernhard Stoeckle[2], Juergen Geist[2], Kentaro Inoue[3], Ralph Kuehn[4], Annie Paquet[5], André L. Martel[6]. [1]Department of Biology, Central Michigan University, Mount Pleasant, MI 48859 USA; [2]Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technical University of Munich, D-85354 Freising, Germany; [3]Institute of Renewable Natural Resources, Texas A&M University, College Station, TX 77843 USA; [4]Unit of Molecular Zoology, Chair of Zoology, Department of Ecology and Ecosystem Management, Technical University of Munich, D-85354 Freising, Germany; [5]Ministère des Forêts, de la Faune et des Parcs, Québec, QC G1S 4X4 Canada; [6]Malacology Unit, Research and Collections, Canadian Museum of Nature, Ottawa, ON, K1P 6P4, Canada.

Understanding the current genetic diversity and population genetic structure of imperiled species is necessary in order to characterize and evaluate population performance and persistence, which can guide management decisions. *Margaritifera margaritifera* (freshwater pearl mussel) occurs across western Russia, north and central Europe (EU), and Atlantic drainages of northeastern North America (NA). Because of severe declines in many European populations, the IUCN has listed *M. margaritifera* as Endangered, conversely NA populations are thought to be relatively secure. As such, the population genetics of *M. margaritifera* occurring in European rivers is relatively well studied while the population genetic structure of NA populations is not known. In this study, we investigated the genetic diversity and differentiation of 17 *M. margaritifera* populations (435 individuals) from drainages of the Atlantic Ocean and the Gulf of Saint Lawrence in Canada and the U.S.A. Genetic diversity of NA populations calculated from nine microsatellite loci was relatively high. Mean allelic richness ranged from 4.3 to 5.7 alleles per locus, mean observed heterozygosity ranged from 0.40 to 0.58, and mean expected heterozygosity ranged from 0.47 to 0.60. Mean subpopulation differentiation (F_{ST}) within NA populations was 0.031. Cluster analysis using STRUCTURE showed that a single panmictic population within North America was most probable. In contrast to most European populations, NA populations have a lower genetic differentiation and a greater diversity, indicative of fewer recent genetic bottlenecks and drift effects. Such information is essential for further evaluating the conservation status of North American *M. margaritifera*. Conservation efforts should incorporate knowledge gained from population genetic studies in order to successfully maintain genetic variation and ensure the evolutionary potential of imperiled species. zanat1d@cmich.edu

PLATFORM SESSION ABSTRACTS

SESSION 19	Threats I Wednesday, March 29, 2017 | 8:20 – 10:00 a.m.
Platform 84 **8:20 a.m.** **March 29, 2017**	**PRELIMINARY ASSESSMENT OF PARASITES IN ALIEN AND NATIVE FRESHWATER MUSSELS IN EUROPE.** Jouni Taskinen[1], Wojciech Andrzejewski[2], Nicoletta Riccardi[3], Maria Urbanska[4]. [1] University of Jyväskylä, Finland. [2] Poznan University of Life Sciences, Poland. [3] Institute of Ecosystem Study, National Research Council, 28922 Verbania-Pallanza, Italy.

Parasites can determine the outcome of the competition between invasive and native species. Invader establishment can be facilitated from the co-introduction of its parasites, if those parasites subsequently infect native species reducing their competitive or predatory impact on the invader (Novel Weapon Hypothesis). Introduced species must also face with native parasites for which they can act as competent hosts. Invasive bivalves are rapidly spreading to almost all European countries causing a remarkable decline of already threatened freshwater native mussel species. It is mainly under stress conditions, such as those increasingly impacting freshwater habitats, that invasive bivalves can become a serious competitor of native mussels. Increased parasite densities are associated with reduced mussel reproductive output and physiological condition. Physiologically compromised mussels are more likely to be susceptible to other stressors, like the impact of invasive bivalves. In Europe three highly impacting invasive mussel species (*Corbicula fluminea, Sinanodonta woodiana, Dreissena polymorpha*) are spreading. The present study aimed at assessing the occurrence of parasites and the frequency of shared parasites in invasive and native bivalve species in Northern (Poland) and Southern (Italy) Europe. The prevalence of parasites in coexisting European native mussels (*Unio elongatulus, U. tumidus, U. pictorum, Anodonta cygnea* and *A. anatina*) and invasive species (*Sinanodonta woodiana, Corbicula fluminea, Dreissena polymorpha*). 30 specimens per each mussel species in each site were dissected to detect the presence and quantify the number of parasites stages (eggs, larvae, adults) in the different animal organs (gonad, digestive gland, palps, gills, mantle). The following parasites were detected and counted: trematodes (*Rhypidocotyle campanula, R. fennica, Bucephalus polymorphus, Aspidogaster conchicola*), oligochaetes (*Chaetogaste*r sp.) water mites (*Unionicola* spp.), bitterlings (*Rhodeo* spp.). Native species showed the highest parasite prevalence – while invasive alien species showed a lower to null prevalence - in both in Italian and polish water bodies. urbanska@up.poznan.pl

Platform 85 **8:40 a.m.** **March 29, 2017**	**FACULTATIVE PARASITIC CILIATED PROTOZOA INFLUENCES GLOCHIDIA VIABILITY OF FRESHWATER MUSSELS.** Ryan Prosser[1], Joseph Salerno[2], Jim Bennet[1], Denis Lyne[3], and Patty Gillis[1]. [1] Aquatic Contaminants Research Division, Environment and Climate Change Canada, Burlington, ON, Canada; [2] School of Environmental Sciences, Guelph, ON; [3] Department of Zoology, University of British Columbia, Vancouver, BC, Canada

A number of studies have documented species of ciliated protozoa residing in the mantle cavity of freshwater mussels (e.g., *Conchophthirus* sp., *Trichodina* sp.). Ciliated protozoa have even been found living in the gill water tubes of mussels (*Conchophthirus acuminatus*). These previous studies have described the relationship between the ciliated protozoa and mussels as mainly commensal. When performing toxicity tests with the glochidia from fatmucket mussel (*Lampsilis siliquoidea*) from Missouri, we observed the presence of a ciliated protozoan. These mussels were cultured in the laboratory and then moved to a pond as juveniles to develop into adults. The presences of protozoa seemed to coincide with a rapid decrease in the viability of glochidia (i.e., ≤ 24 h). A series of experiments were performed to determine whether the presence of the protozoan was the cause of the decline in glochidia viability. Glochidia were removed from the cultured fatmucket mussels, and plain pocketbook (*Lampsilis cardium*) and wavy-rayed lampmussel (*Lampsilis fasciola*) mussels collected from the wild in Ontario, Canada. The glochidia were examined under the microscope for the presence of the protozoa. The protozoa were only observed in the glochidia of fatmucket mussels. The glochidia of the three species had a viability of > 90% at 0 h. Pocketbook and wavy-rayed lampmussel glochidia were infected with protozoa from the fatmucket glochidia. The mean viability of pocketbook and wavy-rayed lampmussel glochidia not infected remained ≥ 89% after 72 h of incubation. The mean viability of fatmucket, pocketbook, and wavy-rayed lampmussel glochidia infected with protozoa declined to 17.9, 4.1, and 9.6%, respectively, after 72 h. The cell density of protozoa with the infected glochidia increased significantly over ~48 h of incubation and then declined as the viability of glochidia decreased below ~25%. Initial analysis of the protozoan DNA indicates that the protozoa belong to the genus *Tetrahymena*.

Platform 86 **9:00 a.m.** **March 29, 2017**	**IDENTIFYING RELATIONSHIPS BETWEEN ENVIRONMENTAL STRESSORS AND SPATIAL AND TEMPORAL TRENDS OF FRESHWATER MUSSEL AND FISH ASSEMBLAGES IN THE POWELL RIVER, VIRGINIA.** Serena Ciparis[1,2] and Susan Lingenfelser[1]. [1]U.S. Fish and Wildlife Service, Gloucester, VA. [2]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA.

The Powell River (Virginia and Tennessee, USA) supports several threatened and endangered species of freshwater mussels and fishes. Coal mining in the Powell River watershed began in the 1800s. Surface mining increased in intensity in the 1980s; active surface mining permits currently occupy 38% of the upper watershed. Temporal changes in freshwater mussel assemblages have been documented, but data have not been extensively compared between studies or with other taxa. The objectives of this study were to evaluate spatial and temporal trends in recent (2000-2013) and historic (1899-1999) freshwater mussel and fish data and to relate these trends to water quality measurements and the prevalence of surface mining. Upper reaches of the river currently have far fewer freshwater mussel species than were observed in the earliest surveys (1899-1913). A significant negative relationship between number of species observed and river km was first observed in the 1970s and this trend has persisted. Quantitative and qualitative data from multiple studies at specific sites indicate declining mussel densities and species numbers as early as the 1970s and 1980s, which corresponds to initial elevation of major ion concentrations (relative to 1949), extremely high iron concentrations, and observed blackwater events and mussel die-offs. Fish assemblage data from both recent and historic collections also demonstrate significant negative relationships between river km and metrics such as percent darters and percent intolerant species. Impaired fish communities were first observed in the Powell River in the 1960s, with complete extirpation of certain species occurring in the late 1970s. Major ion concentrations in the Powell River doubled between 1949 and 1978 and doubled again by 2006. However, whether these concentrations cause changes in freshwater mussel and fish assemblages or contribute to persistence of changes that occurred over 30 years ago is unclear and will be discussed.

Platform 87 **9:20 a.m.** **March 29, 2017**	**WARMING TEMPERATURES LEAD TO RESPIRATORY STRESS AND BROOD EXPULSION BY GRAVID MUSSELS.** Rebecca Tucker and, Jim Stoeckel. Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, AL 36849 **STUDENT SPEAKER*

Events that lead to thermal stress, such as climate change and altered flow regimes, represent a potential treat to mussel populations that are already in decline. Increasing temperatures can cause unionid mussels to reduce mantle lure display and prematurely release their brood. We examined the effects of increasing temperatures and declining dissolved oxygen on brood expulsion of gravid *Ligumia subrostrata* and hypothesized that brood expulsion is correlated with a decreasing ability to regulate oxygen consumption, and an increase in critical dissolved oxygen concentration (DO_{crit}) as temperatures rise. We used a closed respirometry system to measure respiration rates of gravid *Ligumia subrostrata* at five temperatures (13, 18, 23, 25, 28°C) as oxygen levels declined from 6.5 to < 1 mg O_2 / L. Supporting our hypothesis, ability to regulate oxygen consumption decreased, and DO_{crit} increased with increasing temperature. Brood expulsion during periods of steadily declining oxygen was negligible at lower (13-18°C) temperatures but increased to expulsion of 5-30% of brooded glochidia at warmer (23-28°C) temperatures. Results suggest that higher temperatures during the brooding season put mussels at increasing risk of pre-mature brood expulsion due to increased respiratory stress. Standard closed respirometry assays that identify species-specific temperature thresholds beyond which oxygen regulation declines and DO_{crit} increases are a useful approach to determining thermal constraints of freshwater mussel populations. rlt0012@auburn.edu

Platform 88 9:40 a.m. March 29, 2017	**A FIELD EXPERIMENT TO ASSESS CAUSES OF MUSSEL DECLINES.** Wendell Haag[1], Jacob Culp[2], Monte McGregor[3], Robert Bringolf[4], James Stoeckel[5]. [1]US Forest Service, Southern Research Station, Center for Bottomland Hardwoods Research, Frankfort, KY 40601; [2]Kentucky Division of Water, Frankfort, KY 40601; [3]Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY 40601; [4]University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA 30602; [5]Auburn University, School of Fisheries, Aquaculture, and Aquatic Sciences, Auburn, AL 36849.

Mussels have disappeared from many streams that lack obvious, point-source impacts. We conducted a field experiment using in situ exposures of laboratory-reared juvenile *Lampsilis cardium* to assess potential causes of these enigmatic declines. We chose 23 streams in Kentucky ranging from streams that continue to support diverse mussel assemblages to those that have lost their mussel faunas almost entirely. We placed juvenile mussels (mean initial length = 6.4 mm) in each stream in silos and sediment cages (n=5/stream for each type) in May, 2015 and retrieved them in September after a 12-week exposure period. All mussels were propagated on fish (in vivo), but at a subset of sites we deployed additional silos and cages containing in vitro-propagated juveniles. We also collected detailed water quality data monthly at each site. Survival was high in silos at most sites (mean = 90%, range = 44-100) but was lower and more variable in cages (mean = 65%, range = 1-99). Growth in silos was lowest at all seven sites that have lost their mussel faunas (mean increase in length = 1.3 mm, range = 0.5-2.6). Growth was variable, but higher at sites that continue to support mussels (mean increase = 10.6 mm, range = 5.5-18.4). Growth in cages showed a similar pattern, but growth was 22% lower overall in cages. Survival and growth did not differ between in vivo- and in vitro-propagated individuals. Growth was positively related to natural watershed characteristics including alkalinity, productivity, and water temperature. Growth was negatively associated with human-influenced factors including nitrates/nitrites, pesticides, and barium. In addition, all seven sites with low growth have extensive karst influence, suggesting that groundwater contamination may be a contributing factor. These results show that growth inhibition may be a mechanism for mussel declines, and associations with water quality variables suggest potential causes.

PLATFORM SESSION ABSTRACTS

SESSION 20	SPECIAL SESSION: Mussel Habitat: From Computer Models to In-Stream Applications I Wednesday, March 29, 2017 | 8:20 – 10:00 a.m.
Platform 89 **8:20 a.m.** **March 29, 2017**	**GAPS IN CONSERVATION OF FRESHWATER MUSSEL BIODIVERSITY IN EAST TEXAS.** Ashley D. Walters[1], Gina M. Cerbie[1], Madelyn A. Brown[1], Neil B. Ford[2], & David J. Berg[3]. [1]Department of Biology, Miami University, Oxford, OH 45056; [2]Department of Biology, University of Texas at Tyler, Tyler, TX 75799; [3]Department of Biology, Miami University, Hamilton, OH 45011.

Texas contains a high diversity of freshwater mussels belonging to the family Unionidae, with the greatest portion in the eastern part of the state. However due to increasing population size and water demands, east Texas rivers are threatened with habitat alteration as a result of reservoir development. In order to identify areas of high mussel biodiversity, we incorporated regional abiotic data and species occurrence localities into a geographic information system framework, and used the ecological niche modeling software MAXENT to identify areas of high habitat suitability for 29 mussel species throughout the eastern part of the state. Because host fishes are important biological determinants of mussel distributions, we also used MAXENT to predict areas of suitable habitat for 85 fish species belonging to 18 families. We identified areas of predicted high biodiversity for both taxa and examined the relationship between reaches of high habitat suitability between fishes and mussels. We used this information to identify areas of high predicted biodiversity located in protected areas. Our results indicate overlap of potential suitable habitat for mussel and fish species in the upper Neches River. The Big Thicket National Preserve contains the highest quality habitat for the greatest number of species for both taxa. The preserve is surrounded by bottomland hardwood forests mostly unaltered by anthropogenic activities, making it suitable habitat for multiple unionid species. Our results also indicate that a large percentage of potential suitable habitat is unprotected, with a majority occurring on private lands. Because these additional areas are predicted to be suitable habitat for both unionid and fish species, they should be the focus of management and conservation efforts in order to protect large aggregations of aquatic diversity. Our results serve as a model for efforts seeking to create conservation strategies and prioritize areas for protection of imperiled aquatic fauna.

Platform 90 is Canceled

Platform 91 **8:40 a.m.** **March 29, 2017**	**JOINT SPECIES MODELS REVEAL THE EFFECTS OF ENVIRONMENT ON COMMUNITY ASSEMBLAGE OF FRESHWATER MUSSELS AND FISHES IN EUROPEAN RIVERS.** Kentaro Inoue[1], Katharina Stoeckl[2], Juergen Geist[2]. . [1]Institute of Renewable Natural Resources, Texas A&M University, College Station, TX 77843, [2] Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technical University of Munich, Freising, Germany.

Given that riverine systems exhibit longitudinal environmental gradients from headwater to the mouth of a river, habitat heterogeneity is a major driver of spatial variation in community composition among riverine localities. As freshwater ecosystems are amongst the most endangered ecosystems in the world, community-based conservation and multiple-species management are necessary to maximize conservation efficiency and maintain ecosystem integrity. We used joint species distribution models (JSDMs) to investigate the relative importance of abiotic and biotic factors that are responsible for the distribution and co-occurrence of freshwater mussels and fishes in central and northern European rivers. We examined the general patterns of species assemblage of two endangered mussel species (*Margaritifera margaritifera* and *Unio crassus*) and their associated fish communities. We examined the patterns of positive or negative co-occurrence in mussel and fish species, and identified shared abiotic responses between mussel-host pairs. We found that the relative importance of abiotic and residual factors and patterns of significant species correlations varied among taxa: significant residual correlations were prevalent among fish species, whereas mussel occurrences were exclusively explained by abiotic factors. Mussels and their fish-hosts generally had shared abiotic responses with some mismatched responses between mussel-host pairs. Given that the composition of communities were tightly linked with abiotic factors and residual correlations, the results have significant implications for the conservation and restoration of aquatic communities. This study highlights the advantage of simultaneously considering environmental factors and species co-occurrences in the modeling of species distributions and assemblages of riverine communities. Such a holistic community conservation approach can reveal ecological similarities and differences among species, which can help avoid conflicts among species-oriented conservation plans. kentaro.inoue@ag.tamu.edu

Platform 92 9:00 a.m. March 29, 2017	**USING HYDROGEOMORPHIC VARIABLES FOR HABITAT MODELING OF UNIONID MUSSEL CONCENTRATIONS IN MISSOURI OZARK RIVERS.** Garth A. Lindner[1], Kayla Key[1], Amanda Rosenberger[2]. [1] Missouri Cooperative Fish and Wildlife Research Unit; School of Natural Resources, University of Missouri, Columbia, MO 65211. [2]U.S. Geological Survey, Missouri Cooperative Fish and Wildlife Research Unit; School of Natural Resources, University of Missouri, Columbia MO 65211.
The Meramec River watershed (>2,000 square miles), located in the northeastern Ozark region of Missouri, has an extraordinarily diverse mussel fauna for the Midwestern United States. This system is an ideal location for understanding the physical features of the river environment that foster the establishment of mussels and dense aggregations of individuals (i.e., mussel beds). Work that establishes a better understanding of the fundamental needs of mussel communities will eliminate large portions of the river fundamentally unsuitable for mussel establishment from investigations into drivers of mussel declines (e.g., poor water quality). Previous work on mussels have increased focus on hydrogeomorphological features of rivers as the primary determinant of mussel distributions and the establishment of mussel beds. Quantitative measures of these features at the watershed scale, however, pose a particular challenge for physical scientists collaborating with mussel biologists, who require a watershed perspective for conservation and management purposes. The objective of this research therefore is to derive in-channel hydrogeomorphic variables relevant to mussel establishment and persistence for models delineating fundamentally suitable habitat. We use publically available, remotely sensed datasets to characterize channel hydraulics, hydrology, and fluvial processes we hypothesize are required to support diverse aggregations of mussels. In total, six input layers were derived from repeat aerial imagery and high-resolution LiDAR datasets. These layers represent 1) channel bank stability, 2) channel bed stability, 3) gravel bar persistence, 4) low water availability, 5) bluff proximity, and 6) relative stream power. We will describe the process of generating these layers to characterize the hydrogeomorphic properties of the Meramec River. These layers represent essential data for a fundamental niche model that delineates suitable and unsuitable reaches for mussels along the Meramec River (separate presentation by Key et al. in this symposium).	
Platform 93 9:20 a.m. March 29, 2017	**A HIERARCHICAL APPROACH TO MUSSEL CONSERVATION: FROM NICHE MODELING TO FIELD MONITORING.** Kayla Key[1], Garth Lindner[1], Amanda Rosenberger[2], and Kristen Bouska[3]. [1]Missouri Fish and Wildlife Cooperative Research Unit, University of Missouri, Columbia; [2]U.S. Geological Survey, Missouri Fish and Wildlife Cooperative Research Unit, University of Missouri, Columbia; [3]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, LaCross, WI **STUDENT SPEAKER*
State-wide mussel surveys have documented declines in mussel diversity in the Ozark region, including the Meramec River basin, a hotspot of mussel diversity in Missouri and the Midwestern United States. Pinpointing causes of these declines and where threats cause the most risk to populations is an ongoing challenge for management. We aim to develop a spatial assessment of the status and risks to species-rich concentrations of mussel assemblages in the Meramec River Drainage. To initiate this process, we first narrow down fundamental characteristics of habitat that support the establishment of dense mussel assemblages (mussel beds) with high species richness. Given our focus on minimum factors required for mussel bed establishment, we use niche modeling to delineate reaches that meet these requirements and to build a sampling design to investigate threats to mussel species richness. We present the outcome of this model and its validation using historical and existing datasets. The results of this project will improve our basic understanding of the habitat needs of freshwater mussels and the mechanisms leading to their decline, providing key information to guide state-wide mussel conservation.	

PLATFORM SESSION ABSTRACTS

SESSION 21	Conservation IV Wednesday, March 29, 2017 | 8:20 – 10:00 a.m.
Platform 94 **8:20 a.m.** **March 29, 2017**	***UNIO CRASSUS* (PHILIPSSON, 1788), ANOTHER HIGHLY ENDANGERED FRESHWATER MUSSEL SPECIES IN LUXEMBOURG (EUROPE). HOW CAN WE SAVE THE LAST REMAINING POPULATIONS?** Frankie Thielen, Karin Michels, Sonja Heumann, Michel Frisch, Tanja Eybe, Alexandra Arendt. natur & ëmwelt / Fondation Hëllef fir d'Natur, Kierchesstross 2, L-9753 Heinerscheid, Luxembourg,

The thick shelled river mussel *Unio crassus* is like many other freshwater mussel species highly endangered. *Unio crassus* used to be a very common freshwater mussel species throughout Europe and can be found in small ditches as well as in larger streams. In Luxembourg it used to be present in almost all water courses, but meanwhile only two populations remained in the rivers Our and Sauer. Since 2013 the NGO natur & ëmwelt runs a EU co-financed LIFE Nature project for the protection of the two last *Unio crassus* populations in the low mountain range of the Luxembourg Ardennes. The project involves habitat restoration measures, artificial breeding, species and habitat monitoring as well as raising public awareness for these ecological important species. Concrete restoration measures to improve the water quality and river connectivity were done and will be presented. The monitoring of water quality parameters showed that there is still a diffuse input of nutrients into the river systems analyzed. Different observations showed, that the Eurasian minnow (*Phoxinus phoxinus*) is the best host fish to use in the artificial breeding program. It was possible to raise several hundreds of mussels but the production of larger numbers (>2000) still needs to be improved. The release of juvenile mussel in small gravel cages showed so far promising results. A short overview of the public awareness activities is given. The outcome of the project so far, gives us the direction for future work, but it also shows that we urgently need to reduce the intensive use of the land in the catchments, to preserve our freshwater mussel species for the future generations. f.thielen@naturemwelt.lu

Platform 95 **8:40 a.m.** **March 29, 2017**	**PROVIDING AGENCIES WITH THE SCIENCE REQUIRED FOR MANAGEMENT: A CASE STUDY OF AN IMPERILED FRESHWATER MUSSEL IN NEW MEXICO.** David J. Berg[1], Debra Hill[2], and Daniel A. Trujillo[3]. [1]Department of Biology, Miami University, Hamilton, OH 45011, [2]Ecological Services Office, US Fish and Wildlife Service, Albuquerque, NM 87113, [3]New Mexico Department of Game and Fish, Santa Fe, NM 87507

Managing imperiled species is a complex task that requires cooperation among multiple organizations. The US Endangered Species Act (ESA) contains key features that are designed to ensure successful conservation and recovery of listed species, while also containing mechanisms protecting imperiled species before they are listed. Among these are recovery and delisting as a goal (Section 2), protection of candidate species to forestall listing (Section 10), decisions to be based on best scientific and commercial data (Section 4), and promotion of cooperation between the US Fish and Wildlife Service and state wildlife agencies (Section 6). The Texas hornshell (*Popenaias popeii*), a candidate for listing under the ESA, is a case study of such interactions between a research organization (Miami University), a state conservation agency (New Mexico Department of Game and Fish), and a federal agency (US Fish and Wildlife Service). As the first of three talks, we describe the research that informs conservation efforts of this species. The largest population occurs in the Black River of New Mexico and contains ~50,000 individuals. While population size has been relatively stable for the past 15+ years, population growth rate is positively correlated with river discharge. Reproduction occurs primarily in the mid-to-late spring. Principal hosts include several benthic fishes (river carpsucker, gray redhorse) and one pelagic species (red shiner). The Black River population shows some evidence of genetic subdivision, while also showing significant divergence from populations in Texas. Based on these findings, we can conclude that the Black River contains a relatively stable population that is isolated from other populations and forms a distinct management unit. This management unit is likely vulnerable to habitat modification associated with harvesting of groundwater and lower river discharge resulting from climate change. Following talks will describe efforts to manage this vulnerable population and the species as a whole.

Platform 96 **9:00 a.m.** **March 29, 2017**	**SCIENTIFICALLY DEFENISIBLE MANAGEMENT OF AN IMPERILED FRESHWATER MUSSEL IN NEW MEXICO; THE CHALLENGES AND TRAJECTORY FOR CONSERVATION OF AN ENDANGERED SPECIES.** Daniel A. Trujillo[1], David J. Berg[2], Debra Hill[3]. [1]New Mexico Department of Game and Fish, Santa Fe, NM 87507, [2]Department of Biology, Miami University, Hamilton, OH 45011, [3]U.S. Fish and Wildlife Service Ecological Services Office, Albuquerque NM 87113
Management of imperiled freshwater mussels is a task fraught with challenges. The New Mexico Department of Game and Fish and its collaborators have worked through these challenges for nearly two decades to conserve an isolated population of *Popenaias popeii* (Lea) in southeastern New Mexico. This review of the management history for *P. popeii* will define challenges and highlight the efforts of state and federal agencies, university researchers, private landowners, and others to ensure the long-term viability of this population. These actions include promoting biological research, the development of a state conservation plan, and reestablishment of a historic population. In addition to reviewing the work that has been conducted, a trajectory for management of the species based on scientifically defensible actions will be discussed.	
Platform 97 **9:20 a.m.** **March 29, 2017**	**VOLUNTARY CONSERVATION OF AN IMPERILED FRESHWATER MUSSEL IN SOUTHEASTERN NEW MEXICO.** Debra Hill[1], David J. Berg[2], Daniel A. Trujillo[3]. [1]U.S. Fish and Wildlife Service New Mexico Ecological Services Office, Albuquerque NM 87113, [2]Department of Zoology, Miami University, Oxford, OH 45056,[3]New Mexico Department of Game and Fish, Santa Fe, New Mexico 87507
By creating voluntary agreements to manage vulnerable species before they become listed under the Endangered Species Act, many conservation benefits and partnerships are achievable that may not be possible if the species is listed. The U.S. Fish and Wildlife Service and New Mexico Department of Game and Fish, along with many other collaborators, have developed voluntary Candidate Conservation Agreements to conserve an isolated population of *Popenaias popeii* in the Black and Delaware Rivers of southeastern New Mexico and west Texas. These agreements provide the framework for conserving the habitat and water resources necessary for the continued persistence of *P.popeii* in these rivers. Participants to the agreements include the oil and gas industry, water pumpers and sellers, non-profit organizations, conservation districts, and State and Federal agencies. This review will lay out the steps taken to build the conservation agreements, define challenges, identify research needs, and recommend strategies to solve complex conservation issues.	
Platform 98 **9:40 a.m.** **March 29, 2017**	**EFFECTS OF CUMULATIVE SPRING DISCHARGE ON OCCUPANCY AND DETECTION OF FEDERALLY THREATENED SUWANNEE MOCCASINSHELL (*MEDIONIDUS WALKERI*) AND MUSSEL COMMUNITIES IN THE SUWANNEE RIVER BASIN, FLORIDA.** Jordan M. Holcomb[1], Colin P. Shea[2], and Nathan A. Johnson[3]. [1] FL Fish and Wildlife Conservation Commission, 7386 NW 71st St, Gainesville, FL, 32653. [2] FL Fish and Wildlife Conservation Commission, 100 8th Avenue SE St. Petersburg, FL 33701. [3] US Geological Survey Wetland and Aquatic Research Center, 7920 NW 71st Street, Gainesville, FL 32653.
Freshwater mussels (Unionidae) are among the most imperiled groups of organisms in the world. Most unionids lack basic information regarding species distributions, life history characteristics, and ecological and biological requirements. We examined the influence of hydrologic factors on the occurrence of the Suwannee Moccasinshell, *Medionidus walkeri*, a federally threatened freshwater mussel species, endemic to the Suwannee River basin in Georgia and Florida. We also evaluated the influence of survey effort on detection of *M. walkeri* during field surveys. All recent (2013-2016) mussel survey records in the Suwannee River Basin were compiled. For each of 220 survey locations cumulative discharge contributed by upstream springs was calculated. The spring discharge predictor variable was combined with *M. walkeri* detection/non-detection data from each survey location to develop a suite of occupancy models. Additional community metrics (e.g. species richness, % of Anodontines in surveys) were also evaluated. Modeling results indicated that detection of *M. walkeri* during surveys was strongly and positively related to survey effort. Modeling results also indicated that sites with cumulative spring discharge inputs exceeding ~28 cms were most likely (i.e., predicted occupancy probabilities >0.5) to support *M. walkeri* populations; however, occupancy declined in the lowermost reaches of the Suwannee main-stem despite high spring discharge inputs, presumably due to greater tidal influences and differences in physicochemical habitat conditions. Overall community analyses displayed similar trends. Historical localities where *M. walkeri* have presumably been extirpated are nearly all devoid of springs in their upstream watersheds. We hypothesize that springs may buffer extremely tannic, at times polluted surface waters, and maintain adequate flows during periods of drought, thereby promoting the persistence of *M. walkeri* populations. Our study suggests that springs are a critical resource for *M. walkeri* and may be more important for conservation planning than previously recognized.	

PLATFORM SESSION ABSTRACTS

SESSION 22	Threats II Wednesday, March 29, 2017 | 10:40 a.m. – 12:20 p.m.
Platform 99 **10:40 a.m.** **March 29, 2017**	**ABANDONED BUT SHOULD NOT BE FORGOTTEN: RESACA SUPPORTS INVASIVE APPLE SNAILS (*POMACEA MACULATA*, PERRY, 1810; CAENOGASTROPODA: AMPULLARIIDAE) WITHIN THE LOWER RIO GRANDE VALLEY, TEXAS.** Kathryn E. Perez[1], Victoria Garcia Gamboa[1], Caitlin M. Schneider,[2] and Romi L. Burks[2,3]. [1]University of Texas Rio Grande Valley, Department of Biology, 1201 West University Drive, Edinburg, TX, USA 78501,; [2]Southwestern University, Environmental Studies Program, 1001 East University Avenue, Georgetown, TX, USA 78626; [3]Southwestern University, Department of Biology, 1001 East University Avenue, Georgetown, TX, USA 78626.

Former Rio Grande River channels, oxbow lakes, or resacas, provide habitat for diverse wildlife both native and non-native. Biologists found pink egg masses on emergent vegetation (November 2015) and adult apple snails (May 2016) within a resaca at a former fish hatchery in Brownsville, Texas. *Pomacea* spp. thrive in warm waters and deposit clutches terrestrially. Examination of juvenile shell morphology, egg clutch morphology, and COI DNA sequences were used to identify which *Pomacea* spp. is present. Identified as *P. maculata* Perry 1810, this report extends the non-native range of this species by ~500 km in Texas. Abandoned waterbodies within hospitable climates, such as resacas, may act as conduits for invasive species and thus warrant monitoring. kathryn.Perez@utrgv.edu

Platform 100 **11:00 a.m.** **March 29, 2017**	**AMERICA'S NEWEST INVADER? - DISCOVERY OF A THIRD *CORBICULA* IN ILLINOIS.** Jeremy S. Tiemann[1], Amanda E. Haponski[2], Sarah A. Douglass[1], Mark A. Davis[1], Taehwan Lee[2], Kevin S. Cummings[1]. [1]Illinois Natural History Survey, Prairie Research Institute at the University of Illinois, Urbana-Champaign, IL 61820. [2]University of Michigan Museum of Zoology and Department of Ecology and Evolutionary Biology, Ann Arbor, MI 48109

The genus *Corbicula* consists of moderately-sized freshwater clams native to the temperate/tropical regions of Asia, Africa, and Australia and contains some of the most common and successful aquatic invasive species. The genus has both sexual and asexual forms with the former restricted to Asia whereas the latter clones have invaded freshwater ecosystems in North and South America and Europe becoming a major aquatic pest. Here, we report on an apparently novel North American invasive *Corbicula* lineage recently discovered in the Illinois River. This putative new morph was found co-occurring with previously described *Corbicula* morphotypes. Our main objective was to document the occurrence of this new morphotype (=Form D) and perform a preliminary analysis of its distinctiveness from sympatric Forms using shell phenotype characteristics and mitochondrial (mt) and nuclear DNA markers. Results showed that the three Forms were distinguishable using shell phenotype and nuclear 28S ribosomal DNA sequences. Individuals were unambiguously assigned to one of three discrete shell phenotypes, Form A, B, or D, with Form D specimens uniquely characterized by fine pinkish-rust colored rays and white nacre with purple teeth. Likewise, 28S genotypes identified three distinct morphs, with Form D differing from Forms A and B by 2-6 base pairs. In contrast, Form D individuals were distinguishable from Form B via mitochondrial markers but shared an identical mtDNA haplotype with sympatric Form A individuals. This latter result could stem from androgenetic capture of Form A eggs by invasive Form D sperm, a rare form of inheritance previously inferred for co-occurring North American *Corbicula* clones. Further morphological, ecological and genomic analyses characterizing the three morphotypes is required to establish the significance of our preliminary findings.

Platform 101 **11:20 a.m.** **March 29, 2017**	**20 YEARS MEASURING LONG-TERM SURVIVAL RATES AND POPULATION PERSISTENCE OF NATIVE MUSSELS COLONIZED BY ZEBRA MUSSELS IN LAKE PEPIN, MISSISSIPPI RIVER.** Rick A. Hart[1], Mike Davis, Bernard Sietman, Zeb Secrist[2], James W. Grier[3], and Andrew C. Miller[4]. [1] U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Galveston Laboratory, Galveston, TX 77551, [2]Minnesota Department of Natural Resources, Division of Ecological Services, Lake City 55041, [3]North Dakota State University, Department of Biological Sciences, Fargo 58102, [4] US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, 39180.
Facing zebra mussel invasions of native mussel populations in Minnesota, a mark-recapture research program was initiated in 1996 to measure survival of native mussels in the Mississippi and Otter Tail rivers, Minnesota and Wisconsin, USA. Beginning in 1993 quantitative quadrat sampling was conducted within selected sites to provide baseline population data before zebra mussels (*Dreissena polymorpha*) established in the Upper Mississippi River system. Zebra mussels arrived in the 1990s but were not present in the Otter Tail River, MN, which was used as a pseudo-study control site. In 1996, 960 and 240 *Amblema plicata* were marked at three sites in the Mississippi and one site in the Otter Tail Rivers respectively. Data collected then has provided a unique opportunity to measure long-term survival and population persistence of native mussels. In 1997-99, 2000, 2013, and again in 2015 we recaptured marked mussels. Marked mussels were identified; aged and measured; survival determined; and, if alive, returned to the substratum. In the Otter Tail River, where zebra mussels are still absent, populations of *A. plicata* remained normal and large. In 2013, 17 years after initial marking, 73 of the 240 originally marked mussels were recaptured from the Otter Tail River. This recovery rate was adequate for estimating a remarkable mean annual survival rate of 97.5%. In 2015, 19 years after marking, no live marked or unmarked *A. plicata* were recaptured from high and moderate density zebra mussel sites in Lake Pepin. However, at the low density site we recaptured 92 live marked *A. plicata*. Long-term adult mean annual survival rates for this population will be estimated. Populations of mussels declined in all of the high density Mississippi River sites. One bed within the Mississippi river had over 30 species of mussels with densities > than 80/M^2 in 1990. Species richness and density declined by 2015.	
Platform 102 **11:40 a.m.** **March 29, 2017**	**SPATIAL DISTRIBUTION OF *DREISSENA* SPP. AND THEIR EFFECT ON BENTHOS IN THE LOWER NIAGARA RIVER.** Knut Mehler[1,2], Lyubov E. Burlakova[1,2], Alexander Y. Karatayev[1]. [1]Great Lakes Center, Buffalo State College, 1300 Elmwood Ave., Buffalo, NY 14222; [2]The Research Foundation of The State University of New York, Buffalo State College, Office of Sponsored Programs, 1300 Elmwood Ave., Buffalo, NY 14222.
Dreissena spp. (hereafter *Dreissena*) are aggressive invaders, and once they have invaded they become the dominant benthic invertebrate in many waterbodies worldwide. Due to their tremendous ecological and socio-economic damages, information about their spatial distribution is a prerequisite for a better understanding of their impacts on the ecosystem scale. *Dreissena* are tightly linked to a specific suite of biotic and abiotic factors known as their physical habitat or ecological niche. While this link is relatively well known, this information often relies on fragmented data in close proximity to the sampling site or on data taken from literature. However, for a better understanding and effective management purposes, full coverage distribution maps are essential. The objective of this study was to integrate remote sensing data and a species distribution model (MaxEnt) to predict the spatial distribution of *Dreissena* in the lower Niagara River and therefore their effect on stream benthos. *Dreissena* occurrence was best predicted by flow followed by substrate and depth. *Dreissena* occurrence probability peaked at near-bottom flows between 0.1 and 0.6 m/s and approached zero when near-bottom flow was greater than 1.5 m/s. D*reissena* occurrence probability was also higher on consolidated substrate compared to unconsolidated substrate, however, their occurrence did not vary much among different depths. Analysis of Niagara River benthos also showed that *Dreissena* have now become an important factor affecting the abundance of major benthic groups indicating that *Dreissena* should be included in species distribution models beside environmental variables. Since SDM predictions agreed strongly with known habitat requirements of *Dreissena* in this study, the results can be very useful as an early detection and management tool in rivers and connecting channels.	
Platform 103 **12:00 p.m.** **March 29, 2017**	**INTERACTIONS BETWEEN UNIONIDS AND DREISSENIDS: LESSONS LEARNED.** Lyubov E. Burlakova[1], Alexander Y. Karatayev[1]. . [1]Great Lakes Center, SUNY Buffalo State, Buffalo, NY 14222.
Both dreissenid species, *Dreissena polymorpha*, the zebra mussel, and *Dreissena rostriformis bugensis*, the quagga mussel, are spreading in Europe during the last 200 years and in North America during the last three decades. Colonization of waterbodies by *Dreissena* caused dramatic declines in native freshwater mussels, especially in Unionidae. Both European and North American experience suggest that the highest unionid mortalities are recorded during the rapid dreissenid population growth followed by local unionid extirpation or coexistence. The first unionid "refuges" were found in Great Lakes a few years since *Dreissena* introduction, and ongoing studies revealed a suit of conditions that allow dreissenids and unionids to co-exist. Ecological niche model to predict potential refuges based on regional scale GIS data and locations of known refuges has recently been tested successfully in Great Lakes. Another important discovery was that the rate of unionid infestation depends on the dominant *Dreissena* species in the lake, and that competitive replacement of zebra by quagga mussels may relax impact on native species. Critical evaluation of factors that aid or prevent unionid coexistence with dreissenids can provide an opportunity for unionid conservation in regions on both continents that are still being invaded by dreissenids.	

PLATFORM SESSION ABSTRACTS

SESSION 23	Special Session: Mussel Habitat: From Computer Models to In-Stream Applications II Wednesday, March 29, 2017 | 10:40 a.m. – 12:20 p.m.
Platform 104 **10:40 a.m.** **March 29, 2017**	**MODELLING DISTRIBUTIONS OF JUVENILE AND ADULT MUSSELS IN THE UPPER MISSISSIPPI RIVER USING RANDOM FOREST CLASSIFICATION.** Steven J. Zigler and Teresa J. Newton. USGS Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.

We analyzed data from a quantitative survey of native mussels that was conducted in a 42-km impounded reach of the Upper Mississippi River using a systematic design (n=367 sites). For each sampling site, we estimated simple physical (water depth, current velocity) and complex hydraulic variables (e.g., shear stress, boundary Reynolds number, relative substrate stability) that have been shown to be useful descriptors of mussel habitat in other studies of the Upper Mississippi River. Presence-absence of juvenile and adult mussels were analyzed with random forest models. This ensemble learning method aggregated classification tree submodels (N=1200) based on random selection of predictor variables and data. To reduce the effect of prevalence on predictions, models were constructed using down-sampled data to balance sample sizes of presence and absence. Out-of-bag samples were used to provide an unbiased estimate of generalization error. Receiver operating characteristic curves indicated useful models were constructed for both adult and juvenile mussels. However, the model for adult mussels performed considerably better (Area under the Curve, AUC=0.81; overall error rate=24%) than the juvenile mussel model (AUC=0.72, overall error rate=36%) indicating greater predictability for adults. Models primarily depended on complex hydraulic variables including relative substrate stability and boundary Reynolds number. Results suggested that distribution of juvenile mussels are less closely tied to hydrophysical conditions than adult mussels, and that some mussel habitat might be ephemeral based on recent hydrologic patterns. szigler@usgs.gov

Platform 105 **11:00 a.m.** **March 29, 2017**	**FRESHWATER MUSSEL HABITAT CONSTRUCTION/CREATION FOR THE ST. LOUIS DISTRICT.** Heidi L. Dunn[1], Teresa C. Allen[2], Brian Johnson[2]. [1]Ecological Specialists, Inc., O'Fallon, MO 63366. [2]U.S. Army Corps of Engineers, St. Louis District, St. Louis, MO.

St. Louis District Army Corps of Engineers constructs river training structures in the Illinois and Mississippi River to maintain a 9ft channel. Several configurations have been built over the past 20 years that hydraulically act like the traditional wing dikes, but provide a variety of depths and substrates to promote river habitat diversity. These structures provide habitat for a variety of fish and invertebrates, and SLD is interested in determining if these structures provide habitat for freshwater mussels. Literature on mussel habitat, previous mussel habitat construction attempts, and mussel distribution in the SLD was compiled and presented to engineers in a workshop. Several ideas for modifying existing structures were discussed, and determining if existing structures provide habitat was selected as the first task. A study was designed to evaluate mussel habitat at two reference sites (existing mussel beds) and five river training structures (3 areas with chevron dikes, 1 area with a W dike, and 1 area with multiple round point structures) spread throughout Pools 24, 25, and 26 of the Mississippi River. At each site, physical habitat data (Acoustic Doppler Current Profiler data and Bathymetric data) was collected to develop a 2D AdH model of depth, depth averaged velocity (magnitude and direction), and shear stress. Preliminary depth and velocity data was reviewed to determine if stable substrate and flow refugia might be available for mussels. Qualitative mussel sampling was focused in these area, with the objective of delineating any mussel communities. Quantitative samples were collected within and outside of mussel habitat areas. Mussel data was combined with modeled hydraulic conditions to determine what parameters and the magnitude of those parameters associated with mussel communities. Results will be used to recommend changes to river training structures that might enhance mussel communities in the SLD portion of the Mississippi River. HDunn@ecologicalspecialists.com

Platform 106 **11:20 a.m.** **March 29, 2017**	**UPPER MISSISSIPPI RIVER POOL 11 BERTOM AND MCCARTNEY LAKES NATIVE FRESHWATER MUSSEL HABITAT ENHANCEMENT PROJECT – LESSONS LEARNED AND PATH FORWARD.** Dan Kelner U.S. Army Corps of Engineers, St. Paul District, 180 5th Street East, Suite 700, St. Paul, MN, 55101.

The Corps has strong interest in native mussel habitat requirements within its waterways and whether habitat can be enhanced or created. The three Corps districts in the Upper Mississippi River (UMR), St. Louis, Rock Island, and St. Paul, are evaluating whether mussel habitat enhancement can be incorporated into the Upper Mississippi River Restoration (UMRR) Environmental Management Program (EMP), routine UMR channel maintenance activities, and other ecosystem restoration opportunities. In 1992, the Corps completed the Bertom and McCartney Lakes UMRR Project that included fish and mussel enhancement features. One project goal was to establish a mussel bed by creating fish and mussel habitat as a means of introducing mussels via fish hosts and eventual self-sustained mussel recruitment. Project features consisted of creating a 1,500 ft (457m) high velocity run (Habitat Channel) in an existing secondary side channel connected to another secondary channel with no modifications (Control Channel) for comparison. The Habitat Channel contained a gradation of substrate sizes and fish habitat structures within a channel segment with sustained flow velocities designed to deter zebra mussel (*Dreissenna polymorpha*) colonization while favoring riverine native mussels. Monitoring conducted during 2014 indicated physical conditions for the Habitat Channel has not changed since its construction. However, native mussel colonization appeared to be delayed as indicated by age classes represented. Also, abundance was low to moderate and varied spatially within the channel substrate with preference for rounded river-washed rock. A total of eleven species were collected in the Habitat Channel and native mussel densities ranged from 0.8/m^2 to 4.8/m^2 compared to the Control Channel where only six live species were collected with densities <1.0/m^2. Lessons learned from the project and knowledge gained from more recent mussel enhancement efforts and mussel community model development have led to more effective planning, construction, and management of projects to maximize benefits involving native mussel conservation and restoration. daniel.e.kelner@usace.army.mil

Platform 107 **11:40 a.m.** **March 29, 2017**	**A MUSSEL COMMUNITY ASSESSMENT TOOL FOR THE UPPER MISSISSIPPI RIVER.** [1]Heidi Dunn, [2]Steve Zigler, [2]Teresa Newton [1]Ecological Specialists, Inc., O'Fallon, MO 63366 [2]USGS, Upper Midwest Environmental Sciences Center, LaCrosse, WI 54603.

Upper Mississippi River (UMR) managers need a quantitative means of evaluating the relative health or value of a mussel assemblage. We evaluated 46 mussel metrics representing the categories of conservation status/sensitivity, taxonomic composition, population processes, abundance, and diversity developed from 25 quantitative surveys spanning low to high quality mussel assemblages. Ten metrics deemed useful for discriminating the relative health of mussel assemblages were identified using a sequential process that examined ecological relevance and redundancy among the initial metrics. These 10 metrics (percent listed species, percent tolerant taxa, percent tribe Lampsilini, percent freshly dead shells, percent ≤5 years old, percent ≥15 years old, density at the 75th percentile, species evenness, tribe level evenness, and rarefaction species richness) were included in the Mussel Community Assessment Tool (MCAT). Frequency histograms based on the 25 sites were analyzed for each of the 10 metrics, and metrics were divided into good, fair, or poor scoring categories based primarily on quartile analysis. Three methods were used to validate the MCAT metrics; comparison with professional judgment (modified Delphi Technique), comparison of cut-points with additional data sets, and temporal analysis. Mussel biologists from the UMR were provided 10 new data sets to independently evaluate using their professional judgment. Scores from biologists generally agreed with scores based on MCAT metrics. Disagreements largely stemmed from differences in definitions of metrics, and biologists agreed that standard definitions used in the MCAT would provide a more consistent means of evaluating mussel assemblages. New scoring cut-points did not vary substantially from initial cut-points. Although individual metrics varied over time at sites with multiple years of data, metric categories (poor, fair, good) were consistent and generally agreed with professional judgment. All three validation methods suggested that the MCAT can be a useful quantitative tool for management of mussel resources in the UMR. HDunn@ecologicalspecialists.com

PLATFORM SESSION ABSTRACTS

SESSION 24	Status, Trends, and Monitoring of Molluscan Resources V Wednesday, March 29, 2017 | 10:40 a.m. – 12:20 p.m.
Platform 108 10:40 a.m. March 29, 2017	**IMPLEMENTATION OF THE U.S. FISH AND WILDLIFE SERVICE'S SPECIES STATUS ASSESSMENT (SSA) FRAMEWORK FOR TWO FRESHWATER MUSSELS, YELLOW LANCE (*ELLIPTIO LANCEOLATA*) AND ATLANTIC PIGTOE (*FUSCONAIA MASONI*).** Sarah E. McRae. U.S. Fish and Wildlife Service, Raleigh, NC 27606.

The Species Status Assessment (SSA) framework was developed to inform decisions under the U.S. Endangered Species Act (ESA) by compiling the best available scientific information to document a species' historical, current, and future viability and extinction risk. The SSA process has three sequential stages: 1) documentation of the species' life history and ecological relationships to provide the foundation for the assessment, 2) description and hypothesized causes of the species' current condition, and 3) forecasts of the species' future condition in response to scenarios of possible change. The future condition in an SSA describes the species' ability to sustain populations in the wild over time under different plausible future scenarios that account for key uncertainties. We applied the SSA framework to inform an ESA listing decision for two petitioned species freshwater mussels, the Yellow Lance and the Atlantic Pigtoe. To evaluate the current and future viability of the two species, we assessed a range of conditions by applying the conservation biology principles of resiliency, representation, and redundancy, collectively referred to as the 3Rs. The analysis of the 3Rs for current condition revealed that both Yellow Lance and Atlantic Pigtoe abundance and distribution have declined, resulting in largely isolated contemporary populations that have low resiliency and are vulnerable to both stochastic and catastrophic events. Both species face a variety of threats from declines in water quality, loss of stream flow, and riparian and instream habitat fragmentation and deterioration, all of which are expected to be exacerbated by urbanization and climate change. Given consideration of four different scenarios, including status quo, pessimistic, optimistic, and opportunistic cases, estimates of future resiliency for both the Yellow Lance and Atlantic Pigtoe are low, as are estimates of redundancy and representation.

Platform 109 11:00 a.m. March 29, 2017	**CHANGES IN HOLOCENE CLIMATE AND FRESHWATER MUSSEL SPECIES COMPOSITION AT AN ARCHAEOLOGICAL SITE ON THE TENNESSEE RIVER IN NORTHEAST ALABAMA.** Robert E. Warren[1] and Arthur E. Bogan[2]. [1]Illinois State Museum, Springfield, IL; [2]North Carolina State Museum of Natural Sciences, Raleigh, NC.

Pollution, habitat loss and other historic human impacts on lakes and streams have caused major changes in the species compositions of freshwater mussel communities in North America. Shell samples from stratified archaeological sites can provide baseline profiles of prehistoric species composition, and also document long-term changes in mussel communities in response to natural and/or anthropogenic causes. The Widows Creek archaeological site (1JA305) is a prehistoric Native American shell midden located on the right bank of the Tennessee River in northeast Alabama (TRKm 657). Excavations recovered thousands of mussel shells from Late Archaic (ca. 4000-5000 Cal BP), Early Woodland (2100-2400 Cal BP), and Late Woodland (1000-1250 Cal BP) components at the site. Fifty-three species are represented in a sample of nearly 60,000 identified valves, most of which are now extinct, endangered, threatened, or of special concern. Mussels likely were obtained by foraging in the shallow, gravelly shoals of the nearby Widows Bar section of the river, and most were processed and consumed as a food resource. Leading dominant species include the spike (*Elliptio dilatata,* 28%), the dromedary pearlymussel (*Dromus dromas,* 24%), and the mucket (*Actinonaias ligamentina;* 8%). There is a significant negative correlation in the relative abundances of *E. dilatata* and *D. dromas* in excavation units associated with specific cultural periods ($R^2 = 0.57$). *E. dilatata* predominates (30-48%) in the Early Woodland and lower Late Woodland components, whereas *D. dromas* is most abundant (30-42%) in the Archaic and upper Late Woodland components. The transition from *E. dilatata* to *D. dromas* in the Late Woodland period probably occurred at about 1100 cal BP. These changes correlate with long-term hydroclimate data obtained from sediment cores along the Tennessee River (TRKm 546-747), and suggest that *D. dromas* predominated at Widows Creek during dry episodes whereas *E. dilatata* was most abundant during periods of greater moisture. warren@museum.state.il.us

Platform 110 11:20 a.m. March 29, 2017	**SIGNS OF HOPE FOR THE UPPER COOSA RIVER OF GEORGIA.** Jason M. Wisniewski[1], Katie Owens[2]. [1]Wildlife Resources Division, Georgia Department of Natural Resources, Social Circle, Georgia 30025. [2]The Nature Conservancy, Upper Coosa River Program Director, Armuchee, Georgia 30105.

Over 40 unionid species are historically known from the Georgia portion of the Coosa River Basin. Many of these species are presumed extirpated from all or substantial portions of the basin due to extensive habitat degradation resulting from the construction of impoundments, sedimentation, and pollution. Few comprehensive surveys of the Georgia portion of the basin have been conducted with most surveys concentrating on only tributaries, main stem rivers, or specific watersheds of interest. In 2015, we initiated a multi-year occupancy survey of the Coosa River Basin between Weiss Lake and the headwaters of Conasauga River, Carters Lake, and Allatoona Lake. We sampled 72 tributary sites in 2015 and 88 main stem river sites in 2016. Sampling was conducted using a multiple-observer approach within a timed search framework. Thirty-six live mussels representing 6 species were collected from 16 tributary sites in 2015 and 321 live mussels representing 10 species were collected from 50 sites in 2016. Etowah River yielded only one live unionid whereas the highest species richness and counts were in Conasauga River. Several species exhibited evidence of recent reproduction including unionids in Conasauga River, Oostanaula River, and several tributaries. The presence of relatively good habitat in conjunction with evidence of recent reproduction suggest that several portions of the Coosa River Basin in Georgia may be suitable for reintroduction or augmentation projects to begin restoring unionid populations in this once diverse system. Additional surveys are planned to investigate the occurrence of unionids in the Chattooga River, and Etowah and Coosawattee rivers upstream of major reservoirs.

Platform 111 11:40 a.m. March 29, 2017	**STATUS ASSESSMENT AND RANKING OF THE CAROLINA HEELSPLITTER POPULATIONS IN THE CATAWBA RIVER BASIN IN SOUTH CAROLINA.** Timothy W. Savidge [1] and Tom E. Dickinson[2] . [1] Three Oaks Engineering, 1230 Sumter Street, Suite 400, Columbia, SC 29201; [2] Three Oaks Engineering, 1000 Corporate Drive, Suite 101 Hillsborough, NC 27278.

The Carolina Heelsplitter (*Lasmigona decorata*) is a federally endangered freshwater mussel species that occurs primarily within the Carolina Slate Belt geologic unit of the Piedmont physiographic region portions of the Catawba and Pee Dee River systems in North Carolina and the Pee Dee Catawba, Saluda and Savannah River systems in South Carolina. The status of the Carolina Heelsplitter populations within the Catawba River Basin in South Carolina were assessed in terms of relative abundances (targeting the Carolina Heelsplitter), habitat conditions and stability, and identification of any apparent threats such as livestock access, physical barriers to fish passage, and other anthropogenic stressors. This involved compiling previous survey data, performing qualitative and quantitative mussel surveys, gathering in-stream quantitative habitat measurements, and characterizing land use using GIS data layers. Based on the information gathered during this study, each of the population units were evaluated and ranked in the context of current and future population viability. The rankings considered numerous factors such as length of occupied habitat, relative abundance, evidence of reproduction/recruitment of the Carolina Heelsplitter and other associate freshwater mussel species, as well as in-stream habitat conditions, and general watershed land use. The information gathered in this study will help identify priority areas for conservation and management efforts such as habitat preservation/restoration, and population restoration/augmentation.

Platform 112 12:00 p.m. March 29, 2017	**THE BISHOP STEPHEN ELLIOTT MOLLUSK COLLECTION: A PRIVATE COLLECTION OF HISTORICAL SIGNIFICANCE.** K. L. Irwin[1], G. R. Dinkins[2]. [1]Department of Wildlife & Fisheries, University of Tennessee, Knoxville, TN 37996. [2]McClung Museum of Natural History and Culture, University of Tennessee, 1327 Circle Park Dr., Knoxville, TN 37996.

Stephen Elliott (1806-1866) was the 37th bishop of the Protestant Episcopal Church in the United States of America and the first Bishop of Georgia. He was also the first and only Presiding Bishop of the Protestant Episcopal Church in the Confederate States of America, and a co-founder of Sewanee University (University of the South). Elliott was an avid shell collector who corresponded with many esteemed malacologists in the U.S. and Europe, including Isaac Lea and Timothy Abbott Conrad. Elliott provided Isaac Lea specimens of freshwater mussels (including soft parts) and snails from the southeastern U.S. until his death in 1866, and many of Isaac Lea's species descriptions were based on specimens provided by Stephen Elliott. Lea named *Amblema elliotti* in honor of his friend, the "Right Reverend Stephen Elliott, of Georgia". It appears Elliott's collection resided at Sewanee University from the institution's earliest years. In or around 1968, Sewanee University moved Elliott's mollusk collection into several large, cardboard boxes and relocated them in a basement room in the biology building at Sewanee University. Over time, the boxes deteriorated and the collection was nearly discarded. In 2016, Sewanee donated Elliott's collection to the McClung Museum of Natural History and Culture at the University of Tennessee. Elliott's collection included 863 specimens of freshwater mussels representing 154 species of Unionidae, Margaritiferidae, Hyriidae, and Iridinidae collected from 13 countries in North and South America, Africa, Europe and China. His specimens of freshwater mussels from the U.S. came from 25 drainage basins and were collected by 21 different individuals, including Bishop Elliott, Isaac Lea and his brother Thomas Lea. The Bishop Elliott collection contains 36 species of freshwater mussels that are federally endangered and five that are extinct.

PLATFORM SESSION ABSTRACTS

SESSION 25	Ecology IV Wednesday, March 29, 2017 | 2:40 p.m. - 4:40 p.m.
Platform 113 2:40 p.m. March 29, 2017	**ECOSYSTEM SERVICES PROVIDED BY EUROPEAN FRESHWATER MUSSELS.** Juergen Geist. Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technical University of Munich, Mühlenweg 22, D-85354 Freising, Germany.

Freshwater mussels are often referred to as keystone species or ecosystem engineers, yet the functional roles of most European species are still poorly understood. This paper quantified the ecological effects and importance of three European freshwater mussel species (*Unio crassus*, *Unio pictorum* and *Anodonta anatina*) concerning suspended fine sediment clearance, physico-chemical and microbial habitat characteristics, as well as the diversity and abundance of benthic communities. Experiments were conducted in standardized laboratory exposures as well as within typical habitats where patches with and without mussels could be compared. Exposure of *U. pictorum* to fine sediments of different size (<45 µm, 45-63 µm, 63-125 µm) and quantity (0-10 g/L) did not affect mussel behavior measured by Hall sensor technology and mussels consistently improved clearance of suspended particles by 35%, contributing to increased light availability for primary production. The burrowing behavior of *A. anatina* resulted in increased oxygen provision to the hyporheic interstitial and in shifts of the microbial community structure, with possible effects on nutrient fluxes, contaminant degradation and benthic food webs. On the scale of stream patches in a stream within an area of intensive landuse, no differences in redox potential, substrate compaction, and the density, species richness, abundance and taxonomic composition in benthic communities was found between patches with and without *U. crassus* mussels, except for diatoms. The results of these studies clearly suggest that European freshwater mussels play an important role in the improvement of open water quality as well as stream bed oxygenation which is important for many other species. These findings are in line with studies on ecosystem services by North American species. On the other hand, the functional roles and ecosystem services provided by freshwater mussels may be disguised in habitats where population densities have declined and where anthropogenic habitat degradation has occurred. geist@wzw.tum.de

Platform 114 3:00 p.m. March 29, 2017	**COMPARISON OF SESTON PROCESSING RATES AND POTENTIAL ECOSYSTEM SERVICES OF DIVERSE FRESHWATER AND MARINE BIVALVE SHELLFISH.** Danielle Kreeger[1,4], Catherine Gatenby[2], Jeanette Howard[3], Kurt Cheng[1], Josh Moody[1], Angela Padeletti[1], and Roger Thomas[4]. [1]Partnership for the Delaware Estuary, Wilmington, DE 19801; [2]Lower Great Lakes Fish and Wildlife Conservation Office, Basom NY 14013; [3] The Nature Conservancy, San Francisco, CA 94105; [4]The Academy of Natural Sciences of Drexel University, Philadelphia, PA, 19103.

Populations of most native bivalves continue to decline in both fresh and marine waters of North America. Since bivalves convey diverse benefits, there are different motivations for investing in bivalve conservation and restoration. An emerging reason is to promote water quality since robust populations filter and transform vast quantities of particulate pollutants, facilitating some net removal or conversion to less damaging forms. Missing from this dialogue, however, is a science-based comparison of the expected return on investment from different tactics aimed at different species and niches. Invariably, models of ecosystem responses require data on physiological rates, which are notoriously variable with body size, season, food conditions, and other factors. Analysis is further complicated because many physiological studies are conducted under unnatural conditions. To facilitate ecosystem service comparisons, core physiological rate functions of 10 species of freshwater and marine bivalves were assessed using consistent methods (ambient diets and conditions) in dozens of experiments, 1984-2015. Unionids included 7 species spanning the Pacific, Mississippi and Atlantic slopes. Clearance rates of unionids, oysters, ribbed mussels, and Asian clams were generally comparable during the growing season, averaging between 0.5-1.6 L hr^{-1} [g dry tissue]$^{-1}$. Absorption efficiencies were positively correlated with seston quality for all species. The water quality effects of bivalve grazing (seston filtration) largely depended on seasonal and spatial variation in temperature and food conditions. From the physiological perspective, investments in freshwater mussel recovery therefore have similar potential to enhance water quality as tactics aimed at marine species. For example, unionids in the tidal Delaware River can filter >10 tons of suspended solids ha^{-1} yr^{-1}, which is similar to ribbed mussels in nearby salt marshes. To maximize bivalve-mediated ecosystem services at the watershed scale, a diversified approach is warranted that sustains and enhances the carrying capacity of functionally dominant species in diverse niches.

Platform 115 3:20 p.m. March 29, 2017	**RESTORATION OF AMERICAN EELS TO THE SUSQUEHANNA RIVER WATERSHED: IMPLICATIONS FOR *ELLIPTIO COMPLANATA* POPULATIONS.** Julie L. Devers[1], Heather S. Galbraith[2], Carrie J. Blakeslee[2], Jeffrey Cole[2], William Lellis[3], Steve Minkkinen[1]. . [1]U.S. Fish and Wildlife Service, Maryland Fish and Wildlife Conservation Office, 177 Admiral Cochrane Dr., Annapolis, MD 21401; [2]U.S. Geological Survey, Northern Appalachian Research Laboratory, 176 Straight Run Road, Wellsboro, PA 16901; [3]U.S. Geological Survey, Ecosystems, 12201 Sunrise Valley Dr., Reston, VA 20192

Elliptio complanata, a common and abundant Atlantic slope freshwater mussel species, has been documented to be in decline in parts of its range. Survey data from the Susquehanna River watershed suggest that there is little or no recruitment of this species in 10 tributaries with the highest densities of adult *E. complanata*. One possible reason that *E. complanata* is less abundant and has lower recruitment in the Susquehanna River watershed is the absence of its recently documented host fish, American eel (*Anguilla rostrata*). American eel occupies a unique niche in estuarine and freshwater habitats and has also experienced a range-wide population decline during recent decades. The Chesapeake Bay watershed supports a large portion of the eel population, but 40% of the geographic area is blocked to natural migration by dams on the lower part of the Susquehanna River. In 2008, we began stocking eels above dams to evaluate the effects of eel reintroduction on *E. complanata* recruitment and native fish communities. From 2010 to 2013, American eels were stocked in two tributaries to the Susquehanna River with high relative abundance of *E. complanata* (CPUE > 50 mussels/hr). During post stocking monitoring conducted in 2014 and 2015, we found widespread distribution of stocked eels and evidence of *E. complanata* recruitment. The number of *E. complanata* juveniles (< 30 mm) increased from 0 to 26% in one of the stocked tributaries and from 0.6% to 1.6% in the other. Our results indicate that the reintroduction of American eel may be a catalyst to restoring *E. complanata* recruitment in Susquehanna River tributaries. The presence of healthy freshwater mussel beds provides streambed stability, water filtration, and increased macroinvertebrate biodiversity. Permanent eel passage could lead to improved ecological function in the watershed.

Platform 116 3:40 p.m. March 29, 2017	**16S METAGENOMIC PROFILING OF FRESHWATER MUSSEL BED MICROBIAL COMMUNITIES REVEALS INFLUENCE ON NITROGEN-CYCLING BACTERIA.** Ellen M. Black[1], Michael S. Chimenti[2], and Craig L. Just[1]. [1]The University of Iowa Department of Civil and Environmental Engineering, 4105 Seamans Center, Iowa City, IA, 52240 [2]Iowa Institute of Human Genetics, Carver College of Medicine, The University of Iowa, 5167 Westlawn, 200 Newton Road, Iowa City , IA 52242. **STUDENT SPEAKER*

The Upper Mississippi River (UMR) navigation pool 16 contains dense native freshwater mussel populations of 4 mussels per m^2, on average, with tribes *Amblemini* and *Lampsilini* (Bivalvia: Unionidae) representing about 70% of the mussel species present. UMR mussel assemblages collectively have a water filtration rate of 53.1 million m^3 per day and deposit up to 25 kg of nitrogen per day into sediment for subsequent use by benthic organisms. Non-targeted 16S rRNA amplicon sequencing and targeted quantitative polymerase chain reaction (qPCR) of mussel bed sediment was employed to determine how freshwater mussel presence effected microbial community structure and microbial species abundances. Bacteria in the phylum Nitrospirae were five times more abundant in the UMR mussel bed ($p=0.0004$), while archaea in the genus *Nitrososphaera*, responsible for oxidizing ammonium to nitrite, were significantly decreased ($p=0.03$) in the mussel bed. Additionally, anaerobic ammonium oxidizing (anammox) bacteria (phylum Planctomycetes), known to facilitate a significant and unique nitrogen removal mechanism in freshwater ecosystems, were detected in greater abundances near the water-sediment interface in the mussel bed ($P<0.001$). Mussel presence suppressed intra-sample (alpha) microbial species diversity and partially explained the variability in inter-sample species diversity (beta). This research indicates that freshwater mussel presence may be responsible for enhancing the niche of specific nitrogen-transforming microorganisms while lowering overall microbial diversity, perhaps through bioturbation and excretion of nitrogen substrates. Future research is needed to address real-time microbial activity in mussel beds to determine if a biotic coordination between mussels and microorganisms play a large role in freshwater nitrogen cycling.

Platform 117 4:00 p.m. March 29, 2017	**MODULATION OF NEAR-BED HYDRODYNAMICS BY FRESHWATER MUSSELS IN AN EXPERIMENTAL CHANNEL.** Brandon J. Sansom[1], Joseph F. Atkinson[1], and Sean J. Bennett[2]. Department of Civil, Structural, and Environmental Engineering, SUNY University at Buffalo, Buffalo, NY 14260; [2]Department of Geography, SUNY University at Buffalo, Buffalo, NY 14260.

Freshwater mussels are important ecosystem engineers and recent studies have illustrated their many ecological contributions, but little is known about the interaction between mussels and their surrounding flow environment at the organism scale. The objective of this study was to examine the hydraulic interactions between mussels and open channel flow. We quantify how a mussel-covered bed alters bed roughness and near-bed turbulent flow, determine the filter behavior and capacity of live *Lampsilis siliquoidea*, and design a model mussel to simulate live mussel filtering to examine the impact of the biologically mediated activity of filter feeding on near-bed turbulent flow. In comparison to a gravel bed, a mussel-covered bed increased shear velocity by 28% and bed roughness by nearly 300%, and significantly reduced near-bed flow velocity. The filter behavior in *L. siliquoidea* varied within and between individuals, and ranged from 0.4 to 20 cm/s. The excurrent flow of the model mussel accurately simulated excurrent flow observed in live mussels, and when subjected to various boundary conditions, displaced water velocity and turbulent kinetic energy downstream. The ability to describe and quantify these hydrodynamic interactions provides new insight into how mussels modulate near-bed flow and mixing processes, which can contribute to future conservation efforts. bsansom@buffalo.edu

Platform 118 **4:20 p.m.** **March 29, 2017**	**SHIFTING HOTSPOTS: HOW DO AGGREGATIONS OF MUSSELS AND FISH INTERACT TO INFLUENCE RESOURCE HETEROGENEITY AND FLUXES IN STREAMS?** Caryn C. Vaughn[1], Keith B. Gido[2], Thomas B. Parr[1], Kiza K. Gates[1,4], Garrett Hopper[2], James P. Guinnip[2], Traci Popejoy[1], and Carla L. Atkinson[3]. Oklahoma Biological Survey and Department of Biology, University of Oklahoma, Norman, OK 73019; [2]Division of Biology, Kansas State University, Manhattan, KS 66506; [3]Department of Biological Sciences, University of Alabama, Tuscaloosa, AL 35487; [4]Current address: Washington Department of Fish and Wildlife, Olympia, WA 98501.

Aggregations of consumers create local patches of nutrient regeneration and material flux (biogeochemical hotspots). Both stream fish and mussel assemblages generate hotspots, but their contributions to biogeochemical processes may differ based on species traits. Longer-lived mussels are localized, stable, immobile hotspots that provide relatively constant nutrient subsidies. Shorter-lived fishes are mobile, widespread and location of nutrient subsidies is more dependent on hydrologic conditions. How these two hotspots overlap and interact to influence stream function is unknown. Our ongoing research combines comparative field studies, mesocosm experiments, and modelling to ask: (1) *Where and when do fish and mussel hotspots overlap in streams?* and (2) *How does this overlap influence nutrient recycling and the distribution of resources throughout a stream network?* We sampled resource pools (species composition and abundance of mussels, fishes, macroinvertebrates; seston, periphyton, nutrients) and fluxes (excretion and egestion rates of mussels and fishes, nutrient uptake, denitrification/nitrification rates and nutrient limitation) in 100 m river reaches with and without large mussel beds in two Oklahoma rivers in summer and fall 2015 and 2016. Results to date show that fish biomass is distributed more homogenously than mussel biomass, but mussel biomass exceeds fish biomass in reaches with mussel beds. Mussels had higher areal excretion rates than fish, and excrete at a higher N:P ratio. Fish and mussel activity alleviated N limitation of denitrifiers near mussel beds. We also conducted an 8-week experiment in summer 2016 where we examined resource abundance and nutrient fluxes up and downstream of mussel aggregations in artificial streams (3 pool, 2 riffle mesocosm units) with and without fish. Analyses to date show strong effects of mussel-fish hotspot interactions. Fish distribute nutrients homogenously throughout streams and benthic primary production is higher in treatments with fish, whereas in mussel only treatments nutrients concentrate downstream of mussel patches.

PLATFORM SESSION ABSTRACTS

SESSION 26	Genetics and Phylogeny II / Conservation V Wednesday, March 29, 2017 | 2:40 p.m. - 4:40 p.m.
Platform 119 **2:40 p.m.** **March 29, 2017**	**MULTILOCUS PHYLOGENIES PROVIDE EVIDENCE FOR A CRYPTIC NEW NEOTROPICAL GENUS OF FRESHWATER MUSSEL (MOLLUSCA: BIVALVIA: DREISSENIDAE) FROM CLEARWATER RIVERS OF THE BRAZILIAN AND GUIANAN SHIELDS.** Susan R. Geda[1] and Michael M. Gangloff[1]. [1]Biology Department, Appalachian State University, Boone, NC

The freshwater bivalve family Dreissenidae includes three genera, *Dreissena*- the zebra and quagga mussels (and several taxa endemic to the Ponto-Caspian region), *Mytilopsis*- the dark false mussels, and *Congeria*- endemic to the Dinaric Karst caves in southern Europe. Previously, dreissenids from inland South American rivers were ascribed to either *Mytilopsis* or *Congeria*. Our preliminary phylogenetic analyses using one mtDNA gene (COI) suggest that South American dreissenids comprise a distinct clade that warrants recognition as a novel genus. However, basal support for the positioning of this clade within Dreissenidae was low. To obtain additional genetic data and better understand the placement of this clade within Dreissenidae, we visited several Brazilian museums and collected specimens (two undescribed dreissenid taxa and *Congeria hoeblichi*) from the Iriri and Xingu rivers in eastern Brazil in August 2016. We also obtained material from several important outgroup taxa. Preliminary analyses suggest that the South American dreissenid clade includes at least three cryptic species including two in the Xingu-Iriri. Our results strongly suggest that *C. hoeblichi* belongs in the same clade and that *Congeria,* in the strict taxonomic sense, is likely restricted to Balkan cave systems. High genetic diversity was observed both within and between dreissenid populations in the Xingu-Iriri system and a large (100 km) rapid complex appears to be an important isolating mechanism. Divergence rates between Xingu-Iriri taxa were >2x those typically observed for temperate mollusk taxa, suggesting that this geologically-ancient feature has been isolating dreissenid populations for some time. The great age of many South American river systems suggest that the number of operational taxa in this clade is likely high but more sampling is needed in the Xingu and other large, clear-water South American rivers to elucidate species boundaries in this group. gedasr@appstate.edu

Platform 120 3:00 p.m. March 29, 2017	**MITOGENOMICS OF FRESHWATER MUSSELS (BIVALVIA: UNIONIDA): FIRST RESULTS.** Manuel Lopes-Lima[1,2], Elsa Froufe[2], Miguel Fonseca[1,2,3], Han Ming Gan[4], David C. Aldridge[5], Ronaldo Sousa[6], Amílcar Teixeira[7], Simone Varandas[8], David T. Zanatta[9], Alexandra Zieritz[10], Arthur E. Bogan[11]. [1]CIBIO/InBIO - Research Center in Biodiversity and Genetic Resources, Universidade do Porto, Campus Agrário de Vairão, Rua Padre Armando Quintas, 4485-661 Vairão, Portugal. [2]CIIMAR/CIMAR - Interdisciplinary Centre of Marine and Environmental Research, University of Porto, Rua dos Bragas 289, P 4050-123 Porto, Portugal.[3]Department of Biochemistry, Genetics and Immunology, University of Vigo, Vigo, Spain.[4]School of Science, Monash University Malaysia, Petaling Jaya, Selangor, Malaysia.[5]University of Cambridge, Aquatic Ecology Group, Department of Zoology, Cambridge, UK.[6]CBMA - Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Campus Gualtar, 4710-057 Braga, Portugal.[7]CIMO/ESA/IPB - Mountain Research Centre, School of Agriculture, Polytechnic Institute of Bragança, Campus de Santa Apolónia, Apartado 1172, 5301-854 Bragança, Portugal. [8]CITAB/UTAD - Centre for Research and Technology of Agro-Environment and Biological Sciences, University of Trás-os-Montes and Alto Douro, Forestry Department, 5000-801, Vila Real, Portugal. [9]Biology Department, Institute for Great Lakes Research, Central Michigan University, Biosciences 2408, Mount Pleasant, MI 48859, USA. [10] School of Geography, University of Nottingham Malaysia Campus, Jalan Broga, 43500 Semenyih, Malaysia. [11]Research Laboratory, North Carolina State Museum of Natural Sciences, MSC 1626, Raleigh, NC 27699-1626, USA.
Freshwater mussels of the order Unionida are important elements of freshwater habitats and are responsible for important ecological functions and services. Unfortunately, these bivalves are among the most endangered freshwater taxa in the world. However, conservation planning and management are hindered by taxonomic problems and a lack of detailed ecological data. This highlights the urgent need for advances in the areas of systematics and evolutionary relationships within the Unionida. On the other hand, Unionida freshwater bivalves are quite interesting from the molecular viewpoint, as they transmit their mitochondrial genome (mtDNA) both maternally and paternally. Up to now, the majority of molecular studies uses single markers or a combination of a small number of markers to infer the phylogenetic relationships. Due to the recent arrival of high throughput sequencing equipment, sequencing prices have dropped and we are entering the Phylogenomic era. While for some vertebrate taxa the full genome comparison is already undergoing, for other taxa (like bivalves) there are still no studies available, mainly by the increased funds and bioinformatics resources needed. However, more practical and cheaper approaches have become available for phylogeny reconstruction mostly using reduced representations of the whole genome. Our study followed a distinct approach by sequencing big chunks (>10 kb) of DNA from three independent regions: the whole Female and Male mtDNA mitogenomes and one nuclear DNA fragment, the whole rDNA operon including 28S, 18S and 5.8S. The high order phylogenetic analyses of these three markers show distinct evolutionary histories that when analyzed alone might present conflicting results depending on the analytical methods used. In the present communication, the best analytical methods and combination of both Mitochondrial and nuclear ribosomal markers and phylogenetic analytical methods are discussed in the context of a new ongoing phylogenomic project for Unionida mussels. manuelpmlopeslima@gmail.com	

Platform 121 3:20 p.m. March 29, 2017	**APPLYING GENOMICS TO ADVANCE OUR UNDERSTANDING OF FRESHWATER MOLLUSKS.** Nathan V. Whelan[1], Paul D. Johnson[2], Jeffery T. Garner[3], Kenneth M. Halanych[4], Brain S. Helms[4], Ellen E. Strong[5]. [1]Southeast Conservation Genetics Lab, US Fish and Wildlife Service, Warm Springs, GA 31830; [2]Alabama Aquatic Biodiversity Center, Alabama Department of Conservation and Natural Resources, 2200 Highway 175, Marion, AL 36756; [3]Alabama Division of Wildlife and Freshwater Fisheries, 350 Co. Road 275, Florence, AL 35633; [4]Deparment of Biological Sciences, Auburn University, 101 Rouse Life Sciences Building, Auburn, AL 36849; [5]Department of Invertebrate Zoology, Smithsonian National Museum of Natural History, PO BOX 37012, Washington, DC 20560.

Few studies on freshwater mollusks have utilized genome-scale data. As the most imperiled group of organisms in North America, freshwater mollusks stand to gain much from increased study using cutting-edge genetic tools that provide for more accuracy and power than traditional markers (e.g., mitochondrial genes and microsatellites). Yet, mollusks lag behind many other groups in the amount of studies using high-throughput sequencing technologies. Here, we discuss potential of genome-scale studies for freshwater mollusk conservation and review ongoing studies on the gastropod family Pleuroceridae. Past mitochondrial-based studies failed to resolve the phylogeny of pleurocerid gastropods, arguably the freshwater mollusk group most in need of major systematic revision. We are utilizing a target-capture Illumina sequencing approach to cost effectively sequence hundreds of nuclear genes for over 70 pleurocerid species across their ranges. These genes will be used to infer a robust phylogeny so we can revise their classification, elucidate broad macroevolutionary (i.e. tempo and mode of diversification) and biogeographic patterns (i.e. comparative phylogeography), analyze the evolution of their diverse life history strategies (life span, fecundity, egg-laying behavior), and enhance management plans. Resolving relationships among species and genera is important to place our understanding of molluscan biology in an evolutionary framework, but much work is also needed to assess genetic structure of populations of individual species. We currently are focusing efforts on the federally threatened pleurocerid *Leptoxis ampla* using 2b-RAD sequencing. This approach will generate thousands of unlinked loci to measure effective population size and population connectivity across the species' range. Broadly, many advances in invertebrate biology over the next decade will result from studies using genome-wide sequencing. As freshwater malacologists with a considerable stake in managing highly imperiled species, we should all be aware of new technologies that can be used to enhance management plans of the animals we love.

Platform 122 3:40 p.m. March 29, 2017	**PRELIMINARY REPORT ON THE I-74 BRIDGE REPLACEMENT MUSSEL RELOCATION.** David Ford[1], Kristen Lundh[2], Emily Grossman[1], Heidi Dunn[1], Matthew Hill[3], Mary Kay Solberg[4], Felecia Hurley[5], Terry VanDeWalle[6], Stacey Parks[6]. [1]Ecological Specialists, Inc., O'Fallon, MO 63366; [2]U.S. Fish and Wildlife Service, Moline, IL 61265; [3]EcoAnalysts, Moscow, ID 83843; [4]Iowa Department of Transportation, Ames, IA 50010; [5]Illinois Department of Transportation, Springfield, IL 62764; [6]Stantec Consulting Services, Inc., Independence, IA 50644.

The I-74 bridge over the Mississippi River between Bettendorf, IA and Moline, IL crosses over a historic mussel bed, Sylvan Slough Bed, which is known to harbor at least 25 species, including three federally endangered species (*Cumberlandia monodonta*, *Lampsilis higginsii*, and *Plethobasus cyphyus*) as well as several state-listed species. Sylvan Slough is also a designated Essential Habitat Area for *L. higginsii.* IADOT, ILDOT, ESI, Stantec, USFWS, ILDNR, and IADNR worked together to devise a plan to minimize impacts to the mussel bed, and develop monitoring and mitigation designed to answer questions associated with relocation and recolonization. Although the area from which mussels were removed was limited to only direct impact areas in the densest portion of the mussel bed, this was one of the largest freshwater mussel relocations in the country. Approximately 140,000 mussels, representing 32 species, were collected by divers, marked, and relocated between August 1 and October 31, 2016. Relocated mussels were placed into previously approved relocation areas to assess the effects of augmenting existing assemblages with relocated mussels. Relocation sites will be monitored on average once every three years for the next 10 years to assess the health and survival of relocated and resident mussels. Federally endangered species were placed in grids to facilitate future monitoring as well as collection for genetic swabs and future propagation. The construction site will also be monitored to determine the effects of work activity in areas where mussels were not relocated, and to assess recolonization of areas where mussels were removed. Additional mitigation will include a poolwide survey of Pool 15, experimental habitat creation for *Cumberlandia monodonta*, and development of an educational program focused on freshwater mussels.

Platform 123 **4:00 p.m.** **March 29, 2017**	**PENNDOT HUNTER STATION BRIDGE REPLACEMENT: THE STORY OF THE LARGEST ENDANGERED SPECIES RELOCATION PROJECT IN THE WORLD; A TALE OF TEAMWORK, A TALE OF CONSERVATION AND RECOVERY.** Gregory F. Zimmerman[1], Autumn Kelly[2], Philip T. Mathias[1], Robert Anderson[3], Jordan Allison[4], Eric Chapman[5], Jennifer Kagel[3], Ryan Schwegman[1] and the Hunter Station Bridge Replacement Mussel Salvage Team (20+ members). [1]EnviroScience, Inc., 5070 Stow Rd., Stow, Ohio 44224, [2]Pennsylvania Department of Transportation District 1-0, 255 Elm St., Oil City, Pennsylvania, 16301, [3]U.S. Fish and Wildlife Service, Pennsylvania Field Office, 110 Radnor Rd.; Suite 101, State College, PA 16801, [4]Pennsylvania Fish and Boat Commission, Division of Environmental Services, 450 Robinson Lane, Bellefonte, PA 16823, [5]Western Pennsylvania Conservancy, Western Pennsylvania Conservancy Watershed Conservation Program, 1067 Philadelphia Street, Suite 101, Indiana, PA 15701
The S.R. 62 Hunter Station Bridge over the Allegheny River in northwestern Pennsylvania needed to be replaced. The bridge was a massive structure; a 1,050ft (320m) long, six span truss-type bridge that could only be decommissioned by dropping the superstructure into the river. Additional construction challenges included that the bridge was a major, critical roadway for the region with limited detour options and the 800ft (244m) wide, free-flowing river was too shallow to access at the site with barges. The Project footprint was found to be within a reach of the Allegheny River that supported the world's largest remaining populations of two endangered freshwater mussel species; the Clubshell (*Pleurobema clava*) and Northern Riffleshell (*Epioblasma torulosa rangiana*), which were once widely distributed throughout the Midwest, western New York and Pennsylvania, and southern Ontario. PennDOT assembled a team of federal, state, tribal, consultant and other non-profit partners to meet the challenges of the Project. PennDOT ultimately succeeded in receiving federal and state approvals to proceed with construction thanks to inter-agency cooperation and negotiated conservation commitments. The Project's direct and indirect impacts were offset by several key conservation measures, including minimization of the project footprint, project timing, salvage and relocation of resident mussels from project footprint prior to construction, and long-term monitoring. Overall, approximately 155,000 mussels were relocated to seven states and the Seneca Nation of Indians, and of these approximately 105,000 were endangered species. Small pilot monitoring projects on destination streams were initiated with Hunter Station mussels as far back as 10 years prior to construction. The numbers of mussels were then increased at the pilot sites in the streams with positive monitoring results. The majority (90%) of relocation occurred in 2015 and 2016, when mussels were salvaged and relocated over two summers to approved sites throughout the species historic ranges in PA, NY, OH, WV, KY, IL, IN, and the Seneca Nation of Indians. The mussels were salvaged and relocated using a multi-pass design by PennDOT's consultant team and partners, and to add to the challenges the entire impact area could only be accessed by diving. A quality assurance program was implemented to ensure animal recovery and survivorship goals were met, and overall survivorship (>90%) and mussel recovery (>90%) exceeded expectations. While the Project represented an impact to the stronghold of these two species, the implemented conservation measures could potentially re-establish viable populations of these endangered species throughout their historic ranges. We know of few other transportation projects that have successfully integrated various and widespread teaming partners to provide environmental benefit on this scale. In addition, PennDOT realized many benefits since most of the teaming partners provided independent or matching funds, which expanded the impact of the conservation measures while providing significant cost saving to PennDOT and the Federal Highway Administration. The presenters will discuss the project challenges and results to date, as well as discuss the project as a potential model for other transportation impacts to sensitive areas.	

POSTER SESSION ABSTRACTS

Monday March 27, 2017 – 6:00 – 10:00 p.m.

Conservation

Poster 1

"WHO'S GOT IT BETTER THAN US?" OTHER STATES THAT HAVE THEIR OWN FIELD GUIDES. MICHIGAN'S IS FINALLY COMING Renee Mulcrone, ASTI-Environmental and Joe Rathbun, Michigan Department of Environmental Quality

About 45 species of freshwater mussels in the family Unionidae are in Michigan watersheds. These include 20 state listed species (six of these include federally endangered species) and eight state special concern species. From late 1800s to the mid-1900s, freshwater mussels were an economic resource in Michigan for the button industry. Michigan also has a rich historical record of freshwater mussels, with shells deposited in the University of Michigan Museum of Zoology's (UMMZ) Mollusk Division. Most of these included collections from the late 1800s to the 1930s. While Michigan no longer allows a commercial harvest, the conservation of freshwater mussels requires the education of biologists and the general public. Unionid biologists have developed teaching materials and conducted workshops to train various watershed council members, MDNR employees, and non-profit organization members in the identification of mussels. However, this requires using guides from different states, provinces or regions (e.g. Ontario, Freshwater Mussels of the Midwest). A compiled and convenient resource to identify Michigan mussels is needed. This should include range maps, photographs with key identification features and general information specific to Michigan. Individual species accounts were written and published on the University of Michigan's Animal Diversity Web (ADW) for Michigan mussels (www.animaldiversity.org). Each account includes a physical description, a photo of a museum specimen (from Michigan Natural Features Inventory and Michigan State University), and a watershed map of the species' range in Michigan. The accounts were written on-line for use in identification. The Michigan Freshwater field guide will be a hard copy using information from the ADW web site, expanding the identification portion with additional photos from the UMMZ collection. Publication is anticipated next summer, with an on-line component. rsherman@umich.edu

Poster 2

INTRODUCING THE PUBLIC TO FRESHWATER MUSSELS VIA A HATCHERY PROPAGATION EXHIBIT Angela T. Padeletti[1], Danielle A. Kreeger[1,2], Kurt M. Cheng[1] , Victoria A. Prizzia[3] , Roger L. Thomas[2], Karen Young[4]; [1] Partnership for the Delaware Estuary, 110 South Poplar Street Suite 202, Wilmington, DE 19801; [2] The Academy of Natural Sciences of Drexel University, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103; [3] Habithéque Inc. 729 South 4th Street Suite 3, Philadelphia PA 19147; [4] Fairmount Water Works, 640 Water Works Drive, Philadelphia PA 19130

The Partnership for the Delaware Estuary coordinates a Freshwater Mussel Recovery Program (FMRP) with many partners in the Delaware River Basin (DE, NJ, PA). The FMRP strives to conserve and restore populations of native unionids to help achieve National Estuary Program goals related to ecological integrity and water quality. Hence, the program focuses on rebuilding natural species assemblages and distributions that promote the greatest ecosystem services. To address 2 of the 10 core elements of the FMRP, outreach and mussel seed production, a new mussel propagation exhibit is being launched in Philadelphia, PA. The exhibit is being constructed within the Fairmount Water Works Interpretive Center (FWWIC), which is a historic water supply museum on the banks of the Schuylkill River. The FWWIC promotes education regarding the importance of healthy ecosystems for clean drinking water. The permanent exhibit will be 530-square feet and will blend history, art and science. At the heart of the exhibit will be a functional hatchery where the public can learn about unionid life history and watch scientists perform experiments and propagate juveniles. Public outreach will include a website, videos, and a "Mobile Hatchery on Wheels" that will be in various public spaces throughout the city that welcomes 41 million visitors annually. Although outreach is the exhibit's top goal, it is being designed to produce viable mussel seed that can then be moved to suitable rearing ponds and eventually to targeted restoration streams and living shoreline project sites nearby. Hatchery propagation is a key bottleneck in widespread mussel recovery in the upper mid-Atlantic region. Additional propagation partnerships and a potential new production hatchery are being planned with partners in the mid-Atlantic to build on this new initiative. Until those plans mature, the FWWIC mussel exhibit will build awareness for the need and importance of mussel restoration. apadeletti@delawareestuary.org

Poster 3	**COMPARING UNIONID COMMUNITIES SURROUNDING THE FEDERALLY ENDANGERED SNUFFBOX PRE- AND POST-RELOCATION IN LYONS MICHIGAN, USA.** Kelsey R. Krupp[1]* and Daelyn A. Woolnough[1] [1]Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mt. Pleasant, MI, 48859. **STUDENT PRESENTATION*
	Over the years, studies have considered the unique life cycle and importance of freshwater mollusks (family: Unionidae). Research has shown evidence of the importance of unionids in ecosystems they inhabit and how they play significant roles in the environment in which they live. Dams can alter how rivers flow and can modify the sediment of the riverbed; mussel assemblage structure has doubtlessly been changed by human impacts, particularly in impounded streams. Mussel assemblages are important to understand as assemblage structure may play an important role in rare species persistence. The focus of this research is on the mussel assemblages surrounding the federally endangered Snuffbox (*Epioblasma triquetra*). We considered assemblages of the Snuffbox prior to (2013 and 2015) and post relocation (2016) at a dam removal site on the Grand River in Lyons, Michigan. Quantitative and semi-quantitative surveys were performed to detect and quantify the federally endangered Snuffbox in the Grand River, Lyons Michigan. In 2013 and 2015 quadrats ($1m^2$ x $1m^2$) were placed for 100% coverage in the area of impact from the future dam removal (2016) as highlighted in the USFWS Biological Opinion. All Snuffbox were documented, PIT tagged, and transported to a relocation site; habitat was quantified. In 2016, quadrats (0.25m x 0.25m) were placed over recaptured Snuffbox; unionid assemblage and abiotic habitat were quantified. Our hypothesis is that Snuffbox will have similar mussel assemblages at the relocation site as they did before the dam removal; 2013, 2015 and 2016 assemblages will be similar. Our analyses will consider which co-occurring mussels are sympatric with Snuffbox throughout the timeframe of this study. Mechanisms that structure mussel assemblages may help us explain patterns of imperilment and develop more of effective conservation strategies for these animals. Understanding whether Snuffbox maintain pre-relocation assemblages could be beneficial in future management of this species. krupp1kr@cmich.edu
Poster 4	**MOVING MUSSELS AS A MANAGEMENT TOOL DURING DAM REMOVALS: GROWTH, SURVIVAL, AND RECAPTURE OF SNUFFBOX IN THE GRAND RIVER, MICHIGAN USA.** Scott M. La Valley[1]* and Daelyn A. Woolnough[1] .[1]Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mt. Pleasant, MI, 48859. **STUDENT PRESENTATION*
	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 2013 we documented possibly the densest population of Snuffbox in the world; likely due to the upstream dam in Lyons, MI on the Grand River. In 2015 Snuffbox (n=86) and all co-occurring unionids in harm's way of a future dam removal were relocated to a chosen relocation site as requested in the USFWS Biological Opinion. Snuffbox were tagged with Passive Integrated Transponder (PIT) tags. In the summer of 2016 we returned to the relocation site to recapture the Snuffbox. We recaptured 37.2% of the relocated Snuffbox and documented a 75% survival rate. Relocated Snuffbox consisted of 54.6% and 45.3% males and females respectively; whereas recaptured Snuffbox were a similar 56.2% and 43.7% male and female respectively. However, survival of Snuffbox between relocation and recapture varied between sexes of the individuals found dead (25%); 75% of the recaptures were females and 25% were males. Growth of the recaptured individuals found alive was larger for males (mean = 10.3 mm) than females (mean = 3.8 mm). The growth data indicated that the Snuffbox not found alive may have died early after relocation because growth was minimal (males did not grow; females mean growth of 1.75 mm). We will present all recapture, growth, and survival data along with associated habitat data and analyses. 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. laval1sm@cmich.edu

Poster 5	**MOVEMENT OF THE FEDERALLY ENDANGED SNUFFBOX 1 YEAR POST-RELOCATION IN THE GRAND RIVER, MICHIGAN USA.** Rachel M. Paull[1]*, Kyle T. Sullivan[1] and Daelyn A. Woolnough[1] . [1]Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mt. Pleasant, MI, 48859 **STUDENT PRESENTATION*
	Movement of adult freshwater mussels (family: Unionidae) is thought to be minimal but is often not quantified. Snuffbox (*Epioblasma triquetra*) is a federally endangered unionid in the United States and Canada. However, in 2013 a large, reproducing population of Snuffbox was quantified in the Grand River, Michigan (Lyons, MI) immediately downstream of a dam that had been scheduled for potential removal. In 2015, due to the pending dam removal 86 Snuffbox were collected, PIT tagged and moved to a relocation site within the same reach of the Grand River. In 2016 we returned to the relocation site and used BioMark[tm] readers to recapture the relocated Snuffbox. We used ArcGIS and BioMark[tm] data to determine movement of the relocated Snuffbox over the one year period. We hypothesize that female Snuffbox move more than male Snuffbox due to their requirement to capture hosts. Also, a female Snuffbox is smaller so may be more susceptible to extreme flows and high water events that could create the downstream momentum of the mussel. We present the data on our Snuffbox recapture of the relocated mussels from this study. We show the upstream and downstream movements of the Snuffbox as well as the lateral movement relative to the thalweg. We also present the differences (with associated statistics) between the male and female Snuffbox. These data will aid in understanding the mechanisms that adult Snuffbox use in rivers post-relocation and how this species could be managed post-relocation. We will recommend future management of Snuffbox populations across North America which may also be relevant to unionid assemblages with similar situations (e.g., dam removals, relocations) to this population. paull1rm@cmich.edu
Poster 6	**EVALUATING THE LONG-TERM VIABILITY OF A REINTRODUCED POPULATION OF ENDANGERED OYSTER MUSSEL (*EPIOBLASMA CAPSAEFORMIS*) IN THE UPPER CLINCH RIVER, VIRGINIA.** Caitlin S. Carey[1], and Jess W. Jones[2]. [1]Conservation Management Institute, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. [2]U.S. Fish and Wildlife Service, Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.
	From 2006 to 2013, over 6,000 federally endangered oyster mussel (*Epioblasma capsaeformis*) were reintroduced at Cleveland Islands in the Upper Clinch River, Virginia, using translocation and captive propagation methods. Monitoring efforts at this site in 2011 and 2012 revealed successful settlement, high post-release survival, and evidence of recruitment (two individuals)—criteria representing three short-term measures of reintroduction success. Continued long-term monitoring was necessary in order to evaluate oyster mussel recruitment rates and determine if they are occurring at self-sustaining levels—a measure of long-term reintroduction success. To reveal whether recovery efforts were ultimately successful at restoring a long-term viable deme of oyster mussel, we conducted follow-up monitoring (2016) using a capture-mark-recapture sampling design similar to the 2011 and 2012 surveys to estimate abundance, apparent survival and recruitment rates, and detection probabilities. Similar to the previous study, we documented high post-release annual survival of translocated and released captively-propagated oyster mussels (>90%). In contrast to the 2011–2012 study where only one natural recruit was encountered across 10 mark-recapture passes, we collected ten natural recruits across three mark-recapture passes. Although there was not enough data on recruited individuals for mark-recapture models, our observations confirmed that recruitment is occurring and that recruitment rates have increased since previous monitoring efforts. Results from this follow-up monitoring, and future monitoring efforts, will improve our understanding of *E. capsaeformis* vital rates, and provide data on effective population sizes and demographics structures required to make informed decisions for future recovery projects.

Poster 7	**GAUGING THE READINESS OF CANDIDATE MUSSEL RESTORATION SITES USING TAGGED SENTINELS IN THE DELAWARE RIVER BASIN** Kurt M. Cheng[1], Danielle A. Kreeger[1, 2], Angela T. Padeletti[1], Roger L. Thomas[2], Spencer A. Roberts[1]; [1] Partnership for the Delaware Estuary, 110 South Poplar Street Suite 202, Wilmington, DE 19801; [2] The Academy of Natural Sciences of Drexel University, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103
	Freshwater mussels are the most imperiled of all aquatic animals in the United States despite their importance as ecosystem engineers and natural heritage. In most streams of the Delaware River Basin, few or no mussels remain where historical data suggest that most streams surveyed had once supported several of the 12 native species. In 2007, the Freshwater Mussel Recovery Program (FMRP) was designed and implemented with diverse partners with the goal of conserving and restoring native species of freshwater mussels throughout the watershed. As part of the FMRP, streams have been comparatively assessed for their ability to support mussel populations by tracking the survival and growth of more than 1100 mussels that were reintroduced into 12 historic waterways of southeast Pennsylvania and Delaware. Mussels were affixed with passive integrated transponder (PIT) tags, including both *Elliptio complanata* and *Pyganodon cataracta* in several cases. Reintroduction areas were chosen to best support mussels (e.g. adequate flow, presence of suitable substrate, adequate depth). Monitoring of mussels included PIT tag surveying with a electronic reader. Mussels that were found were measured for shell length. Despite extreme weather events (e.g. Hurricanes Irene and Sandy), monitored retention in deployment beds and shell lengths have shown promising trends. Bed retention rates by stream range from 0%-76% for up to five years post-deployment. At locations where mussels have persisted the longest, positive shell growth (>3% increase in shell length) demonstrates that those streams can be prioritized for next steps in the FMRP, possibly including reseeding with propagated juveniles. Drawing from such trends, an optimal monitoring period of adult mussels is suggested which will support future mussel restoration action. kcheng@delawareestuary.org
Poster 8	**CAGING AND REINTRODUCTION STUDIES TO EVALUATE HABITAT SUITABILITY AND RESTORATION PROSPECTS OF FRESHWATER MUSSELS IN DELAWARE** Spencer A. Roberts[1,2], Kurt M. Cheng[1], Angela T. Padeletti[1], and Danielle A. Kreeger[1,2] [1]Partnership for the Delaware Estuary, Wilmington, DE 19801; [2]Drexel University, Philadelphia, PA 19104 **STUDENT PRESENTATION*
	With over 90% of Delaware's waterways classified as impaired, state and regional agencies are eager to identify and implement nature-based restoration tactics that can potentially help sustain or improve water quality. Declines in Delaware's native freshwater mussel populations have prompted new initiatives to assess their ecosystem services, conserve biodiversity and rebuild populations. After baseline surveys identify mussel-poor and –rich areas, the next step to studying restoration streams and ponds via reciprocal transplant experiments. Several such transplant studies have been conducted in Delaware since 2014, building on lessons learned from similar work with partners in Pennsylvania since 2006. As one example, 200 adult eastern elliptio, *Elliptio complanata*, were collected from Blair's Pond, Milford, DE in June 2015 for reintroduction into 2 candidate restoration sites, the St. Jones River, near Dover, and Waples near Lewes, without extant mussel populations. Controls consisted of mussels that were both collected from and returned to Blair's Pond. Replicate groups of mussels were plastic-tagged. Half were held in cages and half were fitted with Passive Integrated Transponders (PIT) then free released. Subsamples of caged mussels were then sacrificed seasonally for 1 year to track changes in fitness, assessed as deviations in seasonal patterns of condition index and proximate tissue biochemistry, compared to reference controls. Seasonal PIT monitoring tracked bed retention, shell growth, and survival. Preliminary results of acute response from PIT monitoring suggest that both candidate restoration sites may now support mussel populations as the St. Jones and Waples sites retained 93% and 77% of PIT mussels after 1 year compared to 90% at the Blairs reference site. Analysis of chronic fitness metrics from caged mussels is underway. Dual monitoring of both acute and chronic mussel responses helps to ensure that candidate restoration sites have suitable food and habitat conditions, thus enhancing the success of subsequent, larger-scale restoration efforts. sroberts@delawareestuary.org

Poster 9	**FRESHWATER MUSSELS (Unionidae) IN THE DELAWARE RIVER AND THEIR POTENTIAL FOR USE IN LOCAL RESTORATION EFFORTS.** Roger L. Thomas[1], Danielle Kreeger[2,1], Kurt Cheng[2], Steven Donohue[3], Elena L. Colon[1], and Lance Butler[4]. [1]The Academy of Natural Sciences of Drexel University, Patrick Center for Environmental Research, Philadelphia, PA 19103, rlt47@drexel.edu; [2]Partnership for the Delaware Estuary, Wilmington, DE 19801; [3]US Environmental Protection Agency Mid-Atlantic Region 3 (3EA40), Philadelphia, PA 19103; [4]Philadelphia Water Department, Philadelphia, PA 19107.
	Freshwater mussels (Unionidae) play an important role in maintaining a healthy freshwater ecosystem and can be used as reliable indicators to evaluate water quality, habitat diversity and bottom stability in streams and rivers throughout the US. As filter feeders, mussels significantly reduce seston in the water thereby influencing water quality. Unfortunately, more than 70% of mussel species in North America are imperiled. During the last 100 years, decreases in mussel populations and species assemblages have been the result of habitat destruction due to land development, dam construction, and channel alterations, in addition to declining water quality. Since 2012, researchers from the Academy of Natural Sciences of Drexel University, the Partnership for the Delaware Estuary, USEPA Mid-Atlantic Region 3 and the Philadelphia Water Department have conducted quantitative and qualitative surveys on the tidal Delaware River between Trenton and Philadelphia to assess current mussel populations and the role of microhabitat factors in their distribution and community composition. Six taxa [*Elliptio complanata, Anodonta implicata, Pyganodon cataracta, Leptodea ochracea, Lampsilis cariosa* and *Ligumia nasuta*] have dominated the collections. High mussel population densities, up to129 individuals/m^2, were also recorded during the surveys, particularly at deeper sampling locations. Furthermore, the presence of juvenile mussels at several locations indicates that natural propagation has been occurring recently in this reach of the lower Delaware River. Data resulting from the surveys revealed several sites with freshwater mussel community composition and densities that would allow relocation of selected specimens to local streams that, historically, served as a refuge for mussels. In addition, the presence of gravid female mussels provides opportunities for propagation and use of seed for restoration purposes within the same drainage basin, where extensive surveys over the past 15 years have documented widespread and ongoing declines in these unionid species.
Poster 10	**SALVAGE OF FRESHWATER MUSSELS AFTER FAILURE OF LOCK AND DAM SIX ON THE GREEN RIVER.** Monte A. McGregor[1], Ken Kern[2], Rickard S. Toomey[2], Sunni L. Carr[3], Andrew T. McDonald[1], Travis Bailey[1], David Cravens[1], and Julieann M. Jacobs[1]. [1]Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, Kentucky, 40601. [2]Mammoth Cave National Park, Mammoth Cave, KY 42259, and [3]Kentucky Department of Fish and Wildlife Resources, 1 Sportsman's Lane, Frankfort, KY, 40601.
	The Green River is a large tributary of the Ohio River located in Tennessee and Kentucky. It historically supported 71 species of freshwater mussels and is considered the most biologically rich branch remaining of the Ohio River system. The Green River system has a series of 12 dams with construction dating from 1836 to 1969. On November 25, 2016, Lock and Dam 6 (completed in 1905) ruptured, causing the pool to drop ~ 10 feet and impacting water levels for up to 15 miles. The KDFWR in cooperation with the Park identified 6 areas that were dewatered. This included four known islands (in order from upstream to downstream): Sand Cave Island, Shoal near Sand Cave, Broadcut Island, Stice Island, Shoal near Stice Island, and Crump Island. We assembled 45 volunteers over a 4 day period to collect any stranded freshwater mussels. After 170 hours of effort, we collected 2,010 live mussels, and 394 fresh dead, representing 32 species, and 2 endangered (sheepnose, *Plethobasus cyphyus*, and fanshell, *Cyprogenia stegaria*). The most common species was the mapleleaf, *Quadrula*, representing 27% of all mussels. Other common species included the pink heelsplitter, *Potamilus alatus* (17%), plain pocketbook, *Lampsilis cardium* (14%), threehorn wartyback, *Obliquaria reflexa* (14%), and pimpleback, *Quadrula pustulosa* (8%). The lower site, Crump Island, had the largest dewatered area (~ 3-4,000m^2) and 32 species (1,380 live and 187 dead) were found on exposed shoals and bank edges. The species most impacted were the pink heelsplitter and fragile papershell (~ 20% mortality), while the least impacted was the mapleleaf (94% survival). Stice Island (~ midway of the affected area of the river) had 24 species, with the most common including the threehorn wartyback (30%) and pink heelsplitter (20%). The three most upstream areas were the least impacted, with 3 to 16 species and ~ 100 individuals. monte.mcgregor@ky.gov.

Poster 11	**BROOK FLOATER RANGEWIDE CONSERVATION AND RESTORATION INITIATIVE.** Sean Sterrett[1], Peter D. Hazelton[2], Ayla Doubleday[1,3], David Perkins[4], Allison H. Roy[1,5], Michelle D. Staudinger[5,6]; [1]Massachusetts Cooperative Fish and Wildlife Research Unit, Department of Environmental Conservation, University of Massachusetts, Amherst, MA 01003; [2]Massachusetts Division of Fisheries & Wildlife, Natural Heritage & Endangered Species Program, Westborough, MA 01581; [3]Connecticut River Watershed Council, Greenfield, MA 01301; [4]U.S. Fish & Wildlife Service, Cronin Aquatic Resource Center, Sunderland, MA 01375; [5]U.S. Geological Survey; [6]DOI Northeast Climate Science Center, University of Massachusetts, Amherst, MA 01003
	The Brook Floater (*Alasmidonta varicosa*) is a stream-dwelling freshwater mussel native to the Atlantic Slope of the United States and Canada that has experienced large population declines over the last 50 years and is at high risk of extinction. The species' distribution has been restricted to approximately 50% of its historic sites, is listed as Threatened or Endangered by most states where it occurs, and has been petitioned for listing under the federal Endangered Species Act. Five states within the region were awarded a competitive State Wildlife Grant (SWG) to increase range-wide cooperative conservation efforts and strategic planning towards reducing further population losses, and defining approaches for recovery of *A. varicosa*. Herein we provide a conceptual model of project approaches, where: (1) Project partners will build upon findings from a recently completed range-wide status assessment. (2) Partners will develop a conservation working group that will help to develop initial standardized surveys that will be conducted throughout partnering states to estimate abundances and predict occupancy of Brook Floater and associated SGCN mussels. (3) We will utilize Structured Decision Making approaches to focus monitoring design and conservation planning objectives at the state and regional scale. (4) We will coordinate the development of propagation methods and approaches for population restoration. (5) We will identify additional site-specific conservation and climate change adaptation actions to benefit *A. varicosa* and associated SGCN habitat.
Poster 12	**STRATEGIC HABITAT AND RIVER REACH UNITS FOR AQUATIC SPECIES OF CONSERVATION CONCERN IN ALABAMA-2016. E.** Anne Wynn[1], Patrick E. O'Neil[1], Stuart W. McGregor[1], Jeffrey R. Powell[2], Jennifer P. Grunewald[2], Anthony D. Ford[2], Paul D. Johnson[3], and Jeffrey T. Garner[3]. [1]Geological Survey of Alabama, P.O. Box 869999, Tuscaloosa, AL 35486; [2]U.S. Fish and Wildlife Service, 1208 Main St., Daphne AL 36526; [3]Alabama Division of Wildlife and Freshwater Fisheries, 2200 Hwy. 175, Marion, AL 36756
	State and federal agencies and NGOs (the Alabama Rivers and Streams Network [ARSN]) uses a watershed-based framework to focus activities on over 225 federally listed or state conservation priority species in Alabama and adjacent states. Based on the diversity and abundance of species present, 59 watersheds are designated Strategic Habitat Units (SHUs) or Strategic River Reach Units (SRRUs). Work includes: establishing population status for species of concern; outlining potential threats (e.g., presence of barriers such as dams); and determining the presence of designated critical habitat(s) and key habitat components for individual species. Achievements to date include: production of educational posters; publication of summary reports; removal of 3 relict dams; establishment of BMPs reducing sediment loading; 200+ fish IBI surveys; 1,500+ road/stream crossing surveys; an economic analysis assigning dollar values to ecosystem services; reintroduction of 17 mollusk species; 5 crayfish precluded from federal listing; and down-listing 1 gastropod. Continuing work includes: additional reports with detailed accounts of surveys and monitoring recommendations; an updated SHU map incorporating additional priority areas is now available online; road crossing survey data is being synthesized to identify fish barriers; another dam removal is being scheduled and another is in the early planning stages; an extension of the SHU program into Mississippi via Buttahatchee River us underway; an online database featuring public access to SHU data will go live by the end of the year; and fish IBIs for Cypress Creek will be completed and a summary report published. Thanks to the efforts of ARSN, stakeholders in a growing number of watersheds have the tools to engage more partners at the local level. This grassroots approach to watershed management provides an avenue for progress with results reflective of stakeholder input unique to Alabama—from economic interests to species conservation to water quality.

Poster 13	**EVALUATION OF RESTORATION EFFECTIVENESS OF FRESHWATER MUSSELS AT NINE SITES IN THE CLINCH AND POWELL RIVER, TENNESSEE AND VIRGINIA.** **J.** Murray Hyde[1] and Jess W. Jones[2]. [1]Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA, 24060. [2]U.S. Fish and Wildlife Service, Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA, 24060
	The Upper Tennessee River Basin is home to one of the most diverse freshwater mussel faunas in the United States. Restoration efforts have been ongoing in the Clinch and Powell Rivers in Virginia and Tennessee since 2004 as a result of two separate releases of hazardous substances. The objective of this study was to monitor mussel population restoration sites in these rivers and compare abundance and density estimates to those expected based on restoration efforts. We sampled nine sites using a systematic quadrat sampling design and estimated abundance and density for each site in 2015 and 2016. Release records of propagated mussels at these sites were compiled to determine expected abundance of released mussels. Data were compared to estimates from quadrat surveys. The total number of taggable sized mussels released at all sites since 2004 (including all species) was 62,358 and ranged from 1,028 to 15,443. Estimated abundances of the species released at each site ranged from 327 to 8,235 in 2015 and from 0 to 3,875 in 2016. In general, our quadrat abundance estimates were much lower than estimates based on past releases at these monitoring sites. In particular, two sites in the Clinch River, VA, where the mussel assemblages were completely destroyed as a result of a chemical spill, had substantially fewer mussels than would be expected, even assuming a conservative annual survival rate of 0.75. It is possible that annual survival at the monitoring sites is lower than expected or dispersal out of the immediate mussel release and monitoring area has occurred as a result of high flow events over the years. Further, it is likely that newly transformed juveniles are excysting from fish hosts in areas outside of the immediate release sites. Future study is needed to determine the degree of downstream dispersal of released mussels. jmhyde89@vt.edu
Poster 14	**PRIORITIZING MUSSEL BEDS TO CONSERVE BASED ON SIMILARITY TO THE PAST AND FEASIBILITY OF PROTECTION.** Traci Popejoy[1], Charles R. Randklev[2], Thomas Neeson[3], and Caryn C. Vaughn[1]. [1]Oklahoma Biological Survey, Department of Biology, and Ecology and Evolutionary Biology Graduate Program, University of Oklahoma, Norman, OK 73019; [2]Texas A&M, Institute of Renewable and Natural Resources, College Station, TX 77843; [3]Department of Geography and Environmental Sustainability, University of Oklahoma, Norman, OK 73019.
	Ideally, managers conserve ecological communities through efficient use of scarce conservation resources. However, there is often uncertainty about what baseline to conserve as communities shift due natural and anthropogenic disturbances and human's ideas of the 'natural' baseline shift due to cultural and scientific perceptions. Shifting baseline syndrome advocates for the inclusion of historical knowledge to inform conservation baselines, but sometimes does not address the feasibility of restoring to these historical baselines. In this study, we evaluate zooarchaeological records as a conservation baseline of the freshwater mussel community's species composition before Euro-American influence at a river-reach scale. But conservation in this region also experiences feasibility problems; limited resources, limited statutory power, and reluctant land-owners can inhibit conservation actions. For freshwater mussels, restoration actions can consist of riparian restoration, cattle fencing, and improved land-use management. Taking this approach, we evaluated the mussel community in the Leon River in Central Texas. We used fuzzy ordination to rank river reaches according to the similarity between present-day mussel assemblages and those in zooarchaeological samples. We also ranked reaches based on the feasibility of two conservation actions: protecting riparian forests and improving local land-management. This was done by evaluating the housing density near each reach (as a measure of property owners in the reach) and the land-use within a buffered zone to the river reach (to evaluate potential nutrient loading). We found that reaches above Lake Belton were similar in species composition and abundance to zooarchaeological sites and had many *Quadrula houstonensis* (a threatened endemic) but were in areas with high housing density that offered few avenues for restoration action. We evaluate this conservation trade-off and identify reaches that offer a balance between conservation benefit (i.e., reaches that contain the best mussel beds) and the feasibility of successfully carrying out restoration actions. tracipopejoy@ou.edu

Poster 15	**ST. REGIS RIVER DAM REMOVAL AND MUSSEL RESTORATION.** Jessica L. Jock, Saint Regis Mohawk Tribe Environment Division
	The Saint Regis Mohawk Tribe (SRMT) is the first Tribe in the United States to remove a FERC-licensed hydroelectric dam. The 2016 construction activities occurred in a unique section of the St. Regis River, shared by SRMT and New York State (NYS). To mitigate unintentional harm to freshwater mussels during construction activities, and reduce mortality from stranding, the SRMT Environment Division conducted an extensive Freshwater Mussel salvage and relocation effort coinciding with water drawdown over the period of June 30, 2016-July 27, 2016. The mussel salvage and relocation, a restorative action, was funded by the USEPA Great Lakes Restoration Initiative (GLRI) funds (GL-00E01943). Pre-construction surveys conducted over 8-working days identified 11-species present. Of the 11 species, four are New York State (NYS) Species of Greatest Conservation Need (SGCN): *Alasmidonta marginata, Lampsilis cariosa, Lampsilis cardium,* and *Ligumia recta*. During the dewatering activities, 66,539 freshwater mussels were salvaged. Of the 66,539 mussels salvaged, 6,717 were identified as SGCN and relocated and hand-planted in an upstream, un-impacted site. This poster will outline the June-September 2016 Mussel Restoration successes of the pre-construction surveys, mussel salvage and relocation, post-salvage monitoring, and Akwesasne Mohawk community volunteer activities in the St. Regis River. jessica.jock@srmt-nsn.gov
Poster 16	**CASE STUDY: GROUP 1 MUSSEL RELOCATION FOR THE CR 180 BRIDGE EPLACEMENT ON THE KOKOSING RIVER IN MORROW COUNTY, OHIO.** Megan M. Michael, Environmental Specialist 3, Ohio Department of Transportation – Office of Environmental Services.
	A Group 1 mussel survey and relocation was conducted in the Kokosing River at the CR 180 bridge during the summer of 2016. The purpose of this study was to move mussels out of the project area prior to the replacement of the bridge. Because the Kokosing River is very small at this location (approximately 50 square miles in drainage), the work was to be done in-house by ODOT biologists utilizing the methods outlined in the Ohio Mussel Survey Protocol. During the first day of survey work, biologists noted a very dense mussel bed within the project area. ODOT biologists worked closely with personnel from USFWS, ODNR, Ohio EPA, Kenyon College, and Columbus Zoo Mussel Propagation lab to collect and relocate the large number of mussels within the project area, and to find suitable relocation areas. Some of the mussels were also retained for use in mussel propagation studies. ODOT and USFWS biologists used alternate tactile and excavation methods for ensuring that buried, small adult, and juvenile mussels were collected and relocated over four field days. A total of 6,896 live mussels representing 12 species (including five state species of concern) were collected from the ADI, upstream and downstream salvage buffers, and downstream survey buffer. Of these, 6,861 mussels were relocated to five different relocation areas or taken to the Columbus Zoo propagation lab. Megan.michael@dot.ohio.gov

CONTAMINANTS	
Poster 17	**VALUING POLLUTANT REMOVAL BY UNIONOID MUSSELS AS AN ECOSYSTEM SERVICE.** Jennifer M. Archambault[1]*, W. Gregory Cope[1], Teresa J. Newton[2], and Heidi L. Dunn[3]. [1]Department of Applied Ecology, North Carolina State University, Raleigh, NC 27695; [2]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603; [3]Ecological Specialists, Inc., 1417 Hoff Industrial Dr, O'Fallon, MO 63366. **STUDENT PRESENTATION*
	As mussels filter water for nutritional gain, they also ingest pollutants. Because mussels comprise a large proportion of benthic biomass, and each individual may filter several liters of water/day, there is great potential for mussel populations to sequester large masses of pollutants. The purpose of this study is to quantify the ecological function of pollutant removal by North American native freshwater mussels and to conduct an economic valuation of their ecosystem services related to reducing pollutants for ecosystem and human well-being. The questions driving this research form a two-fold framework: (1) what economic and health benefits do mussels provide by removing pollutants; (2) what are the consequences of incidental pollutant sequestration to mussel communities? *The main objectives of the proposed research are: (1) use population estimates to calculate the total mass of pollutants sequestered by mussels; (2) conduct valuations of the economic benefit of pollutants removed by native mussels (e.g., water treatment), and the cost of ecosystem services lost from impacts on mussel populations (e.g., population decline).* To address these questions, the three dominant species from each of two pools in the Upper Mississippi River (UMR) were collected (*Amblema plicata, Fusconaia flava,* and *Lampsilis cardium* from Pool 5 and *A. plicata, Obliquaria reflexa,* and *Quadrula quadrula* from Pool 18), and soft tissues were analyzed for a suite of pollutants. In addressing Objective 1, a preliminary analysis of the average total metal tissue concentrations (for 22 metals) in the mussels collected, scaled up to the overall population estimates of 190 million and 212 million mussels in Pools 5 and 18 respectively, suggests that the mussel fauna from just these two pools in the UMR contained a total of 18.2 tons of metals. Our findings will provide insight on the economic benefits of environmental stewardship, allowing better communication with stakeholders and policy makers who may better understand the currency of economics than biodiversity and ecosystem integrity.
Poster 18	**ACUTE AND CHRONIC TOXICITY OF ALUMINUM TO A UNIONID MUSSEL (FATMUCKET, *LAMPSILIS SILIQUOIDEA*) AND AN AMPHIPOD (*HYALELLA AZTECA*).** Ivey CD[1], Wang N[1], Brunson EL[1], Cleveland D[1], Stubblefield WA[2], Cardwell AS[2], Eignor D[3] [1]USGS Columbia Environmental Research Center, Columbia, MO, USA; [2]Oregon State University, Corvallis, OR, USA; [3]USEPA, Washington, DC, USA
	The U.S. Environmental Protection Agency (USEPA) is reviewing the protectiveness of the national ambient water quality criteria (WQC) for aluminum (Al), and compiling a toxicity dataset to update the WQC for Al. Freshwater mussels are one of the most imperiled groups of animals in the world, but little is known about the sensitivity of mussels to Al. The objective of this study was to evaluate acute 96-h and chronic 28-d toxicity of Al to a unionid mussel (*Lampsilis siliquoidea*) and a commonly tested amphipod (*Hyalella azteca*) at a pH of 6 and hardness of 100 mg/L (as $CaCO_3$). Acute 50 % effect concentrations (EC50s) for survival of both species were >6,200 µg total Al/L, which was greater than any EC50s in the USEPA acute Al dataset for freshwater species at pH 5.0 to <6.5 and hardness of 100 mg/L. Chronic 20% effect concentrations (EC20s) based on mussel dry weight and biomass were 2.5-fold less than EC20s for amphipod dry weight and biomass. When including the chronic data from the present study in the USEPA chronic Al dataset at pH 5.0 to <6.5, the mussel (*L. siliquoidea*) would be the 4th most sensitive species and the amphipod (*H. azteca*) would be the 5th most sensitive species. The results indicate that the mussel and amphipod were insensitive to Al in acute exposures but sensitive to Al in chronic exposures. The USEPA draft revised acute and chronic WQC for Al would adequately protect mussels and amphipods tested; however, including the chronic data from the present study to recalculate the criterion would likely lower the proposed chronic criterion.

Poster 19	**RESPONSES OF JUVENILE FAT MUCKET (*LAMPSILIS SILIQUOIDEA)* TO ELEVATED CARBON DIOXIDE CONCENTRATIONS IN ACUTE AND CHRONIC EXPOSURES.** *Diane Waller*, Michelle Bartsch and Craig Jackson. USGS – Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603.
	Carbon dioxide concentrations in freshwater systems may be elevated above ambient levels from an array of anthropogenic (e.g., climate change, invasive species control) and natural sources (e.g., productivity, respiration, precipitation). The potential use of carbon dioxide to control Asian carp and dreissenid mussels prompted investigation into the effects of elevated pCO2 (partial pressure carbon dioxide) on unionid mussels under different scenarios. We measured responses of juvenile fat mucket (*Lampsilis siliquoidea)* mussels to elevated pCO_2 in acute (96 h) and chronic (28 d) exposures. Acute exposures were conducted in tandem with zebra mussels (*Dreissena polymorpha*) to compare efficacy of carbon dioxide to dreissenids and safety to native mussels. In addition to lethality, we assessed byssal thread formation and burial behavior of fat muckets. Survival of fat muckets was 100% after exposure to CO_2 concentrations of 178 to 457 mg/L while zebra mussel survival was <20%. Carbon dioxide induced fat mucket mussels to unbury and inhibited byssal thread formation. Recovery from carbon dioxide was evident at 1 week post-exposure as >40% of fat muckets were buried and >60% produced new byssal threads. In a second study, fat muckets were exposed to lower concentrations of carbon dioxide (32 to 118 mg/L) for 28 d to simulate potential exposure pattern from deployment of a CO_2 barrier for Asian carp control or supersaturation by other processes. Mortality exceeded 50% in juveniles exposed to ≥60 mg/L CO_2. Sublethal effects of carbon dioxide on growth were evidenced by reduced shell growth and body condition (dry tissue weight: shell length) and reduced chitinase activity. The results indicate that the response of freshwater mussels to elevated pCO2 varies with exposure pattern. Acute exposure to even extremely high pCO_2 appears to be safer to juvenile mussels than extended exposure to sublethal concentrations of carbon dioxide. dwaller@usgs.gov

ECOLOGY	
Poster 20	**FACTORS INFLUENCING THE DISTRIBUTION OF LEPTOXIS DILATATA IN THE UPPER NEW RIVER DRAINAGE IN NORTH CAROLINA.** Victoria C. Fowler, Susan R. Geda, Jordan N. Lollar, Michael M. Gangloff Biology Department, Appalachian State University, Boone, NC USA 28608-2027 **STUDENT PRESENTATION*
	The geologically-ancient headwaters of the Kanawha River originate in the Blue Ridge Mountains and support a number of endemic invertebrate and fish taxa. *Leptoxis dilatata* is a Pleurocerid snail endemic to the Kanawha Drainage that is considered a threatened species by the State of North Carolina. The objectives of this study were to compare recent and historical occurrence data to assess whether the range of *L. dilatata* has changed over the past decade and to assess the degree to which environmental factors are associated with *L. dilatata* occurrence at sites across the upper New River Drainage in northwestern North Carolina. We sampled 40 sites across the upper New River Drainage during spring 2016. At each site, we used five 30-second kick net samples to estimate the likelihood of detecting *L. dilatata* and measured a suite of water quality parameters (Temperature, DO, pH, conductivity) for use in habitat models. *Leptoxis dilatata* was detected at 25 of 40 (62%) sites and within-site detectability was 72%. Historical survey data (1996, 1997, 2005, and 2008) were available for 22 of 40 sites. Comparisons at repeatedly-sampled sites indicate that *L. dilatata* occupancy declined from 95% to 81% during recent surveys. Although this change is not statistically significant, we found that DO, pH and nitrate concentration were significant predictors of *L*. *dilatata* occupancy. Although *L*. *dilatata* remains abundant at many sites, changes to water and habitat quality associated with increased urban development and encroachment on riparian habitats in the headwaters coupled with a shift from row crop to ornamental agriculture and ex-urban development in the lower reaches of the watershed will likely continue to have profound effects on the distribution of this snail and other sensitive mollusk taxa in the upper Kanawha-New River Drainage.
Poster 21	**POPULATIONS ON THE BRINK: PREDICTIVE ESTIMATES OF TIME SINCE RECRUITMENT FOR *ELLIPTIO COMPLANATA* BY THIN-SECTION AGING OF DECEASED INDIVIDUALS.** Mark L. Kugler[1], Paul H. Lord[2], Andrew M. Gascho Landis[1,3]. [1] Department of Fisheries, Wildlife, and Environmental Science, State University of New York at Cobleskill, NY 12043. [2]Department of Biology, State University of New York at Oneonta, NY 13820. **STUDENT PRESENTATION*
	A hallmark of many freshwater mussel population declines is the failure of recruitment. Recent surveys in the upper Susquehanna drainage of New York found no evidence of recruitment for *Elliptio complanata*. Our goal was to determine the age distribution of dead individuals and to create a relationship between length and age for predicting the ages of the remaining living mussels in each population. Lack of catadromous American eel (*Anguilla rostrate*) hosts has been hypothesized as the cause for decline and date of last *E. complanat*a recruitment is thought to correspond to the time period which eel migrations ceased. Timed searches were conducted in 5 Susquehanna River tributaries for both live and dead *E. complanata*. Live samples were measured for length and returned to the river unharmed, while dead samples were returned to the lab for aging using standard thin-sectioning techniques. Length frequency of dead samples were consistent with those of live samples from each tributary. Length ranges for dead samples were between 71-136mm with live ranges between 76-144mm. Youngest ages of dead mussels ranged from 15-46y across all study areas; while the youngest predicted ages of living mussels ranged from 35-48y. Overall, this confirms aging populations with little to no recruitment in the past several decades. Our conservative estimates of time since last recruitment correspond to dam construction on the Susquehanna River creating impassible barriers for eels to migrate up tributaries and provide a host for *E. complanata*. While limited recruitment may be occurring on secondary hosts it appears that eels are important for the recruitment of large year classes of Elliptio. Supplemental stockings of American eel, in addition to the construction of eel ladders are recommended to promote recruitment of *E. complanata*. Kuglerm778@cobleskill.edu

Poster 22	**REPRODUCTIVE TIMING OF *ELLIPTIO COMPLANATA* IN AN UPPER SUSQUEHANNA RIVER TRIBUTARY.** Robin LaRochelle[1], Thomas Franzem[2], Paul Lord[2], Andrew Gascho Landis[1,3]. [1] Department of Fisheries, Wildlife, and Environmental Science, State University of New York at Cobleskill, NY 12043. [2]Department of Biology, State University of New York at Oneonta, NY 13820. **STUDENT PRESENTATION*
	Recent surveys of the freshwater mussel fauna of the Upper Susquehanna River drainage in New York have suggested that *Elliptio complanata* is experiencing widespread recruitment failure. Dams have cut off historic migration routes of American Eel, which because of their importance as hosts of *E. complanata* is hypothesized to be one of the main causes of lack of recruitment. It is however possible that bottlenecks in recruitment are due to problems in the other parts of the life cycle. The goal of this study was to determine if the relictual populations of *E. complanata* females are able to spawn, brood, and release glochidia successfully. To track spawning and brooding, gonad and gill extracts were completed on six occasions from April 22 to July 8, 2016 in Otego Creek, Otsego Co., NY. Drift nets were used to collect glochidia on six occasions from June 1 to July 8, 2016. Temperature and discharge data were collected during sampling events. Sex ratio of the population was 1 female: 0.77 male, and males often contained large quantities of sperm. Females began brooding fertilized eggs by mid-May, and by early June, 100% of captured females were brooding fertilized eggs or d-shaped glochidia. Temperature corresponding to all females brooding was 18 C, and when temperatures surpassed 20 C, the number of brooding females rapidly declined. Peak of glochidia drift occurred approximately one week after highest levels of brooding were recorded and continued at low levels for several weeks. Our evidence indicates that *E. complanata* in an Upper Susquehanna tributary successfully spawn, brood and release glochidia, making apparent that lack of a primary host is limiting recruitment. Stocking eels may become necessary, and our data show that stocking in the spring before water temperatures reach 20 C will allow for the highest level of host-parasite interaction. gaschoam@cobleskill.edu
Poster 23	**ASSESSMENT OF MICROHABITAT PREFERENCES FOR *EPIOBLASMA TRIQUETRA* ACROSS THE GREAT LAKES DRAINAGE USING PRESENCE-ONLY DATA.** Caitlin Beaver[1]*, Randal Piette[2], Daelyn Woolnough[1], and David Zanatta[1]. [1]Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI 48859 USA; [2]Wisconsin Department of Natural Resources, Oshkosh, WI 54901 USA. **STUDENT PRESENTATION*
	Epioblasma triquetra, the Snuffbox mussel, is an endangered species in the USA and Canada as a result of population declines and losses across its range. We collected microhabitat data from 178 (0.25 m x 0.25 m) quadrats where Snuffbox were present to determine if any specific parameters differed among sites and rivers where Snuffbox are present in the Great Lakes watershed. Parameters measured included water depth (cm), distance from the nearest bank (m), water flow (m/s), presence of woody material, percent macrophyte cover, percent algal cover, and percent substrate composition (e.g., sand, gravel, cobble). All quadrats were sampled from seven rivers in the Great Lakes watershed in Michigan, Ohio, and Wisconsin between 2013 and 2016. Approximately 75% the quadrats sampled were collected from the Wolf, Little Wolf, and Embarrass rivers of Wisconsin. Principal Component Analyses were conducted to evaluate relationships between parameters and groupings of quadrats by drainage and rivers. We found that water depth (cm) and distance to bank (m) explained the most variation in the samples collected from the Lake Michigan drainage, specifically the Wolf and the Little Wolf rivers. Distance to bank explained the most variation in the Wolf River. When the water depth and distance to bank parameters were removed to determine if any substructure existed in the data, the Embarrass River was further characterized by higher water velocity and sediments with higher components of cobble and gravel. Snuffbox microhabitats in the Clinton, Belle, and Huron rivers in the Lake Erie drainage of Michigan were best characterized by sediments dominated by sand and silt. Generally, data suggest that microhabitat preferences of Snuffbox may be different among sampled watersheds. Future research should be conducted to include quadrats where Snuffbox were not detected to further analyze the microhabitat patterns of this species. beave1c@cmich.edu

Poster 24	**COMPARISON OF CONDITION FACTOR AND AGES OF TWO SPECIES OF UNIONIDS FROM THE MAUMEE RIVER BASIN, OHIO, USA.** Nicole Dennis[1]*, Mandy Annis[2] and Daelyn A. Woolnough[1] [1]Department of Biology and Institute for Great Lakes Research, Central Michigan University (CMU), Mt. Pleasant, MI, 48859. [2]US Fish & Wildlife Service, East Lansing Ecological Services Field Office, 2651 Coolidge Road, Suite 101, East Lansing, MI, 48823. **STUDENT PRESENTATION*
	Condition of organisms is often difficult to quantify yet essential to understanding survival of populations or the health of an ecosystem. For unionids, there are a variety of methods that condition of communities and individuals has been gauged. Quantification of condition of unionids range from diversity and size classes to chemical analyses (e.g., glycogen). We collected Lampsilis siliquoidea (n=92 total from 6 sites; 3 rivers) and Elliptio dilatata (n=67 total from 3 sites; 2 rivers) from 3 tributaries of the Maumee River. We estimated age for all individuals via external annuli. Multiple estimates for age were made from all mussel researchers at CMU. Condition index (CI) was calculated using wet weight and lengths; we made a separate calculation of CI using wet tissue weight (wet weight - shell weight) and lengths to determine whether non-lethal estimates may correlate with lethal sampling. Our results show that ages of individuals were correlated with length and varied among sites, however variability of age estimates was higher in E. dilatata than L. siliquoidea. CI showed that trends within streams varied but CI was higher for L. siliquoidea than E. dilatata at the three sites where both were collected. Results also showed that CI was highest for L. siliquoidea at the upstream sites when compared to the downstream sampling sites; E. dilatata showed the reverse trend of decreasing CI within the one river that we had two sampling sites. We will show that CI for both species was significantly lower at the one site where we also sampled a large number of federally endangered Villosa fabalis. These data will aid in understanding the mechanisms that drive survivorship and sustainability of unionid populations. We will recommend future management of these species in the Maumee Basin which may also be relevant to unionid assemblages across North America.
Poster 25	**EFFECTS OF DENSITY AND SPECIES RICHNESS ON THE THERMAL TOLERANCE OF FRESHWATER MUSSELS IN THE GREAT LAKES REGION.** Megan C. Malish[1]* and Daelyn A. Woolnough[1]. [1]Department of Biology and Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI 48859. **STUDENT PRESENTATION*
	Understanding the effects of climate change on freshwater mussels has been identified as an essential issue of conservation by the Freshwater Mollusk Conservation Society (FMCS 2016). In this study, we will examine the impact of mussel density and species richness on the thermal tolerance of two species of freshwater mussel, *Lampsilis cardium* and *Amblema plicata*. These species were chosen because they are ubiquitous, common, and have been found to vary in their thermal tolerance (Spooner and Vaughn 2008). We will be measuring rates of resource acquisition, resource assimilation, and ecosystem services at incrementally increasing temperatures relevant to the Great Lakes region and predictions by the Intergovernmental Panel on Climate Change. We expect increases in the rates of physiological processes in response to rising temperature, but rates of increase are expected to vary by mussel species, mussel density, and species richness. We will then extrapolate our results to reaches in five rivers (4 tributaries and main branch) of the Grand River watershed in southwest Michigan where these species are found. When these data are extrapolated to mussel beds, we expect increases in mussel bed excretion (N:P ratio) and decreases in mussel bed clearance rates associated with increased relative abundance of a thermally tolerant species. We will be presenting our study design and analyses of species found in the five rivers of this study. malis1mc@cmich.edu

Poster 26	**QUANTIFICATION OF THE INTRASPECIFIC INTERACTIONS ON THE MOVEMENT OF THE FRESHWATER MUSSEL SPECIES *LAMPSILIS CARDIUM*.** Kyle Sullivan[1]* and Daelyn Woolnough[1]. [1]Biology Department and the Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, Michigan 48858, USA. **STUDENT PRESENTATION*
	Movement ecology is a critical component to helping understand how organisms interact with one another and their abiotic environment. The movement of freshwater mussels occurs at multiple scales and varies considerably depending on its life history stage. As adults, mussels are mostly sedentary, though will move vertically or horizontally to avoid adverse environmental conditions. With abiotic variation being the main facilitator of movement, less emphasis has been placed on understanding how biotic interactions of individuals within a patch of aggregated mussels influence movement patterns. We experimentally manipulated mussel abundances and sex-ratios in a laboratory setting to examine potential differences in movement of the freshwater mussel species *Lampsilis cardium*. Vertical and horizontal movements were documented twice daily during two 7 day trials. In 9 mesocosms we utilized a 3 x 3 factorial design of treatments consisting of sex-ratios and abundances. We found, sex-ratio influenced vertical movement while density affected horizontal movement. The interaction between sex-ratio and density influenced horizontal movement, but not vertical movement. Furthermore, mussels exhibited greater vertical movements in the day vs. night while differences between horizontal movement and time of day did not exist. Lastly, gravid females moved more vertically and horizontally when compared to non-gravid females. Understanding the underlying mechanisms behind the movement of freshwater mussels as they interact with the surrounding unionid fauna is essential to receive a holistic representation on these behavioral responses. The movement of unionids has implications for survival, giving mussels the ability to respond to disturbances and increase individual fitness. sulli2kt@cmich.edu
Poster 27	**A YEAR-LONG MARK-RECAPTURE STUDY OF THE THREATENED RABBITSFOOT MUSSEL (*QUADRULA CYLINDRICA CYLINDRICA*).** Bryce Maynard[1]*, Chris Barnhart[1], and Marc Owen[2]. [1]Department of Biology; [2]Ozarks Environmental and Water Resources Institute, Missouri State University, Springfield, MO 65897 **STUDENT PRESENTATION*
	Increasing instability in stream flow is a growing concern for freshwater mussels. The Federally threatened Rabbitsfoot (*Quadrula cylindrica cylindrica*) may be particularly vulnerable to these trends. The Rabbitsfoot is seldom buried, and is frequently observed in shallow habitat. This behavior may be an adaptation for contacting cyprinid host fish, which are attracted by a visual lure. We conducted a year-long mark-recapture study of a rabbitsfoot population at a site in War Eagle Creek in Northwestern Arkansas. A meso-scale habitat delineation was performed throughout the site to characterize areas by substrate particle sorting, average depth, and flow velocity. A total of 42 adult rabbitsfoot were marked with passive integrated transponder (PIT) tags and returned to the exact sites of initial capture. The mussels were subsequently relocated and identified without handling using an extended RFID antenna (Biomark). Point locations were recorded using benchmarks and an electronic total station (Topcon) with 1.6 cm accuracy. Relocation surveys were carried out with an average sampling interval of 37.2 days. Shell orientation to flow and substrate surface, and degree of burial were recorded. Sex of 27 individuals of the marked individuals (15 males and 12 females) was determined by post-survey gonad biopsy and/or by observing conglutinate release. Seven females were observed releasing conglutinates during May, and one of these individuals brooded a second time in June. A total of 378 position observations were recorded in 10 surveys over 372 days. Female rabbitsfoot traveled further overall (mean 3.7 m) than males (2.2 m) and moved further than males in 8/9 measurement intervals. Mean rate of movement increased abruptly in the spring. Comparing means in April and in May, movement increased from 7.5 to 71.1 cm/month in males, and from 13.3 to 78.0 cm/month in females. Mussels were typically at depths of 50 cm or less at base flow and nearly always on top of the substrate. Only two individuals were ever observed completely buried. Both sexes tended to orient with the long axis perpendicular to flow, lying their side, with their apertures pointed downstream. Movements of female Rabbitsfoot might attract the attention of fish hosts but the possible adaptive significance of male movements is unclear.

Poster 28	**LOCAL HABITAT EFFECTS ON THE ABUNDANCE AND DISTRIBUTION OF BROOK FLOATER (*ALASMIDONTA VARICOSA*) IN MASSACHUSETTS.** Ayla J. Doubleday[1,2], Peter D. Hazelton[3], Allison H. Roy[1,4], Andrew Fisk[2], and David Perkins[5]. [1]Massachusetts Cooperative Fish and Wildlife Research Unit, Department of Environmental Conservation, University of Massachusetts, Amherst, MA 01003; [2]Connecticut River Watershed Council, Greenfield, MA 01301; [3]Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program, Westborough, MA 01581; [4]U.S. Geological Survey; [5]U.S. Fish and Wildlife Service, Cronin Aquatic Resource Center, Sunderland, MA 01375.
	Brook Floater (*Alasmidonta varicosa*) have experienced large declines or have been extirpated throughout Massachusetts. There has been varying success in the ability to correlate Unionidae mussels to environmental predictors. At the reach (10 to 100-m) scale flow stability and substrate were the most important variables within a study in southeastern Michigan. However, little quantitative research exists regarding Brook Floater habitat. The objective of this study is to determine the extent to which local habitat (i.e., mesohabitat type, sediment size, depth) can explain the abundance or distribution of Brook Floater. There are four remaining populations of Brook Floater in Massachusetts, and in three of those populations we surveyed mussels in two or three 100-m reaches. At each reach the river was divided into meshohabitat type: slow riffle, fast riffle, scour pool (geological depression), dammed pool (block in water flow), or run. Four to seven surveyors used snorkels and view buckets to collect mussels while swimming or walking upstream within non-overlapping longitudinal transects (hereafter, "lane") to encompass the entire width of the river. Within each lane, we also measured depth (mean and maximum), the presence of emergent vegetation, submerged vegetation, and algae, and the proportional area containing large wood. At the mesohabitat scale, we measured canopy cover, bed texture, and proportions of vegetation, algae, and wood. A total of 21 Brook Floater were found in our preliminary surveys. Mussel length ranged from 34-mm to 68-mm. Brook Floater occurred in three different mesohabitats: scour pools (n=5), dammed pools (n=5) and runs (n=11). The lanes within the mesohabitats where Brook Floater occurred ranged in depth from 7-cm to 97-cm. The median particle size of scour pools, dammed pools and runs was 23-mm, 25-mm and 38-mm, respectively. Results from these initial surveys combined with additional survey sites and water quality data will be used to better define habitat use of Brook Floater in Massachusetts. ajdoubleday@gmail.com
Poster 29	**AGE VERIFICATION AND GROWTH-INCREMENT ANALYSIS OF UNIONID MUSSEL, OBLIQUARIA REFLEXA, FOUND IN THREE EAST TEXAS RIVER BASINS.** Wayne P. Hall, Megan C. Hess, Geoff Szafranski, Kelsey M. Marshall, Kentaro Inoue, Eric Tsakiris, Charles Randklev. Texas A&M, Institute of Renewable and Natural Resources, Dallas, TX 75252
	Rings deposited yearly in shells of unionid mussels (i.e., annuli) are often used to determine the age and growth of individuals. These rings result from the change in growth rates in different thermal and hydrologic regimes of streams, which are regulated by seasonal climate variability. However, there has been much debate over whether this technique can be applied to mussel species occurring in subtropical regions where winter temperatures are mild, and as a result, growth may occur year-round, which could preclude the development of conspicuous annuli. It is important to determine whether or not this is the case because subtropical regions of North America, including the west Gulf Coastal Plain, harbor a number of endemic mussel species for which information on age and growth is generally lacking. In this study, we explore whether internal rings in shells of *Obliquaria reflexa* (threehorn wartyback), distributed across three river basins in east Texas, can be interpreted as annual growth. Individuals from these populations were vouchered and their shells processed following standard methods for preparing and interpreting shell thin sections. Although this project is ongoing, preliminary results indicate synchronous growth among individuals within populations. This information validates the use of dendrochronology techniques to assess age and growth for species of mussels inhabiting subtropical regions. The results of this study will be useful for conservation efforts in temperate regions, and perhaps subtropical regions, focused on developing age-based population models or investigating population performance in response to environmental stressors. Hall.p.wayne@gmail.com

Poster 30	**CRUSHING RESISTANCE OF FRESHWATER SNAIL SHELLS ALONG ENVIRONMENTAL GRADIENTS.** Kevin Hart[1], Riccardo Fiorillo[2], Christopher Brown[2], and Russell Minton[1]. [1]Department of Biological and Environmental Sciences, University of Houston Clear Lake, Houston, TX 77058; [2]School of Science and Technology, Georgia Gwinnett College, Lawrenceville, GA 30043.
	In freshwater snails, shell morphology is correlated with environmental conditions including flow rate and water depth. In rivers, snails follow Ortmann's rule, where those occurring downstream possess shells that are more robust, sculptured, and globose than their upstream counterparts. These differences may be due to predation and protection against tumbling and dislodgment. We measured shell strength in four nominal morphotypes of *Lithasia* (Pleuroceridae) species from the Duck River, Tennessee and compared it to shell shape and river position. We present comparisons of the different forms and discuss the results in the context of adaptation to clinal freshwater habitats.
Poster 31	**SCALE-DEPENDENT ENVIRONMENTAL FACTORS INFLUENCE FRESHWATER MUSSEL ASSEMBLAGES IN AN OHIO RIVER SYSTEM** Clarissa Lawlis[1], S. Mažeika P. Sullivan[2], Daniel E. Symonds[2,3] [1]Lewis Environmental Consulting, LLC, Baltimore, OH 43105.[2]The Ohio State University, School of Natural Resources, 2021 Coffey Road, 210 Kottman Hall, Columbus, OH 43210 *STUDENT PRESENTATION
	Untangling the relative influences of hierarchically-structured environmental characteristics on riverine biota has proven challenging, in spite of significant research on the subject. For freshwater mussels, whose larvae are obligate ectoparasites on fish, mussel assemblage characteristics should also be influenced by the distribution and abundance of cohabitating fish assemblages. We conducted coordinated surveys of fish and mussel assemblages at 20 reaches in Big Darby Creek, Ohio, USA. For each reach, we also collected environmental data at local- (i.e., riparian land cover, stream hydrogeomorphology) and catchment- (i.e., drainage area, catchment land cover) scales. Partial constrained ordination indicated that environmental and fish datasets explained the majority of variation in mussel assemblages, with the environmental component being most important. Local-scale factors appear to predict more variation than catchment-scale factors. Fish assemblage density and evenness accounted for very little mussel assemblage variation. Thus, although fish have been shown to be strong predictors of mussels, in certain environmental contexts, environmental factors at both fine and broad scales may be the strongest determinants of mussel assemblage structure. Our results reinforce the notion that conservation and management efforts of freshwater mussels should consider a hierarchical suite of environmental factors. symonds.13@osu.edu
Poster 32	**SMALL SCALE SPATIAL PATTERNS OF FRESHWATER MUSSELS IN THE UPPER MISSISSIPPI RIVER.** Patricia Ries, Nathan De Jager, Teresa Newton, and Steve Zigler. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.
	Occurrence of Unionid mussels is often clustered, but a useful definition of these "beds" is lacking because little is known about their scale or structure. We recently assessed spatial patterns of native mussels in the Upper Mississippi River using data from large-scale (i.e., >300 m) systematic mussel surveys. That study suggested that multiple mechanisms might contribute to spatial structure in mussel distributions, and a nested or hierarchical sampling might provide improved information for conservation purposes. Currently, we are assessing spatial patterns in the mussel distributions at finer scales to address information gaps, and evaluate the variation and scale of patchiness. Using existing datasets with quantitative sampling from within a mussel bed (i.e., < 300 m scale), we quantified spatial patterns of both adult and juvenile mussels using Moran's I. Next, we identified any statistically significant spatial clusters within the bed using a hot spot analysis. Successful restoration efforts for native mussels will benefit from knowledge of where these aggregations occur, where the highest density areas are, and how they are spatially structured. Quantifying the spatial patterns of mussels across a range of scales will lead to more informed habitat restoration efforts to benefit mussels.

Poster 33	**ECOSYSTEM EFFECTS OF FILTERING BY *ANODONTA ANATINE*** Jouni Taskinen Department of Biological and Environmental Science, University of Jyväskylä, P.O. Box 32, FI-40014 Jyväskylä, Finland,
	Mussels filter phytoplankton, bacteria and detritus from the water and biodeposit pseudofecaes to river bottom, thereby transporting nutrients from the water to the river bed and supporting benthic invertebrates and fish populations. Mussel shells create habitat for epiphytic and epizoic organisms, stabilizes sediment and provide refugia for benthic fauna. Mussels decrease chlorophyll-*a* content and clear the water. Bioturbation of sediments through mussel movements increases sediment water and oxygen content. Thus, unionoid mussels may provide important services and link different trophic levels in river ecosystems. We studied effects of the duck mussel, *Anodonta anatina*, on phytoplankton and water quality in a 48-h laboratory/mesocosm experiment. Mussels decreased total phytoplankton cell count to one fifth of the control, but they were selective. Density of small Cryptophyceae flagellates (e.g. *Cryptomonas* sp.) decreased by a factor of 1:15, and density of big diatoms decreased to half in mussel containers compared to controls. However, effect on blue green algae was not evident, and there was no effect on the rest of algae species combined. Biomass of photosynthetically active phytoplankton measured photometrically (Scufa) decreased significantly in mussel containers. In addition, presence of mussels also increased nitrogen and phosphorus concentrations, as well as turbidity, and decreased pH of the water in experimental containers. Results support the view that freshwater mussels can significantly affect phytoplankton. Furthermore, the results show that *A. anatina* can selectively feed on Cryptophyceae flagellates – a group which often dominates phytoplankton and plays an important role in aquatic food webs. Thus, filtering activity of a dense mussel bed can potentially influence water quality and function of freshwater ecosystem. jouni.k.taskinen@jyu.fi
Poster 34	**HEAVY LOADS OF PARASITIC FRESHWATER PEARL MUSSEL (MARGARITIFERA MARGARITIFERA L.) LARVAE IMPAIR FORAGING, ACTIVITY, AND DOMINANCE PERFORMANCE IN JUVENILE BROWN TROUT (SALMO TRUTTA L.).** Filipsson K[1,2], Petersson T[2], Höjesjö J[1], Piccolo J.J[2], Näslund J[1], Wengström N[1,3], Österling E.M[2] [1]University of Gothenburg, Department of Biological and Environmental Sciences. SE 405 30 Gothenburg, Sweden. [2]Karlstad University, Institution for Environmental and Life Sciences. SE 651 88 Karlstad, Sweden. [3] Swedish Anglers Association, Sjölyckan 6, SE 416 55 Gothenburg, Sweden
	The life cycle of the endangered freshwater pearl mussel (*Margaritifera margaritifera*) includes a parasitic larval phase (glochidia) on the gills of a salmonid host. Glochidia load has been shown to affect both swimming ability and prey capture success of brown trout (*Salmo trutta*), which suggests possible fitness consequences for host fish. To further investigate the relationship between glochidia encystment and behavioral parameters in brown trout, pairs (n = 14) of wild-caught trout (infested vs uninfested) were allowed to drift feed in large stream aquaria and foraging success, activity, agonistic behavior, and fish coloration were observed. No differences were found between infested and uninfested fish except for in coloration, where infested fish were significantly darker than uninfested fish. Glochidia load per fish varied from one to several hundred glochidia, however, and high loads had significant effects on foraging, activity and behavior. Trout with high glochidia loads captured less prey, were less active, and showed more subordinate behavior than fish with lower loads. Heavy glochidia loads, therefore, may negatively influence host fitness due to reduced competitive ability. These findings have implications not only for management of mussel populations in the streams, but also for captive breeding programs which perhaps should avoid high infestation rates. Thus, low levels of infestation on host fish which do not affect trout behavior but maintains mussel populations may be optimal in these cases. karl.filipsson91@gmail.com

GENETICS	
Poster 35	**DEVELOPING A QPCR ASSAY FOR THE DETECTION OF THE FEDERALLY ENDANGERED SPECTACLECASE MUSSEL.** Diane Waller, Yer Lor, and Christopher Merkes. USGS - Upper Midwest Environmental Sciences Center, La Crosse, WI 54603.
	Cumberlandia monodonta, or the spectaclecase mussel, is a federally endangered freshwater mussel historically found throughout the Mississippi, Ohio and Missouri River basins that is now predominantly concentrated in two rivers (Gasconade and Meramec Rivers) in Missouri and the St. Croix River in Wisconsin. Despite numerous studies, the fish host of the spectaclecase has not been identified. We developed a quantitative polymerase chain reaction (qPCR) assay that is specific for the spectaclecase mussel. We used the qPCR assay to identify glochidia collected from wild caught fish as spectaclecase mussel or not in a search to determine potential fish hosts. Our assay will also be used to determine whether these mussels occupy waters that are currently being invaded by the molluskivore Black Carp (*Mylopharyngodon piceus)* using environmental DNA methods. Additionally, we will test the feces of Black Carp captured from waters where the spectaclecase mussel co-occurs to determine if Black Carp are using them as prey. The availability of this qPCR assay will greatly assist in the conservation and management of spectaclecase mussels through multiple applications. dwaller@usgs.gov
Poster 36	**REDUCING FALSE DETECTIONS IN eDNA METABARCODING DATA FROM FRESHWATER MUSSEL COMMUNITIES.** Grayson R. Patton[1] and David M. Hayes[2]. [1]Science Department, Surry Community College, 630 South Main Street, Dobson, NC, 27017; [2]Department of Biological Sciences, Eastern Kentucky University, 521 Lancaster Ave., Richmond, Ky, 40475.
	The field of eDNA metabarcoding has seen rapid improvements in all aspects, from sample collection to data analysis. eDNA metabarcoding of freshwater mussels can be particularly challenging because species richness at a site may be very high (up to 70 species in some south eastern drainages), however many species may have mtDNA divergences below the 3% divergence typically used in metabarcoding studies. Additionally, some mussel lineages have been shown to have mtDNA divergences exceeding 15%. Using a predefined percent identity threshold for identifying freshwater mussel eDNA may lead to misleading results, including false detections. Further complicating mussel eDNA sequence identification is the size and completeness of the reference database used for identification. Fully complete reference databases may produce false hits for closely related species that have low mtDNA divergence, but are geographically isolated. Sample site reference databases or drainage specific reference databases may be useful for reducing this type of false detection. In this study, we compare methods of assigning eDNA reads to mussel references sequences and the impact of reference database size. We use two sequence classification tools; Basic Local Alignment Search tool (BLAST) which uses a % identity threshold for identification and Evolutionary Placement Analysis (EPA) in RAxML which is a maximum likelihood approach for placing reads on to a reference tree. We also explore the size and comprehensiveness of the reference database using reference databases at the site, drainage, and continental scale. Our results show that the using EPA produces fewer false detections than BLAST. Also, our results demonstrate that the use of a site specific reference database produces less false detections than a globally comprehensive reference database. Reference database size did not influence the number of positive detections, however, more comprehensive reference databases are still vital for improving positive detections.
Poster 37	**NEXT-GENERATION SEQUENCING TOOLS FOR CONSERVATION AND GENETIC ASSESSMENT OF UNIONID MUSSELS: A BRIEF OVERVIEW OF WHOLE GENOME SEQUENCING, MITOCHONDRIAL ASSEMBLY, AND GENOTYPING-BY-SEQUENCING.** Katie Bockrath[1], Emy Monroe[1], Nathan Eckert[2], Tam Smith[3]. [1]US Fish and Wildlife Service, Midwest Fisheries Center, Onalaska, WI 54650; [2]US Fish and Wildlife Service, Genoa National Fish Hatchery, Genoa, WI 54632; [3]US Fish and Wildlife Service, The Twin Cities Ecological Services Field Office, Bloomington, MN 55425.
	With many of the native unionids mussel species in decline, identifying species and populations of most concern is important for the long-term conservation and future restoration of North American Unionids. Molecular markers for species identification and population assessment have historically been limited in Unionids, but with the ever decreasing cost of next-generation sequencing techniques, generating large sequence datasets across multiple individuals, populations, and species is increasingly more obtainable. Here, we describe the next-generation sequencing methods currently used at the USFWS Midwest Fisheries Center for the conservation and genetic assessment of unionid mussels. Whole genome sequencing and mitochondrial genome assembly is described for the development of additional mitochondrial markers and for the evolutionary comparison of mitochondrial genomes. Additionally, the use of Genotyping-by-Sequencing to generate thousands of nuclear Single Nucleotide Polymorphisms is described for the population genetic assessment of two threatened unionids (*Lampsilis higginsii* and *L. abrupta*) across their range.

Poster 38	**HAVE YOU SWORN AT PIGTOES RECENTLY? PHYLOGENETICS OF PLEUROBEMINI** Kentaro Inoue[1], David M. Hayes[2], John L. Harris[3], Nathan A. Johnson[4], Cheryl L. Morrison[5], Michael S. Eackles[5], Tim L. King[5], Alan D. Christian[6], Charles R. Randklev[1]. [1]Institute of Renewable Natural Resources, Texas A&M University, College Station, TX 77843 USA, [2]Department of Biological Sciences, Eastern Kentucky University, Richmond, KY 40475 USA, [3]Department of Biological Sciences, Arkansas State University, Jonesboro, AR 72467 USA, [4]US Geological Survey, Wetland and Aquatic Research Center, Gainesville, FL 32653 USA, [5]US Geological Survey, Leetown Science Center, Kearneysville, WV 25430 USA, [6]School for the Environment, University of Massachusetts Boston, Boston, MA 02125 USA.
	The Pleurobemini (Unionidae) represents approximately one-third of mussel diversity in North America. Species identification within this group is particularly challenging due to prevalent morphological convergence and phenotypic plasticity with regard to shell morphology. Because many species in the group are currently imperiled, accurate species identification as well as identifying currently unrecognized taxa is required to develop effective conservation strategies. We examined 521 *cox1* gene sequences of Pleurobemini (60 species in eight genera) in order to better understand phylogenetic relationships among species (mainly *Fusconaia*, *Pleurobema*, and *Sintoxia*) and delineate species boundaries. Network analyses showed *Pleurobema* to be polyphyletic with *P. collina*, *P. cordatum*, *P. plenum*, and *P. stabile* aligned elsewhere. The results of phylogenetic analyses generally followed similar patterns to the network analyses. We found little or no phylogeographic pattern within widespread species (e.g., *F. flava*, *F. subrotunda*, *P. cordatum*, *S. rubrum*, and *S. sintoxia*). Additionally, the results illustrated close relationships between *Elliptio lanceolata* and *P. collina* and aligned *P. cordatum* within the *Fusconaia* clade. Furthermore, the results revealed that some clades formed species complexes, including *P. hanleyianum* and *P. troschelianum*; *P. chattanoogaense* and *P. decisum*; *P. clava* and *P. oviforme*; *S. rubrum* and *S. sintoxia*; *F. askewi*, *F. chunii*, and *F. lananensis*; and *F. cerina* and *F. flava*. Finally, we identified multiple currently unrecognized taxa, including three unique lineages of *Fusconaia* and one unique lineage of *Sintoxia*. Further investigation requiring additional genetic markers and population genetic analyses is necessary before taxonomic changes are formalized. kentaro.inoue@ag.tamu.edu
Poster 39	**MOLECULAR PHYLOGENETIC AND GEOMETRIC MORPHOMETRIC EVIDENCE FOR CRYPTIC TAXA WITHIN THE *LAMPSILIS TERES* (RAFINESQUE, 1820) SPECIES COMPLEX.** Sean Keogh[1,2]* and Andrew Simons[2,3]. [1] University of Minnesota Conservation Sciences Graduate Program, [2] Bell Museum of Natural History, [3] University of Minnesota Department of Fisheries, Wildlife & Conservation Biology. *STUDENT PRESENTATION
	The identification of species diversity is essential for conservation, management and evolutionary biology. It is particularly important for understudied and imperiled groups of organisms like freshwater mussels (Family Unionidae), because diversity can be lost faster than it is described. Traditionally, species descriptions of unionid mussels relied on the morphology of these phenotypically plastic organisms. One such species, *Lampsilis teres,* has two distinct morphotypes. These have been variously classified as different subspecies, *L. teres teres* and *L. teres anodontoides*, implying underlying genetic variation, or considered morphological variants resulting from ecophenotypic plasticity. These morphotypes have not been investigated critically using both molecular and quantitative morphological data. The objective of this study was to determine if these morphotypes are indicative of intra- or interspecific variation, by a) quantifying morphological and molecular variation within *L. teres*, b) determining if genetic variation correlates with the morphological variation, and c) examining this variation in the context of phylogeny. In the summer of 2016 we obtained *L. teres* specimens across most of its distribution including the Wisconsin and Embarrass Rivers where we collected specimens with the *L. t. anodontoides* morphology. We sequenced the mtDNA COI gene of all *L. teres* as well as outgroups *Lampsilis floridensis, Lampsilis straminea* and *Lampsilis siliquoidea*. The *L. t. anodontoides* individuals were genetically distinct at the COI locus and preliminary analysis suggests they do not even exhibit a sister relationship to the *L. t. teres* group. Additionally, phylogenetic analysis suggests the existence of a cryptic species within *L. straminea* on the Gulf Coast.

Poster 40	**PHYLOGENETIC AND EXPERTS IDENTIFICATION OF "LOOK-ALIKE" FRESHWATER MUSSEL SPECIES BELONGING TO THE GENERA *FUSCONAIA* AND *PLEUROBEMA* IN THE GREEN RIVER, KENTUCKY.** Miluska O. Hyde[1], Jess W. Jones[1,2], and Eric M. Hallerman[1]. [1]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA 24061-0321. [2]U.S. Fish and Wildlife Service, Blacksburg, VA 24061-0321
	Species from the genera *Fusconaia* and *Pleurobema* are particularly difficult to morphologically identify. Morphological and genetic data are needed to improve accuracy of field survey identifications and make population genetics-based management decisions on augmentation, reintroduction and monitoring activities for these mussels, especially for species such as rough pigtoe (*Pleurobema plenum*) and clubshell (*Pleurobema clava*). In this study, the main objective was to determine the phylogenetic relationships of mussel species in the genera *Fusconaia* and *Pleurobema* using mitochondrial DNA markers (*COI* and *ND1*). We collected 209 individuals including *F. flava*, *F. subrotunda*, *P. cordatum*, *P. plenum*, and *P. sintoxia*/*P. rubrum* from the Green River, Kentucky (KY). Regions from *COI* (158 bp) and *ND1* (814bp) were amplified for 205 and 203 individuals respectively. The sequences were used to construct three Bayesian trees (*COI*, *ND1*, and *COI* + *ND1*). We used reference *ND1* sequences from previous studies to define our species, and compared our identification with those of experts. The results suggested that the probability of the experts correctly identifying a mussel belonging to these species ranged from 0.55 to 0.83.
Poster 41	**IDENTIFICATION OF SPHAERIID CLAM POPULATIONS IN THE CHIHUAHUAN DESERT** Ethan E. DeVillez[1], Steven R. Hein[1], Ashley D. Walters[1] and David J. Berg[2] [1]Department of Biology, Miami University, Oxford, OH 45056. [2]Department of Biology, Miami University, Hamilton, OH 45011 **STUDENT PRESENTATION*
	Among freshwater ecosystems, springs and spring fed waterways in arid environments support a disproportionate share of species diversity due to extreme habitat patchiness, stable environmental conditions, and long-term geographic isolation. The Chihuahuan Desert supports high levels of aquatic species endemism making this an attractive region for biogeographic and conservation inquiry. The Davis Mountain Preserve (DMP), located in Jeff Davis County of western Texas and managed by The Nature Conservancy, hosts a number of springs, small spring-fed streams, and cattle tanks. Within the preserve, small sphaeriid clams can be found in the benthic zones of these waterways. Many sphaeriid species are considered to be cosmopolitan with continental distributions, and therefore, may exhibit broader distribution trends than other aquatic desert invertebrates. We surveyed four small creeks and one cattle tank in the DMP and one additional spring roughly 120 km east of the preserve for the presence of sphaeriids. We used external shell characteristics to make species identification. In total, we identified four species and found only one species at each individual site. Specimens from three of the creeks were identified as *Sphaerium nitidum*, the forth creek as *S. traversum*, from the cattle tank as *S. lacustre*, and the spring outside of the DMP as *Pisidium fallax*. We are currently in the process of sequencing the mitochondrial COI and ND1 genes for each population to confirm our species identifications and for insight as to how sphaeriid populations are distributed throughout the region. Additionally, we are using geometric morphometric analyzes to look for evidence of intraspecies morphological variation. Sphaeriid populations in west Texas are poorly known and to our knowledge no published information describes which species are present. Our study aims to shed light on patterns of biodiversity in arid regions and the conservation implications of these patterns.

Poster 42	**GENETIC DIVERSITY IN THE THREATENED FRESHWATER MUSSEL *LAMPSILIS POWELLII*** Kristina N. Taynor[1], Ashley D. Walters[1], & David J. Berg[2] [1]Department of Biology, Miami University, Oxford, OH 45056; [2]Department of Biology, Miami University, Hamilton, OH 45011 **STUDENT PRESENTATION*
	North America is home to the greatest share of the world's freshwater mussel diversity: however, approximately >72% of its ~300 species are endangered or threatened. *Lampsilis powellii*, the Arkansas fatmucket, is currently restricted to the headwaters of the Ouachita, Saline, and Caddo rivers in Arkansas. Historically, *L. powellii* was distributed throughout the entire length of these systems. Along with habitat destruction, the fragmentation of rivers has had serious consequences for fish movement and, therefore, mussel dispersal and gene flow. These factors are likely causes of population declines and extirpations that have led to the listing of *L. powellii* as federally threatened. The species is still in decline, and steps such as augmenting or reintroducing populations may be necessary to prevent it from being extirpated throughout its current range. Such conservation actions require information about the distribution of genetic variation within and among extant populations. We obtained DNA from 15 individuals from a population in the South Fork of the Ouachita River (SFOR) and 27 individuals from populations in the Saline River (SR and AFS). We used primers designed for *Lampsilis abrupta* to amplify microsatellite fragments from 14 loci. The SFOR population showed polymorphisms at all loci. Allelic richness varied from two to sixteen alleles, with an average of eight alleles per locus. The mitochondrial CO1 gene was sequenced. Four individuals from the same population had identical sequences for the mitochondrial CO1 gene. Our preliminary results suggest that the SFOR population contains relatively low genetic diversity. We will report results for additional individuals from this population, along with all samples from the SR and AFS populations, in order to estimate genetic variation within populations and genetic divergence among populations. Our results will be used to suggest strategies that should be employed in captive propagation and population augmentation for this species.taynorkn@miamioh.edu
Poster 43	**GENETIC DIVERSITY WITHIN AND BETWEEN POPULATIONS OF POTAMILUS ALATUS IN MINNESOTA** Ashley Smith[1,2.] [1] University of Minnesota Conservation Sciences Graduate Program, [2] James Ford Bell Museum of Natural History.
	Potamilus alatus, the Pink Heelsplitter, is widespread in Minnesota, found in several watersheds. Some populations inhabit relatively pristine habitats and co-occur with several other unionid species, whereas populations inhabiting streams with poor water quality are often one of the few species present. Little is known of the genetic structure of populations, or of gene flow within and among these populations. The objectives of this study are to document genetic diversity within and between populations of *P. alatus* within Minnesota, to quantify gene flow between populations, and to identify populations with unusually high or low genetic diversity. 250 individuals were sampled for DNA in the St. Croix River, Mississippi River above St. Anthony Falls, Chippewa River, and Red Lake River in the summers of 2015 and 2016. DNA was extracted from these samples and microsatellite loci were PCR amplified and scored. Effective population sizes were estimated using the program LDNE, and the M-ratio test used to test for evidence of population bottlenecks. Pairwise Fst and Jost's D were calculated in F-stat. Relatedness between populations was found using Poptree. Results from these analyses will be discussed These data will inform management efforts to conserve threatened populations of *Potamilus alatus* and serve as a basis for comparison with other threatened Minnesota mussel species.
Poster 44	**USING NINE MICROSATELLITE LOCI TO ANALYZE POPULATION STRUCTURE AND PATERNITY OF THE THREERIDGE MUSSEL (*AMBLEMA PLICATA*) IN SOUTHEAST OKLAHOMA.** Patrick Olson[1,2], Caryn Vaughn[1,2],. [1]Department of Biology, University of Oklahoma, Norman, OK 73019. [2]Oklahoma Biological Survey, Norman, OK, 73019 **STUDENT PRESENTATION*
	A myriad of anthropogenic drivers have led to a substantial decline in North America's freshwater mussel populations over the last century. A greater understanding of mussel dispersal abilities and population structure is imperative to improve conservation strategies. Impoundments restrict fish movement, thereby reducing gene flow in mussels. We predicted that genetic structuring may form upstream and downstream of impoundments due to reduced gene flow. Here we used nine microsatellite loci to evaluate population structure and paternity of a common mussel species (*Amblema plicata*, a host generalist) in the Little River in southeast Oklahoma. A total of 270 individuals from nine mussel beds distributed throughout the Little River were genotyped. We are examining population structure with STRUCTURE and ML-Relate to estimate relatedness, specifically parent-offspring relationships. Results from this study will have important conservation implications by providing a better understanding of the dispersal capabilities of host-generalist mussel species and the number of males contributing to broods. Understanding mussel population structuring can improve mussel conservation strategies by informing management where to reintroduce mussels and which mussel beds are most important to protect. olso7823@ou.edu

Poster 45	**MODELING POPULATION CONNECTIVITY OF AN IMPERILED FRESHWATER MUSSEL, *Popenaias popeii*, THROUGH THE USE OF NEXT GENERATION SEQUENCING.** Steven R. Hein[1] and David J. Berg[2].[1]Department of Biology, Miami University, Oxford, OH 45056; [2]Department of Biology, Miami University, Hamilton, OH 45011. **STUDENT PRESENTATION*
	Population connectivity models have seen longstanding use to explain patterns of gene flow within and between populations. These types of models can be used to infer evolutionary history of species and to inform conservation activities. In desert aquatic ecosystems, the Death Valley (DVM) and stream hierarchy models (SHM) are the most commonly applied models. Populations that conform to the DVM show either extremely little or no gene flow between populations and in deserts are typically associated with isolated springs. Populations represented best by the SHM can show high degrees of gene flow and are generally found in riverine systems. However, the critically imperiled unionid mussel *Popenaias popeii* may present an exceptional case. *Popenaias popeii* is endemic to the Rio Grande drainages of the Chihuahuan Desert of New Mexico, Texas, and northern Mexico. In the U.S.A., *P. popeii* is restricted to four extant populations each separated by hundreds of miles. We tested the hypothesis: that *P. popeii* will conform to the DVM of population structure due to historical range restrictions currently maintained by anthropogenic disturbances. We used 2b-restriction site-associated DNA sequencing (2bRAD) to scan the genome for single nucleotide polymorphisms (SNPs). After processing with a custom work flow pipeline, over 3,000 polymorphic loci containing SNPs were included in our data set. We used a Bayesian framework implemented in the SNAPP extension of BEAST to reconstruct historical demographics and the program STRUCTURE to analyze population structure for two of the four extant populations. We are currently in the process of extending our data set to include all four populations. This research can shed light on how historical climatic conditions have shaped the evolutionary trajectory of isolated populations. An improved understanding of population structuring of *P. popeii* is also widely applicable to making effective conservation and management decision regarding this species. heinsr@miamioh.edu

LIFE HISTORY	
Poster 46	**FISH HOSTS AND LIFE HISTORY OF THE KENTUCKY CREEKSHELL, VILLOSA ORTMANNI.** Travis J. Bailey[1], Adam Shepard[1], Wendell Haag[2], Monte McGregor[1], Andrew McDonald[1], David Cravens[1], Fritz Vorisek[1]. [1]Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY 40601; [2]US Forest Service, Southern Research Station, Center for Bottomland Hardwoods Research, Frankfort, KY 40601.
	The Kentucky Creekshell (*Villosa ortmanni*) is endemic to the Green River drainage, Kentucky, and is closely related to *V. vanuxemensis* (sensu lato) of the Cumberland and Tennessee river drainages. We conducted laboratory trials to identify the host of *V. ortmanni* using females from two populations, Rough River, Grayson County, KY, and Brush Creek (Barren River system), Warren County, KY. Across trials, we tested the suitability of 15 fish species from four families (Cottidae, 1 species; Percidae, 8; Centrarchidae, 5; Ictaluridae, 1). The Banded Sculpin, *Cottus carolinae*, was the only primary host identified, and this species produced robust and consistent metamorphosis of glochidia from both populations. Sculpins produced an average of 23 live juveniles/fish (range, 7-63) in 13-21 days post infestation. In the Brush Creek trial, a single Bluegill, *Lepomis macrochirus*, produced one live juvenile, but three other Bluegill in this trial sloughed all glochidia within 5 days; no other fishes produced juveniles or carried glochidial infestations for >5 days. Fecundity of three females from Rough River averaged 19,935 (range, 10,473-28,339). Host use of *V. ortmanni* is very similar to *V. vanuxemensis*, which also is a specialist on sculpins.
Poster 47	**IMPROVING SURVIVAL OF JUVENILE WINGED MAPLELEAF MUSSELS (*QUADRULA FRAGOSA*) THROUGH IDENTIFICATION OF HOST FISH OVER WINTERING AREAS** Michelle Bartsch[1], Diane Waller[1], Brent Knights[1], Jon Vallazza[1], Mark Hove[2] and Byron Karns[3]. [1]US Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603; [2]Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St. Paul, MN 55108; [3]St. Croix National Scenic Riverway, National Park Service, St. Croix Falls, WI 54024.
	The St. Croix National Scenic Riverway (SACN) is one of the last best refuges for rapidly declining populations of native unionids in the United States and supports the only known self-sustaining population of the federally endangered winged mapleleaf mussel (*Quadrula fragosa*) in the upper Mississippi River basin. Channel catfish (*Ictalurus punctatus*) are the only known host for winged mapleleaf in the SACN. Although channel catfish are common in the river, little is known about the frequency of winged mapleleaf infestation and dispersal on their host fish. Our research is designed to characterize the movements and habitat use of channel catfish in the vicinity of a known winged mapleleaf population during glochidial release, encystment, and juvenile release periods. Adult channel catfish (N=35; mean length 605 mm) were collected near the mussel bed and implanted with acoustic transmitters. Catfish are being passively tracked using Lotek submersed data loggers (model 3250) that were clustered in an array near the mussel bed and dispersed singularly along the 84 kilometer river reach between St. Croix Falls, WI to the confluence with the Mississippi River at Prescott, WI. To date, no tagged catfish have moved from the SACN into the Mississippi River. Catfish movement patterns will be discussed in relation to the mussel bed and the delineated study area. mbartsch@usgs.gov

Poster 48	**WHAT IS GOING ON WITH *PLEUROBEMA SINTOXIA* IN CANADA?** K.M. McNichols-O'Rourke, J. Epp, and T.J. Morris. Fisheries and Oceans Canada, Burlington, ON, Canada, L7R 4A6.
	Currently, there are nine species of freshwater mussels listed as endangered under the Canadian *Species at Risk Act*. *Pleurobema sintoxia* was listed in 2004, yet information about the life history characteristics of this species in Ontario remains limited. This study was designed to identify reproductive timing windows - spawning, brooding, glochidial release and host infestation - for *P. sintoxia* in the Sydenham River in southwestern Ontario, Canada. During the open water periods in 2013 and 2014, 54 *P. sintoxia* were followed on a weekly basis. Following initial collection each animal was tagged with a 12.5 mm Passive Integrated Transponder tag from Biomark. During each of the 25 sampling events, gonad samples were taken from 1-6 tagged individuals, drift net samples were collected, and a number of fish species were vouchered. Based on the presence of sperm or eggs in the gonad samples, 17 females (25%) and 25 males (46%) were identified. Males had mature sperm and females showed the presence of mature eggs continuously between June and October indicating a prolonged spawning period. Over the study period, only three females showed the development of conglutinates. Suspected host fishes collected were Spotfin Shiner (*Cyprinella spiloptera*; n = 146), Bluntnose Minnow (*Pimephales notatus*; n = 130), and Creek Chub (*Semotilus atromaculatus*; n = 6). Preliminary data show that 82 of the 230 glochidia obtained from these fishes classified as *P. sintoxia* based on a morphometric DFA model. An additional 46 *P. sintoxia* glochidia were also observed on other fish species: Blackside Darter (*Percina maculata*), Greenside Darter (*Etheostoma blennioides*), Johnny Darter (*E. nigrum*), Logperch (*Percina caprodes*) and Round Goby (*Neogobius melanostomus*). The identification of these reproductive timing windows is vital to facilitate successful recovery and the continued protection of this species in Canada. Kelly.McNichols-O'Rourke@dfo-mpo.gc.ca

METHODS	
Poster 49	**ARE STANDARDIZED MUSSEL SURVEY PROTOCOLS EFFECTIVE? THE PROS, CONS, AND CHALLENGES IN APPLICATION**. Lindsey Moss and Rebecca Winterringer. TRC Environmental Corporation, Cleveland, Ohio.
	The need for standardization of methods used on mussel surveys is an important goal of regulatory agencies. Professionals performing surveys often rely on the regulatory agencies to provide guidance as to acceptable levels of effort based on the survey objective. Using standardized protocols promotes uniform data collection and reporting among different surveyors. These protocols are applied across varying stream types and survey objectives. Challenges in using standardized protocols are predominantly connected to presence or absence criteria dictating survey need, stream conditions not adhering to a generalized method guidance, and level of effort proposed versus what was required to meet the survey objective. Ninety (90) streams were evaluated where methods were required to follow a standardized protocol. Factors such as stream drainage size, species composition, stream morphology, and effort required to meet survey objectives were compared against expected and actual outcomes. In all 90 surveys, protocol application was effective in meeting the overall study objectives. Protocols were not effective in several instances where mussel resources were overlooked due to protocol constraints. The efficacy of standardized protocols and conservation of freshwater mussels is key, especially when faced with the future implications of climate change and freshwater resources. Lmoss@trcsolutions.com
Poster 50	**NOVEL MINI DOWNWELLING REARING CHAMBERS FOR STUDIES OF JUVENILE FRESHWATER MUSSELS.** Timothy Warren and David Perkins, U.S. Fish & Wildlife Service, Richard Cronin Aquatic Resource Center, Sunderland, MA 01375.
	Numerous systems have been developed for rearing of juvenile mussels, often with a focus on production needs. Systems intended for research have a different set of needs, and have been less well developed and described. Our objective was to design a system which was able to operate with a large number of replicates, provide uniform application of different treatments (e.g., diets), required minimal space and maintenance, minimized opportunities for mortality of mussels during routine handling, allowed for either flow-through or recirculating water, and provided the ability to observe, enumerate and measure mussels quickly, with minimal disturbance. These design parameters resulted in development of mini down-welling chambers (MDC), essentially a mesh-bottomed cup within a larger cup, fed by individual water/feed lines via a peristaltic pump. Each MDC comprised a 2.25” long section of 2” diameter PVC tube, with 150 micron nylon mesh glued to the bottom and a 2” Uniseal placed around the top, seated in a 3” diameter PVC flat-bottomed cup. The Uniseal rested on the rim of the cup and kept the chamber raised above the bottom. Water/feed lines entered the top of each MDC, flowed out the bottom, and then out a discharge line that exited the side of the cup. One pump operated up to 24 feed lines. Using this system, a small 3-level cart was able to easily accommodate 16 chambers, the pump and four 20-L feed containers. Discharge from the MDCs can be recirculated if desired by simply directing discharge lines back to the feed containers. Unaided visual inspection of mussels and the chambers is possible at all times. For examination under a stereoscope, the feed/water line detaches easily and allows the MDC to be removed, lightly rinsed with a sprayer if desired, and set in a petri dish. Daily cleaning is similarly easy.

PROPAGATION	
Poster 51	**SIMPLIFYING METHODS FOR IN VITRO METAMORPHOSIS OF GLOCHIDIA.** Morgan A. Kern and Chris Barnhart, Department of Biology, Missouri State University, Springfield, MO 65897. **STUDENT PRESENTATION*
	The parasitic stage of the mussel life cycle presents many challenges for captive culture. In some cases, suitable fish host are not known or are difficult to obtain and maintain. The recovery of the microscopic-sized juveniles in significant numbers from fish is labor intensive and requires specialized recirculating systems. Since Isom and Hudson successfully metamorphosed six species in the 1980s, 42 species have been transformed using *in vitro* methods. Methods employed were initially patterned on those used for mammalian cell culture, using 5% CO_2 atmosphere and bicarbonate to stabilize pH. Subsequent improvements have varied media components but retained the CO_2 atmosphere, usually requiring a specialized incubator. We have found that it is possible to metamorphose some species with equivalent metamorphosis success in air, 1%, and 5% CO_2. Species metamorphosed without elevated CO_2 include *Anodonta californiensis, A. oregonensis, Quadrula cylindrica,* and *Lampsilis siliquoidea*. Timing for removal of glochidia from the culture media is another important variable. Juvenile survival post-incubation generally declines with time after an optimum incubation period. Foot movement is a convenient marker, but our results indicate that foot movement may not occur until after the optimum incubation period. We have also attempted to extend *in vitro* methods to species which grow during metamorphosis. Species with unusually small glochidia, including *Margaritifera, Leptodea, Truncilla* and some *Quadrula* species, grow 25-100 times in mass while encapsulated. We hypothesized that higher nutrient use by these species during growth and metamorphosis might result in local diffusion-limited depletion of the growth medium, which might be alleviated by circulation. However initial attempts to metamorphose *Leptodea fragilis* glochidia in media circulated by a slow rocker system were unsuccessful.
Poster 52	**REDISCOVERY, PROPAGATION, AND REINTRODUCTION OF SPINDLE ELIMIA (*ELIMIA CAPILLARIS*, LEA 1861).** Michael L. Buntin, Thomas A. Tarpley, Todd B. Fobian, Jesse T. Holifield, Jeffery T. Garner and Paul D. Johnson. Alabama Department of Conservation and Natural Resources, Wildlife and Freshwater Fisheries Division, Alabama Aquatic Biodiversity Center, Marion, AL 36756.
	The Spindle Elimia (*Elimia capillaris*), a pleurocerid gastropod endemic to the Coosa River Basin, was last collected in 1964 prior to closure of Logan-Martin Dam in Alabama. Despite multiple collection reports, a review of recent collection records determined those specimens were misidentified and the species was listed as extinct in Johnson et al. 2013. Review of museum records determined the historic distribution was restricted to the Coosa River system in north Georgia downstream to central Alabama. In October 2014, quantitative mussel monitoring in the lower section of Big Canoe Creek, a large Coosa River tributary, located putative *E. capillaris*. Further survey efforts determined *E. capillaris* was restricted to lower Big Canoe Creek, upstream of impounded portion with a maximum range of 26.4 km. Subsequent review of University of Florida Natural History museum records in 2015 revealed a single specimen of *E. capillaris* from Big Canoe collected in 1990. In November 2014 ADCNR collected and transported 170 *E. capillaris* and two other sympatric Pleuroceridae (*Elimia modesta*, *Pleurocera prasinata*) to support life history observations, phylogenetic review and character analyses. Pleurocerid species were held in separate 75 gal polyethylene tanks containing tiles and powerheads to facilitate reproduction and oviposition. Single eggs were laid by *E. modesta* in the spring and throughout the summer for *E. capillaris*, while *P. prasinata* laid small clutches in early spring. Propagation efforts were successful and, in August 2016, 1,486 propagated *E. capillaris* were reintroduced into the Weiss Reservoir bypass section of the Coosa River, from where they had been extirpated since 1960. A recent flow agreement reached by APC and the USFWS restored hydrologic flow to this section in 2014. Propagation efforts will continue in an attempt to establish a reproducing population of *E. capillaris* in the Coosa River, 52 years after they disappeared. michael.buntin@dcnr.alabama.gov

Poster 53	**OVERWINTER OF *LEMIOX RIMOSUS* (BIVALVIA: UNIONIDAE) GLOCHIDIA ON FISH HOSTS TO INCREASE PRODUCTION AND PERFORMANCE IN LABORATORY CULTURE** Sarah L. Colletti[1], Tim W. Lane[1], Joseph F. Ferraro[1] and Tiffany C. Leach[1]. [1]Aquatic Wildlife Conservation Center, Virginia Department of Game and Inland Fisheries, Marion, Virginia 24354.
	The endangered birdwing pearlymussel *Lemiox rimosus* (Rafinesque, 1831) is a Cumberlandian endemic now restricted to two reproducing populations in the Clinch River, TN/VA and Duck River, TN. The recovery of this species will rely on successful lab propagation and culture to augment declining populations. As a long-term brooder, females have been reported to be gravid from September to June. However, individuals can be manipulated in captivity to remain gravid later into the summer through exposure to cooler holding temperatures. This species has been successfully propagated and cultured at the Virginia Department of Game and Inland Fisheries' Aquatic Wildlife Conservation Center, since 2008, with past infestations typically occurring from late spring to early summer. Survival and grow-out have proved challenging post-excystment, primarily due to an inability to culture newly metamorphosed juveniles to a large enough size by the end of the natural growing season. The life history of this species suggests the glochidia may target over-wintering on the gills of its host fish, allowing for increased dispersal and healthier juvenile condition in early spring months. Such a strategy might also provide bradytictic species with a longer growing period in year one, thus helping to increase survival when paralleled in laboratory culture. In November 2016, we infested three species identified as suitable hosts, *Etheostoma blennioides* (N=176)*, E. simoterum* (N=51) and *E. zonale* (N=51), using glochidia extracted from gravid females (*N*=10) from the Duck River, TN. Inoculated fish were held in temperature controlled re-circulating aquaculture systems gradually dropped to 5°C to 9°C to mimic winter conditions. In addition, a control was set to a constant 18°C to mimic a typical spring inoculation. Temperatures in the control and one treatment were raised a degree a day up to 20°C following a period of 45 days, while a second treatment was warmed following a period of 75 days. Results are ongoing and will be reported and discussed.
Poster 54	**CAPTIVE PROPAGATION OF RARE EPIOBLASMA SPECIES FOR REINTRODUCTION AND AUGMENTATION EFFORTS.** David Cravens, Andy McDonald, Monte McGregor, Adam Shepard, Julieann Jacobs, Travis Bailey, Scott Watts, and Fritz Vorisek. Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY 40601
	In 2016, Kentucky Department of Fish and Wildlife Resource's Center for Mollusk Conservation (CMC) used in-vitro and in-vivo methods to produce 12,000 Golden Riffleshells, *Epioblasma florentina aureola*, 6,954 Cumberlandian Combshells, *Epioblasma brevidens*, 20,442 Purple Catspaws, *Epioblasma obliquata obliquata*, and 6,013 Tan riffleshells, *Epioblasma florentina walkeri*. We reared 1,566 *E. f. aureola* to an average length of 11.8mm in 8 months, 349 *E. brevidens* to an average length of 6.6mm in 6 months, 3007 *E. o. obliquata* to and average length of 8.1mm in 7 months, and 357 *E. f. walkeri* to and average length of 9.5mm in 8 months. Juvenile mussels were maintained in a recirculating tray system with automated water changes every 1.5 hours. Mussels were fed a mixed algae diet consisting of a commercially available marine algae mix (*Nannochloropsis* 3600, Shellfish Diet, and TP 1800-Reed Mariculture®) and a freshwater cultured algae mix (*Chlorella sorokininana*, *Neochloris oleoabundans*, and *Phaeodactylum tricornutum*) dispensed directly to each mussel tank via an automated ball valve every hour. Propagated mussels will be tagged and used in reintroduction and augmentation efforts in KY and surrounding states. A total of 1,178 *E. f. aureola* have been sent to Virginia for growout at a second facility for future release and studies. Individuals of other *Epioblasma* species were produced at the CMC in previous years, and include the Oyster mussel, *E. capsaeformis*, Northern riffleshell, *E. torulosa rangiana,* and Snuffbox, *E. triquetra.* Previous batches of *E. triquetra* have been used in reintroduction efforts in the Green River and augmentation efforts in the Rolling Fork (Salt River drainage). Several hundred juveniles of *E. f. walkeri* and *E. brevidens* have been released in the Big South Fork Cumberland River in 2015 and 2016.

Poster 55	**USE OF PUBLIC AND PRIVATE PONDS FOR REARING OF RARE FRESHWATER MUSSELS. Chris B. Eads and Jay F. Levine. Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, 2800 Faucette Drive, Raleigh, NC 27607.**
	While captive culture of freshwater mussels has become an important tool in their conservation, it can prove to be a costly and labor-intensive endeavor. In some situations, the use of cage-culture in the wild may provide an alternative that does not require a dedicated hatchery facility or full-time staff to conduct. We constructed floating cages from plastic fish baskets fitted with floats and anchored them in a variety of ponds and small reservoirs in three different river basins. A layer of sand on the bottom of the baskets provided substrate for the mussels. Mussels were reared both by initially stocking glochidia-infested host fish and by stocking larger juveniles (Length = 4-10 mm) into the cage. Cages were left in place for one to two growing seasons. While rearing success varied by pond and species, we have successfully used these techniques to rear eight species across three taxonomic tribes from the juvenile stage up to a tag-ready size. Species successfully reared include the federally endangered Tar River spinymussel (*Elliptio steinstansana*) as well as two candidates for federal listing (*Fusconaia masoni* and *Elliptio lanceolata*). We present growth and survival data as well as lessons learned. This technique could be a useful tool for biologists without access to a hatchery facility or as an overflow solution to a crowding problem in a hatchery. Chris_Eads@ncsu.edu
Poster 56	**ADVANCEMENTS IN CULTURE TECHNIQUES FOR ALABAMA PEARLSHELL (MARGARITIFERA MARRIANAE, R.I. JOHNSON, 1983) TO SUPPORT SPECIES RECOVERY AND REINTRODUCTION.** Todd B. Fobian, Michael L. Buntin, Jesse T. Holifield, Thomas A. Tarpley and Paul D. Johnson. Alabama Department of Conservation and Natural Resources, Wildlife and Freshwater Fisheries Division, Alabama Aquatic Biodiversity Center, Marion, AL 36756.
	Alabama Pearlshell (*Margaritifera marrianae*) is a federally endangered mussel currently restricted to nine headwater streams within the Conecuh River basin in Conecuh, Escambia and Crenshaw Counties, Alabama. Although a formal Recovery Plan has not been published, propagation and reintroduction was a recommended recovery activity identified in the *Plan for the Population Restoration and Conservation of Imperiled Freshwater Mollusks of the Mobile River Basin*, a multi-agency recovery strategy completed in 2010. Routine monitoring detected gravid females in March 2013 and host trials initiated were quickly initiated at the Alabama Aquatic Biodiversity Center (AABC). In 2013 and 2014, host trials determined Redfin Pickerel (*Esox americanus*) the primary host of 23 species evaluated. Production efforts metamorphosed 29,647 juvenile mussels from n = 45 *E. americanus* in March 2016. Newly transformed juveniles were placed in HruŜka culture boxes, and weekly water and sediment changes completed for 8 months post metamorphosis. Shell length growth was consistent at 8.2µm/day for 243 days. Juvenile mortality was highest during first two months of grow-out, with 48% survival on day 63 then stabilizing to 27% on day 175 and 25% on day 243. After 175 days, *M. marrianae* juveniles > 1 mm shell length were transitioned from HruŜka boxes to submerged sediment trays, sand aquaria, and sand suspended upweller buckets (sand SUPSYS). In comparison to HruŜka boxes, submerged sediment trays and sand aquaria systems had higher growth rates (11.2µm/day and 13.6µm/day respectively), but reduced survivorship (14% and 24% respectively) compared to 99% survival in HruŜka boxes from day 175 - 243. Sand SUPSYS buckets produced the highest shell length growth rate (42µm/day) and maintained 99% survival. Currently, ≈2000 juvenile *M. marrianae* remain in culture sediment trays and ≈4000 in sand upwellers, ranging from 1.5-5.0 mm shell length. This project will continue development of *M. marrianae* culture protocols in anticipation of initiating reintroductions into unoccupied historical habitat in 2017. Todd.Fobian@dcnr.alabama.gov

Poster 57	**USE OF A PHOTOBIOREACTOR TO PRODUCE THE DIATOM, *PHAEODACTYLUM TRICORNUTUM*, AS A FOOD SOURCE IN FRESHWATER MUSSEL CULTURE.** Julieann M. Jacobs, Monte A. McGregor, Fritz E. Vorisek, Andrew T. McDonald. Center for Mollusk Conservation, Kentucky Department of Fish and Wildlife Resources, Frankfort, KY 40601.
	Microalgae have an important role in the culture of freshwater mollusks since they provide the majority of these animals' nutritional requirements. Dependable and sustainable culture of microalgae is necessary for the growth and survival of freshwater mollusks. Photobioreactors are real-time monitoring systems that are used for large scale production of microalgae species. We tested a 1000 L Industrial Plankton® photobioreactor purchased from Pentair® Aquatic Ecosystems. This system is designed to automate the addition of water and nutrients through an ultra-fine filter to reduce contamination. Cell-Hi F2P®, which is similar to Guillard F/2 part A and B medium, was used at 1 mL/L to provide the appropriate nitrogen, phosphorus, trace elements and vitamins. A sodium metasilicate solution, secondary salt solution, and calcium chloride solution (recipe from the WSS National Fish Hatchery) was also added at 1 mL/L, 1 mL/L, and 0.5 mL/L, respectively. The LB642 (University of Texas Culture Collection of Algae) fusiform strain of the diatom, *Phaeodactylum tricornutum,* was grown in freshwater using a photobioreactor and produced an average of 0.7895 g/L with a total of 3,097 g in 3,923 L over a 6 month period. The use of the photobioreactor to produce *P. tricornutum* was compared to the use of 12 and 20 L glass carboys. In the same 6 month period, 216 L was harvested from the 12 L glass carboys giving 364 g and an average of 1.69 g/L. The 20 L glass carboys produced 701 g from 547 L with an average of 1.28 g/L. Although the 12 and 20 L glass carboys produced more *P. tricornutum* per L, the photobioreactor was able to produce more total harvest in the same amount of time due to the larger water volume available for production. The photobioreactor was labor efficient and required limited maintenance. julieann.jacobs@ky.gov
Poster 58	**PROPAGATION AND CULTURE TECHINIQUES FOR *ALASMINDONTA RAVENELIANA* AND *ALASMIDONTA VIRIDIS*.** Rachael A. Hoch[1], Chris B. Eads[2], and Stephen J. Fraley[3]. [1]Division of Inland Fisheries, North Carolina Wildlife Resources Commission, Marion, NC 28725; [2]College of Veterinary Medicine, North Carolina State University, Raleigh, NC 27606; [3]Division of Inland Fisheries, North Carolina Wildlife Resources Commission, Waynesville, NC 28786.
	Since the early work of Coker and colleagues in 1914, mussel propagation has made great advances, especially in the past two decades. Government agencies at the federal and state levels, as well as universities, continue to invest in freshwater mussel propagation programs, and have established four new freshwater mollusk facilities in the United States past two years. Although advances in propagation have been made for numerous species, particularly species in the Lampsilini tribe, several members in the *Alasmidonta* genus have proven difficult to culture in captive settings. Two such species are *Alasmidonta raveneliana*, Appalachian Elktoe, a federally endangered species from the Little Tennessee and French Broad River systems, and the more widespread *Alasmidonta viridis,* Slippershell. Propagation of *Alasmidontas* at the Marion Conservation Aquaculture Center (MCAC) located in Marion, North Carolina has improved over the last five years with one-year survival rates as high as 60% and growth reaching 15 mm within one culture year. Culture requirements at the MCAC include use of fine substrates sieved below 125 micrometers, filtered and U.V. treated surface water, 24hr supplemental feed rates of 100,000-450,000 cells/mL, and lower culture temperatures that mirror natural fluctuations of 15-24°C from spring to fall. Utilizing these culture requirements, the MCAC has aided ongoing restoration efforts through the production and release of over 16,000 taggable *A. raveneliana* into portions of the Little Tennessee and the Nolichucky river systems, and over 3,000 *A. viridis* into portions of the Little Tennessee River system, in NC. rachael.hoch@ncwildlife.org

STATUS / TRENDS	
Poster 59	**SPECIES ABUNDANCE OF GASTROPODS IN TIGEA RIVER, SAN FERNANDO, BUKIDNON, PHILIPPINES AS AFFECTED BY SAMPLING METHOD** Pepito, Michelle V., Porquis, Heidi C., and Gloria Lonop-Galan Department of Biology, College of Arts and Science, Central Mindanao University.
	This study aimed to determine the abundance of gastropods in Tigea River. Specifically to: 1.) list species composition and determine the abundance using the sieve and handpicking method. Three study stations were chosen: the Upperstream, the middle stream and downstream. In every station a 100 meter line was laid where three, 2x5 meter quadrat were laid as collection sites. Result showed 8 species of gastropods belonging to 5 genera: *Belamya, Melanoides, Tarebia, Thiara*, and *Phyoa*; and 3 families: Viviparidae, Thairidae, Physidae. Upperstream had the highest number of species (8), followed by middle stream (7) and downstream with 5 species using sieve method. The hand picking method reveled that stations 1 and 2 had the highest species abundance (7) while station 3 with three species only. Data analysis showed that the species mean value of station 3 was significantly different (P=0. 0001) no significant difference was found in both methods of collection of gastropods.
Poster 60	**STUDY THE STATUS AND IDENTIFICATION OF THE FRESHWATER BIVALVE IN THE WESTERN GHAT OF THE INDIA.** Hukam Singh Dhaker [1], Dabir Pathan[2] and Murari Bhalekar[3]. [1,2]College of Fisheries, Ratnagiri Maharashtra, India [3]G-113, Sec#3, Airoli, NaviMumbai, Maharashtra, India.
	The purpose of this study was to study the status and identification of the freshwater bivalve in the western ghat of the country. The first objective was to identification of freshwater bivalves in the western ghat based on shell morphology. The second objective was to document the distribution and status of the two genus i.e. *Lamellidens* and *Parreysia* in the western ghat. Museum holding these species at Zoological Survey of India (ZSI), Kolkata have been also examined before confirming the species. External character and digital images acquired for eight species of freshwater bivalves, the external characters were analysed for genus *Lamellidens Parreysia* of *Archiodopsis* and *Corbicula.* DNA sequence data from 25 specimens *Lamellidens* and *Parreysia* have been carried to confirm the identity of the species. The DNA sequences of 25 specimens were submitted to NCBI through Barcode of Life Data (BOLD). The phylogenic tree was prepared and observed that *Parreysia khadakvaslaensis* is not matched with the genus *Parreysia,* hence revised taxonomic status of these species is proposed. The species wise distribution of freshwater bivalves in 13 rivers of Karnataka, 10 rivers of Kerla, 4 rivers of Goa and 16 rivers of Maharashtra is prepared. The *Lamellidens marginalis, Lamellidens corrianus, Lamellidens consobrinus* and *Parreysia corrugata* are available in abundance in the rivers of western ghat but *Parreysia khadakvaslaensis, Arcidopsis footei* and *Pseudomulleria dalyi* needs attention for conservation. These species are available in only specific area in small quantity. The fatty acid profile showed that SFA (*L. marginallis* = 36.48, *L. corrianus* = 42.41, *P. corrugata* = 41.47 and,*P. khadakvaslaensis* = 36.42) is more than monosaturated fatty acid (*L. marginallis* = 10.20*, L corrianus* = 10.48, *P. corrugata* = 14.44 and *P. khadakvaslaensis* = 10.72). The PUFA is higher in genus *Lamellidens* than *Parreysia*. EPA is higher in genus *Parreysia* as compared to *Lamellidens*. Thus, *Lamellidens marginalis* and *Parreysia corrugata* is useful for extraction of omega 3 oil for the benefit of human health. murari521@gmail.com

Poster 61	**THE FRESHWATER MUSSELS (BIVALVIA: UNIONIDA) OF SOUTH AMERICA.** Kevin S. Cummings[1] & Daniel L. Graf[2]. [1]Illinois Natural History Survey, University of Illinois, Champaign, Illinois, USA. [2]Biology Department, University of Wisconsin-Stevens Point, Stevens Point, Wisconsin, USA.
	We are preparing a monograph of the freshwater mussels (Bivalvia: Unionoida) of South America (projected publication date – 2017) based on a through a review of the published geographic and taxonomic data from the last 200 plus years and examination of over 8500 specimen lots from 22 museum collections in the United States, Europe, Australia, and South America during the period from December 2002 to November 2015. Three additional South American collections were queried on-line for holdings. Each museum lot personally examined was digitally photographed to document shell morphology and original label information. Textual data (catalogue number, previous identifications, collection locality, etc.) were captured subsequently from the images. Locality data were geo-referenced (if possible) and images were databased along with taxonomic information. To date, we have captured data on over 8500 lots from South America. The continent is inhabited by three families of freshwater mussels: Etheriidae, Hyriidae, and Mycetopodidae. In the monograph we recognize 127 species in 20 genera. All species are arranged alphabetically by family, genus, species, and followed by the author and date. For each species the original description, type locality, type specimens, and remarks about the distribution, status, and/or taxonomic issues are given. All primary synonyms are listed under each species with the same data as for the currently recognized taxa. A distribution map and photograph is given for each species. For direct comparative purposes with fishes we used the South American natural drainages proposed by Reis et al. (2016). The large basins were consolidated as a single basin unit in addition to adjacent coastal drainages historically connected, whereas smaller coastal basins were grouped together based on proximity and geography. These regions approximate those of Graf & Cummings (2007) and both were based on "*Freshwater Ecoregions of the World*" proposed by Abell et al. (2008).
Poster 62	**LOCALIZED POPULATION ESTIMATE OF SHEEPNOSE (*PLETHOBASUS CYPHYUS*) IN A MUSSEL BED OF THE OHIO RIVER.** John P. Spaeth, Gregory B. Anderson, and Casey D. Swecker. Environmental Solutions & Innovations, Inc. 4525 Este Avenue, Cincinnati, OH 45232
	Sheepnose (*Plethobasus cyphyus*) is a federally endangered freshwater mussel that occupies large Midwestern rivers of the United States. Isolated occurrences of the species are known from numerous large tributaries within the Mississippi, Tennessee, Cumberland, and Ohio river drainages; however, limited information is available to generate estimates of local abundance in mussel beds with known or probable occurrence. In 2014 and 2016, systematic, qualitative mussel surveys were completed along 10 miles of the Ohio River which resulted in the identification of a diverse mussel bed harboring numerous live sheepnose. Using these data, and information from relevant literature sources, a localized population estimate was generated using a hierarchical model of abundance within the mussel bed. Results demonstrate that this mussel resource is of significant value and worthy of future research and protection.
Poster 63	**QUANTITATIVE ASSESSMENT OF A FRESHWATER MUSSEL ASSEMBLAGE IN THE ROLLING FORK, SALT RIVER DRAINAGE, KY, IN 2007 AND 2013**. David Cravens, Monte A. McGregor, Andrew T. McDonald, Adam C. Shepard, Julieann M. Jacobs, Travis Bailey, and Fritz E. Vorisek. Kentucky Department of Fish and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY 40601
	The Rolling Fork is a 108-mile-long river located in central Kentucky and is part of the Salt River, a direct tributary of the Ohio River. The Salt River drainage historically contained 56 species of freshwater mussels including known populations of federally endangered mussels such as snuffbox, *Epioblasma triquetra,* and fanshell, *Cyprogenia stegaria*. A 300 m² area long-term monitoring site was designated and quantitative surveys were conducted in 2007 and 2013. During both surveys we randomly sampled the area using 1m² quadrants (n=30). In 2007 we collected and measured 554 individual mussels representing 20 species (1 endangered, fanshell, *C. stegaria*). Average densities were 21/m² with individual species density ranging from 0.04-11/m². Three species were rare (< 0.1/m²) in the 2007 survey. In 2013 the survey was repeated with 771 individuals collected and measured, representing 25 species including 2 endangered species (fanshell, *C. stegaria,* and snuffbox, *E. triquetra*). Average density was 24/m², and individual species densities ranged from 0.03-7.9/m² with 6 species being considered rare. In 2007, the top five dominant species were the mucket, *Actinonaias ligamentina* (53.7%), kidneyshell, *Ptychobranchus fasciolaris* (18.2%), spike, *Elliptio dilatata* (9.7%), fanshell, *C. stegaria* (2.7%), and pistolgrip, *Quadrula verrucosa* (2.3%). The 2013 survey identified five dominant species: *A. ligamentina* (33%), *P. fasciolaris* (19.7%), *E. dilatata* (15.6%), deertoe, *Truncilla truncata* (4.3%), and *C. stegaria* (3.9%). In 2007 the endangered fanshell, *C. stegaria,* was found in densities of 0.5m², and had increased to 0.9m² in 2013. In 2009, juvenile *Epioblasma triquetra* were released and were found in our sampling area in 2013 at a density of .03m².

Poster 64	**DISTRIBUTION AND DENSITY OF THREE UNCOMMON OR IMPERILED UNIONID SPECIES IN NORTHERN NEW YORK**. John E. Cooper, Cooper Environmental Research, 1444 County Route 23, Constantia, NY. 13044.
	The New York Natural Heritage Program lists Eastern pearlshell *Margaritifera margaritifa* as imperiled, and Pocketbook *Lampsilis ovata* and Yellow lampmussel *Lampsilis cariosa* as uncommon in New York. The population and distribution of these mussels in the lower Salmon and Little Salmon rivers (Franklin County) were estimated using double sampling at 10 transects from 2005 through 2012. Thirteen species of living mussels were collected in the study area dominated by Eastern elliptio *Elliptio complanata* (89%). Pocketbook, Yellow lampmussel, and Eastern pearlshell each represented 1% or less of the living mussels collected in transects and the distribution of empty shells of Pocketbook was similar to those living; Yellow lampmussel empty shells were more abundant (49% of those collected) at the most upriver part of the Little Salmon River where no living Yellow lampmussel was collected. Eastern pearlshell was found only in 2012. Comparison of midden shells revealed a greater concentration of Pocketbook (90% of those collected in middens) at the lower part of the Salmon River that was not associated with a transect. This midden also produced 72% of Yellow lampmussel collected in all middens. Density of Eastern pearlshell, Pocketbook, and Yellow lampmussel was one-tenth of the average density of all mussels and 95 times less that the density of Eastern elliptio.
Poster 65	**TEMPORAL VARIATION IN BIODIVERSITY OF NORTH AMERICAN FRESHWATER MUSSELS THROUGH THE 19TH AND 20TH CENTURIES.** Robert A Francis[1] & David J. Berg[2].[1]Department of Biology, Miami University, Oxford, OH, 45056. Department of Biology, Miami University, Hamilton, OH, 45011 **STUDENT PRESENTATION*
	Freshwater mussel communities within the United States have declined substantially during the 19th and 20th centuries, resulting in extirpation of many species from their historic distributions. Federal conservation efforts focusing on freshwater ecosystems were not widely implemented until the late 20th century. However, implementation of efficient and effective conservation strategies requires a firm multi-scale understanding of biodiversity patterns across time. Using published survey data from the late 19th century to the present, we will calculate the temporal change in beta diversity based upon species richness of freshwater mussels from periods of exploitation (POE<1972) and periods of conservation (POC≥1972). Temporal changes in beta diversity will be compared between both time periods in their entirety, and at a decadal scale. We predict that during the POE there will be a pattern of substantially lower beta diversity than during the POC, showing consistent turnover towards communities composed of historically wide-spread, generalist taxa. At the decadal scale, we expect that turnover and turnover rate will show a positive trend during the POE, and a negative trend during the POC. We also predict that variation in beta diversity will be larger during the POE and lower during the POC. We expect a negative trend in variation and variation rate during the POE and a positive trend during the POC at the decadal scale. Clear patterns of biodiversity across temporal scales serve as benchmarks for assessing the effectiveness and efficacy of specific conservation strategies, and are required if freshwater mussel biodiversity is to be restored to historic levels.
Poster 66	**FRESHWATER MUSSEL DECLINE IN THE MIDDLE FORK JOHN DAY RIVER, OREGON.** [1]Alexa Maine, [2]Donna Nez, and [3]Christine O'Brien. [1]DNR Fisheries Program, Freshwater Mussel Project, Confederated Tribes of the Umatilla Indian Reservation, 500 Tausick Way, Walla Walla, WA 99362; [2]DNR Fisheries Program, Freshwater Mussel Project, Confederated Tribes of the Umatilla Indian Reservation, 46411 Timine Way, Pendleton, OR; [3]Browns River Environmental Consultants, 130 Sesame Street, Waynesville, NC, 28785.
	Freshwater mussels (Bivalvia: Unionoida) are an important, but often over looked component of Pacific Northwest (PNW) river systems. Although historically widespread and abundant, PNW mussels are in decline, a trend mirrored nationally, making freshwater mussels one of the most critically imperiled faunal groups in the nation. Mussels are an important component of an intact salmonid ecosystem because they clean the water of particulate matter and stabilize substrates that are beneficial to many other aquatic species. In 2003, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) surveyed 84 sites in the Middle Fork John Day (MFJD). All three genera (*Margaritifera*, *Gonidea* and *Anodonta*) were present. 15 of the 2003 surveyed sites where mussels were present were randomly selected and resurveyed in 2015. The results of the resurvey showed *Anodonta* populations declined by 36%, *Gonidea* populations declined by 12% and *Margaritifera* populations declined by 15%. Three monitoring sites were also set up (2 sites in 2009 and 1 site in 2011) in the MFJD. In 2016 all three sites showed a drastic decline in mussel populations. Although the reason for these declines remains a mystery, extended drought, outbreak of *Chladophora spp*., *Cymbella janischii* and *Gomphoneis spp*., extreme heat, and instream activities may have contributed to the mussel decline in the MFJD.

Poster 67	**UPDATE ON A SPECIES STATUS ASSESSMENT FOR FOUR CENTRAL TEXAS FRESHWATER MUSSELS: FALSE SPIKE (*FUSCONAIA MITCHELLI*), TEXAS FATMUCKET *(LAMPSILIS BRACTEATA)*, TEXAS PIMPLEBACK *(QUADRULA PETRINA*), AND TEXAS FAWNSFOOT *(TRUNCILLA MACRODON)*** Gary Pandolfi[1] and Chris Harper[2 1] Freshwater Mussel Biologist, US Fish and Wildlife Service, Austin Texas Ecological Services Field Office, 10711 Burnet Road, Suite 200 Austin, TX 78758, [2] Supervisory Biologist, US Fish and Wildlife Service, Austin Texas Ecological Services Field Office, 10711 Burnet Road, Suite 200 Austin, TX 78758
	Fifteen mussel species are considered state-threatened by Texas Parks and Wildlife Department; of these fifteen, five are considered candidates for federal Endangered Species Act (ESA) protections by the U.S. Fish and Wildlife Service (Service). On October 6, 2011, the Service published a 12-month finding for five central Texas mussel species indicating that listing the species as threatened or endangered under the Act is warranted; however, their listing at that time was precluded by higher priority listing actions. The Service is now gathering information to support the development of a Species Status Assessment (SSA) for these four mussel species. The SSA is an analytical tool the Service uses to summarize the best available science for any given species and is used to appropriately inform ESA listing and recovery decisions. The Service is actively working with other federal agencies, state and local governments, and academic institutions in obtaining additional biological information about these Texas mussels. While the Service gathers information, pro-active conservation actions are being developed and implemented to benefit freshwater mussels and their habitats. The US Department of Agriculture's Natural Resources Conservation Service (NRCS) recently announced a Working Lands for Wildlife (WLFW) project to address natural resource concerns which have been identified to negatively impact freshwater mussels. This project seeks to maintain or restore working lands in the middle and lower Colorado River basin (Texas) to benefit fish, wildlife and their habitats. Candidate Conservation Agreements with Assurances (CCAA) are voluntary agreements between private entities and the Service that encourage positive conservation efforts that may remove or reduce threats to a species before it becomes listed as threatened or endangered. Private landowners and other non-federal entities may receive "regulatory assurances" by participating in voluntary agreements like WLFW and CCAAs. gary_pandolfi@fws.gov
Poster 68	**ILLINOIS NATURAL HISTORY SURVEY GASTROPOD HOLDINGS - DETERMINING ILLINOIS GASTROPOD CONSERVATION AT A SNAIL'S PACE.** Rachel M. Vinsel[1], Alison P. Stodola[1], Jeremy S. Tiemann[1], and Kevin S. Cummings[1]. [1]Illinois Natural History Survey, Prairie Research Institute, Champaign, IL 61820
	A recent assessment has shown that freshwater gastropods are the most imperiled group of mollusks in North America (Johnson 2013) yet much focus of conservation efforts and natural history collections has been on freshwater bivalves. Nearly 75% of North American gastropods (523 of 706 species) are believed to be extinct, endangered, or vulnerable, yet protective status at the state or federal level has been established for less than 10% of these species. A similar pattern persists in Illinois, as only 6 of 74 taxa are state or federally protected or established as in need of conservation. Lack of finical sponsorship is partially responsible for the slow process. However, Illinois has recently placed nearly all aquatic gastropods on a "watch list" to support new research on status and distribution. Concurrently, researchers at INHS are identifying, georeferencing, databasing and cataloging specimens stored in the museum collection's backlog to provide new information on gastropod distribution in Illinois. The INHS's Mollusk Collection includes more than 20,500 North American gastropod holdings. Over 70% were cataloged as part of the University of Illinois Museum of Natural History (UIMNH) and were curated prior to 1940. The majority of our backlogged specimens were collected between 1970 and 2011 and the backlog contains specimens from nearly every basin in the state of Illinois. We have developed a dichotomous key for shell characteristics specifically for Illinois fauna and have been beta testing for 12 months. In 2016 we curated more than 800 lots of from over 50 species of gastropods. As we continue to process our backlogged specimens we hope to add more recent status and distribution data. These contributions will be used to guide gastropod conservation efforts in Illinois.
Poster 69	**RELOCATION OF FEDERALLY ENDANGERED RAYED BEAN MUSSEL IN ALLEGHENY RIVER.** Paul H. Lord, Zachary T. Piper, and Amanda L. Barber.
	In June 2016, we relocated 503 freshwater pearly mussels listed as endangered by U.S. Fish and Wildlife Service or as species of greatest conservation need by the New York State Department of Conservation from a proposed bridge maintenance site in the Allegheny River near Carrolton, NY. SCUBA divers and others excavated twelve species of pearly mussels, including the federally endangered Rayed bean mussel, then tagged and replanted them in suitable habitat upstream of the bridge site. We completed a follow-up survey in August 2016 to evaluate the success of the move of the short term. We found 189 of the tagged mussels and 123 previously untagged Rayed beans. Losses of moved mussels were minimal. Pearly mussel populations have declined throughout New York, necessitating focused conservation measures to prevent the losses of pearly mussel populations. Paul.Lord@oneonta.edu

2017 FMCS SYMPOSIUM BINGO

Talk with a poster presenter	**Attend a talk by a student**	**Tip your hotel room housekeeper**	**Use your FMCS swag**	**Attend a committee meeting**
Thank a facility employee for his/her service	**Tweet/post to Facebook about the symposium**	**Support a local restaurant or store**	**Attend a freshwater mussel talk**	**Donate an auction item**
Meet a new colleague	**Attend a mixer**	**Be a FMCS member**	**Attend a plenary session**	**Thank a symposium sponsor for their support**
Attend auction	**Attend a workshop**	**Thank staff at registration desk**	**Participate in student/ professional mixer**	**Attend gastropod talk**
Talk to a colleague about the FMCS national strategy	**Visit Cuyahoga River or Lake Erie**	**Attend a committee meeting**	**Like FMCS or one of our posts on Facebook**	**Buy a raffle ticket**

Want a chance to win prizes while meeting new people, reconnecting with colleagues, and engaging in awesome symposium activities?! Well, then let's play BINGO! On the honor system, mark a square when you complete an activity.

Show your BINGO card at the registration desk for a chance to win prizes.

One BINGO: Get your BINGO initialed at registration *before* the afternoon break on Monday, Tuesday, or Wednesday for a chance to win drink tickets! Winning tickets will be drawn during the last concurrent session each day. (BINGO = 5 squares in a row: up, down, or diagonal.)

Three or more BINGOs: Get your BINGOs initialed at registration by the morning break on Wednesday for a chance to win Grand Prizes – you won't want to miss them! Winning tickets will be drawn at the Business Lunch.

Notes

From the 2017 Biennial Symposium Planning Committee:

Thank you for making the 2017 Symposium a Success!