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FRESHWATER MOLLUSK CONSERVATION SOCIETY

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

Acknowledgement of the 8th Biennial FMCS Symposium Sponsors

Meeting Host:

Alabama Department of Conservation and Natural Resources
Alabama Division of Wildlife and Freshwater Fisheries
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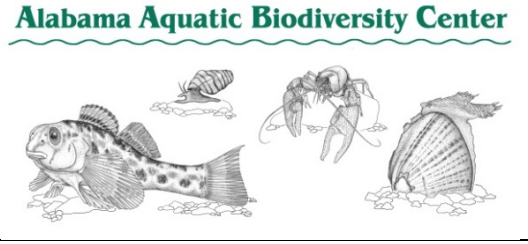

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FMCS GUNTERSVILLE SYMPOSIUM GENERAL SCHEDULE – MARCH 10-14, 2013

Recovery and Restoration – From Concept to Implementation

SUNDAY MARCH 10, 2013	MONDAY MARCH 11, 2013	TUESDAY MARCH 12, 2011	WEDNESDAY MARCH 13, 2013	THURSDAY MARCH 14, 2013
	7:20-8:20 a.m. BREAKFAST MAIN DINING ROOM	7:20-8:20 a.m. BREAKFAST MAIN DINING ROOM	7:20-8:20 a.m. BREAKFAST MAIN DINING ROOM	7:20-8:20 a.m. BREAKFAST MAIN DINING ROOM
	8:20-10:00 p.m. CAMELLIA ROOM *Emerging Trends I* GOLDENROD ROOM *Biology I*	8:20-10:00 p.m. CAMELLIA ROOM *Survey & Monitoring I* GOLDENROD ROOM *Population Genetics I*	8:20-10:00 p.m. CAMELLIA ROOM *Recovery I* GOLDENROD ROOM *Population Demographics I*	*DAY TRIPS (Optional):* Paint Rock River Project Little River & Cathedral Caverns U.S. Space & Rocket Center
	10:00-10:20 a.m. BREAK	10:00-10:20 a.m. BREAK	10:00-10:20 a.m. BREAK	
	10:20-12:00 p.m. CAMELLIA ROOM *Emerging Trends II* GOLDENROD ROOM *Biology II*	10:20-12:00 p.m. CAMELLIA ROOM *Survey & Monitoring II* GOLDENROD ROOM *Population Genetics II*	10:20-12:00 p.m. CAMELLIA ROOM *Recovery II* GOLDENROD ROOM *Population Demographics II*	
	12:00-1:20 p.m. BOXED LUNCH COMMITTEE MEETINGS	12:00-1:20 p.m. BOXED LUNCH COMMITTEE MEETINGS	12:00-1:40 p.m. LUNCH & BUISNESS MEETING GRANDVIEW BALLROOM	
FMCS EXECUTIVE BOARD MEETING DOGWOOD ROOM 2:00-5:00 p.m.	1:20-2:40 p.m. CAMELLIA ROOM *Toxicology* GOLDENROD ROOM *Habitat I*	1:20-2:40 p.m. CAMELLIA ROOM *Survey & Monitoring III* GOLDENROD ROOM *Propagation & Culture I*	1:40-3:00 p.m. CAMELLIA ROOM *Systematics* GOLDENROD ROOM *Habitat II*	
REGISTRATION 1:00-6:00 p.m. SPEAKER SET-UP / PRESENTATION LOADING AZALEA II COMMITTEE MEETINGS 5:00-7:00 p.m.	2:40-3:20 p.m. BREAK	2:40-3:20 p.m. BREAK	3:00-3:20 p.m. BREAK	
	3:20-5:00 p.m. CAMELLIA ROOM *Emerging Trends II* GOLDENROD ROOM *Histology & Parasitology I*	3:20-5:00 p.m. CAMELLIA ROOM *Histology & Parasitology* GOLDENROD ROOM *Propagation & Culture II*	3:20-5:00 p.m. CAMELLIA ROOM *Recovery III* GOLDENROD ROOM *Biology III*	
P0STER SET-UP GRANDVIEW BALLROOM WELCOME 7:00 p.m.	POSTER SESSION GRANDVIEW BALLROOM *heavy HORS D'OEUVRES*	DINNER NATIONAL STRATEGY AUCTION GRANDVIEW BALLROOM	DINNER MUSIC BY THE OKRATONES TOP O' THE RIVER	

SUNDAY, March 10, 2013| 1:00-6:00 p.m.	
SYMPOSIUM REGISTRATION 1:00-6:00 p.m.	**GUNTERVILLE STATE PARK LODGE LOBBY**
POSTER SETUP 1:00-6:00 p.m.	**GRANDVIEW BALLROOM**
DOGWOOD ROOM 2:00-5:00 p.m.	**FMCS EXECUTIVE COMMITTEE MEETING**
AZALEA III 5:00-6:20 p.m.	**SYMPOSIUM COMMITTEE MEETING**
BOARDROOM 5:00-6:20 p.m.	**OUTREACH COMMITTEE MEETING**
HICKORY ROOM 5:00-6:20 p.m.	**MUSSEL STATUS & DISTRIBUTION COMMITTEE MEETING**
AZALEA II 1:00-6:00 p.m.	**AUTHOR REVIEW ROOM**
REGISTRATION DESK 1:00-6:00 p.m.	**PLATFORM PRESENTATION LOADING**
WELCOME RECEPTION 7:00 p.m. – GRANDVIEW BALLROOM	

SESSION 1: EMERGING TRENDS I **Monday, March 11, 2013 | 8:20-10:00 a.m.** **Camellia Room** *Moderator: Caryn Vaughn, Oklahoma Biological Survey, Department of Biology, Ecology, and Evolutionary Biology, University of Oklahoma, Norman, OK*		**SESSION 2: BIOLOGY I** **Monday, March 11, 2013 | 8:20–10:00 a.m.** **Goldenrod Room** *Moderator: Stuart McGregor, Ecosystems Investigation Program, Geological Survey of Alabama, Tuscaloosa, AL*	
Platform 1 **8:20 a.m.**	**MODELING THE RELATIONSHIP BETWEEN MUSSEL ECOSYSTEM SERVICES AND ENVIRONMENTAL FLOWS**. Caryn Vaughn[1], Jason Julian[2], Carla Atkinson[1]	**Platform 6** **8:20 a.m.**	**BURROWING, BYSSUS, AND BIOMARKERS: BEHAVIORAL AND PHYSIOLOGICAL INDICATORS OF SUBLETHAL THERMAL STRESS IN FRESHWATER MUSSELS.** Jennifer Archambault[1], Gregory Cope[2], Thomas Kwak[3] STUDENT PRESENTATION
Platform 2 **8:40 a.m.**	**VALUING ECOSYSTEM SERVICES FROM SUPPLY TO DEMAND SIDE: AN INTERDISCIPLINARY APPROACH FOR WATERSHED MANAGEMENT IN SOUTHEAST OKLAHOMA.** Antonio Castro[1], Caryn Vaughn[1], Jason Julian[2]	**Platform 7** **8:40 a.m.**	**BOTTOM-UP MUSSEL DERIVED NUTRIENT EFFECTS ON JUVENILE LARGEMOUTH BASS.** Brandon Sansom[1], Caryn Vaughn[1], William Shelton[1], Greg Summers[2] STUDENT PRESENTATION
Platform 3 **9:00 a.m.**	**PREDICTION OF RESILIENT SYSTEMS FOR LONG TERM CONSERVATION OF AQUATIC RESOURCES.** Arlene Olivero[1], Braven Beaty[2], Mark Anderson[1]	**Platform 8** **9:00 a.m.**	**JUVENILE DRIFT HELPS EXPLAIN THE PATCHY DISTRIBUTION OF UNIONID MUSSELS.** Pascal Irmscher, Caryn Vaughn STUDENT PRESENTATION
Platform 4 **9:20 a.m.**	**JEOPARDY! TWELVE YEARS OF REINTRODUCTION, PROPAGATION, AUGMENTATION, AND MONITORING THE FEDERALLY ENDANGERED HIGGINS' EYE PEARLY MUSSEL (*LAMPSILIS HIGGINSII*) IN THE UPPER MISSISSIPPI RIVER DRAINAGE. – PART I**. Gary Wege[1], Mike Davis[2], Interagency Mussel Conservation Team[3]	**Platform 9** **9:20 a.m.**	**LIFE HISTORY OF THE CUMBERLAND PAPERSHELL (*ANODONTOIDES DENIGRATA*).** Tyler Hern[1], James Layzer[2]
Platform 5 **9:40 a.m.**	**JEOPARDY! TWELVE YEARS OF REINTRODUCTION, PROPAGATION, AUGMENTATION, AND MONITORING THE FEDERALLY ENDANGERED HIGGINS' EYE PEARLY MUSSEL (*LAMPSILIS HIGGINSII*) IN THE UPPER MISSISSIPPI RIVER DRAINAGE. – PART II.** Gary Wege[1], Mike Davis[2], Interagency Mussel Conservation Team[3]	**Platform 10** **9:40 a.m.**	**STRUCTURE AND FUNCTION OF MOLLUSKS COMMUNITIES IN ESTUARIES OF THE SOUTHERN BALTIC SEA.** Dmitry Filippenko
MORNING BREAK 10:00–10:20 a.m. – GRANDVIEW BALLROOM		**MORNING BREAK 10:00–10:20 a.m. – GRANDVIEW BALLROOM**	

SESSION 3: EMERGING TRENDS II **Monday, March 11, 2013 | 10:20 a.m.-12:00 p.m.** **Camellia Room** *Moderator: Teresa Newton, US Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI*		**SESSION 4: BIOLOGY II** **Monday, March 11, 2013 | 10:20 a.m.–12:00 p.m.** **Goldenrod Room** *Moderator: Steve McMurray, Missouri Department of Conservation, Columbia, MO*	
Platform 11 **10:20 a.m.**	**MUSSELS ARE NOT ALONE: EXPLORING THE MICROBIAL DIVERSITY IN UNIONIDS**. Cova Arias[1], Stacey LaFrentz[1], Ash Bullard[1], Paul Johnson[2]	**Platform 16** **10:20 a.m.**	**WINTER MONITORING OF TRANSLOCATED MUSSEL POPULATION IN THE WALKILL RIVER, SUSSEX COUNTY, NEW JERSEY.** Kyle McGill[1,2], Casey Swecker[1], Thomas Jones[2] STUDENT PRESENTATION
Platform 12 **10:40 a.m.**	**MECHANISMS OF DISRUPTION OF MUSSEL REPRODUCTION BY HIGH SUSPENDED SOLIDS.** Andrew Gascho Landis[1], Wendell Haag[2], James Stoeckel[1] STUDENT PRESENTATION	**Platform 17** **10:40 a.m.**	**CORRELATING ENVIRONMENTAL VARIABLES WITH FRESHWATER SNAIL SHAPE: AN EXAMPLE IN *ELIMIA PROXIMA*.** Joseph Styga, Benjamin Shepard, Russell Minton STUDENT PRESENTATION
Platform 13 **11:00 a.m.**	**TRACING MUSSEL-DERIVED NITROGEN IN RIVERINE FOOD WEBS.** Carla Atkinson, Caryn Vaughn STUDENT PRESENTATION	**Platform 18** **11:00 a.m.**	**SHELL SHAPE DIFFERENCES IN *ELIMIA POTOSIENSIS* (LEA, 1841) CAN BE ATTRIBUTED TO ECOPHENOTYPIC PLASTICITY.** Russell Minton, Christopher Paight
Platform 14 **11:20 a.m.**	**ASSESSING THE EFFECTS OF NATIVE FRESHWATER MUSSELS ON NITROGEN DYNAMICS IN CONTINUOUS-FLOW MESOCOSOMS**. Jeremy Bril[1], Jonathan Durst[1], Craig Just[1], Teresa Newton[2]	**Platform 19** **11:20 a.m.**	**ANNULUS DEPOSITION AND INTRA-ANNULAR GROWTH OF *EPIOBLASMA AHLSTEDTI* AND *LEMIOX RIMOSUS* IN THE DUCK RIVER, TENNESSEE.** Ryan Foley[1], James Layzer[2] STUDENT PRESENTATION
Platform 15 **11:40 a.m.**	**BEYOND MULTI-DISTRICT LITIGATION AND MEGAPETITIONS: DEVELOPING AN EFFECTIVE APPROACH TO CONSERVING CANDIDATE, PETITIONED, AND OTHER AT-RISK SPECIES IN THE SOUTHEAST.** Shannon Holbrook	**Platform 20** **11:40 a.m.**	**REINTRODUCTION OF *CYCLONAIAS TUBERCULATA* AND *QUADRULA PUSTULOSA* IN THE LOWER PIGEON RIVER.** Andy Pigg, Michael McKinney, Sarah Flower STUDENT PRESENTATION
	BOXED LUNCHES – GRANDVIEW BALLROOM **FMCS COMMITTEE MEETINGS CONCURRENT** **12:00–1:20 p.m.**		**BOXED LUNCHES – GRANDVIEW BALLROOM** **FMCS COMMITTEE MEETINGS CONCURRENT** **12:00–1:20 p.m.**
	Information Exchange – Azalea III		***Genetics – Main Dining Room***
	Environmental Affairs – Dogwood		***Ad Hoc – National Strategy - Boardroom***

SESSION 5: TOXICOLOGY **Monday, March 11, 2013 | 1:20-2:40 p.m.** **Camellia Room** *Moderator: Gregory Cope, Department of Environmental and Molecular Toxicology, NC State University, Raleigh, NC*		**SESSION 6: HABITAT I** **Monday, March 11, 2013 | 1:20–2:40 p.m.** **Goldenrod Room** *Moderator: Jeff Powell, US Fish and Wildlife Service, Alabama Field Office, Daphne, AL*	
Platform 21 **1:20 p.m.**	**HAPPY AS A CLAM? BEHAVIORAL AND PHYSIOLOGICAL EFFECTS OF THE ANTIDEPRESENT FLUOXETINE ON FRESHWATER MUSSELS.** Peter Hazelton[1], Bowen Du[2], Bryan Brooks[2], Robert Bringolf[4] STUDENT PRESENTATION	**Platform 25** **1:20 p.m.**	**DEFINING FRESHWATER MUSSEL HABITAT IN A LARGE COASTAL PLAIN RIVER USING SIDE SCAN SONAR.** Reuben Smit[1], Adam Kaeser[2], Michael Gangloff[3], Steve Sammons[1], Jim Stoeckel[1] STUDENT PRESENTATION
Platform 22 **1:40 p.m.**	**METABOLOMIC, BEHAVIORAL, AND REPRODUCTIVE EFFECTS OF THE SYNTHETIC ESTROGEN 17 α-ETHINYLESTRADIOL ON THE UNIONID MUSSEL *LAMPSILIS FASCIOLA*.** Jeremy Leonard[1], Gregory Cope[1], Chris Barnhart[2], Robert Bringolf[3] STUDENT PRESENTATION	**Platform 26** **1:40 p.m.**	**HABITAT-MEDIATED CHANGE IN MUSSEL COMMUNTIY STRUCTURE FOLLOWING CONSTRUCTION OF THE TENNESSEE-TOMBIGBEE WATERWAY.** Byron Hamstead[1], Paul Hartfield[2], Michael Gangloff[1] STUDENT PRESENTATION
Platform 23 **2:00 p.m.**	**ACUTE SENSITIVITY OF FRESHWATER MUSSELS TO SELECTED CHEMICALS WITH DIFFERING TOXIC MODES OF ACTION.** Ning Wang[1], Chris Ingersoll[1], Chris Ivey[1], Bill Brumbaugh[1], Ed Hammer[2], Candice Bauer[2], Tom Augspurger[3], Sandy Raimondo[4], Burt Shephard[5], Joe Bartoszek[6], Chris Barnhart[7], Nathan Eckert[8]	**Platform 27** **2:00 p.m.**	**ASSESSMENT OF RIVER MOUTHS AS UNIONID REFUGIA ALONG A LAURENTIAN GREAT LAKE** Trevor Prescott[1], Robert Krebs[1], Wentworth Clapham[1], David Klarer[2] STUDENT PRESENTATION
Platform 24 **2:20 p.m.**	**EVALUATION OF THE ACUTE TOXICITY OF A LAMPRICIDE ON MULTIPLE LIFE STAGES OF THE SNUFFBOX MUSSEL.** Teresa Newton[1], Michael Boogaard[1], Terrance Hubert[1], Cheryl Kaye[2], Chris Barnhart[3]	**Platform 28** **2:20 p.m.**	**BEAVER AND MILL DAMS ALTER FRESHWATER MUSSEL HABITAT, GROWTH AND SURVIVAL IN NORTH CAROLINA PIEDMONT STREAMS.** Rachael Hoch[1], Megan McCormick[1], Chris Eads[2], Michael Madritch[1], Michael Gangloff[1] STUDENT PRESENTATION
AFTERNOON BREAK 2:40–3:20 p.m. – GRANDVIEW BALLROOM		**AFTERNOON BREAK 2:40–3:20 p.m. – GRANDVIEW BALLROOM**	

SESSION 7: EMERGING TRENDS III **Monday, March 11, 2013 | 3:20-5:00 p.m.** **Camellia Room** *Moderator: Chris Barnhart, Biology Department, Missouri State University, Columbia, MO*		**SESSION 8: HISTOLOGY & PARASITOLOGY I** **Monday, March 11, 2013 | 3:20–5:00 p.m.** **Goldenrod Room** *Moderator: Jess Jones, US Fish and Wildlife Service, Virginia Tech, Blacksburg, VA*	
Platform 29 **3:20 p.m.**	**IS THE LARVA OF *MARGARITIFERA* A GLOCHIDIUM?** Chris Barnhart	**Platform 34** **3:20 p.m.**	**RELATIONSHIPS BETWEEN NUTRIENT ENRICMENT, PLEUROCERID SNAIL DENSITIES, AND TREMATODE INFECTION RATES IN STREAMS**. Serena Ciparis[1], Deborah Iwanowicz[2] STUDENT PRESENTATION
Platform 30 **3:40 p.m.**	**EVOLUTION OF ASYMMETRICAL LARVAE IN FRESHWATER MUSSELS BIVALVIA: UNIONOIDA).** John Pfeiffer III[1], Daniel Graf[2] STUDENT PRESENTATION	**Platform 35** **3:40 p.m.**	**SHIFTS IN STABLE ISOTOPE SIGNATURES CONFIRM PARASITIC RELATIONSHIP OF FRESHWATER MUSSEL GLOCHIDIA ATTACHED TO HOST FISH.** Andrea Fritts[1], Mark Fritts[1], Scott Carleton[2], Robert Bringolf[1]
Platform 31 **4:00 p.m.**	**UNIOBARCODE: A COMPREHENSIVE DNA BARCODE LIBRARY FOR FRESHWATER MUSSELS (BIVALVIA: UNIONIDAE).** Nathan Johnson[1,2], James Williams[3], James Austin[1] STUDENT PRESENTATION	**Platform 36** **4:00 p.m.**	**HEALTH ASSESSMENT OF FRESHWATER MUSSELS USING METABOLITE PROFILING.** Ieva Roznere[1], Thomas Watters[1], Barbara Wolfe [2], Marymegan Daly[1]
Platform 32 **4:20 p.m.**	**MORPHOLOGY, MOLECULES AND TAXONOMY: THE PLEUROCERID PROBLEM.** Nathan Whelan[1], Ellen Strong[2], Paul Johnson[3] STUDENT PRESENTATION	**Platform 37** **4:20 p.m.**	**HISTOPATHOLOGICAL OBSERVATIONS OF NEMATODES INFECTING FOOT AND INTESTINE OF THE ALABAMA RAINBOW (*VILLOSA NEBULOSA*).** Andrew McElwain[1], Stephen Bullard[1]
Platform 33 **4:40 p.m.**	**CORRELATING GENETIC AND SPECIES DIVERSITY OF UNIONIDS ACROSS VARIABLE HABITATS IN WESTERN LAKE ERIE.** Traci Griffith, David Zanatta STUDENT PRESENTATION	**Platform 38** **4:40 p.m.**	**CELLULAR ANATOMY OF THE MANTLE EDGE OF ALABAMA RAINBOW (*VILLOSA NEBULOSA*), GULF PIGTOE (*FUSCONAIA CERINA*), AND ALABAMA CREEKMUSSEL (*STROPHITUS CONNASAUGAENSIS*), INSIGHTS ON SHELL FORMATION AND HISTOPATHOLOGICAL BIOMARKER POTENTIAL IN UNIONIDAE.** Andrew McElwain, Stephen Bullard[1]
POSTER SESSION – 6:00 – 9:00 p.m. - GRANDVIEW BALLROOM ***heavy Hors D'oeurvres served***		**POSTER SESSION – 6:00 – 9:00 p.m. - GRANDVIEW BALLROOM** ***heavy Hors D'oeurvres served***	
Poster Authors to remove displays by 10:20 a.m. – Tuesday Morning		***Poster Authors to remove displays by 10:20 a.m. – Tuesday Morning***	

SESSION 9: SURVEY & MONITORING I **Tuesday, March 12, 2013 | 8:20-10:00 a.m.** **Camellia Room** *Moderator: Jeff Garner, Alabama Department of Conservation and Natural Resources, Florence, AL*		**SESSION 10: POPULATION GENETICS I** **Tuesday, March 12, 2013 | 8:20-10:00 a.m.** **Goldenrod Room** *Moderator: David Berg, Department of Zoology, University of Miami, Hamilton, OH*	
Platform 39 **8:20 a.m.**	**DISTRIBUTION AND ABUNDANCE OF FRESHWATER MUSSELS IN THE PROJECT AREA OF A LOWHEAD DAM REMOVAL PROJECT IN COLUMBUS, OHIO.** Cody Fleece[1], James Kiser[2], Michael Hoggarth[3] Scott Peyton[1]	**Platform 44** **8:20 a.m.**	**POPULATION GENETIC ANALYSES REVEAL RECENT ISOLATION OF *POPENAIAS POPEII*, IN THE SOUTHWEST UNITED STATES.** Kentaro Inoue[1], Brian Lang[2], David Berg[3] STUDENT PRESENTATION
Platform 40 **8:40 a.m.**	**CATSPAW MUSSEL (*EPIOBLASMA OBLIQUATA OBLIQUATA*) (RAFINESQUE, 1820)…ON THE BRINK?** Steve Ahlstedt[1], Greg Zimmerman[2], Angela Boyer[3], Leroy Koch[4], Martin Huener[2], Ryan Schwegman[2], Patrick Evankovich[2]	**Platform 45** **8:40 a.m.**	**GENETIC STRUCTURE OF MAPLELEAF MUSSELS (*QUADRULA QUADRULA*) AND EFFECTS OF THE *DREISSENA* INVASION IN THE WESTERN BASIN OF LAKE ERIE.** Wendy Paterson, David Zanatta STUDENT PRESENTATION
Platform 41 **9:00 a.m.**	**RESULTS OF A SURVEY OF THE MUSSEL FAUNA AT SELECTED STATIONS IN THE BLACK WARRIOR RIVER SYSTEM, ALABAMA, 2009-2012.** Stuart McGregor[1], Anne Wynn[1], Jeffrey Garner[2]	**Platform 46** **9:00 a.m.**	**USING MOLECULAR DATA TO AID DELINEATION OF TWO SPECIES IN THE FRESHWATER MUSSEL GENUS *CYPROGENIA* (BIVALVIA: UNIONIDAE).** Jer Pin Chong[1], John Harris[2], Kevin Roe[1] STUDENT PRESENTATION
Platform 42 **9:20 a.m.**	**STATUS OF RARE AND ENDANGERED FRESHWATER MUSSELS (BIVALVIA: UNIONOIDEA) IN MISSOURI**. Stephen McMurray[1], Chris Barnhart[2], Scott Faiman[1], Travis Moore[3], Andrew Roberts[4], Bryan Simmons[4], Michael Taylor[5]	**Platform 47** **9:20 a.m.**	**SPATIALLY EXPLICIT GENETIC STRUCTURE OF TWO UNIONID SPECIES, *LAMPSILIS CARDIUM* AND *LASMIGONA COSTATA*, IN THE CENTRAL GREAT LAKES.** Jennifer Bergner, Daelyn Woolnough, David Zanatta STUDENT PRESENTATION
Platform 43 **9:40 a.m.**	**DISTRIBUTION OF FRESHWATER GASTROPODS OF NEBRASKA AND SOUTH DAKOTA: RESULTS OF AN ONGOING SURVEY.** Bruce Stephen, Patricia Freeman	**Platform 48** **9:40 a.m.**	**PHYLOGEOGRAPHIC AND POPULATION GENETIC ANALYSES REVEAL MULTIPLE LINEAGES AND POST-GLACIAL EXPANSION IN A WIDE-RANGING ENDANGERED MUSSEL, *CUMBERLANDIA MONODONTA* (SAY 1829).** Kentaro Inoue[1], Emy Monroe[1], Curt Elderkin[1, 2], David Berg[3]
MORNING BREAK 10:00–10:20 a.m. – GRANDVIEW BALLROOM		**MORNING BREAK 10:00–10:20 a.m. – GRANDVIEW BALLROOM**	

SESSION 11: SURVEY & MONITORING II Tuesday, March 12, 2013 – 10:20 a.m.-12:00 p.m. Camellia Room *Moderator: Todd Fobian, Alabama Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, AL*		SESSION 12: POPULATION GENETICS II Tuesday, March 12, 2013 – 10:20 a.m.–12:00 p.m. Goldenrod Room *Moderator: Nathan Whelan, University of Alabama, Department of Biological Sciences, Tuscaloosa, AL*	
Platform 49 10:20 a.m.	**CONSERVATION STATUS OF EUROPEAN FRESHWATER BIVALVES.** Manuel Lopes-Lima[1,2], Ronaldo Sousa, David Aldridge, Rafael Araujo, Jakob Bergengren, Erika Bódis, Phillipe Bouchet, Karel Douda, Jurgen Geist, Ian Killeen, et al.	**Platform 54 10:20 a.m.**	**PHYSIOLOGICAL AND GENETIC DIFFERENCES BETWEEN *ELLIPTIO COMPLANATA* POPULATIONS FROM ATLANTIC SLOPE DRAINAGES.** Curt Elderkin[1], James Stoeckel[2]
Platform 50 10:40 a.m.	**NATIVE MUSSEL POPULATIONS OF DOURO BASIN, PORTUGAL: ECOLOGICAL PATTERNS, MAIN THREATS AND CONSERVATION MEASURES.** Amílcar Teixeira[1], Simone Varandas[2], Ronaldo Sousa[3,4], Elsa Froufe[3], Manuel Lopes-Lima[3]	**Platform 55 10:40 a.m.**	**CHROMOSOMAL CHARACTERISTICS – ANOTHER CHARACTER SET TO HELP CLARIFY RELATIONSHIPS AMONG THE FRESHWATER MUSSELS.** John Jenkinson
Platform 51 11:00 a.m.	**DISTRIBUTION AND RELATIVE ABUNDANCE OF THE GASTROPOD FAUNA OF THE MUKWONAGO RIVER, WISCONSIN.** Rex Hanger, Kristie Hansen	**Platform 56 11:00 a.m.**	**DIFFERENCES IN POPULATION STRUCTRE ESTIMATED WITHIN MATERNALLY- AND PATERNALLY-INHERITED FORMS OF MITOCHONDRIA AND THEIR IMPLICATIONS TO CONSERVATION.** Robert Krebs[1]
Platform 52 11:20 a.m.	**A LIFE STAGE STORY OF THE KIDNEYSHELL MUSSEL, *PTYCHOBRANCHUS FASCIOLARIS*, IN SOUTHERN ONTARIO, CANADA.** Kelly McNichols-O'Rourke, Todd Morris	**Platform 57 11:20 a.m.**	**A COMPARISON OF GENETIC DIVERSITY BETWEEN SYMPATRIC POPULATIONS OF THE ENDANGERED WINGED MAPLELEAF (*QUADRULA FRAGOSA*) AND THE NOT-SO-ENDANGERED PIMPLEBACK (*QUADRULA PUSTULOSA*) IN THE ST. CROIX RIVER, USA**. Kevin Roe[1], Sara Boyer[2]
Platform 53 11:40 a.m.	**UNIONID ASSEMBLAGES IN TWO ST. FRANCIS RIVER DRAINAGE DITCHES BEFORE AND AFTER CHANNEL MAINTENANCE CLEANOUTS.** John Harris[1], Mark Smith[2], Kevin Piggott[2], Andrew Peck[3], Alan Christian[4]	**Platform 58 11:40 a.m.**	**GENETIC STRUCTURE AND INTRASPECIFIC PHYLOGEOGRAPHY OF THREE REPRODUCING POPULATIONS OF THE CLUBSHELL MUSSEL (*PLEUROBEMA CLAVA*).** Kody Kuehnl[1, 2], Michael Sovic[2]
	BOXED LUNCHES – GRANDVIEW BALLROOM FMCS COMMITTEE MEETINGS CONCURRENT 12:00–1:20 p.m.		**BOXED LUNCHES – GRANDVIEW BALLROOM FMCS COMMITTEE MEETINGS CONCURRENT 12:00–1:20 p.m.**
	Awards – Azalea III		***Guidelines & Techniques – Main Dining Room***
	Gastropod Status – Dogwood		***Propagation - Boardroom***

SESSION 13: SURVEY & MONITORING III **Tuesday, March 12, 2013 | 1:20-2:40 p.m.** **Camellia Room** *Moderator: Heidi Dunn, Ecological Specialists Incorporated, O'Fallon, MO*		**SESSION 14: PROPAGATION & CULTURE I** **Tuesday, March 12, 2013 | 1:20–2:40 p.m.** **Goldenrod Room** *Moderator: Bryan Simmons, US Fish and Wildlife Service, Missouri State University, Springfield, MO*	
Platform 59 **1:20 p.m.**	**LONG-TERM MONITORING OF SIX MUSSEL BEDS IN POOL 14, MISSISSIPPI RIVER.** Heidi Dunn[1], John Petro[2]	**Platform 63** **1:20 p.m.**	**REARING AND CULTURING ACTIVITIES FOR *MARGARITIFERA MARGARITIFERA* IN EUROPE.** Frankie Thielen[1], Michael Lange[2], Jurgen Geist[3]
Platform 60 **1:40 p.m.**	**A MUSSEL COMMUNITY ASSESSMENT TOOL FOR THE UPPER MISSISSIPPI RIVER.** Heidi Dunn[1], Steve Zigler[2], Teresa Newton[2]	**Platform 64** **1:40 p.m.**	**ASSESSMENT OF IN VITRO MUSSEL CULTURE WITH ESTIMATES OF PRODUCTION POTENTIAL.** Chris Owen, Monte McGregor, Andy McDonald, David Cravens, Adam Shepard, Fritz Vorisek, Travis Bailey
Platform 61 **2:00 p.m.**	**UNIONID COMMUNITY OF SOUTHERN LAKE ONTARIO: LOCATING EXISTING REFUGES AND ASSESSING DREISSENID IMPACTS.** Lyubov Burlakova[1], Alexander Karatayev[1], Jonathan Bossenbroek[2], David Zanatta[3], Brianne Tulumello[1], Robert Krebs[4], Wendy Paterson[3], Traci Griffith[3]	**Platform 65** **2:00 p.m.**	**MULTIPLE USES FOR THE GENOA NATIONAL FISH HATCHERY STREAMSIDE MUSSEL REARING TRAILER.** Jorge Buening, Nathan Eckert
Platform 62 **2:20 p.m.**	**REASSESSMENT OF THE REMNANT UNIONID COMMUNITY IN LAKE ERIE AND LAKE ST. CLAIR, 25 YEARS AFTER THE DREISSENID INVASION.** David Zanatta[1], John Bateman[2], Jonathan Bossenbroek[3], Lyubov Burlakova[4], Todd Crail[3], Ferenc de Szalay[5], Traci Griffith[1], Doug Kapusinski[5], Alexander Karatayev[4], Robert Krebs[6], Gary Longton[2], Elizabeth Meyer[7], Wendy Paterson[1], Trevor Prescott[6], Matthew Rowe[1], Donald Schloesser[8], Matthew Shackelford[2], Mary Walsh[7]	**Platform 66** **2:20 p.m.**	**EVALUATING FLOATING CAGES IN PONDS AS A POTENTIAL LOW-INPUT, HIGH-YIELD METHOD FOR CULTURING FRESHWATER MUSSELS.** Chris Eads, Luke Borst, Jennifer Hurley-Sanders, Jay Levine
AFTERNOON BREAK 2:40–3:20 p.m. – GRANDVIEW BALLROOM		**AFTERNOON BREAK 2:40–3:20 p.m. – GRANDVIEW BALLROOM**	

SESSION 15: HISTOLOGY & PARASITOLOGY II **Tuesday, March 12, 2013 | 3:20-5:00 p.m.** **Camellia Room** *Moderator: Jay Levine, College of Veterinary Medicine, North Carolina State University, Raleigh, NC*		**SESSION 16: PROPAGATION & CULTURE II** **Tuesday, March 12, 2013 | 3:20–5:00 p.m.** **Goldenrod Room** *Moderator: Megan Bradley, Virginia Department of Game and Inland Fish, Aquatic Wildlife Conservation Center, Marion, VA*	
Platform 67 **3:20 p.m.**	**TREMATODE PARASITE *PROSORHYNCHOIDES PUSILLA*: OCCURRENCE, LIFE CYCLE AND EFFECT ON REPRODUCTION OF UNIONIDS IN BATTLE RIVER, ALBERTA, CANADA.** Jouni Taskinen	**Platform 72** **3:20 p.m.**	**PROPAGATION AND CAPTIVE CULTURE OF WESTERN PEARLSHELL, (*MARGARITIFERA FALCATA*).** Beth Glidewell[1], Chris Barnhart[1], Jeanette Howard[2], Chris Ingersoll[3], Ning Wang[3] STUDENT PRESENTATION
Platform 68 **3:40 p.m.**	**EXOTIC SNAIL SPECIES IN *SCHISTOSOMA* ENDEMIC AREAS OF NIGERIA.** Oyetunde Salawu[1,2], Alexander Odaibo[1]	**Platform 73** **3:40 p.m.**	**EFFECTS OF GLOCHIDIA AGE ON JUVENILE CONDITION IN FRESHWATER MUSSELS.** Amy Maynard, Rowena Woode, Chris Barnhart STUDENT PRESENTATION
Platform 69 **4:00 p.m.**	**EFFECTS OF COAL PARTICLES IN AQUATIC SEDIMENTS ON ORGAN TISSUES OF RAINBOW MUSSELS, *VILLOSA IRIS*.** William Henley, Nels Johnson[2], Serena Ciparis[1], Shane Hanlon[3], Douglas Heffinger[3]	**Platform 74** **4:00 p.m.**	**IS GLOCHIDIA VIABILITY INDICATIVE OF INFECTIVITY, THE ABILITY TO ATTACH AND METAMORPHOSE?** Robert Bringolf[1], Andrea Fritts[1], Chris Barnhart[2], Gregory Cope[3]
Platform 70 **4:20 p.m.**	**QUANTIFYING EFFECTS OF TEMPERATURE ON RESPIRATION OF SELECTED MUSSEL HOST FISH FROM THE TENNESSEE AND MOBILE RIVER BASINS.** Nathan Hartline, Dennis DeVries, Russell Wright	**Platform 75** **4:20 p.m.**	**PARTICLE SIZE, CAPTURE EFFICIENCY AND CLEARANCE RATES BY JUVENILE UNIONID MUSSELS.** Madeline Pletta, Chris Barnhart STUDENT PRESENTATION
Platform 71 **4:40 p.m.**	**THE EFFECTS OF INCREASING POPULATION SIZE OF ASIATIC CLAM, *CORBICULA FLUMINEA*, ON PREDATION BY AN OMNIVOROUS TURTLE, *STERNOTHERUS ODORATUS*.** Caitlin Wilhelm[1], Mike Plummer[2], Chris Barnhart[1] STUDENT PRESENTATION	**Platform 76** **4:40 p.m.**	**USE OF GILL EXCISION TO IDENTIFY HOST FISHES FOR *ELLIPTIO CRASSIDENS*.** Michael Hart[1], James Stoeckel[1], Wendell Haag[2] STUDENT PRESENTATION
	DINNER – GRANDVIEW BALLROOM 6:00 p.m.		**DINNER – GRANDVIEW BALLROOM 6:00 p.m.**
	FMCS NATIONAL STRATEGY – GRANDVIEW BALLROOM 7:00 p.m.		**FMCS NATIONAL STRATEGY – GRANDVIEW BALLROOM 7:00 p.m.**
	FMCS AUCTION – GRANDVIEW BALLROOM 8:30 p.m.		**FMCS AUCTION – GRANDVIEW BALLROOM 8:30 p.m.**

SESSION 17: RECOVERY I **Wednesday, March 13, 2013 | 8:20-10:00 a.m.** **Camellia Room** *Moderator: Steve Fraley, North Carolina Wildlife Resources Commission, Nongame Diversity, Clyde, NC*		**SESSION 18: POPULATION DEMOGRAPHICS I** **Wednesday, March 13, 2013 | 8:20-10:00 a.m.** **Goldenrod Room** *Moderator: Jason Wisniewski, Georgia Department of Natural Resources, Nongame Conservation, Social Circle, GA*	
Platform 77 **8:20 a.m.**	**FRESHWATER MUSSEL POPULATION RESTORATION AND AUGMENTATION IN WESTERN NORTH CAROLINA.** Steve Fraley, T.R. Russ	**Platform 82** **8:20 a.m.**	**DECLINES IN IMPERILED SPECIES CAN BE MASKED BY COMMUNITY CHANGES: ELUCIDATING CHANGES USING ORDINATION.** Daelyn Woolnough, Jennifer Bergner
Platform 78 **8:40 a.m.**	**REINTRODUCING A FEDERALLY ENDANGERED SPECIES TO OHIO – THE NORTHERN RIFFLESHELL MUSSEL.** Thomas Watters[1,2], Trisha Gibson[1], Clarissa Bey[1], Kody Kuehnl[3], Howard Albin[4]	**Platform 83** **8:40 a.m.**	**OCCUPANCY, DETECTION, AND HABITAT RELATIONSHIPS OF UNIONIDS IN THE LOWER FLINT RIVER, GEORGIA.** Jason Wisniewski[1], Nicole Rankin[2], Deborah Weiler[1], Bradley Strickland[1], Houston Chandler[1]
Platform 79 **9:00 a.m.**	**REINTRODUCTION OF THE FEDERALLY-ENDANGERED NORTHERN RIFFLESHELL (*EPIOBLASMA RANGIANA*) AND CLUBSHELL (*PLEUROBEMA CLAVA*) IN ILLINOIS.** Jeremy Tiemann[1], Robert Szafoni[2], Joseph Kath[3], Kevin Cummings[1]	**Platform 84** **9:00 a.m.**	**USING STRUCTURED DECISION MAKING TO DEVELOP CONSERVATION STRATEGIES FOR DWARF WEDGEMUSSEL IN NORTH CAROLINA.** Dave Smith[1], Sarah McRae[2], Judy Ratcliffe[3], Rob Nichols[4], Chris Eads[5], Tom Augspurger[6], Tim Savidge[7], Art Bogan[8], Brett Hillman[7]
Platform 80 **9:20 a.m.**	**QUANTITATIVE ASSESSMENT OF MUSSEL FAUNA RECOVERY IN THE DUCK RIVER, TENNESSEE.** Don Hubbs	**Platform 85** **9:20 a.m.**	**NOW YOU SEE THEM, NOW YOU DON'T: APPLYING OCCUPANCY MODELING TO MONITOR A RARE AND CRYPTIC SPECIES.** Shane Hanlon[1], Brett Ostby[2], Steve Fraley[3]
Platform 81 **9:40 a.m.**	**MONITORING RECOVERY OF MUSSELS IN THE ELK RIVER DOWNSTREAM OF TIMS FORD DAM.** Chuck Howard[1], Don Hubbs[2], Stephanie Chance[3], Paul Johnson[4]	**Platform 86** **9:40 a.m.**	**STREAMLINING ENDANGERED SPECIES CONSULTATIONS UTILIZING THE USFWS IPaC AND CONSERVATION FRAMEWORK BUILDER WEB TOOLS.** Josh Seagraves[1], Mitch Wine[2], Randal Looney[3], John Fleming[1]
MORNING BREAK 10:00–10:20 a.m. – GRANDVIEW BALLROOM		**MORNING BREAK 10:00–10:20 a.m. – GRANDVIEW BALLROOM**	

SESSION 19: RECOVERY II **Wednesday, March 13, 2013 | 10:20 a.m.-12:00 p.m.** **Camellia Room** *Moderator: Patty Morrison, US Fish and Wildlife Service, Ohio River Islands NWR, Williamstown, WV*		**SESSION 20: SYSTEMATICS** **Wednesday, March 13, 2013 | 10:20 a.m.-12:00 p.m.** **Goldenrod Room** *Moderator: Thomas Watters, Department of Evolution, Ecology and Organismal Biology, The Ohio State University, Columbus, OH*	
Platform 87 **10:20 a.m.**	**USING MARK-RECAPTURE SAMPLING TO ASSESS POPULATIONS OF THE ENDANGERED JAMES SPINYMUSSEL (*PLEUROBEMA COLLINA*).** Brian Watson[1], Brett Ostby[2], Caitlin Carey[2]	**Platform 92** **10:20 a.m.**	**DIVERGENT HAPLOTYES AND IMPLICATIONS FOR PHYLOGENY OF THE PLEUROCERIDAE USING MITOCHONDRIAL MARKERS.** Ellen Strong[1], Jeffrey Garner[2], Paul Johnson[3], Nathan Whelan[4]
Platform 88 **10:40 a.m.**	**REINTRODUCTION OF MUSSELS INTO THE CALDERWOOD BYPASS OF THE LITTLE TENNESSEE RIVER; A CASE OF FRATERNIZING WITH THE ENEMY?** Kendall Moles[1], James Layzer[2]	**Platform 93** **10:40 a.m.**	***VILLOSA* 2.0.** Thomas Watters[1], Kody Kuehnl[2]
Platform 89 **11:00 a.m.**	**PARTNERSHIPS PROTECTING THE PAINT ROCK WATERSHED.** Paul Freeman[1], Doug Fears[1], Traci Wood[2]	**Platform 94** **11:00 a.m.**	**NEW SPECIES OF NORTH AMERICAN PHYSIDAE (MOLLUSCA: GASTROPODA: BASOMMATOPHORA).** John Burch[1], David Hooper[2], Alexandria Moore[1], Thomas Duda, Jr.[1,3]
Platform 90 **11:20 a.m.**	**RESTORING THE FRESHWATER MOLLUSK COMMUNITY FOLLOWING A TOXIC EVENT: PART I – ASSESSING THE DAMAGES AND DEVELOPING A RESTORATION PLAN.** Patricia Morrison[1], Janet Clayton[2]	**Platform 95** **11:20 a.m.**	**GENUS *ELLIPTIO* IN THE GREATER FLORIDAN REGION: MAKING SENSE OF BEWILDERING VARIATION IN SHELL MORPHOLOGY.** James Williams[1], Robert Butler[2], Gary Warren[1], Nathan Johnson[3]
Platform 91 **11:40 a.m.**	**RESTORING THE FRESHWATER MOLLUSK COMMUNITY FOLLOWING A TOXIC EVENT: PART 2 – RESTORATION ACTIVITIES AND SUCCESSES.** Janet Clayton[1], Patricia Morrison[2]	**Platform 96** **11:40 a.m.**	**PHYLOGEOGRAPHY OF FRESHWATER MUSSELS IN THE UPPER TALLAPOOSA DRAINGE (ALABAMA AND GEORGIA, USA).** Michael Gangloff, Erin Abernethy, Raymond Kessler IV, Michael Perkins, Lynn Siefferman
FMCS BUSINESS LUNCH **GRANDVIEW BALLROOM** **12:00–1:40 p.m.**		**FMCS BUSINESS LUNCH** **GRANDVIEW BALLROOM** **12:00–1:40 p.m.**	

SESSION 21: HABITAT II Wednesday, March 13, 2013 | 1:40–3:00 p.m. Camellia Room *Moderator: Gregory Zimmerman, EnviroScience Inc., Stow, OH*		SESSION 22: POPULATION DYNAMICS II Wednesday, March 13, 2013 | 1:40-3:00 p.m. Goldenrod Room *Moderator: Kevin Cummings, Illinois Natural History Survey, Campaign, IL*	
Platform 97 1:40 p.m.	**GROUND-TRUTHING MAXENT IN EAST TEXAS RIVERS.** David Ford[1], Ashley Walters[2], Judith Bilyea[1], Marsha Williams[1], Josh Banta[1], Neil Ford[1], Lance Williams[1]	**Platform 101 1:40 p.m.**	**POPULATION ASSESSEMENT OF THE ENDANGERED FANSHELL, *CYPROGENIA STEGARIA*, IN THE LICKING RIVER, KENTUCKY, PRIOR TO AND AFTER REMOVAL FROM A FIXED LOCATION.** Monte McGregor[1], Adam Shepard[1], Fritz Vorisek[1], Travis Bailey[1], Chris Owen[1], Jacob Culp[2], Leroy Koch[3]
Platform 98 2:00 p.m.	**IMPACT OF A SPILLWAY AND A HYDROELECTRIC DAM ON UNIONID MUSSEL DIVERSITY AND ABUNDANCE IN THE SABINE RIVER.** Neil Ford[1], Charles Randklev[2]	**Platform 102 2:00 p.m.**	**CAN AN OPPORTUNISTIC MUSSEL BECOME ENDANGERED? THE CASE OF THE INFLATED HEELSPLITTER IN THE AMITE RIVER.** Kenneth Brown, Wesley Daniel
Platform 99 2:20 p.m.	**ARAGONITE SATURATION AND BED STABILITY CONSTRAIN THE DISTRIBUTION OF *ALASMIDONTA HETERODON* IN A TRIBUTARY OF THE UPPER DELAWARE RIVER.** Cara Campbell[1], Karen Prestegaard[2]	**Platform 103 2:20 p.m.**	**LONG-TERM CHANGES IN THE DISTRIBUTION RANGE AND POPULATION SIZE OF TEXAS HORNSHELL (*POPENAIAS POPEII*).** Alexander Karatayev[1], Lyubov Burlakova[1], Thomas Miller[2]
Platform 100 2:40 p.m.	**DEVELOPMENT OF A PROGRAMMATIC AGREEMENT FOR FEDERAL AND STATE ENDANGERED MUSSELS IN WESTERN PENNSYLVANIA FOR THE PENNSYLVANIA DEPARTMENT OF TRANSPORTATION BRIDGE PROGRAM.** Gregory Zimmerman	**Platform 104 2:40 p.m.**	**ASSESSING POPULATION AND HABITAT VIABILITY OF DWARF WEDGEMUSSEL (*ALASMIDONTA HETERODON*) IN SWIFT CREEK, ASSOCIATED WITH SECTION 7 CONSULTATION FOR A MAJOR HIGHWAY PROJECT IN NORTH CAROLINA.** Tim Savidge, Tom Dickinson
AFTERNOON BREAK 3:00–3:20 p.m. – GRANDVIEW BALLROOM		**AFTERNOON BREAK 3:00–3:20 p.m. – GRANDVIEW BALLROOM**	

SESSION 23: RECOVERY III Wednesday, March 13, 2013 | 3:20-5:00 p.m. Camellia Room *Moderator: Arthur Bogan, North Carolina State Museum of Natural Sciences, Research Laboratory Raleigh, NC*		SESSION 24: BIOLOGY III Wednesday, March 13, 2013 | 3:20–5:00 p.m. Goldenrod Room *Moderator: Michael Buntin, Alabama Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, AL*	
Platform 105 3:20 p.m.	**MUSSEL RESTORATION IN THE LOWER OSAGE RIVER.** Bryan Simmons[1,4], Andy Roberts[1], Tracy Divis[2], Stephen McMurray[3], Chris Barnhart[4]	**Platform 110 3:20 p.m.**	**PATTERNS IN FISH PREDATION ON ZEBRA MUSSELS (*DREISSENA POLYMORPHA*) IN THE LOWER ST. CROIX RIVER.** Steve Zigler[1], Michelle Bartsch[1], Lynn Bartsch[1], William Richardson[1], Byron Karns[2], Brenda Moraska Lafrancois[3]
Platform 106 3:40 p.m.	**CONSERVATION AND RESTORATION OF EUROPEAN FRESHWATER MUSSEL POPULATIONS.** Jurgen Geist	**Platform 111 3:40 p.m.**	**LANDMARK ANALYSIS OF SHELL MORPHOLOGY IN SILT SNAILS OF THE GENUS *FLORIDOBIA.*** Timothy Roberts[1], Jason Bond[2], Alicia Schultheis[1]
Platform 107 4:00 p.m.	**PROPAGATION, RELEASE, AND MONITORING OF MUSSELS TO RESTORE POPULATIONS IN THE CLINCH AND POWELL RIVERS, TENNESSEE AND VIRGINIA.** Dan Hua[1, 3], Jess Jones[1, 2, 3], Tim Lane[1, 3], Yan Jiao[3], Richard Neves[1, 3]	**Platform 112 4:00 p.m.**	**THIRTY YEARS LATER, HOW ARE THE MUSSELS DOING IN TWELVE-POLE CREEK, WV?** Thomas Jones, Erica Thompson, Nathan Hoxie
Platform 108 4:20 p.m.	**REDISCOVERY OF THE FEDERALLY ENDANGERED ALABAMA LAMPMUSSEL (*LAMPSILIS VIRESCENS*) IN EMORY RIVER, MORGAN COUNTY, TENNESSEE.** Gerald Dinkins, Hugh Faust, Steven Ahlstedt	**Platform 113 4:20 p.m.**	**LOOK BEFORE YOU LEAP: NEW INFORMATION ON HABITAT AND HOST FISH REQUIREMENTS OF UNIO CRASSUS IMPLIES NEW CONSERVATION MANAGEMENT PRACTICES.** Katharina Stöckl, Jürgen Geist
Platform 109 4:40 p.m.	**REINTRODUCTION OF ALABAMA LAMPMUSSEL (*LAMPSILIS VIRESCENS*) INTO THREE MIDDLE TENNESSEE RIVER BASIN TRIBUTARIES – AN EXAMPLE OF FRESHWATER MUSSEL RECOVERY.** Todd Fobian[1], Michael Buntin[1], Jeff Powell[2], Don Hubbs[3], Jeff Garner[1], Paul Johnson[1]	**Platform 114 4:40 p.m.**	**ASSESSING THE EFFECT OF OIL AND GAS WELL WASTEWATER DISCHARGES ON ENDANGERED FRESHWATER MUSSELS.** Kathleen Patnode[1], Robert Anderson[1], Lora Zimmerman[1], Elizabeth Hittle[2]
5:30 p.m. – Load Buses – Front Parking Lot		**5:30 p.m. – Load Buses – Front Parking Lot**	
6:15 p.m. – Dinner - Top O' The River Music by the Okratones Load Busses 9:30–10:00 p.m. Return to Guntersville State Park		**6:15 p.m. – Dinner Top O' The River Music by the Okratones Load Busses 9:30–10:00 p.m. Return to Guntersville State Park**	

Thursday, March 14, 2013| 9:00-6:00 p.m.	
8:00 a.m.	Breakfast Main Dining Room (optional).
9:oo a.m.	***Optional Trip I*** **TOUR OF THE PAINT ROCK RIVER WATERSHED** Trip Leader: Paul Freeman, The Nature Conservancy of Alabama Vans depart from the front parking lot at 9:00 a.m. Limit of 24 participants
9:00 a.m.	***Optional Trip II*** **TOUR OF CATHEDRAL CAVERNS AND LITTLE RIVER CANYON** Trip Leader: Lori Tolly-Jordon, Jacksonville State University Bus departs from the front parking lot at 9:00 a.m. Limit of 45 participants
9:00 a.m.	***Optional Trip III*** **TOUR OF THE US SPACE AND ROCKET CENTER** Trip Leader: Bus departs from the front parking lot at 9:00 a.m. Limit of 45 participants

SESSION 1	EMERGING TRENDS I Monday, March 11, 2013 | 8:20-10:00 a.m. Camellia Room
Platform 1 **8:20 a.m.** **March 11, 2013**	**MODELING THE RELATIONSHIP BETWEEN MUSSEL ECOSYSTEM SERVICES AND ENVIRONMENTAL FLOWS**. Caryn Vaughn[1], Jason Julian[2], Carla Atkinson[1]. [1]Oklahoma Biological Survey, Department of Biology and Ecology and Evolutionary Biology Graduate Program, University of Oklahoma, Norman, OK; [2]Department of Geography and Environmental Sustainability, University of Oklahoma, Norman, OK.

Freshwater mussels are large, long-lived suspension feeders that provide important, quantifiable ecosystem services such as biofiltration, nutrient recycling and nutrient storage. Mussels occur in speciose aggregations (mussel beds) at high biomass, and species have different biofiltration and nutrient excretion rates. We have been studying mussel communities in the Kiamichi River, Oklahoma, intensively for over 20 years and know the location, size, species composition and biomass of most mussel beds in the river, and the filtration rates, nutrient excretion rates, and tissue nutrient concentration of dominant mussel species. We have used this information to calculate mussel aggregate biofiltration and nutrient stores and fluxes. An impounded tributary provides one third of inflows to the river and in recent drought years, management of this tributary reservoir has contributed to extremely depleted downstream flows, high water temperatures, mass mussel mortality and subsequent loss of ecosystem services. We deployed submerged data loggers at 8 sites in the watershed that recorded water level and temperature every 15 minutes for 18 months. We used these data and air temperature and solar radiation data to develop empirical rating curves that combine information on discharge and water temperature under various reservoir release schedules and atmospheric conditions. We are combining this information with our knowledge of temperature-specific mussel filtration and excretion rates to produce an empirical, predictive model of the ecosystem services provided by mussel communities under various flow and atmospheric conditions in the Kiamichi River watershed. cvaughn@ou.edu

Platform 2 **8:40 a.m.** **March 11, 2013**	**VALUING ECOSYSTEM SERVICES FROM SUPPLY TO DEMAND SIDE: AN INTERDISCIPLINARY APPROACH FOR WATERSHED MANAGEMENT IN SOUTHEAST OKLAHOMA.** Antonio Castro[1], Caryn Vaughn[1], Jason Julian[2]. [1]Oklahoma Biological Survey, Department of Biology and Ecology and Evolutionary Biology Graduate Program, University of Oklahoma, Norman, OK; [2]Department of Geography & Environmental Sustainability, University of Oklahoma, Norman, OK.

Ecosystem services — the benefits that people obtain from ecosystems — have become a new impetus for sustainable environmental resource management. An ecosystem services framework shows the links between healthy ecosystems and the maintenance of human welfare. Despite the relevance of this approach, there is ongoing debate over which services can be measured and how they should be valued considering their multidimensional nature (e.g. biophysical, socio-cultural or monetary). This makes it difficult to integrate the ecosystem services concept into decision making. Here, we present an interdisciplinary approach in which biophysical, socio-cultural and monetary values can be integrated into watershed management. Our approach pays special attention to assessing the impact of trade-offs between the supply-side (assessing ecosystem services provisioning from a biophysical dimension) and the demand-side (analyzing the importance people give to particular services and assessing their market values). Our study focuses on the Kiamichi River watershed in southeast Oklahoma, a biodiversity hotspot with valuable cultural and water resources. Our objectives are to rank the most important ecosystem services in the watershed, identify the services beneficiary groups, quantify the spatial distribution of services, evaluate their socio-cultural and monetary values, and assess how all of the above are affected by a multi-year drought. acastro@ual.es

Platform 3 **9:00 a.m.** **March 11, 2013**	**PREDICTION OF RESILIENT SYSTEMS FOR LONG TERM CONSERVATION OF AQUATIC RESOURCES.** Arlene Olivero[1], Braven Beaty[2], Mark Anderson[1]. [1]The Nature Conservancy, Eastern Region Science Center, Boston, MA; [2] The Nature Conservancy, Clinch Valley Program, Abingdon, VA.

Resilience is the ability of an ecosystem to adapt to change and maintain key functional processes in the face of oncoming shifts in ambient conditions. Resilient systems will maintain high levels of biodiversity and functional integrity even as species compositions change with conditions such as climate change. In order to improve the long term effectiveness of conservation efforts, resource managers need information about the expected resilience of potentially selected stream systems. We hypothesized that resilience of freshwater systems can be predicted by six characteristics including 3 condition variables: 1) lateral connectivity, 2) water quality as driven by surrounding land use, and 3) instream flow regime; and 3 diversity variables: 1) complexity of the stream network, 2) linear connectivity, and 3) diversity of geophysical settings. We mapped each variable for

connected stream networks, bounded by dams or headwaters, for the Northeastern and Mid-Atlantic Regions of the US to develop a comprehensive assessment of resilience across the freshwater systems. Further analyses refined these comparisons by fish subregions within freshwater ecoregions to normalize the results for representativeness across the study area. Results identified 346 networks, out of 1438 total, that consisted of 5+ stream or lake sizes, and 211 of those scored above the overall regional mean for both condition and diversity variables. In addition, 96 networks scored above the mean for diversity and 26 scored above the mean for condition. The high diversity, low condition networks should be further analyzed for remediation work suitability. Based on this analysis, the majority of networks with 5 or greater stream and lake sizes have characteristics that suggest good resiliency into the future. arlene_olivero@tnc.org, bbeaty@tnc.org,

Platform 4 **9:20 a.m.** **March 11, 2013**	**JEOPARDY! TWELVE YEARS OF REINTRODUCTION, PROPAGATION, AUGMENTATION, AND MONITORING THE FEDERALLY ENDANGERED HIGGINS' EYE PEARLY MUSSEL (*LAMPSILIS HIGGINSII*) IN THE UPPER MISSISSIPPI RIVER DRAINAGE. – PART I**. Gary Wege[1], Mike Davis[2], Interagency Mussel Conservation Team[3]. [1]US Fish and Wildlife Service (Retired), Cottage Grove, MN; [2]Minnesota Department of Natural Resources, Lake City, MN; [3]Interagency Mussel Conservation Team, US Army Corps of Engineers, St. Paul and Rock Island Districts; US Fish and Wildlife Service, Genoa National Fish Hatchery, Twin Cities and Rock Island Field Office's; USGS, Upper Midwest Environmental Science Center; National Park Service, Mississippi National River and Recreation Area; MN, WI, IA, and IL.

Zebra mussels (*Dreissena polymorpha*) colonized the Upper Mississippi River (UMR) in 1992 and quickly smothered entire mussel beds including Higgins' eye Essential Habitat Areas. Because of these impacts and the upstream transport of zebra mussels by vessels using this navigation system, in April 2000 the U.S. Fish and Wildlife Service determined that continued operations would jeopardize Higgins' eye recovery. To avoid jeopardy, the Service prepared a Biological Opinion (BO) that recommended the U.S. Army Corps of Engineers (Corps) reestablish historical populations of Higgins eye. The Corps accepted these recommendations and established an interagency Mussel Coordination Team to assist in implementing the BO requirements. A plan was prepared with the goal of reestablishing five viable Higgins eye populations. Since 2000, a variety of measures have been implemented to achieve this goal including: public outreach, genetics studies, zebra mussel monitoring, cleaning and relocating adult Higgins eye, hatchery propagation of juveniles, captive cage propagation and cage rearing in the UMR and tributaries, stocking propagated juveniles, and releasing glochidia-inoculated fish. Monitoring existing and newly established populations is a critical and ongoing part of these actions. Milestones measured during monitoring include: 1) Survival of stocked adults and their continued production of viable larvae 2) Survival of stocked propagules 3) Production of viable larvae by propagated females 4) Higgins' eye populations established by fish release in the Wapsipinicon and Iowa Rivers in Iowa 5) Documented recruitment of juveniles in the Wisconsin River in 2011 and 6) Documented independent recruitment of juveniles in the urban Mississippi River in the Twin Cities, MN in 2012. Funding these efforts has exceeded $5.5 million by the Corps with substantial amounts passed on to MCT members. This successful reintroduction and augmentation program can serve as a model for other cooperative efforts to restore imperiled mollusks. garywege@comcast.net

Platform 5 **9:40 a.m.** **March 11, 2013**	**JEOPARDY! TWELVE YEARS OF REINTRODUCTION, PROPAGATION, AUGMENTATION, AND MONITORING THE FEDERALLY ENDANGERED HIGGINS' EYE PEARLY MUSSEL (*LAMPSILIS HIGGINSII*) IN THE UPPER MISSISSIPPI RIVER DRAINAGE. – PART II.** Gary Wege[1], Mike Davis[2], Interagency Mussel Conservation Team[3]. [1]US Fish and Wildlife Service (Retired), Cottage Grove, MN; [2]Minnesota Department of Natural Resources, Lake City, MN; [3]Interagency Mussel Conservation Team, US Army Corps of Engineers, St. Paul and Rock Island Districts; US Fish and Wildlife Service, Genoa National Fish Hatchery, Twin Cities and Rock Island Field Office's; USGS, Upper Midwest Environmental Science Center; National Park Service, Mississippi National River and Recreation Area; MN, WI, IA, and IL. mike.davis@state.mn.us
SESSION 2	**BIOLOGY I** **Monday, March 11, 2013 | 8:20–10:00 a.m.** **Goldenrod Room**
Platform 6 **8:20 a.m.** **March 11, 2012**	**BURROWING, BYSSUS, AND BIOMARKERS: BEHAVIORAL AND PHYSIOLOGICAL INDICATORS OF SUBLETHAL THERMAL STRESS IN FRESHWATER MUSSELS.** Jennifer Archambault[1], Gregory Cope[2], Thomas Kwak[3]. [1] North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, NC State University, Raleigh, NC; [2] Department of Environmental and Molecular Toxicology, NC State University, Raleigh, NC; [3] U.S. Geological Survey, North Carolina

	Cooperative Fish and Wildlife Research Unit, Department of Biology, NC State University, Raleigh, NC. *STUDENT PRESENTATION*

Recent research has elucidated the acute lethal effects of elevated water temperature to glochidia (larvae), juvenile, and adult life stages of several freshwater mussel species (Order Unionida), but few studies have focused on sublethal effects of thermal stress. We evaluated the sublethal effects of elevated temperature on burrowing behavior, byssus production (in juveniles; *Amblema plicata, Lampsilis abrupta, Lampsilis cariosa,* and *Lampsilis siliquoidea*), and on enzymatic biomarkers of stress (in adults of *Lampsilis fasciola*) in acute (96 h) laboratory experiments in sediment, with two acclimation temperatures (22 and 27°C) and two experimental water levels (low water and dewatered treatments) as proxies for flow regime. Increasing temperature significantly reduced burrowing in all five species tested, and the dewatered treatment (a proxy for drought conditions) reduced burrowing in all but *Amblema plicata*. Production of byssal threads was affected most drastically by flow regime, with the probability of byssus presence reduced by 93 – 99% in the dewatered treatment, compared to the low water treatment (a proxy for low flow conditions). Increasing temperature alone reduced byssus by 18 – 35%. Alanine aminotransferase and aspartate aminotransferase, biomarkers of tissue damage, were significantly affected by treatment temperature in the 27°C acclimation, low water test (p = 0.04 and 0.02, respectively). Our results are highly relevant in the context of climate change, because stream temperature and flow are expected to change with increasing air temperature and altered precipitation patterns. jmarcham@ncsu.edu

Platform 7 **8:40 a.m.** **March 11, 2012**	**BOTTOM-UP MUSSEL DERIVED NUTRIENT EFFECTS ON JUVENILE LARGEMOUTH BASS.** Brandon Sansom[1], Caryn Vaughn[1], William Shelton[1], Greg Summers[2]. [1]Oklahoma Biological Survey, Department of Biology and Ecology and Evolutionary Biology Graduate Program, University of Oklahoma, Norman, OK; [2]Oklahoma Department of Wildlife Conservation, Fisheries Division, Norman, OK. *STUDENT PRESENTATION*

Freshwater mussels are an important guild of benthic organisms that contribute to the function of stream ecosystems. As filter feeders, mussels facilitate bottom-up nutrient effects on stream food webs and thereby increase the standing crop of benthic algae and abundance of grazing macroinvertebrates. The extent of benefits transferred to higher trophic levels, however, is not well understood. Here, we test if mussel-derived nutrients are translated to a higher trophic level by raising juvenile largemouth bass in flow-through mesososms. We raised juvenile bass in mesocosms with low, medium, and high-densities of *Actinonaias ligamentina*, as well as in a control containing no mussels. Preliminary results suggest that after seven weeks, bass raised in the high-density mussel treatment had a higher average condition than in other treatments, suggesting that mussels do influence fish condition. We are conducting additional analyses to further examine the transfer of mussel-derived nutrients throughout the food web. sansomb2@gmail.com

Platform 8 **9:00 a.m.** **March 11, 2012**	**JUVENILE DRIFT HELPS EXPLAIN THE PATCHY DISTRIBUTION OF UNIONID MUSSELS.** Pascal Irmscher, Caryn Vaughn. Oklahoma Biological Survey, Department of Biology and Ecology and Evolutionary Biology Graduate Program, University of Oklahoma, Norman, OK. *STUDENT PRESENTATION*

Freshwater mussels (Bivalvia, Unionidae) occur in dense agglomerations called mussel beds. This patchy distribution, based on studies of adult distribution and abundance, has been attributed to abiotic habitat variables such as water depth, substrate particle size and stability, and most recently to hydraulic variables. We hypothesized that the patchy distribution of unionid mussels in streams can be partially explained by the drift of juveniles after excystment from their fish hosts. We predicted that spatial and temporal flow patterns govern locations in the stream channel where the likelihood of drifting juveniles settling on the riverbed is high. We combined laboratory experiments and field studies to quantify the various components governing juvenile drift. Using mark-recapture techniques, we quantified up- and downstream movement distances of host fishes in the Little River in southeastern Oklahoma. We conducted lab experiments using glass cylinders and flow flumes to measure the sinking rates and flow-dependent drift distances of juveniles. We initially conducted the experiments with actual juveniles and used these data to select synthetic microspheres that matched the size and density of juveniles. We subsequently conducted experiments using microspheres as surrogate juveniles. These microspheres were also released in the field in large quantities and captured with drift nets at locations with known mussel densities. Initial results indicate that the movement of host fishes and the drift distances of juveniles occur within a range of meters to tens-of-meters in our study systems. Our findings should have important implications for our understanding of the spatial distribution of freshwater mussels in streams, as well as for studies concerned with gene flow and connectivity between metapopulations. Pascal.Irmscher-1@ou.edu

Platform 9	**LIFE HISTORY OF THE CUMBERLAND PAPERSHELL *ANODONTOIDES DENIGRATA.*** Tyler Hern[1], James Layzer[2]. [1]Tennessee Cooperative Fishery Research

9:20 a.m. March 11, 2012	Unit, Tennessee Technological University, Cookeville, TN; [2]US Geological Survey, Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville, TN.

The Cumberland Papershell *Anodontoides denigrata* is a poorly known species endemic to the upper Cumberland River. We monitored two populations from October 2011 to October 2012, to determine spawning and brooding period, fecundity, age and growth, size and age at maturity, suitable host(s) in the laboratory and verify their use as hosts in the field, and natural glochidial infestation rates. *Anodontoides denigrata* is a bradytictic species. Spawning occurred in late July or early August. Gravid females were observed August through March. Fecundity ranged from 2,364 to 45,254 per mussel and was positively related to mussel length (R^2=0.75). Shells were thin-sectioned to determine age and growth rates. Individuals live to at least 13 years. The smallest sexually mature female was 29 mm long. Fish were collected monthly November 2011 to October 2012 to identify potential host fish and determine natural infestation rates. In all, 1,284 individuals representing 24 species were collected. Natural infestation rates were highest in February and March. Naturally infested fish were collected November through April, suggesting that females release some glochidia throughout most of the brooding period. Thirteen (representing 4 families: Catostomidae, Centrarchidae, Cyprinidae, and Percidae) of the 24 species collected had encysted *A. denigrata* glochidia. Seven of the 13 species infested in the wild were artificially infested in the laboratory and confirmed as hosts. thern@tntech.edu

Platform 10 9:40 a.m. March 11, 2012	**STRUCTURE AND FUNCTION OF MOLLUSKS COMMUNITIES IN ESTUARIES OF THE SOUTHERN BALTIC SEA.** Dmitry Filippenko. Turku University, Finland

Current study was aimed at the research of species distribution, structure and function of mollusk settlements, and its changes along the salinity gradient in estuaries of the southern Baltic. Study area was located at three estuaries of the southern Baltic Sea (German coast): Darss-Zingst Bodden chain, Ruegen lagoon, Salzhaff bay. Waterbodies were characterized by the salinity range 2-10 psu. Samples were collected from April to September of 2011 year by the grab (1/40 square m) at the depth from 0.3 to 6.2 m. Species composition included 11 species, belonging to Gastropoda, Rissoiformes (36 %), Lymnaeiformes (10 %), Neritopsiformes (10 %) orders. Bivalvia contained 5 species of Veneroida (24 %), Myoida (10 %) and Mythiloida (10 %) orders. The community *Hydrobia ulvae* + *Mya arenaria* was prevailing in studied estuaries and distributed among the most of sites of waterbodies. Most diversity of settlements was found on the sand soils covered by macrophytes, where mollusks created density up to 5229 ind./sq. m and biomass up to 42.8 g/sq. m. The lowest quantitative data of settlements were obtained from muddy bottom. Most of species were found under water salinity, higher than 5 psu. Water body sites with lower salinity were inhabited by only Hydrobiidae with dominant species *H. ulvae* (98 % of quantity). Positive correlation between quantitative characteristics of mollusk settlements (density, biomass) and water salinity was estimated ($r = 0.65$, $p < 0.0001$ and $r = 0.83$, $p < 0.0001$). Production of mass species *H. ulvae, M. arenaria, Cerastoderma lamarcki, Theodoxus fluvitilis* (kJ/sq.m season) increased along the salinity gradient ($r = 0.99$, $p < 0.0001$). Inverse relation between primary production of water bodies and mollusks production was estimated in studied estuaries ($r = -0.97$, $p < 0.05$). This fact can be determined by the critical salinity (horogalinicum) influence on the production process within the examined salinity range. dmiphi@utu.fi

SESSION 3	**EMERGING TRENDS II Monday, March 11, 2013 | 10:20 a.m. - 12:00 p.m. Camellia Room**
Platform 11 10:20 a.m. March 11, 2013	**MUSSELS ARE NOT ALONE: EXPLORING THE MICROBIAL DIVERSITY IN UNIONIDS**. Cova Arias[1], Stacey LaFrentz[1], Ash Bullard[1], Paul Johnson[2]. [1]Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, AL; [2]Alabama Aquatic Biodiversity Center, Alabama Department of Conservation and Natural Resources, Marion, AL.

As individuals we are not alone. We share our bodies, inside and out, with microbes whose cell counts vastly outnumber our own. Recent studies have helped determine the important relationships that we have with our microbial inhabitants, particularly those affecting our health. The classical paradigm in microbiology 'one microbe, one disease' is changing nowadays thanks to next generation sequencing methods that are revealing how many diseases are caused by altered microbiotas in humans. The same principle should apply to other animal hosts such as freshwater mussels that, to date, have been largely unexplored in terms of their associated microbiotas. The aims of this study were i) to

investigate the diversity of microbial communities associated with mussels of the genera *Villosa*, *Lampsilis*, and *Strophitus* collected from the wild and ii) to compare microbial communities from wild mussels with those from hatchery-reared mussels. We used two culture-independent methods to analyze the microbial communities associated with digestive gland and gill tissues. The first method, Ribosomal Intergenic Spacer Analysis, provided us with a fingerprint of the bacterial community from each individual mussel. This method showed that different mussels species exhibited unique microbial communities. Within a species, wild and hatchery-reared mussels also differed in their microbial communities. To investigate the composition of the microbial communities, we used standard and next generation sequencing methods using the 16S rRNA gene as target. Sequencing data revealed that the microbial communities of digestive gland had lower diversity indexes than those from gill tissue. Interestingly, a large percentage of the sequences obtained from digestive gland had no clear match in GenBank and putatively represents a new bacterial family (or perhaps even a new order). Our results suggest a close association between unionids and their microbial communities although further studies are needed to fully comprehend those relationships. ariascr@auburn.edu

Platform 12 **10:40 a.m.** **March 11, 2013**	**MECHANISMS OF DISRUPTION OF MUSSEL REPRODUCTION BY HIGH SUSPENDED SOLIDS.** Andrew Gascho Landis[1], Wendell Haag[2], James Stoeckel[1]. [1]Auburn University, Department of Fisheries and Allied Aquaculture, Auburn, AL; [2] U.S. Forest Service, Center for Bottomland Hardwood Research, Oxford, MS. *STUDENT PRESENTATION*

In a previous study, we showed that increasing levels of total suspended solids (TSS) resulted in a decreased proportion of gravid female mussels; however, the generality of this pattern and the specific stage at which reproduction is inhibited remain unknown. We conducted a follow up study to examine stage-specific disruption of reproduction in a short-term brooding species (*Reginaia ebena*) and a long-term brooder (*Ligumia subrostrata*). For the long-term brooder, we also examined effects of chronically high TSS levels on glochidial viability over a ~ 5 month brooding period and on metamorphosis success at the end of that period. A high proportion of female *Reginaia ebena* became gravid across the entire TSS gradient (11 to 92 mg/L), but glochidia developed poorly at TSS >20 mg/L. In contrast, a low proportion of female *Ligumia subrostrata* became gravid at high TSS levels, but all gravid female eventually produced fully developed glochidia. For *L. subrostrata*, neither glochidia viability nor metamorphosis rate was reduced by chronic exposure to high TSS levels. High TSS levels can disrupt reproduction in both short- and long-term brooding species, but the specific mechanism appears to differ between brooding strategies. High TSS does not appear to negatively affect egg fertilization in short-term brooders, but it appears to inhibit embryo development. In long-term brooders, high TSS appears to interfere with sperm acquisition or egg fertilization, but it does not appear to adversely affect subsequent development of eggs that do become fertilized. andrewmgl@gmail.com

Platform 13 **11:00 a.m.** **March 11, 2013**	**TRACING MUSSEL-DERIVED NITROGEN IN RIVERINE FOOD WEBS.** Carla Atkinson, Caryn Vaughn. Oklahoma Biological Survey, Department of Biology & Ecology and Evolutionary Biology Graduate Program, Norman, OK. *STUDENT PRESENTATION*

Consumer mediated nutrient sources have been increasingly recognized as an important process in many ecosystems. Several studies have quantified the flux of consumer-derived nutrients into various ecosystems, however few have quantified the impact of these fluxes on food webs. The well-documented abundance of unionids suggests that they can potentially exert large effects on stream food webs. The objective of our study was to determine the importance of mussel-derived nitrogen (MDN) relative to ecosystem demand and the quantity that is directly assimilated into the food web. Based on previous findings, mussels supply a large quantity of N through remineralization, but little is known about the assimilation of this nitrogen. We used an experimental stable isotope tracer approach in conjunction with a nutrient uptake experiment and nutrient excretion experiments. We fed mussels (*Lampsilis siliquiodea*, n = 249) enriched (N15) algae and placed them into an N-limited stream for 63 days. Excretion experiments were done to model the amount of N mussels provided in comparison to the N uptake demand of the stream. Various components of the food web were sampled (primary producers and consumers) twice prior to the addition and five times following the enrichment to trace the ^{15}N leaving the mussels and entering the food web. Our excretion experiment results in comparison to the uptake drip experiment suggested that mussel excretion can account for 40% of N demand in this stream. Through the stable isotope enrichment we found that MDN was entering the food web and supplied up to 19% of the N in many of the food web components near the mussel bed. Approximately 4% of the ^{15}N added to the system was recovered in the food web pools we sampled. Our results show that N supplied by mussels can be an important nutrient subsidy that provides food web support. carlalatkinson@gmail.com

Platform 14 **11:20 a.m.** **March 11, 2013**	**ASSESSING THE EFFECTS OF NATIVE FRESHWATER MUSSELS ON NITROGEN DYNAMICS IN CONTINUOUS-FLOW MESOCOSOMS**. Jeremy Bril[1], Jonathan Durst[1], Craig Just[1], Teresa Newton[2]. [1]Department of Civil and Environmental Engineering, IIHR Hydroscience & Engineering, The University of Iowa, Iowa City, IA; [2]US Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI.

Management of the nitrogen cycle has been identified as one of fourteen grand challenges for engineering and is an especially important issue for agricultural watersheds of the Upper Midwest. In large river systems, it has become increasingly important to understand the interactions between abiotic and biotic processes that influence nitrogen cycling. Native freshwater mussels are one of the most influential organisms in aquatic ecosystems due to their ability to transfer nutrients from the overlying water to the sediments. The objective of this study was to utilize continuous-flow laboratory mesocosms, highly time resolved water chemistry data, and a mass balance model to assess the effects of *Amblema plicata* and *Lampsilis cardium* on aquatic nitrogen dynamics in the Iowa River. Concentration changes for nitrate, ammonium, and phytoplankton in the overlying water were determined to be significantly different (ANCOVA, $p < 0.05$) between mesocosms containing mussels and mesocosms without mussels (control). Our results indicated that mussels increased ammonium (112%) via mussel excretion, indirectly increased nitrate (5%) via nitrification of the excreted ammonium, and decreased phytoplankton (-46%) via mussel filtration. Application of the deterministic mass balance model predicted that increases in phytoplankton concentrations significantly influenced the effect of mussels on nitrogen dynamics in the overlying water of the mesocosms. The results of this study will aid the scalability of mussel effects to larger systems and will help to predict how changes in environmental conditions influence the interactions of biotic and abiotic processes. These findings will also help determine to what extent the effects of mussels should be included in strategies for nitrogen management. bril@uiowa.edu

Platform 15 **11:40 a.m.** **March 11, 2013**	**BEYOND MULTI-DISTRICT LITIGATION AND MEGAPETITIONS: DEVELOPING AN EFFECTIVE APPROACH TO CONSERVING CANDIDATE, PETITIONED, AND OTHER AT-RISK SPECIES IN THE SOUTHEAST.** Shannon Holbrook. US Fish and Wildlife Service, Daphne, AL.

Since 2010, the U.S. Fish and Wildlife Service (FWS) has been petitioned to list over 400 species in the southeastern U.S., including 76 freshwater mollusks, as threatened or endangered species under the Federal Endangered Species Act (ESA). Through settlements with environmental groups in 2011, FWS has also committed to make proposed or final listing determinations on 251 candidates for ESA protection and several other species, including two freshwater mussels, by 2016. The Southeast Region of FWS and its partners are implementing an effective, sustainable, and science-based strategy to address the conservation needs of these species. The five step strategy includes species categorization, identification of possible conservation actions, development of partnerships with varied stakeholders, collection of biological and threat data, and promotion of conservation through outreach and education. Through this strategy we hope to address threats to as many target species as possible, hopefully precluding the need for ESA protection. This presentation will outline this strategy, focus on progress to date, and discuss planned activities that will benefit imperiled mollusks and other wildlife. shannon_holbrook@fws.gov

SESSION 4	**BIOLOGY II** **Monday, March 11, 2013 | 10:20a.m. – 12:00 p.m.** **Goldenrod Room**
Platform 16 **10:20 a.m.** **March 11, 2013**	**WINTER MONITORING OF TRANSLOCATED MUSSEL POPULATION IN THE WALKILL RIVER, SUSSEX COUNTY, NEW JERSEY.** Kyle McGill[1,2], Casey Swecker[1], Thomas Jones[2]. [1]Environmental Solutions & Innovations, Inc., Cincinnati, OH; [2]Marshall University, Huntington, WV. *STUDENT PRESENTATION*

In May 2010, 672 live Unionids including 144 New Jersey state threatened eastern lampmussel (*Lampsilis radiata*) were translocated in the Wallkill River within the Wallkill River National Wildlife Refuge in Sussex County, New Jersey. Monitoring freshwater mussel (Unionidae) populations are generally conducted when water temperatures promote mussel activity therefore reducing potential stress to the individuals being monitored. However, this relocated population was monitored monthly for twelve months to determine the success of the project. Researchers challenged the elements and utilized cold water dive gear to document and video unionids filtering under the ice. Monitoring techniques were adapted to minimize impacts to the individuals during the winter months. The monitoring project aided in documenting mussel activity through the seasons including filtering mussels in the winter. Researchers also observed marked eastern lampmussel females displaying. The relocation efforts have proved successful and annual monitored has continued each year since their initial move in 2010. kmcgill@westliberty.edu

Platform 17 **10:40 a.m.** **March 11, 2013**	**CORRELATING ENVIRONMENTAL VARIABLES WITH FRESHWATER SNAIL SHAPE: AN EXAMPLE IN *ELIMIA PROXIMA*.** Joseph Styga, Benjamin Shepard, Russell Minton. Department of Biology, University of Louisiana at Monroe, Monroe, LA. *STUDENT PRESENTION*

Understanding variation and plasticity in freshwater snail shell phenotypes requires data on environmental and genetic effects. While many studies provide one dataset or the other, few studies on freshwater snails contain both. In an effort to better understand freshwater snail shell phenotypes, we re-examined specimens from Dillon's (1980) study on the ecological correlates of the morphological variation in *E. proxima*. In this study we used size-independent geometric morphometric analysis, combined with the environmental and genetic data provided. Samples of snail shells from 25 populations (*n*=1203) were photographed and digitized with 19 landmarks. Landmarks were put into partial Procrustes superimposition, and the resulting weight matrix used as the dependent variables in MANOVA and partial Mantel tests. Dillon's original 14 environmental variables were clustered into three new composite independent variables, and his genetic distance data were used as well. Results of the MANOVA and Mantel tests indicate a complex interaction of both genetics and environmental variables in the generation of shell phenotype, and we assess the relative contribution of each to the overall variation seen in *E. proxima*. minton@ulm.edu

Platform 18 **11:00 a.m.** **March 11, 2013**	**SHELL SHAPE DIFFERENCES IN *ELIMIA POTOSIENSIS* (LEA, 1841) CAN BE ATTRIBUTED TO ECOPHENOTYPIC PLASTICITY.** Russell Minton, Christopher Paight. Department of Biology, University of Louisiana at Monroe, Monroe, LA.

Phenotypic plasticity in freshwater mollusks is a well-known phenomenon, occurring in both bivalves and gastropods. Most work on freshwater snail plasticity has focused either on presence/absence of a single factor, or has looked at responses to environmental gradients over large geographical scales in a descriptive manner. Often lacking from this work is examination of a genetic component of plasticity. Using ISSRs and supported by geometric morphometrics, we suggest that shell shape variation in the pyramid Elimia, *Elimia potosiensis*, is ecophenotypic. Samples of *E. potosiensis* were collected from two systems: a spring run, and the creek it drained into. Within the spring run, collections were made at 50m intervals starting at the springhead and proceeding downstream. The creek was sampled at the point where the spring entered; additional collections were made at 50m intervals upstream and downstream from that point. Ten individual snails from each sample were used in ISSR analysis. ISSR analysis was performed on DNA from each snail using six primers. A total of 22 scorable bands were generated in all 120 individuals by the six primers used. AMOVA indicated that most of the molecular variance existed within populations (98%), but that a significant percentage (2%) existed among populations ($\Phi pt = 0.024$, $p<0.05$, 10,000 permutations) suggesting two groups, one consisting of spring sites only, and the other containing only creek sites. Combined with results of geometric morphometric analyses on shell outlines, our data suggest that *E. potosiensis* exhibits ecophenotypic plasticity, most noticeably in small, spring-fed systems. Our results are also in agreement with recent works on *Leptoxis ampla* that recommend not using ecophenotypic plasticity as a null hypothesis in the absence of genetic data. minton@ulm.edu

Platform 19 **11:20 a.m.** **March 11, 2013**	**ANNULUS DEPOSITION AND INTRA-ANNULAR GROWTH OF *EPIOBLASMA AHLSTEDTI* AND *LEMIOX RIMOSUS* IN THE DUCK RIVER, TENNESSEE.** Ryan Foley[1] James Layzer[2]. [1]Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville, TN; [2]US Geological Survey, Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville, TN. *STUDENT PRESENTATION*

The Duck River, situated in central Tennessee, flows approximately 468 km towards its confluence with the Tennessee River. The river is home to a diverse aquatic fauna, including 151 species of fish and 56 species of mussels currently inhabiting the river. The Duck River darter snapper (*Epioblasma ahlstedti*) and the Birdwing pearlymussel (*Lemiox rimosus*) are abundant in the stretch of river downstream of Lillards Mill. The objectives of this study are to determine when annulus formation occurs and to describe their intra-annular growth rates. Fresh-dead shells were collected from muskrat middens immediately downstream of Lillards Mill from January 2012 through December 2012. To determine annulus formation, fresh-dead shells were thin-sectioned and post-annulus growth was measured. Annulus formation occurred in early spring. fole0108@umn.edu

Platform 20 **11:40 a.m.** **March 11, 2013**	**REINTRODUCTION OF *CYCLONAIAS TUBERCULATA* AND *QUADRULA PUSTULOSA* IN THE LOWER PIGEON RIVER.** Andy Pigg, Michael McKinney, Sarah Flower. Department of Geology and Environmental Sciences, University of Tennessee, Knoxville, TN. *STUDENT PRESENTATION*

Working with the Tennessee Wildlife Resource Agency (TWRA), two species of unionid mussels were reintroduced to the lower Pigeon River near Newport, Tennessee. The mussels were harvested on the lower branch of the Tennessee River and the Clinch River. The mussels were immediately quarantined in TWRA facilities in Gallatin, Tennessee for a month to aid in removal of Zebra mussel, *Dreissena polymorpha*, larvae on the valves. Two relocations were conducted: on July 8th, 2012 and on October 7th, 2012, and a total of 1,527 individuals of both species were reintroduced into the Pigeon River. Before relocating into the water, the mussel shells were washed to remove Zebra mussel larvae. The mussels were then dried, tagged with a number, and the length was recorded. Mussels were placed in 3 areas, each area constituting differing water depths ranging from 0.15 meters to 3.66 meters. Site sizes ranged from 50 meters squared to 50 meters by 75 meters. Following relocation, multiple surveys examined the presence and health of the mussels. The fourth survey took place 4 months after the initial relocation and found just 40 living individuals (about 2.6% of the total number relocated) in a 7 man-hour search. It is unclear if this small number is from a low sampling efficiency or actually reflects low survivorship. To date, only 3 dead individuals were found. In future surveys, shell length will gauge the growth rate for each species. Regular monitoring in the relocation sites for the next year will check for continued presence of both mussel species as well the establishment of a new population of juvenile mussels after the reproductive period of mussels from April to August. apigg@utk.edu

SESSION 5	TOXICOLOGY Monday, March 11, 2013 | 1:20 - 2:40 p.m. Camellia Room
Platform 21 1:20 p.m. March 11, 2013	**HAPPY AS A CLAM? BEHAVIORAL AND PHYSIOLOGICAL EFFECTS OF THE ANTIDEPRESENT FLUOXETINE ON FRESHWATER MUSSELS.** Peter Hazelton[1], Bowen Du[2], Bryan Brooks[2], Robert Bringolf[4]. Warnell School of Forestry & Natural Resources, Interdisciplinary Toxicology Program, University of Georgia, Athens, GA; [2]Department of Environmental Science Baylor University, Waco, TX. *STUDENT PRESENTATION*

The antidepressant fluoxetine (Prozac) is commonly found in aquatic fauna living near or downstream from point-sources of municipal waste effluent. Continuous release of fluoxetine results in pseudo-persistence in surface waters, creating a chronic exposure for animals downstream. Fluoxetine is known to cause disruptions in reproductive behavior of mollusks, including parturition of gametes, parturition of glochidia, and changes in lure display and foot protrusion. However, the ecological relevance of these effects at environmental concentrations is unknown. We used two experimental approaches to assess the effects of fluoxetine on mussel behavior and physiology. First, we conducted a 90 day exposure of *Lampsilis fasciola* to 0, 0.5, 5.0, and 50 µg/L fluoxetine in the presence of sediment and assessed impacts on mussel burrowing and filtering behavior, and metabolism (glycogen storage and respiration). The 90 day exposure was paired with a 28 day fluoxetine uptake and kinetics experiment in which tissue concentrations of fluoxetine were quantified in *Lampsilis* species at the 0.5 µg/L exposure concentration on days 0, 1 , 7, 14, 28 and two depuration time points (7 and 14 days post exposure). The uptake study in combination of with physiological and behavioral experiments will help clarify the potential risk for adverse effects of fluoxetine to unionids. phase@uga.edu

Platform 22 1:40 p.m. March 11, 2013	**METABOLOMIC, BEHAVIORAL, AND REPRODUCTIVE EFFECTS OF THE SYNTHETIC ESTROGEN 17 α-ETHINYLESTRADIOL ON THE UNIONID MUSSEL *LAMPSILIS FASCIOLA*.** Jeremy Leonard[1], Gregory Cope[1], Chris Barnhart[2], Robert Bringolf[3]. [1]Department of Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC; [2]Biology Department, Missouri State University, Springfield, MO; [3]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA. *STUDENT PRESENTATION*

Endocrine disrupting effects of estrogenic compounds in surface waters observed in fish may also occur in aquatic invertebrates. However, the underlying mechanisms of action and toxicity, especially in native freshwater mussels (Order Unionida), remain undefined. We evaluated the effects of sub-chronic exposure of 17α-ethinylestradiol (EE2), a synthetic estrogen found in oral contraceptives, on the behavior, metabolism, and reproductive status of the unionid mussel *Lampsilis fasciola*. Mussels of both sexes were exposed to a control and 3 concentrations of EE2 (5 ng/l, 1 µg/l, 500 µg/l), and samples of gill tissue were taken on days 0, 4 and 12 for metabolomic analysis. Observations of mussel behavior, such as foot and mantle display, were made daily. Significant larval (glochidia) mortality was observed at the greatest test concentration (500 µg/l) relative to the control for those glochidia released freely into the water, whereas no differences were observed in condition of glochidia contained within conglutinates (glochidia packets). Exposure to EE2 altered female mantle display behavior, suggesting that EE2 may cause complications in attracting suitable host fish in wild populations. In addition, EE2 exposure resulted in increased weight and more instances of foot extension and swelling in both sexes, indicating possible water uptake into tissues. Metabolomic analysis revealed 207 known biochemicals in mussel gill tissue and that EE2 exposures led to decreases in glycogen metabolism end products. The two highest concentrations resulted in decreased

glucose and glucose intermediates and increases in Krebs cycle intermediates. These changes indicate EE2-related reductions in energy reserves that would be available for growth and reproduction in exposed wild populations of mussels. jaleonar@ncsu.edu

Platform 23 **2:00 p.m.** **March 11, 2013**	**ACUTE SENSITIVITY OF FRESHWATER MUSSELS TO SELECTED CHEMICALS WITH DIFFERING TOXIC MODES OF ACTION.** Ning Wang[1], Chris Ingersoll[1], Chris Ivey[1], Bill Brumbaugh[1], Ed Hammer[2], Candice Bauer[2], Tom Augspurger[3], Sandy Raimondo[4], Burt Shephard[5], Joe Bartoszek[6], Chris Barnhart[7], Nathan Eckert[8]. [1]US Geological Survey, Columbia, MO; [2]US Environmental Protection Agency, Chicago, IL; [3]US Fish and Wildlife Service, Raleigh, NC; [4]US Environmental Protection Agency, Gulf Breeze, FL; [5]US Environmental Protection Agency, Seattle, WA; [6]US Fish and Wildlife Service, Burbank, WA; [7]Missouri State University, Springfield, MO; [8]US Fish and Wildlife Service, Genoa, WI.

The objectives of this ongoing study are (1) to evaluate sensitivity of several species of mussels, snails, and commonly tested invertebrate species in acute water exposures with 10 chemicals (Tier 1 testing), and (2) to "screen" acute sensitivity to additional chemicals with a commonly tested mussel species (Tier 2 testing). This poster describes the Tier 1 testing with mussels selected to be representative of four tribes of the family Unionidae widely distributed in the midwestern and the southeastern United States, and the family Margaritiferidae in the Pacific Northwest. The chemicals were chosen based on the US Environmental Protection Agency (USEPA) ambient water quality criteria (AWQC), availability of toxicity data for non-mollusks, other non-unionid mollusks sensitivity to the chemicals, and toxic mode of action. The EC50s for each of the 10 Tier 1 chemicals generally differed by less than a factor of 2 among the different mussel tribes or families. Species mean acute values for mussels based on the current study and previous studies were mostly in the lower 30th percentiles of the species sensitivity distributions for all tested chemicals, except for metolachlor. The ranks of mussels in the species sensitivity distribution were generally similar among different tribes or families. The ammonia, sodium chloride, and nickel EC50s for mussels were about equal to or less than the final acute value used to derive USEPA AWQC. The preliminary results of this study indicate that (1) mussels representing different tribes or families have similar sensitivity to the tested chemicals despite differing toxic modes of action, (2) mussels are sensitive to 9 of the 10 tested chemicals, (3) the AWQC may not be protective of mussels from acute exposures of ammonia, chloride, and nickel, and (4) AWQC may need to be derived or updated for sodium chloride, potassium chloride, and sulfate, common pollutants to which mussels are sensitive. nwang@usgs.gov

Platform 24 **2:20 p.m.** **March 11, 2013**	**EVALUATION OF THE ACUTE TOXICITY OF A LAMPRICIDE ON MULTIPLE LIFE STAGES OF THE SNUFFBOX MUSSEL.** Teresa Newton[1], Michael Boogaard[1], Terrance Hubert[1], Cheryl Kaye[2], Chris Barnhart[3]. [1]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI; [2]U.S. Fish and Wildlife Service, Marquette, MN; [3]Missouri State University, Biology Department, Springfield, MO.

The sea lamprey (*Petromyzon marinus*) was first reported in the Great Lakes in 1921 and has caused substantial damage to native fish populations. Since 1958, the Great Lakes Fishery Commission's sea lamprey control program has used TFM (3-trifluoromethyl-4-nitrophenol) to kill larval sea lampreys in streams. This effort has reduced the sea lamprey population in the Great Lakes by about 90%. However, there is growing concern over the risk of TFM applications to non-target fauna, including native mussels. A number of tributaries to the Great Lakes that are routinely treated for larval sea lampreys also contain populations of the snuffbox mussel (*Epioblasma triquetra*), which was recently listed as federally endangered. In order to assess potential impacts of future lampricide treatments, we evaluated the acute toxicity of TFM to glochidia and 1-wk old juvenile snuffbox, to its host fish (log perch, *Percina caprodes*), and to glochidia, 1-wk old juvenile and adult ellipse mussels (*Venustachoncha ellipsiformis*) as a surrogate for adult snuffbox mussels. We also assessed the ability of TFM-exposed log perch to support metamorphosis of glochidia into juveniles. TFM concentrations routinely applied to streams did not cause substantial mortality in glochidia, juveniles or adult mussels. There was no effect of TFM on the ability of glochidia to attach and metamorphose on log perch at 1.2 times the minimal lethal concentration (MLC) but substantial mortality of log perch (65%) occurred at concentrations 1.4 times the MLC. Collectively, these data suggest that the risks of TFM exposure on multiple life stages of the snuffbox mussel are minimal, but indirect effects on its host fish are possible. tnewton@usgs.gov

SESSION 6	HABITAT I Monday, March 11, 2013 | 1:20. – 2:40 p.m. Goldenrod Room
Platform 25 1:20 p.m. March 11, 2013	**DEFINING FRESHWATER MUSSEL HABITAT IN A LARGE COASTAL PLAIN RIVER USING SIDE SCAN SONAR.** Reuben Smit[1], Adam Kaeser[2], Michael Gangloff[3], Steve Sammons[1], Jim Stoeckel[1]. [1]Auburn University, Department of Fisheries and Allied Aquaculture, Auburn, AL; [2]US Fish and Wildlife Service, Panama City, FL; Appalachian State University, Department of Biology, Boone, NC. *STUDENT PRESENTATION*
Physical parameters such as hydrology and substrate attributes are key variables determining suitable mussel habitats. However, measuring these variables in large rivers can be time consuming and require expensive equipment. More economical and accurate techniques are needed to define the spatial extent and quantity of key habitat features, as well as prediction of distribution and abundance of freshwater mussels in large river systems. Side scan sonar enables high resolution mapping of habitat features at multiple spatial scales in large, turbid, low gradient rivers. We used texture and tone of georeferenced sonar imagery to map river bedforms in a 50 km reach of the Apalachicola River in northwest Florida. The resulting delineated areas were classified into 5 hydromorphological units (HMU). This classification scheme was used to stratify freshwater mussel and substrate surveys, and to assess differences in mussel density and species richness among HMUs. Initial survey results yielded 18 mussel species among HMUs and total mussel densities ranging from 0 – 101 mussels/m^2. Preliminary Classification and Regression Tree analysis (CART) showed that HMU, substrate, and latitude together explained 82% of the variation in total mussel density from the surveys. Subsequent analysis will explore species-specific distributions, spatial relationships involving distance to habitat features and boundaries within the sonar habitat map, and facilitate development of a predictive model for relative freshwater mussel densities throughout the study reach. Results of this study validate the use of side scan sonar to create high resolution maps of HMU's that are relevant to the study of mussels at the landscape scale. rzs0028@auburn.edu		
Platform 26 1:40 p.m. March 11, 2013	**HABITAT-MEDIATED CHANGE IN MUSSEL COMMUNTIY STRUCTURE FOLLOWING CONSTRUCTION OF THE TENNESSEE-TOMBIGBEE WATERWAY.** Byron Hamstead[1], Paul Hartfield[2], Michael Gangloff[1]. [1]Appalachian State University, Department of Biology, Boone, NC; [2]US Fish and Wildlife Service, Jackson, MS. *STUDENT PRESENTATION*
The Tennessee-Tombigbee Waterway (TTW) is among the largest and most expensive environmental engineering projects of the 20th century. The TTW accommodates barge navigation between the Tennessee and Mobile drainages through a series of locks, dams, dredged canals, and diverted streams. These alterations have fragmented aquatic habitats resulting in isolated freshwater mussel populations in patches of streams like the East Fork Tombigbee River (EFTR). The first post-TTW mussel surveys in 1987 and 1988 reported 31 taxa (including 2 federally-listed species). We re-sampled 70 sites in 2010 and 2011 using both quadrats and timed-searches. Mussel richness was relatively unchanged, but total abundance declined significantly. Relative abundance of 8 taxa decreased significantly. However, relative abundance increased for 9 species including 3 federally listed taxa. Mussel species dominance shifted dramatically suggesting that modern stream habitats and/or fish hosts in the EFTR are selecting for smaller-bodied taxa. We found no live evidence for the 4th (*Quadrula verrucosa*) and 10th (*Lasmigona alabamensis*) most abundant species from 1988 surveys and demographic data suggest that other historically dominant species are at risk of extirpation from the EFTR. Finally, we detected 2 non-native unionids, *Quadrula quadrula* and *Potamilus ohiensis,* that may have colonized the EFTR from the Tennessee River Drainage via the TTW. byron.hamstead@gmail.com		
Platform 27 2:00 p.m. March 11, 2013	**ASSESSMENT OF RIVER MOUTHS AS UNIONID REFUGIA ALONG A LAURENTIAN GREAT LAKE** Trevor Prescott[1], Robert Krebs[1], Wentworth Clapham[1], David Klarer[2]. [1]Department of Biological, Geological and Environmental Sciences, Cleveland State University, Cleveland, OH; [2]Old Woman Creek National Estuarine Research Reserve, East Huron, OH. *STUDENT PRESENTATION*
Invasion of lakes and rivers by dreissenid mussels since the 1990's have pushed out native species, particularly native freshwater mussels in the Unionidae across the northern hemisphere, and perhaps most infamously, within the U.S. Great Lakes. However, several small coastal areas along Lake Erie have been identified as refugia for native species, but the conditions under which native species may persist are unknown. We identified that unionid species may frequently be using river mouths (freshwater estuaries) even of small streams as refugia along the Lake Erie coastline. Comparing nine such streams, we qualitatively assessed mussel diversity and compared species presence to land use based on remote sensing techniques and to water chemistry. Sampling focused on stream zones influenced by lake-water levels for three streams each in the western basin, central basin and Sandusky Bay regions of Lake Erie. Eight of the nine streams possessed mussels: *Pyganodon grandis* (7 streams), *Toxolasma parvum* (5 streams), *Quadrula quadrula* (5		

streams), *Lasmigona complanata* (5 streams), *Leptodea fragilis* (4 streams), and *Utterbackia imbecillus* (2 streams), while *Amblema plicata*, *Obliquaria reflexa* and *Uniomerus tetralasmus* were found each in only one stream. Diversity levels were not affected by any distinct bathymetric features, although water chemistry and regional land use impacted diversity subtly. Importantly, river mouths are refugia for unionid mussels in regions exposed to dreissenid infestation, and these areas must return to or come under regulatory control to monitor habitat alteration, a process stopped in this region following the belief the dreissenid mussels had eradicated all species of interest. krebs.r@gmail.com

Platform 28 **2:20 p.m.** **March 11, 2013**	**BEAVER AND MILL DAMS ALTER FRESHWATER MUSSEL HABITAT, GROWTH AND SURVIVAL IN NORTH CAROLINA PIEDMONT STREAMS.** Rachael Hoch[1], Megan McCormick[1], Chris Eads[2], Michael Madritch[1], Michael Gangloff[1]. [1]Appalachian State University, Department of Biology, Boone, NC; [2]North Carolina State University, College of Veterinary Medicine, Raleigh, NC. *STUDENT PRESENTATION*

Ecosystem engineers play an important role in the modification and partitioning of habitats and resources. In aquatic systems, anthropogenic and beaver (*Castor spp.*) dam building activities alter habitats and have profound effects on the availability, quality, and connectivity of resources. Freshwater mussels are imperiled indicator species, perform key ecosystem services and serve as basal resources in stream foodwebs. We examined the effects of beaver and mill dams on freshwater mussel resource availability and quality. We complemented stream survey data with a common garden experiment conducted in the upper Tar River Basin of North Carolina, USA. We found that mill impoundments improved mussel food quality and significantly (*p< 0.05)* increased species richness and growth of freshwater mussels in mill dam tailraces. In contrast, mussels growing in streams with beaver impoundments did not experience elevated food resources or growth. Mussel mortality was twofold higher across all beaver reaches (39.9%) compared to mill reaches (20.0%). Patterns in mussel growth and survival were positively correlated with increased total suspended solid (TSS, <250 um) mass and %N, measures of mussel food quantity and quality. Our research suggests that discontinuities in the flow continuum alter stream energetic pathways with dramatic consequences for the growth and survivorship of freshwater mussels. Increased water retention times resulting from impoundments may decrease nutrient spiraling lengths and increase nitrogen and small particle retention thereby increasing mussel food quality. Recently, advocates of wide-scale dam removals have suggested that removal of dams may improve habitat connectivity but in nutrient-rich Piedmont steams this may not be desirable as impoundments serve as important nutrient (including C) sinks. Quantifying costs and benefits of restored connectivity to taxa across multiple trophic levels as well as addressing effects on key small stream and wetland ecosystem services should be considered when prioritizing restoration projects. hoch.rachael@gmail.com

SESSION 7	**EMERGING TRENDS – III** **Monday, March 11, 2013 | 3:20 - 5:00 p.m.** **Camellia Room**
Platform 29 **3:20 p.m.** **March 11, 2013**	**IS THE LARVA OF *MARGARITIFERA* A GLOCHIDIUM?** Chris Barnhart. Missouri State University, Biology Department, Springfield, MO.

The larva of *Anodonta* was described as *Glochidium parasiticum* by Rathke (1797) and the name glochidium has subsequently been applied to the parasitic larvae of Unionidae, Margaritiferidae and Hyriidae. The glochidium is usually considered to be a primitive feature of Order Unionida and is contrasted with the lasidium larvae of the Etheriidae, Mycetopodidae, and Iridinidae. However, recently observed features of the metamorphosis of *Margaritifera falcata* suggest that the larvae of Margaritiferidae and Unionidae may be distinctly different from one another. The larvae of *Margaritifera* and a few Unionid taxa grow substantially during encapsulation and metamorphosis. In Unionidae, both pre- and post-metamorphic shell growth occurs by accretion on the edge of the glochidium shell, and the glochidium shell is retained on the umbo. In contrast, the initial growth of encapsulated *M. falcata* occurred by the inflation of paired lateral lobes and was accompanied by the disappearance of the primary larval shell. The shell of the resulting secondary larva was an uncalcified cuticle, and the accretion of calcified shell at the margins of the cuticle was evident only after excapsulation from the host. The cuticular shell of the postmetamorphic juvenile was fragile and easily damaged, and that region of the shell remained fragile even after subsequent growth. Captive culture was more successful in static systems than in downwellers. Further observations are needed to determine if this form of larval development is general in Margaritiferidae. Comparisons of larval development might provide clues to phylogenetic relationships among the Unionoid families, which remain unresolved. The few published observations of hyriid metamorphosis show only post-metamorphic shell growth with retention of the glochidium shell, similar to most Unionidae. However, it is intriguing that lasidia possess an uncalcified cuticle and grow while attached to the host. ChrisBarnhart@MissouriState.edu

Platform 30 **3:40 p.m.** **March 11, 2013**	**EVOLUTION OF ASYMMETRICAL LARVAE IN FRESHWATER MUSSELS BIVALVIA: UNIONOIDA).** John Pfeiffer III[1], Daniel Graf[2]. [1]Department of Biological Sciences, University of Alabama, Tuscaloosa, AL; [2]Department of Biology, University of Wisconsin-Stevens Point, Stevens Point, WI. *STUDENT PRESENTATION*

Freshwater mussels have evolved an elaborate life history strategy that uses highly specialized larvae (glochidia) to parasitize freshwater fishes. This unique parasitic life cycle has affected the speciation, biogeography, morphology, ecology, and life history of these animals. Freshwater mussel exhibit tremendous amount of life history variation including broadcasting free glochidia to host capture and maternal-sacrifice, host generalists to species specialists, various brooding and larval morphologies, and life spans that differ by an order of magnitude. Much of this variation has a strong phylogenetic component (e.g. larval morphologies) and has been useful in determining evolutionary relationships, morphological evolution, and functional significance. Despite the demonstrated taxonomic utility of glochidial morphologies systematists have yet to include asymmetrical glochidia in an evolutionary perspective. Asymmetrical glochidia are characterized by having a large marginal appendage on only one of the two glochidial valves. The current classification recognizes the five asymmetrical glochidia-bearing genera in two putative subfamilies, the Gonideinae (*Pseudodon*, *Solenaia,* and *Physunio*) and the Rectidentinae (*Contradens* and *Trapezoiedus*). This classification suggests that asymmetrical glochidia evolved twice in the same geographic region, rather than once in a common ancestor of these sympatric taxa. We set out to test whether the asymmetrical glochidia-bearing mussels are a monophyletic assemblage diagnosed by this unusual glochidial morphology. The reconstructed phylogeny clearly rejects the monophyly of the asymmetrical glochidia-bearing mussels and suggests that this unusual glochidial morphology arose twice in the same geographic region. However, we find symmetrical glochidia in congeners of each of the Gonideinae genera previously reported to have asymmetrical glochidia. Our results challenge the presence of asymmetrical glochidia in the Gonideinae, but confirm it in the Rectidentinae. These results have important implications on the evolution of glochidial morphologies, patterns of life history traits, and the classification of freshwater mussels generally. jmpfeiffer@crimson.ua.edu

Platform 31 **4:00 p.m.** **March 11, 2013**	**UNIOBARCODE: A COMPREHENSIVE DNA BARCODE LIBRARY FOR FRESHWATER MUSSELS (BIVALVIA: UNIONIDAE).** Nathan Johnson[1,2], James Williams[3], James Austin[1]. [1]University of Florida, Gainesville, FL; [2]US Geological Survey, Caribbean Science Center, Gainesville, FL; [3]Florida Fish and Wildlife Conservation Commission, Gainesville, FL. *STUDENT PRESENTATION*

Freshwater mussels represent one of the most imperiled groups of animals in the world, yet taxonomic uncertainties continue to complicate conservation strategies. Traditional methods for identifying and classifying freshwater mussels are largely based on visible morphology. Homoplasy and phenotypic plasticity of shell characters are common in this group of bivalves, making morphology-based taxonomic approaches problematic and often inadequate for discriminating between intraspecific variation and interspecific similarity. Here we report the release of a comprehensive reference library of DNA barcodes for freshwater mussels known from Florida and adjoining drainages in Alabama and Georgia and compare the suitability and efficacy of DNA barcoding to the traditional morphological approach. To date, 60 of 65 species currently known from the study area are included in the library. Average pairwise divergences were determined at two taxonomic levels (intraspecific and congeneric) using Kimura 2-parameter (K2P) distance model for gender-associated copies of cytochrome c oxidase I (FcoxI and McoxI), the mtDNA marker proposed for DNA barcoding. Neighbor-Joining trees were constructed using the K2P distances to examine species clusters. Results from DNA barcoding revealed high coherence with estimates based on morphological taxonomy. However, results indicate both DNA-based and morphological-based methods are overly conservative in specific lineages. We highlight these discrepancies and demonstrate the utility of these data for 1) rapid, reliable identification of unknown specimens at multiple developmental stages, 2) facilitating discovery and description of new species, 3) tracking the origin of introduced populations, and 4) evaluating taxonomically meaningful geographic variation. We conclude that DNA barcoding provides a powerful tool for freshwater mussel identification and we call for collaborations to build a comprehensive DNA barcode library for all freshwater mussel species in North America. vtdna@ufl.edu

Platform 32 **4:20 p.m.** **March 11, 2013**	**MORPHOLOGY, MOLECULES AND TAXONOMY: THE PLEUROCERID PROBLEM.** Nathan Whelan[1], Ellen Strong[2], Paul Johnson[3]. [1]Department of Biological Sciences, University of Alabama, Tuscaloosa, AL; [2]National Museum of Natural History, Smithsonian Institution, Washington, D.C.; [3]Alabama Aquatic Biodiversity Center, Alabama Department of Conservation and Natural Resources, Marion, AL. *STUDENT PRESENTATION*

Over 74% of species in the family Pleuroceridae (Gastropoda: Cerithioidea) are considered imperiled, and many are the current focus of state and federal recovery programs. However, an outdated taxonomy complicates pleurocerid conservation efforts and the delimitation of biologically relevant management units. A recently documented, but poorly understood, phenomenon that obscures species delimitation is the presence of highly divergent haplotypes within any given putative pleurocerid species. Through sequencing of

over 240 individuals for the COI and 16S mitochondrial genes, we explore the presence of divergent haplotypes in *Leptoxis ampla*, *L. praerosa*, *Pleurocera prasinata*, and *P. pyrenellum*. We also document the radular and female reproductive anatomy of individuals with and without divergent haplotypes. Within each putative species sampled, we found up to six mitochondrial haplotype clades which differed by up to 89 mutations in the COI gene. However, we found no morphological differences among individuals of the same putative species. This extreme example of morphological and molecular incongruence demands explanation. Cryptic speciation appears unlikely given that individuals with highly divergent mitochondrial haplotypes are sympatric, and this would be the most notable example of convergent morphological evolution ever documented. Population genetic metrics (e.g. Fu's Fs and R_2) provide evidence for diversifying selection, but the mechanism for maintaining such molecular diversity within a species is unclear. We discuss the management implications of our findings and present a framework that includes robust sampling of the nuclear genome and advanced computational methods for phylogenetic inference and species delimitation for advancing the field of pleurocerid systematics. nathan.whelan@gmail.com

Platform 33 **4:40 p.m.** **March 11, 2013**	**CORRELATING GENETIC AND SPECIES DIVERSITY OF UNIONIDS ACROSS VARIABLE HABITATS IN WESTERN LAKE ERIE.** Traci Griffith, David Zanatta. Biology Department and Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI. *STUDENT PRESENTATION*

Understanding the relationships between diversity metrics and ecological variables can help diagnose environmental and anthropogenic forces hurting or facilitating populations. Parallels in genetic and species diversity also occur and different landscape changes can influence genetic structure. The western basin of Lake Erie was selected because it has been found to sustain sizable, remnant populations of native freshwater mussels despite the negative impacts of dreissenid mussels. Unionids and habitat quality data were collected at numerous sites within discrete sampling areas throughout Lake Erie. A total of 1356 mussels from 16 species were found in 15 discrete sampling locations. *Quadrula quadrula*, the Mapleleaf mussel, is considered an adaptable mussel and is abundant in the coastal regions of western Lake Erie, representing more than half of the unionids collected. This species was used to represent genetic variation in the region. Of the 752 *Q. quadrula* mussels found, Mantle tissue samples were collected from 243. Genomic DNA was amplified from the tissues samples at six microsatellite loci and genotyped. *Quadrula quadrula* abundance was found to correlate with species diversity. It is expected that *Q. quadrula* genetic diversity (e.g., allelic richness and heterozygocity), as established with microsatellite DNA analysis, will also correlate with species diversity both within populations and among populations. Furthermore, it is expected that abiotic conditions should be predictive for both genetic diversity and species diversity. Trends among genetic diversity, species diversity, and habitat factors such as size of a specific unionid habitat, distance from other unionid habitats, presence of dreissenid mussels, and depth can be used to assist in the assessment of the quality of remnant unionid habitat in Lake Erie. Determining the relationships among habitat, genetic, and species diversity metrics will help in assessing if conservation methods can be applied to promoting population and species-level diversity. griff2t@cmich.edu

SESSION 8	**HISTOLOGY & PARASITOLOGY I** **Monday, March 11, 2013 | 3:20 – 5:00 p.m.** **Goldenrod Room**
Platform 34 **3:20 p.m.** **March 11, 2013**	**RELATIONSHIPS BETWEEN NUTRIENT ENRICHMENT, PLEUROCERID SNAIL DENSITIES, AND TREMATODE INFECTION RATES IN STREAMS**. Serena Ciparis[1], Deborah Iwanowicz[2]. [1]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [2] US Geological Survey, Leetown Science Center, Kearneysville, WV. *STUDENT PRESENTATION*

Nutrient enrichment is a widespread environmental problem in freshwater ecosystems. Eutrophic conditions caused by nutrient enrichment may result in higher infection prevalence of trematode parasites in host populations due to greater resource availability for molluscan first intermediate hosts. This study examined relationships between land use, environmental variables indicative of eutrophication, population densities of the pleurocerid snail, *Leptoxis carinata,* and trematode infection prevalence. Fifteen study sites were located in streams within the Shenandoah River watershed (Virginia, USA), where nutrient enrichment has occurred over a large spatial scale. Snail population densities were positively related to in-stream nutrient concentrations. Snail population densities also increased as human activities within stream watersheds increased, but densities did not continue to increase in watersheds with the highest levels of anthropogenic disturbance. Cercariae from five families of trematodes were identified in *L. carinata*, and infection rates were generally low (< 10 %). Contrary to the working hypothesis of the study, neither total infection rates nor infection rates of individual trematode types showed a positive relationship with snail population densities, nutrients, or land use. There were statistically significant relationships between infection prevalence of two trematode families and

physical and biological variables. Prevalence of Notocotylidae was positively related to depth, which may be related to habitat usage by definitive hosts. Prevalence of Opecoelidae was negatively related to orthophosphate concentrations and showed a polynomial relationship with chlorophyll a concentrations. Transmission of Opecoelid trematodes between hosts may be inhibited by eutrophic conditions. *Leptoxis carinata* appears to be a useful species for monitoring biological effects of eutrophication and investigating trematode transmission dynamics in lotic systems. sciparis@vt.edu

Platform 35 **3:40 p.m.** **March 11, 2013**	**SHIFTS IN STABLE ISOTOPE SIGNATURES CONFIRM PARASITIC RELATIONSHIP OF FRESHWATER MUSSEL GLOCHIDIA ATTACHED TO HOST FISH.** Andrea Fritts[1], Mark Fritts[1], Scott Carleton[2], Robert Bringolf[1]. [1]University of Georgia, Warnell School of Forestry and Natural Resources, Athens, GA; [2]US Geological Survey, New Mexico Cooperative Fish and Wildlife Research Unit, New Mexico State University, Las Cruces, NM. *STUDENT PRESENTATION*

Freshwater mussels (Bivalvia: Unionoidea) are characterized by complex lifecycles composed of multiple, distinct life-stages, including a larval stage referred to as a glochidium. The parasitic nature of larval freshwater mussels, specifically, the role that the fish hosts play in providing nutritional resources to the developing glochidia, is still uncertain. While previous work provided unique morphological descriptions of developing glochidia while they were transforming on fish hosts, earlier studies have not explicitly documented the flow of nutrition from the fish host to the juvenile mussel. Therefore, our objective was to evaluate the feasibility of using stable isotope analysis to quantitatively document nutrient flow between fish hosts and mussel glochidia. Glochidia were collected from nine adult *Lampsilis cardium* and used to inoculate largemouth bass (*Micropterus salmoides*, n=27) that produced juvenile mussels for the experiment. Adult mussel tissue samples, glochidia, transformed juvenile mussels, and fish gill tissues were analyzed for $\delta^{15}N$ and $\delta^{13}C$ ratios. We used a linear mixing model to estimate the fraction of juvenile mussel tissue derived from the host fish's tissue during attachment. Our analyses indicate a distinct shift in both C and N isotopic ratios from the glochidial stage to the juvenile stage during mussel attachment and development. Linear mixing model analysis indicated that 90.0% of the $\delta^{13}C$ and 57.4% of the $\delta^{15}N$ in juvenile tissues were obtained from the host fish. This work provides novel evidence that larval unionids are true parasites that derive nutrition from a host fish during their metamorphosis into the juvenile stage. ac528@uga.edu

Platform 36 **4:00 p.m.** **March 11, 2013**	**HEALTH ASSESSMENT OF FRESHWATER MUSSELS USING METABOLITE PROFILING.** Ieva Roznere[1], Thomas Watters[1], Barbara Wolfe [2], Marymegan Daly[1]. [1]Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, OH; [2]College of Veterinary Medicine, The Ohio State University, Columbus, OH.

Freshwater mussels are the most endangered faunal group in North America. Due to the increased interest in conserving, propagating, and restoring populations, mussels are often translocated to other habitats or brought into captivity in conservation facilities. The objective of this study is to assess health by characterizing the metabolic profile of freshwater mussels in response to captivity and translocation. A total of 99 *Amblema plicata* were collected from the Muskingum River in Washington Co., OH, in June of 2012. One group of mussels was brought into captivity inside the Freshwater Mussel Conservation and Research Center in Powell, OH. A second group of mussels was transported to Big Darby Creek in Franklin Co., OH, and a third group was placed in secured mobile enclosures deployed in the Scioto River near the facility. Hemolymph was collected from the adductor muscle every two months from June through November of 2012 and will be collected from April through June of 2013. A pilot study was designed to characterize the metabolic profile of mussels subjected to starvation. Eight of the mussels brought into captivity were moved into a separate aquarium for 18 days without any food source. Hemolymph samples were taken prior to the experiment and 9 days and 18 days after the start of the experiment. Samples were analyzed on GC/MS and LC/MS/MS platforms. A total of 71 biochemicals of known identity were detected. Captivity and starvation stress resulted in changes in energy metabolism, free amino acids, fatty acids, nucleosides, and proliferation pathways. Although starvation resulted in more severe changes, in most cases these changes were evident in captivity, indicating that mussels may already be experiencing a nutritional deficiency. The results of the long-term study will provide more in-depth information about the differences between stressed and non-stressed mussels, seasonal variability, and the recovery process. roznere.1@buckeyemail.osu.edu

Platform 37 **4:20 p.m.** **March 11, 2013**	**HISTOPATHOLOGICAL OBSERVATIONS OF NEMATODES INFECTING FOOT AND INTESTINE OF THE ALABAMA RAINBOW (*VILLOSA NEBULOSA*).** Andrew McElwain, Stephen Bullard. [1]Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, AL.

The Mobile River Basin historically contained a rich freshwater mussel fauna comprising species of Unionidae and Margaritiferidae. A recent review regarding parasites and diseases of freshwater mussels indicates that biodiversity of metazoan parasites infecting freshwater mussels in the Mobile Basin is poorly understood. Nematoda is a species rich group of pseudocoelomate worms with many free-living and parasitic representatives in aquatic ecosystems. While many species of parasitic nematodes are known from aquatic gastropods, there are scant records of nematode infections from members of Unionidae. While studying the cellular anatomy of Alabama rainbow (*Villosa nebulosa*) towards the development of a histological atlas for freshwater mussels, we observed filiform nematodes infecting mussel tissues. From a sample of 14 *V. nebulosa* (24-51 mm shell length) from Terrapin Creek (Coosa River tributary) in May 2010, 8 were infected. Infections were localized to foot and intestine. Nematode infections in foot ranged from a low number of isolated worms threaded through somatic musculature, to a larger, circular mass consisting of 100 or more individuals. Intestinal infections were characterized by a low number of worms delimited to the epithelium of the major typhlosole. Typically foot and intestine infected with a low number of worms exhibited minimal pathological change except for a small, localized gap surrounding a worm. Foot infected with a large mass of worms exhibited localized compression of myofibers. Since these nematodes infect foot and damage somatic muscle, it is possible that these parasites can limit pedal extension and retraction such that mussels may be more vulnerable to predation or to scouring water currents. azm0034@tigermail.auburn.edu

Platform 38 **4:40 p.m.** **March 11, 2013**	**CELLULAR ANATOMY OF THE MANTLE EDGE OF ALABAMA RAINBOW (*VILLOSA NEBULOSA*), GULF PIGTOE (*FUSCONAIA CERINA*), AND ALABAMA CREEKMUSSEL (*STROPHITUS CONNASAUGAENSIS*), INSIGHTS ON SHELL FORMATION AND HISTOPATHOLOGICAL BIOMARKER POTENTIAL IN UNIONIDAE.** Andrew McElwain, Stephen Bullard[1]. [1]Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, AL.

The mantle edge of freshwater mussels (Unionoida) is a muscular brim around the shell, and its primary function is to secrete the calcareous valves. However, information regarding the functional morphology of the mantle edge of unionids (Unionidae) is scant. Additionally, mantle edge may have potential as a sentinel tissue for the study of histopathological biomarkers since its small size makes it easy to sample, and since it may be partially buried making it useful for studying effects of water-borne or sediment-laden contaminants. Considering the above and given the species richness of Unionidae (ca. 674 spp.) we set out to compare cellular structure of the mantle edge between a representative species of each unionid subfamily (Lampsilinae: *Villosa nebulosa*, Unioninae: *Fusconaia cerina*, Alabama creekmussel: *Strophitus connasaugaensis*). We collected 14 *V. nebulosa* (31-51 mm shell length) from Terrapin Creek (Coosa River tributary), 16 *F. cerina* (39-76 mm shell length) from the Cahaba River, and 12 *S. connasaugaensis* (31-73 mm shell length) from Shoal Creek, Terrapin Creek. Each species differed in terms of mantle lobe morphology, especially the outer lobe. The outer lobe of *V. nebulosa* and *S. connasaugaensis* was uniramous with short plicae while outer lobe of *F. cerina* was branched with tall plicae. Epithelial cells around the outer lobe exhibited a basophilic cytoplasm possibly indicating specialization for protein secretion. Considering these observations, a branched, highly-folded epithelium characterizing the outer lobe of *F. cerina* may correspond to greater protein synthesis than an epithelium featuring shorter plicae along a uniramous lobe (*V. nebulosa* and *S. connasaugaensis*). These structural differences may be associated with interspecific differences in shell thickness, the structural features exhibited by *F. cerina* may correspond to a thick shell; whereas, the outer lobe of *V. nebulosa* and *S. connasaugaensis* may be related to a thinner shell. azm0034@tigermail.auburn.edu

SESSION 9	**SURVEY & MONITORING I** **Tuesday, March 12, 2013| 8:20-10:00 a.m.** **Camellia Room**
Platform 39 **8:20 a.m.** **March 12, 2013**	**DISTRIBUTION AND ABUNDANCE OF FRESHWATER MUSSELS IN THE PROJECT AREA OF A LOWHEAD DAM REMOVAL PROJECT IN COLUMBUS, OHIO.** Cody Fleece[1], James Kiser[2], Michael Hoggarth[3] Scott Peyton[1]. [1]Stantec, Cincinnati OH; [2]Stantec, Louisville, KY; [3]Otterbein University, Westerville, OH.

In early September of 2012 the 5th Avenue Dam in the Olentangy River in Columbus, Ohio was demolished. The dam was approximately 500 feet wide, eight feet tall, and built of structurally reinforced concrete. The backwater from the dam extended approximately 10,000 feet upstream. Pre-demolition surveys documented high mussel densities, comprised of 11 species, in the reach downstream of the dam. Freshwater mussel rescue and relocation was conducted for areas within the construction footprint (two areas downstream of the dam) and for areas subject to rapid dewatering from the lowering of the pool (four areas within the dam pool). The rescue consisted of 515 total hours of search effort where a total of 7,513 mussels, comprised of 16 species, were moved to nearby locations. The pool was lowered in two phases with the water surface dropping

approximately four feet in a matter of hours. Over 219 hours of search effort were expended during the rescue with catch per unit effort ranging between 5 and 156 mussels per hour. The transition zone near the limit of the backwater proved to be an area of unusually high species richness and density. The data generated in this study provide a conceptual framework for predicting the distribution and abundance of mussels associated with lowhead dams. This information can also inform pre-project presence/absence study designs, construction implementation and sequencing, rescue effort prioritization, and inform geomorphic design for restoration projects targeting freshwater mussels. cody.fleece@stantec.com

Platform 40 **8:40 a.m.** **March 12, 2013**	**CATSPAW MUSSEL, *EPIOBLASMA OBLIQUATA OBLIQUATA* (RAFINESQUE, 1820)…ON THE BRINK?** Steven Ahlstedt[1], Greg Zimmerman[2], Angela Boyer[3], Leroy Koch[4], Martin Huener[2], Ryan Schwegman[2], Patrick Evankovich[2]. [1]P. O. Box 460, Norris, TN; [2]Enviroscience, Inc., Stow, OH; [3]US Fish and Wildlife Service, Columbus, OH; [4]US Fish and Wildlife Service, Frankfort, KY.

The Catspaw mussel was federally listed endangered in 1990. Only two populations were known at the time of listing (Cumberland River, TN and Green River, KY) and their current status was unknown. In 1994, Dr. Michael Hoggarth discovered a previously unknown population in Killbuck Creek, a tributary stream to the Walhonding > Muskingum > and Ohio River located in the north-central Ohio. Subsequent sampling in 1995-1996 produced numerous live and dead individuals but in limited reaches of the creek. Intensive searches were initiated in 2006 to find live individuals, especially females, for culture and propagation. Since 2006, an estimated 559 sampling hours was spent snorkeling, diving, raking, and sieving substrate in Killbuck and other streams resulting in a total of 30 live males and 11 live females (66% of these were found in 2012). 2012 was the first time that live females were found since 1996. Efforts to hold individuals in propagation facilities have met with mixed success, and little is known about the host species. Catspaw is recruiting at some level in Killbuck Creek but rare. At present, 6 males and 3 females are currently held in a cage in Little Darby Creek, OH and the remaining 9 males and 7 females are held in cages in Killbuck Creek. Future plans are to keep this species from going extinct via culture and propagation techniques, but the best strategy for obtaining viable glochidia is still unknown. This project has brought to light many challenges to the recovery of a species on the brink of extinction with very few live individuals available for culture. bigshelldaddy@bellsouth.net

Platform 41 **9:00 a.m.** **March 12, 2013**	**RESULTS OF A SURVEY OF THE MUSSEL FAUNA AT SELECTED STATIONS IN THE BLACK WARRIOR RIVER SYSTEM, ALABAMA, 2009-2012.** Stuart McGregor[1], Anne Wynn[1], Jeffrey Garner[2]. [1]Ecosystems Investigations Program, Geological Survey of Alabama, Tuscaloosa, AL; [2]Division of Wildlife and Freshwater Fisheries, Alabama Department of Conservation and Natural Resources, Florence, AL.

During 2009-12 qualitative sampling was performed in the Black Warrior River system (Mobile River Basin) to ascertain mussel distribution, especially regarding federally protected and State of Alabama Conservation Priority species. Methodology was dictated by conditions: surface air source in the river; mask and snorkel, view buckets, and hand picking in tributaries. A cumulative total of 28 species from 16 main channel and 119 tributary stations was recorded. Mussels were more widespread and abundant in Coastal Plain tributaries and in the Sipsey Fork. Among federally listed species only *Potamilus inflatus* was collected in the main channel; *Hamiota perovalis* was found on Coastal Plain tributaries and in the Sipsey Fork; and *Medionidus acutissimus*, *Pleurobema rubellum* (= *P. furvum*), and *Ptychobranchus greenii* were found in Sipsey Fork. Most tributary stations upstream of the Fall Line at Tuscaloosa that were direct tributaries yielded no mussels or only shells of common species. Some Locust Fork stations yielded a few animals, and six species were collected live there. No listed species were found, but weathered dead valves of *Elliptio arctata*, a State of Alabama Conservation Priority 1 (P1) species, were found in Locust Fork and Sipsey Fork. Mulberry Fork and its tributaries yielded no live animals or shells at any station. The Sipsey Fork, sampled mostly in or near Bankhead National Forest, still harbors what one of the most intact faunas remaining in the Mobile River Basin. All federally listed species documented from that watershed in the past two decades were collected, but in lower numbers and with less frequency than 20 years ago. smcgregor@gsa.state.al.us

Platform 42 **9:20 a.m.** **March 12, 2013**	**STATUS OF RARE AND ENDANGERED FRESHWATER MUSSELS (BIVALVIA: UNIONOIDEA) IN MISSOURI**. Stephen McMurray[1], Chris Barnhart[2], Scott Faiman[1], Travis Moore[3], Andrew Roberts[4], Bryan Simmons[4], Michael Taylor[5]. [1]Missouri Department of Conservation, Columbia, MO; [2]Missouri State University, Springfield, MO 65897; [3]Missouri Department of Conservation, Hannibal, MO; [4]US Fish and Wildlife Service, Columbia, MO 65203; [5]Southeast Missouri State University, Cape Girardeau, MO.

Efforts to document the state's mussel fauna began in the 1900s and intensified in the late 1970s; these efforts continue today. Of the 69 species of freshwater mussels native to Missouri, 29 are Species of Conservation Concern (SOCC), including 11 federally listed or proposed as endangered or threatened. The greatest abundance and diversity of mussels

in the state is associated with the rivers draining the Ozark Plateaus, a distinctive highland biogeographic region with many endemic aquatic species. Most mussel SOCC are associated with these rivers including the northward-flowing Meramec, Gasconade, and Osage, the southward-flowing White, Black and St. Francis, and the west-flowing Spring river systems. A few of these rivers (Meramec, Gasconade, Spring) have so far escaped major impoundments, while the faunas of others dammed as recently as the early 1970s may not yet have reached equilibrium. Other important regional impacts include gravel mining, heavy metal pollution from historic lead and zinc mining, nutrient pollution, and ongoing range expansion of zebra mussel. Missouri harbors key populations of scaleshell (*Leptodea leptodon*), pink mucket (*Lampsilis abrupta*), sheepnose (*Plethobasus cyphyus*), Neosho mucket (*L. rafinesqueana*), spectaclecase (*Cumberlandia monodonta*), and snuffbox (*Epioblasma triquetra*), while some SOCC are range-limited in Missouri or nearly extirpated including southern hickorynut (*Obovaria jacksoniana*), fat pocketbook (*Potamilus capax*), winged mapleleaf (*Quadrula fragosa*), salamander mussel (*Simpsonaias ambigua*), and Curtis pearlymussel (*Epioblasma florentina curtisii*). We will present the current status of rare and endangered mussels in Missouri, as well as other species that may warrant consideration as state or federal endangered species. Stephen.McMurray@mdc.mo.gov

Platform 43 **9:40 a.m.** **March 12, 2013**	**DISTRIBUTION OF FRESHWATER GASTROPODS OF NEBRASKA AND SOUTH DAKOTA: RESULTS OF AN ONGOING SURVEY.** Bruce Stephen, Patricia Freeman. School of Natural Resources, University of Nebraska Lincoln, Lincoln, NE.

Current knowledge of the distribution of species of freshwater gastropods in the prairie states of South Dakota and Nebraska is sparse with no recent comprehensive studies. Historical surveys of gastropods within this region were done in the late 1800's to the early 1900's, and most current studies that include gastropods do not identify to species. Here we present results of an ongoing survey of these prairie regions. Our survey to date includes 258 sites within eight level III ecoregions and includes palustrine, riverine, reservoir and lacustrine water bodies under a variety of hydrologic conditions. Sample sites contain from 0-6 species with an average of 2.4 species per site and a total of 622 records of species. Nineteen species in seven families are identified. The two most abundant species *Physa gyrina* and *Helisoma trivolvis* are found at 192 and 107 sites respectively. Four species, including the two most abundant and including *Lymnaea elodes,* and *Gyraulus deflectus*, are found in all eight of the ecoregions sampled. Eight species are found at five or fewer sites including two non-indigenous species, *Bellamya chinensis* and *Melanoides tuberculata*. Species similarity metrics are used to compare regions and water bodies. Species richness of each ecoregion varies from 5 to 13. Estimates from rarefaction analysis are used to compare species richness among geographic covariates. Although taxonomic revisions may condense some nominal species listed historically, our new data suggest that up to twelve additional species of fresh water gastropods may have been present in this region. bstephen@mac.com

SESSION 10	**POPULATION GENETICS I** **Tuesday, March 12, 2013| 8:20-10:20 a.m.** **Goldenrod Room**
Platform 44 **8:20 a.m.** **March 12, 2013**	**POPULATION GENETIC ANALYSES REVEAL RECENT ISOLATION OF *POPENAIAS POPEII*, IN THE SOUTHWEST UNITED STATES.** Kentaro Inoue[1], Brian Lang[2], David Berg[3]. [1]Department of Zoology, Miami University, Oxford, OH; [2]New Mexico Department of Game and Fish, Santa Fe, NM; [3]Department of Zoology, Miami University, Hamilton, OH. *STUDENT PRESENTATION*

Analysis of genetic variation provides insight into the ecological and evolutionary forces that produce patterns of population structure in time and space. This information is particularly useful for conservation management of imperiled populations. *Popenaias popeii* (Lea, 1857), the Texas hornshell, is endemic to the Rio Grande drainage of the US and Mexico, and coastal rivers of northern Mexico. It is a candidate for listing under the US Endangered Species Act due to population reduction and current anthropogenic habitat alteration. We examined population genetic structure throughout the Rio Grande portion of its range using mitochondrial COI gene sequences and 20 microsatellite loci. We collected 154 swab samples from five sites in the Black River, NM; three samples from sites in the Devils River, TX; and 58 samples from five sites in the Rio Grande, TX. Our analyses recovered 33 haplotypes of COI. Rio Grande populations contain 32 of these haplotypes; Black River populations have one haplotype, which is shared with Rio Grande populations; and the Devils River individuals possessed a single unique haplotype. Genotypic diversity varied greatly among rivers: mean allelic richness is 3.5 alleles per locus in the Black River and 9.9 in the Rio Grande. Analysis of molecular variance (AMOVA) revealed 21.9% of genetic variation is among rivers. Cluster analysis using STRUCTURE identified two distinct populations from the dataset, one found in the Black River and the other in both the Rio Grande and Devils River. Current genetic population structure is a

reflection of both historical gene flow and population expansion, along with more recent habitat fragmentation and interruption of population connectivity. Our results will form the basis of future population viability analyses designed to evaluate alternative management strategies to ensure persistence of this imperiled species. inouek@muohio.edu

Platform 45 **8:40 a.m.** **March 12, 2013**	**GENETIC STRUCTURE OF MAPLELEAF MUSSELS (*QUADRULA QUADRULA*) AND EFFECTS OF THE *DREISSENA* INVASION IN THE WESTERN BASIN OF LAKE ERIE.** Wendy Paterson, David Zanatta. Biology Department and Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI. *STUDENT PRESENTATION*

Following the invasion of dreissenids only small remnant unionid communities remain in coastal habitats of Lake Erie. Based on surveys conducted in western Lake Erie in 2011 and 2012 the most common species remaining was the Mapleleaf mussel, *Quadrula quadrula*. Mapleleaf had been observed in the lake since at least 1927, but did not become the dominant unionid until the 1990's, coinciding with the invasion of dreissenid mussel. In 2011 and 2012, 133 sites in Lake Erie were surveyed and tissue samples for genetic analyses were collected from 243 Mapleleaf mussels. Mapleleaf was selected as a surrogate for rare species to better understand and conserve the greatly reduced unionid fauna. To assess genetic diversity and structure of Mapleleaf from 15 sampling locations across western Lake Erie primers were optimized for 6 microsatellite loci with alleles per locus ranging from 4 to 17. The samples collected from Lake Erie were also compared to 167 profiled individuals from two major Lake Erie tributaries, the Maumee River (Ohio) and the Grand River (Ontario). Assessments of genetic diversity, genetic bottlenecking, source and sink populations, and gene flow are underway. It is expected that little genetic structure will be found among Mapleleaf sampling locations in Lake Erie. This can be attributed to their use of catfish as hosts leading to high rates of dispersal. The absence of significant genetic structure would indicate that Mapleleaf in Lake Erie can be managed as a single population, however if structure is present each sampling location will need to be managed as a unique population. It is expected that a genetic bottleneck will be observed for Mapleleaf and it is likely that other unionid species have had this occur as well. All of this information will lead to insight on management plans of remnant unionid diversity in Lake Erie. pater1wl@cmich.edu

Platform 46 **9:00 a.m.** **March 12, 2013**	**USING MOLECULAR DATA TO AID DELINEATION OF TWO SPECIES IN THE FRESHWATER MUSSEL GENUS *CYPROGENIA* (BIVALVIA: UNIONIDAE).** Jer Pin Chong[1], John Harris[2], Kevin Roe[1]. [1]Department of Natural Resource Ecology and Management, Ames, IA. [2]Department of Biological Sciences, Arkansas State University, Jonesboro, AR. *STUDENT PRESENTATION*

It is critical that appropriate taxonomic or evolutionarily significant units be recognized to develop proper conservation strategy for freshwater mussels. Recent molecular studies have shown that lineages identified using morphological characters alone are not always congruent with evolutionary lineages identified using molecular markers. This study focused on using molecular data to review the delineation of two species in the genus *Cyprogenia*: the western fanshell *Cyprogenia aberti* (Conrad 1850) and the endangered fanshell pearlymussel *Cyprogenia stegaria* (Rafinesque 1820). Under recent taxonomy, *Cyprogenia* specimens found west of the Mississippi River have been ascribed to *C. aberti*, and specimens found east of the Mississippi River have been identified as *C. stegaria*, although shells morphologically resembling both species have been found co-occurring in Arkansas. Previous molecular studies using mitochondrial DNA sequences indicated that both *C. aberti* and *C. stegaria* are not reciprocally monophyletic groups. The mtDNA lineages identified for *C. stegaria* were found incongruent with a microsatellite dataset, although no nuclear data for *C. aberti* was included in that study. The goal of our study was to examine range-wide mtDNA and nuclear genetic variation in an attempt to identify the number of distinct evolutionary lineages and their distributions for these two species. As part of an ongoing study that will include morphological and both nuclear and mitochondrial DNA data, we utilized 170 *C. aberti* and 50 *C. stegaria* from Missouri, Arkansas, Kentucky and Tennessee. An 854bp fragment of mtDNA ND1 region was sequenced, and the results of the analyses will be discussed during the presentation. jchong@iastate.edu

Platform 47 **9:20 a.m.** **March 12, 2013**	**SPATIALLY EXPLICIT GENETIC STRUCTURE OF TWO UNIONID SPECIES, *LAMPSILIS CARDIUM* AND *LASMIGONA COSTATA*, IN THE CENTRAL GREAT LAKES.** Jennifer Bergner, Daelyn Woolnough, David Zanatta. Biology Department and Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI. *STUDENT PRESENTATION*

Freshwater mussels (Family: Unionidae) and their host fish presumably colonized the Laurentian Great Lakes and Michigan waterways from Mississippian refugia via two main routes following the last retreat of the Wisconsin glaciation as recently as 9,000 ybp. With limited dispersal ability between these hypothesized routes, mussels and host fishes may have remained relatively isolated since post-glacial colonization establishing genetically distinct populations within the state of Michigan, USA. We investigated the current genetic structure of two unionid species, *Lampsilis cardium* and *Lasmigona costata*, at a variety of spatial scales (i.e., 24 sites from 13 rivers in 8 watersheds within four Great Lake

drainages) throughout Michigan. These species are relatively common throughout their range, but differ in their life histories (e.g., host fish used). Using microsatellite DNA markers (6 loci for *L. cardium*, 8 loci for *L. cardium*), we found significant genetic structuring occurring for both species. Two genetically distinct populations were identified using assignment tests and further supported by significant F_{ST}/D_{est} values, neighbor joining networks, and significant isolation by distance. The patterns of genetic structure observed are consistent with the hypothesized post-glacial colonization routes of host fish, spanning multiple Great Lakes drainages. Non-glaciated regions have shown evidence of genetic structuring occurring at smaller geographic scales (e.g., within watersheds). Large-scale genetic structuring, observed in this study, may be primarily influenced by historical biogeography while smaller scale structuring, observed in non-glaciated landscapes, (e.g., within watersheds) may be primarily influenced by host fish and sperm dispersal. Successful efforts to augment unionid populations using translocation and propagation in the Great Lakes region may rely on the results of this study. bergn1j@cmich.edu

Platform 48 **9:40 a.m.** **March 12, 2013**	**PHYLOGEOGRAPHIC AND POPULATION GENETIC ANALYSES REVEAL MULTIPLE LINEAGES AND POST-GLACIAL EXPANSION IN A WIDE-RANGING ENDANGERED MUSSEL, *CUMBERLANDIA MONODONTA* (SAY 1829).** Kentaro Inoue[1], Emy Monroe[1], Curt Elderkin[1, 2], David Berg[3]. [1]Department of Zoology, Miami University, Oxford, OH; [2] Department of Biology, The College of New Jersey, Ewing, NJ; [3]Department of Zoology, Miami University, Hamilton, OH.

Cumberlandia monodonta (Say 1829), the spectaclecase, was historically widespread and abundant throughout the Mississippi River system. However, extirpation of some local populations and drastic population reduction of others have led to endangered status for this species under the US Endangered Species Act. We examined phylogeographic and population genetic structure of five populations of *C. monodonta* using mitochondrial COI gene sequences and 17 microsatellite loci. Phylogenetic analysis revealed two distinct lineages: Lineage 1 is found in populations from the Clinch, Gasconade, Meramec, and St. Croix rivers, while Lineage 2 is found in all those populations along with the Ouachita River population. Nucleotide diversity was 0.0024 within Lineage 1 and 0.0011 within Lineage 2. Genetic divergence between the two lineages was 0.0115. Molecular clock analysis estimated that the divergence time of the two lineages was approximately 1.57 to 0.31 million years ago. Population assignment using STRUCTURE with microsatellite data revealed two distinct clusters: the Ouachita population and the rest of the populations. Mean allelic richness was 8.1 alleles per locus in the Ouachita population and 13.1-13.8 in the rest of the populations. AMOVA showed that 7.6% of genetic variation was found between the Ouachita populations and the other populations, and only 0.7% of genetic variation was found among populations. Bottleneck tests showed that all populations have undergone recent population bottlenecks, whereas the Ouachita population had a historic bottleneck as well. Two mtDNA lineages with their relatively long divergence time indicate two refugia during the Pleistocene glaciation and rapid post-glacial expansion throughout the range of the species. Cluster and bottleneck analyses indicate that the Ouachita population was likely a marginal population exhibiting a founder effect from post-glacial dispersal. Our analyses suggest that this geographic differentiation needs to be considered in the development of conservation strategies for this species. bergdj@muohio.edu

SESSION 11	**SURVEY & MONITORING II** **Tuesday March 12, 2013 | 10:20 a.m.-12:00 p.m.** **Camellia Room**
Platform 49 **10:20 a.m.** **March 12, 2013**	**CONSERVATION STATUS OF EUROPEAN FRESHWATER BIVALVES.** Manuel Lopes-Lima [1,2], Ronaldo Sousa, David Aldridge, Rafael Araujo, Jakob Bergengren, Erika Bódis, Phillipe Bouchet, Karel Douda, Jurgen Geist, Ian Killeen, Rosaria Lauceri, Bjørn Larsen, Sabela Lois, Stefan Lundberg, Evelyn Moorkens, Gregory Motte, Karl Nagel, Momir Paunovic, Ondina Paz, Vincent Prié, Ted von Proschwitz, Nicoletta Riccardi, Simone Varandas. [1]CIIMAR-UP – Interdisciplinary Centre of Marine and Environmental Research, University of Porto. Porto, Portugal; [2]ICBAS-UP - Institute of Biomedical Sciences Abel Salazar, University of Porto, Porto, Portugal.

In Europe, one of the world's most populated and industrialized areas, freshwater ecosystems are at risk and invertebrates are particularly vulnerable. However, this situation is not recognized since major conservation efforts are directed to vertebrate species (particularly birds and mammals). Given this situation mollusks and freshwater bivalves in particular, deserve conservation attention. The conservation status of European bivalve species rests on the scientific knowledge of the 1980s before the current revival of taxonomic reappraisals based on molecular characters with some groups presenting extensive misidentification (e.g. *Anodonta* and *Unio*). This situation makes the use of previous bibliographical data extremely difficult to compile. Additionally few of the recent works have been carried in only a few species (mainly in *Margaritifera* spp. and *Unio crassus*) and generally with a reduced geographical range (generally a small country). Therefore in Europe there is an urgent need for a more integrated and holistic conservation approach on

these taxa. In the present work several European experts on freshwater bivalves were invited to bring input on the distribution and conservation status of freshwater bivalves in their countries. The integration of all these datasets is here presented as well as directives and opportunities for cooperative European conservation with regard to freshwater bivalves. These challenges will require the participation of as many affected and interested groups, from local communities to governmental and European agencies for successful implementation and management. lopeslima.ciimar@gmail.com

Platform 50 **10:40 a.m.** **March 12, 2013**	**NATIVE MUSSEL POPULATIONS OF DOURO BASIN, PORTUGAL: ECOLOGICAL PATTERNS, MAIN THREATS AND CONSERVATION MEASURES.** Amílcar Teixeira[1], Simone Varandas[2], Ronaldo Sousa[3,4], Elsa Froufe[3], Manuel Lopes-Lima[3, 5]. [1]CIMO-ESA-IPB – Mountain Research Centre, School of Agriculture, Polytechnic Institute of Bragança, Bragança, Portugal; [2]CITAB-UTAD - Centre for Research and Technology of Agro-Environment and Biological Sciences, University of Trás-os-Montes and Alto Douro, Vila Real, Portugal; [3]CIMAR-LA/CIIMAR – Centre of Marine and Environmental Research, Porto, Portugal; [4]CBMA – Molecular and Environmental Biology Centre, Department of Biology, University of Minho, Campus de Gualtar, Braga, Portugal; [5]ICBAS – Abel Salazar Biomedical Sciences Institute, University of Porto, Porto, Portugal.

Native freshwater mussel populations of northeastern Portugal are severely threatened by the drastic reduction in the available habitat and biotic shifts that can be expected from the construction of 3 big dams recently developed for Sabor, Tua and Tâmega rivers, tributaries of Douro River, by the Portuguese government. The main goal of the present study was to investigate the ecological patterns and the potential impacts of these dams on local freshwater habitats, where mussel populations, such as *Margaritifera margaritifera* (L.), and *Potomida littoralis* (Cuvier 1798) *Unio delphinus* (Spengler 1793) and *Anodonta anatina* (L.), are still present in high densities in order to define the best conservation measures for these species. From 2009 to 2012, several sampling sites were selected and abiotic (e.g. sediment, water quality and hydromorphological features) and biotic (e.g. algae, macroinvertebrate and fish communities) analyses made, following the European Water Framework Directive procedures. Habitat and microhabitat used by native naiads were evaluated and host fish species determined, only for unionid mussels. For host determination, glochidia were extracted from each species and exposed, in laboratory experiments, to autochthonous and exotic fish species that co-occur in the same basin. The results allowed to define the spatial distribution of the mussel populations: *M. margaritifera* populations are located in headwater streams, with good ecological integrity, colonizing, preferably, riffle zones, with permanent water current, buried in the fine sediments and covered by coarse substrate. *U. delphinus*, *P. littoralis* and *A. anatina* are naturally distributed along the middle and lower sections, adapted to more eutrophic waters. They tended to occupy fine sediment zones, reaching high densities in banks and particularly in lateral arms of the main river. The results of host fish experiments showed that almost all effective hosts were only native fish species. Conservation measures must consider monitoring, legislation and translocation programs for mussel populations and the global ecosystem protection. amilt@ipb.pt

Platform 51 **11:00 a.m.** **March 12, 2013**	**DISTRIBUTION AND RELATIVE ABUNDANCE OF THE GASTROPOD FAUNA OF THE MUKWONAGO RIVER, WISCONSIN.** Rex Hanger, Kristie Hansen. Department of Geography & Geology, University of Wisconsin-Whitewater, Whitewater, WI,

Knowledge of the gastropod fauna of the Mukwonago River is minimal, especially in comparison with the mussels and other macroinvertebrates. A gastropod-specific monitoring program has been in existence for the 2011 and 2012 field seasons to gather baseline information on the group. Gastropods were sampled using Hess and shallow coring samplers in three locations of the Mukwonago River in Waukesha County, Wisconsin –gravel then sand substrates immediately downstream from the low-head, Phantom Lake dam, and sand substrates further downstream in Wisconsin State Natural Area #417. The following physical-environmental data were collected simultaneously: water temperature, bottom flow velocity, DO, EC, pH, turbidity and light intensity. Discharge and Gage Height were provided by the USGS for station 05544200. Collection frequency was biweekly below the dam and monthly within the SNA417 from June through November of 2011, and monthly for all localities in 2012. Gastropods of the Family Pleuroceridae were the target organisms of the study, although all taxa were collected, sorted, identified to the lowest level possible and counted. Species richness indices were high (12 species), confirming the previous designation of the Mukwonago River as a Wisconsin Exceptional Water Resource. The Pleurocerid gastropod species: *Elimia livescens* and *Pleurocera acuta* were numerical dominants throughout all habitats, with *E. livescens* dominant in gravel substrates (densities up to 434/m^2) and *P. acuta* dominant in sands (densities up to 560/m^2). This relationship between the two species held throughout all months of the two-year monitoring interval. As most of the other physical-environmental parameters varied little between the two sampling locations, substrate was taken to be the primary determinant of gastropod dominance within the faunas. Work has begun on measuring the Pleurocerids and using established length-mass relationships to calculate biomass, as data for future secondary production analyses. hangerr@uww.edu

Platform 52 **11:20 a.m.** **March 12, 2013**	**A LIFE STAGE STORY OF THE KIDNEYSHELL MUSSEL, *PTYCHOBRANCHUS FASCIOLARIS*, IN SOUTHERN ONTARIO, CANADA.** Kelly McNichols-O'Rourke, Todd Morris. Fisheries and Oceans Canada, Burlington, ON, Canada.

Of the 54 species of freshwater mussels in Canada eight species have been listed as endangered under the Canadian *Species at Risk Act*. One of these is the Kidneyshell mussel, *Ptychobranchus fasciolaris*. Information about the life history characteristics of *P. fasciolaris* in Ontario is limited and is required to facilitate the recovery of this species. Our goal was to identify the reproductive timing windows - spawning, brooding, glochidial release and host infestation - for *P. fasciolaris* in the Ausable River in southwestern Ontario, Canada. One 300 m^2 plot was sampled weekly during the open water period in 2012-2013. All individuals in the plot were given a unique number and during each sampling event the behaviour of each individual was noted, gonad samples were taken, drift net samples were collected, and suspected host fish were vouchered. Over 250 *P. fasciolaris* were found and of the 160 individuals that had gonad samples taken, 31% were identified as females and 50% as males. Preliminary data suggest that spawning occurs in early summer (June – early July) as males and females were observed at the substrate surface with large amounts of sperm and eggs present. Conglutinates were observed beginning in mid-August and continued until at least December. Suspected host fishes collected were Greenside Darters, Johnny Darters and Blackside Darters. To date, 38 fish (25 Greenside Darters, 2 Johnny Darters, and 11 Blackside Darters) have been examined (collected from July 3 to August 1, 2012) and one glochidium was found on a Greenside Darter (unknown mussel species). The identification of these reproductive timing windows is vital to the successful recovery and the continued protection of *P. fasciolaris* under the *Species at Risk Act* in Canada. Kelly.McNichols-O'Rourke@dfo-mpo.gc.ca

Platform 53 **11:40 a.m.** **March 12, 2013**	**UNIONID ASSEMBLAGES IN TWO ST. FRANCIS RIVER DRAINAGE DITCHES BEFORE AND AFTER CHANNEL MAINTENANCE CLEANOUTS.** John Harris[1], Mark Smith[2], Kevin Piggott[2], Andrew Peck[3], Alan Christian[4]. [1]Department of Biological Sciences, Arkansas State University, Jonesboro, AR; [2]Environmental Compliance Branch, U.S. Army Corps of Engineers, Memphis District, Memphis, TN; [3]The Nature Conservancy, New Paltz, NY; [4]Biology Department, University of Massachusetts Boston, Boston, MA.

The fat pocketbook, *Potamilus capax*, has been one of the most researched and discussed North American species since endangered listing in 1976, due in part to U.S. Army Corps of Engineers public works projects. Numerous fat pocketbook translocations have occurred prior to federally-funded, channel-altering activities. We evaluated 2 mussel assemblages in St. Francis River drainage ditches, northeastern Arkansas, prior to and after maintenance activities. Partial cleanouts (dredging) were conducted on a 5.7-km reach of State Line Outlet near Manila, Mississippi County and an 8.75-km reach of Rivervale Outlet near Marked Tree, Poinsett County. For State Line, a pre-dredge, quantitative population estimate was conducted in 2001, followed by translocation of 2000+ fat pocketbook in Fall 2002, ditch cleanout completion in 2003, and another quantitative estimate in March 2005. The pre-dredge State Line survey sampled 2225 m^2-quadrats yielding 507 individuals representing 18 species, and the post-dredge survey sampled 2,850 quadrats producing 680 mussels of 17 species. The State Line assemblage was primarily lampsiline (11) and anodontine (5) species; however, 3 *Quadrula* species were numerically dominant (~50%). Seven species were relatively abundant (>4% contribution each) in the pre-dredge sample, and post-dredge densities (n/m^2) remained the same for 4 species, decreased for 1, and increased for 2. The 2009 pre-dredge Rivervale survey sampled 3,831 m^2-quadrats yielding 2,167 specimens representing 21 species, while the 2012 post-dredge survey sampled 3,433 quadrats yielding 1,268 specimens from 21 species. The Rivervale assemblage was primarily lampsiline species (11); however, it was dominated numerically by *Amblema plicata* (~40%) and 5 *Quadrula* species (~35%). Once again, 7 species were relatively abundant in the pre-dredge sample; however, post-dredge Rivervale densities decreased for 5 species and remained the same for 2. Post-dredge fat pocketbook densities increased in both ditches. We evaluate the efficacy of translocation efforts with respect to partial ditch cleanouts. omnibob1@gmail.com

SESSION 12	**POPULATION GENETICS II** **Tuesday, March 12, 2013 | 10:20 a.m.-12:00 p.m.** **Goldenrod Room**
Platform 54 **10:20 a.m.** **March 12, 2013**	**PHYSIOLOGICAL AND GENETIC DIFFERENCES BETWEEN *ELLIPTIO COMPLANATA* POPULATIONS FROM ATLANTIC SLOPE DRAINAGES.** Curt Elderkin[1], James Stoeckel[2]. [1]Department of Biology, The College of New Jersey, Ewing, NJ. [2]Auburn University, Department of Fisheries and Allied Aquacultures, Auburn, AL.

The Eastern Elliptio mussel (*Elliptio complanata)* is widespread and common throughout the Northeast. However, major dam projects may have significantly affected host dispersal in the Susquehanna River. Little is known about *E. complanata* in terms of its genetic diversity within and among the many drainages where it occurs. The current study used a mitochondrial DNA locus (COI), and 7 microsatellite loci to analyze genetic diversity among sites in Pennsylvania and New Jersey. Both markers were compared among populations from the Delaware (NJ), Raritan (NJ), and Susquehanna (PA) drainages. Results indicate both long term (MtDNA) and recent (Microsatellite loci) isolation of populations in the Juniata River, a tributary of the Susquehanna River, when compared to all other collection sites, including other Susquehanna tributaries. *E. complanata* collected from Juniata sites were consistently different by ~1% bp at a mitochondrial locus (F_{st} = 0.58), and significantly different at microsatellite loci using a Bayesian analysis of allele frequency (F_{st} = 0.04). To test for concurrent differences in physiology, we collected 24 live individuals each from the Juniata River and the Raritan River. Mussels from each location were tagged and acclimated to two temperatures (23 °C and 10 °C) for two weeks in common gardens (12 mussels per population per temperature). Clearance rates of individual mussels were measured at the appropriate acclimation temperatures. Raritan mussels exhibited significantly higher clearance rates at both temperatures (P = 0.039), than Juniata mussels. We are currently comparing valve morphology between the two populations. The observed differences may be due to reproductive isolation, adaptation to local environmental conditions, or a combination of both. These results have implications for management of *E. complanata* and its host fish in the Susquehanna River, where Juniata River populations may require different management strategies from other tributaries in the drainage. elderkin@tcnj.edu

Platform 55 **10:40 a.m.** **March 12, 2013**	**CHROMOSOMAL CHARACTERISTICS – ANOTHER CHARACTER SET TO HELP CLARIFY RELATIONSHIPS AMONG THE FRESHWATER MUSSELS.** John Jenkinson. Clinton, TN.

Recently, biologists interested in the evolutionary and taxonomic relationships among the freshwater mussels have begun to analyze data from mitochondrial and ribosomal character sets in conjunction with the sets of morphological and life history characters that had been used alone in the past. The tacit assumption involved in this new synthesis is that, now, these are all of the character sets that can clarify relationships among the groups of mussel species. While that assumption may be largely correct at the moment, a growing body of work with marine bivalves and some initial work with freshwater species indicates that chromosomal characteristics also may be useful in clarifying relationships among the groups of freshwater mussels. Chromosomal characteristics can be divided into three variously diverse data sets: data associated with chromosome number, the analysis of karyotypes, and the analysis of chromosomal banding. The increasing number of chromosome counts for freshwater mussels and other bivalves shows that chromosome number is surprisingly uniform in most bivalve orders, and that differences in chromosome number may indicate separations between lineages. When metaphase chromosome spreads are viewed clearly, similarities and differences in the lengths of the chromosomes and their arms – the karyotypes – can be used to indicate relationships between populations, species, and higher taxa. The differential staining of material along the length of chromosomes – chromosomal banding – is not as advanced in malacological studies as it is in mammalian work; however, various types of banding patterns already have been used to differentiate populations and species in oysters and scallops. The take home message from this overview is that chromosomal characteristics offer new and largely independent data sets that can add a new perspective on the taxonomy and evolutionary history of freshwater mussels. jjjenkinson@hotmail.com

Platform 56 **11:00 a.m.** **March 12, 2013**	**DIFFERENCES IN POPULATION STRUCTRE ESTIMATED WITHIN MATERNALLY- AND PATERNALLY-INHERITED FORMS OF MITOCHONDRIA AND THEIR IMPLICATIONS TO CONSERVATION.** Robert Krebs[1]. Department of Biological, Geological and Environmental Sciences, Cleveland State University, Cleveland, OH.

Mussels in several orders possess two separate mitochondrial lineages, a standard female-inherited form and one inherited only through males. This system of doubly uniparental inheritance (DUI) for mitochondrial genes provides an opportunity to compare population structure of gene-lineages inherited either mother-to-daughter or father-to-son. We contrast these lineages using a fragment of CO1 in a common species *Lampsilis siliquoidea* (sometimes called *Lampsilis radiata luteola*) in the Lake Erie, Ohio River, and upper Mississippi River watersheds. The goal was first to compare genetic variation against abundance across diverse unionids where information is available, and second to assess genetic isolation across watersheds. *Lampsilis siliquoidea* showed a level of variation (i.e., 25 F-haplotypes) that is similar to that of other common species in the region: Elderkin *et al.* (2008) found 38 haplotypes for *Elliptio dilatata*, of which 25 are the geographic region examined here, and 72 haplotypes for *Actinonaias ligamentina* over a broad region;

Doucet-Beaupré *et al.* (2012) reported over 100 haplotypes among *Pyganodon grandis*, but the study areas only partially overlapped. By contrast *Fusconaia flava*, which is widely dispersed but often of low abundance, had just 13 haplotypes (Burdick & White, 2007). For a rare species, Zanatta & Wilson (2010) had to apply microsatellite variation in the federally endangered *Epioblasma triquetra*, because mtDNA variation was very low. These female lineages tended to exhibit extensive population structure even when there was little phylogenetic diversity. However, an unexpected observation was that even with complex phylogenetic structure in M-haplotypes of *L. siliquoidea*, almost no geographic pattern within haplotypes was found, a result concordant to the allozyme results of Berg et al. (2007). The implications to rare species from male mtDNA variation are that much of the historical genetic variation may still be recovered from the few extant populations if they can soon be expanded. krebs.r@gmail.com

Platform 57 **11:20 a.m.** **March 12, 2013**	**A COMPARISON OF GENETIC DIVERSITY BETWEEN SYMPATRIC POPULATIONS OF THE ENDANGERED WINGED MAPLELEAF (*QUADRULA FRAGOSA*) AND THE NOT-SO-ENDANGERED PIMPLEBACK (*QUADRULA PUSTULOSA*) IN THE ST. CROIX RIVER, USA**. Kevin Roe[1], Sara Boyer[2]. [1]Department of Natural Resource Ecology and Management, Iowa State University, Ames, IA; [2]Biology Department, Macalester College, Saint Paul, MN.

Robust estimation of population genetic parameters for species of freshwater mussels has become more common with the development and implementation of microsatellite markers and non-destructive methods of sampling. Comparisons of these parameters between imperiled and non-imperiled species are often complicated by confounding evolutionary and/or environmental factors that sometimes may preclude characterization of what a "typical" population looks like from a genetic perspective. Such characterizations may be useful because recovery plans for imperiled species often include goals for maintaining a certain number of populations, but do not include goals for what these populations should look like genetically. By comparing endangered species to closely related sympatric common species we may be able to develop targets for what a recovered endangered species looks like. For this study we compared sympatric populations of two species, *Quadrula fragosa* and *Quadrula pustulosa* using standard genetic parameters such as allelic richness, inbreeding coefficient, and effective population size. We hypothesized that because of its status as an endangered species, *Q. fragosa* would exhibit values for these measures that were typical of a smaller, less genetically diverse population than the non-imperiled *Q. pustulosa*. The results of the study will be presented and the implications for the conservation and management of freshwater mussels will be discussed. kjroe@iastate.edu

Platform 58 **11:40 a.m.** **March 12, 2013**	**GENETIC STRUCTURE AND INTRASPECIFIC PHYLOGEOGRAPHY OF THREE REPRODUCING POPULATIONS OF THE CLUBSHELL MUSSEL (*PLEUROBEMA CLAVA*).** Kody Kuehnl[1,2], Michael Sovic[2]. [1]Department of Social and Natural Sciences, Franklin University, Columbus, OH; [1]Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, OH.

The clubshell (*Pleurobema clava*) is a critically endangered species of freshwater mussel and is in need of conservation throughout its range. Presently, the most stable and viably reproducing populations appear to occur in drainages north of the Ohio River making these populations of essential conservation interest as they represent potential broodstock for augmenting populations of clubshell that are small, no longer reproducing, or extirpated. We expand on previous genetic work by comparing the utility of 6 nuclear microsatellite loci and two mtDNA genes (CO1, ND1) for discriminating between three of the largest remaining reproducing populations of clubshell collected from the Alleghany River, PA; East Branch West Fork St. Joseph River, MI; and Little Darby Creek, OH. Mitochondrial data were not found to indicate significant geographic structure. However, analyses of microsatellite allelic data suggest substantial population structure that may be important when making conservation oriented decisions. kody.kuehnl@franklin.edu

SESSION 13	**SURVEY & MONITORING III** **Tuesday, March 12, 2013 | 1:20-2:40 p.m.** **Camellia Room**
Platform 59 **1:20 p.m.** **March 12, 2013**	**LONG-TERM MONITORING OF SIX MUSSEL BEDS IN POOL 14, MISSISSIPPI RIVER.** Heidi Dunn[1], John Petro[2]. [1]Ecological Specialists, Inc., O'Fallon, MO; [2]Exelon Generation Company, LLC, Warrenville, IL.

Unionid mussel beds occur in stable habitat areas within the Mississippi River. Sampling within these beds is most frequently a one-time event that only provides a snap shot of community characteristics. Since unionids are long-lived animals, only through long-term monitoring can community metrics and variability with these metrics be defined. In 2004 through 2008, six unionid beds within Pool 14 of the Mississippi River between river miles 495.4 and 515.0 were identified and sampled using quantitative (90, 0.25m^2

samples) and qualitative methods (25, 5-minute spot dives). Three unionid beds (Wapsi, SS, Cordova beds) were sampled in 2004 through 2008, and three additional beds (Albany, Hansons Slough, and Woodward Grove beds) were sampled in 2007 and 2008. These beds represented a variety of habitats (channel border, side channel) and impacts (zebra mussels, thermal effluent). Species and subfamily relative abundance, age structure, species richness, and mortality varied among beds. *Amblema plicata* dominated Albany and Cordova, *Quadrula pustulosa* dominated Hansons Slough, *Obliquaria reflexa* dominated Wapsi bed, *Quadrula quadrula* dominated Woodwards Grove, and *Amblema plicata* and *Obliquaria reflexa* dominated SS bed. Density averaged 4.4 to 10.5 unionids/m^2. Species richness per year averaged 16.3 to 23.5 species. Recruitment (%≤5 years old) averaged 25 to 43% among beds, and differed as much as 40% within a bed over time. Mortality was generally <10%, but was as high as 24% following high zebra mussel infestation. Results of long-term monitoring suggest that mussel community metrics and species composition can vary with habitat conditions within a short river reach. HDunn@ecologicalspecialists.com

Platform 60 **1:40 p.m.** **March 12, 2013**	**A MUSSEL COMMUNITY ASSESSMENT TOOL FOR THE UPPER MISSISSIPPI RIVER.** Heidi Dunn[1], Steve Zigler[2], Teresa Newton[2]. [1]Ecological Specialists, Inc., O'Fallon, MO; [2]US Geological Survey, Upper Midwest Environmental Sciences Center, LaCrosse, WI.

Managers in the Upper Mississippi River (UMR) need a quantitative means of evaluating the relative health or value of a mussel bed for identifying and preserving mussel resources, assessing anthropogenic impacts, assessing the efficacy of restoration techniques, and other regulatory tasks. We evaluated a series of statistically derived curves that plot the frequency distribution of different mussel metrics representing the categories conservation status/sensitivity, taxonomic composition, population processes, abundance, and diversity. Multiple metrics in each category were calculated using existing quantitative data from 25 surveys that spanned low to high quality mussel communities over a 925 km reach of the UMR. Metrics in each category were evaluated for range, ecological significance, sampling bias, and redundancy. Of the 50 metrics initially evaluated, 10 were selected (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 quartile, species evenness, tribe level evenness, and rarefaction species richness) for further analysis. Frequency distributions of these metrics were plotted using the 25 test data sets. Distributions were divided into good, fair, and poor categories based largely on quartile analysis. Scoring categories assumed that a healthy freshwater mussel community consists of species with a variety of reproductive and life history strategies, a low percentage of tolerant species and a high percentage of sensitive species, evidence of recruitment and diverse age classes, low mortality, high density, and high species richness and evenness. These data provide a preliminary range of values for the selected metrics within the UMR. Although data gaps exist, testing with additional data sets is needed, and some categories need refining with additional data. However, the selected metrics appear to provide a much needed tool to assess mussel communities in the UMR. HDunn@ecologicalspecialists.com

Platform 61 **2:00 p.m.** **March 12, 2013**	**UNIONID COMMUNITY OF SOUTHERN LAKE ONTARIO: LOCATING EXISTING REFUGES AND ASSESSING DREISSENID IMPACTS.** Lyubov Burlakova[1], Alexander Karatayev[1], Jonathan Bossenbroek[2], David Zanatta[3], Brianne Tulumello[1], Robert Krebs[4], Wendy Paterson[3], Traci Griffith[3]. [1]Buffalo State College, Great Lakes Center, Buffalo, NY; [2]Department of Environmental Sciences, Lake Erie Center, University of Toledo, Oregon, OH; [3]Biology Department, Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI; [4]Kent State University, Department of Biological Sciences, Kent, OH.

The invasion of zebra mussels (*Dreissena polymorpha*) and quagga mussels (*Dreissena rostriformis bugensis*) has threatened survival of native unionid mussels in the Great Lakes. While live mussels were reported from several refuges in lakes Erie and St. Clair, no data existed on unionid distribution and diversity in southern Lake Ontario after dreissenid invasion. Using funding from the Great Lakes Fish and Wildlife Restoration Act we produced a model to predict potential unionid refuges based on extensive unionid surveys in Lakes Erie and St. Clair. We used Maxent and environmental GIS layers of the near shore areas of Lake Erie to predict potential habitat of unionids in Lake Ontario. In summer 2012 we surveyed a total of 46 sites at 26 locations in Lake Ontario bays, coastal wetlands, and tributary mouths and collected over 1800 live unionids belonging to 10 species. We found that the model successfully predicted many unionid refuges in Lake Ontario. Most of the live unionids found during our study in the lower Great Lakes were free of dreissenids, and infested unionids had few attached dreissenid mussels. These results are encouraging given the high infestation rate of unionids shortly after the dreissenid invasion. This approach will be extended to develop predictive models of refuges in Lakes Michigan and Huron, and used in designing management strategies to provide additional unionid habitats. burlakle@buffalostate.edu

Platform 62 **2:20 p.m.** **March 12, 2013**	**REASSESSMENT OF THE REMNANT UNIONID COMMUNITY IN LAKE ERIE AND LAKE ST. CLAIR, 25 YEARS AFTER THE DREISSENID INVASION.** David Zanatta[1], John Bateman[2], Jonathan Bossenbroek[3], Lyubov Burlakova[4], Todd Crail[3], Ferenc de Szalay[5], Traci Griffith[1], Doug Kapusinski[5], Alexander Karatayev[4], Robert Krebs[6], Gary Longton[2], Elizabeth Meyer[7], Wendy Paterson[1], Trevor Prescott[6], Matthew Rowe[1], Donald Schloesser[8], Matthew Shackelford[2], Mary Walsh[7]. [1]Central Michigan University, Biology Department, Institute for Great Lakes Research, Mount Pleasant, MI; [2]DTE Energy Corporate Services LLC, Detroit, MI; [3]Department of Environmental Sciences, Lake Erie Center, University of Toledo, Oregon, OH; [4]Great Lakes Center, Buffalo State College, Buffalo, NY; [5]Kent State University, Department of Biological Sciences, Kent, OH; [6]Department of BGES, Cleveland State University, Cleveland OH; [7]Pennsylvania Natural Heritage Program, Western Pennsylvania Conservancy, Hollidaysburg, PA; [8]US Geological Survey, Great Lakes Science Center, Ann Arbor, MI.

The invasions of Ponto-Caspian dreissenid mussels (zebra mussels and quagga mussels) have caused massive change to the Great Lakes ecosystem. Among their more prominent and well documents effects was on the diversity and abundance of native unionid mussels in Lake Erie and Lake St. Clair. With support of funding from the Great Lakes Fish and Wildlife Restoration Act, our group conducted extensive surveys of known and potential unionid refugia from dreissenid mussels. Over the summers of 2011 and 2012, we visited 46 discrete locations with replicate samples at each for a total of 139 sites in bays, coastal wetlands, and drowned river mouths on the U.S. side of Lake Erie and Lake St. Clair. Using an identical sampling regime at each site, a timed survey within a 0.5 ha area was searched for 2 person-hours with SCUBA, snorkeling, wading, and/or raking. We recorded species presence, abundance and lengths, water depth, soft substrate depth and type, and several water chemistry variables. Twenty-three 23 species and 1923 live unionids were documented from these lakes. While species assemblages have shown major shifts and several rare species have probably been extirpated based on data available prior to the dreissenid invasion, these findings are especially encouraging that mussels survived, particularly given that surveys shortly after the dreissenid invasion pointed toward total extirpation of the unionid fauna. Our continuing research will prioritize areas for continued management and monitoring. zanat1d@cmich.edu

SESSION 14	**PROPAGATION & CULTURE I** **Tuesday, March 12, 2013 | 1:20-2:40 p.m.** **Goldenrod Room**
Platform 63 **1:20 p.m.** **March 12, 2013**	**REARING AND CULTURING ACTIVITIES FOR *MARGARITIFERA MARGARITIFERA* IN EUROPE.** Frankie Thielen[1], Michael Lange[2], Jurgen Geist[3]; [1] natur & ëmwelt / Fondation Hëllef fir d'Natur, Heinerscheid, Luxembourg; [2]PLD Vogtland, Plauen, Germany; [3]Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technische Universität München, Freising, Germany.

All over Europe, the Freshwater Pearl Mussel (*Margaritifera margaritifera*) shows a dramatic decline in most of its populations. They consist predominantly of adult specimens and have not shown recruitment for many years. In many European countries, national, international and EC (European Commission) funded conservation programs have started and most of them include captive breeding as a last-minute rescue tool in order to retain the evolutionary potential of local populations. Compared to the USA, culturing freshwater mussels for conservation issues is quite new in Europe. Nevertheless, in 14 European countries, reaching from Portugal in the south to Norway in the north, captive breeding programs have been started, completed or are still running at the moment. This presentation gives an overview of the breeding programs in the different countries, highlighting the advantages and disadvantages of the various methods used. In most cases, glochidia are harvested from adult mussels in the wild to carry out laboratory-based infection of brown trout (*Salmo trutta*) which are maintained in aquaculture facilities. After approximately 2500 day degrees, juvenile mussels are harvested by increasing temperature. In a next step, juveniles are most often kept for several months under controlled laboratory conditions until they reach a lengths of 1 mm. Subsequently, in many countries, the juvenile mussels are transferred into "hole-cages" which are installed in the natural habitat. Also, semi-natural methods such as the direct release of infested fish or more labour-intensive methods have been tested. Whilst captive breeding provides opportunities for better understanding the autecological requirements of the juvenile stages of freshwater pearl mussel and whilst this method is suitable for providing sufficient numbers of juveniles for stocking and bioindication testing, it cannot replace the restoration of functional stream habitats. f.thielen@naturemwelt.lu

Platform 64 **1:40 p.m.** **March 12, 2013**	**ASSESSMENT OF IN VITRO MUSSEL CULTURE WITH ESTIMATES OF PRODUCTION POTENTIAL.** Chris Owen, Monte McGregor, Andy McDonald, David Cravens, Adam Shepard, Fritz Vorisek, Travis Bailey. Center for Mollusk Conservation, Kentucky Department of Fish and Wildlife Resources, Frankfort, KY.

In vitro mussel culture is a method used to develop glochidia into newly metamorphosed pediveligers. Glochidia develop using basal cell culture media, animal sera and various nutritional and antibiotic additives, thereby bypassing the host fish altogether. Considerable research has gone into testing various media components, including basal media, serum source, lipids, cholesterol, amino acids, vitamins and sugar sources. Additional work has been done to test various combinations of antibacterial and antimycotic agents for controlling fungal and bacterial contamination. Over the course of this research, 36 species of North American unionid species have been show to successfully metamorphose *in vitro*. Testing with multiple unionid tribes and brooding strategies indicates general success with most mussels. The only group of mussels to not metamorphose *in vitro* are species that grow during metamorphosis. While many species were confirmed to metamorphose *in vitro*, research was not conducted to assess their growth and survival post-metamorphosis. Two large scale cultures were produced *in vitro* using the Plain Pocketbook (*Lampsilis cardium*) and the Wavyrayed Lampmussel (*Lampsilis fasciola*). Total number of viable larvae, percent metamorphosis, number of pediveligers and number of juveniles were estimated. Length – weight regressions were also recorded. Approximately ~144,000 glochidia were recovered from one female *L. cardium*. Of those ~128,000 were viable (89%), and after 15 days *in vitro*, the number of newly metamorphosed pediveligers was ~113,152 (88%). After 100 days, an estimated 13,560 individuals remain, ranging from 2.8 mm to 1 cm. Approximately ~63,500 glochidia were recovered from one female *L. fasciola*. Of those ~52,500 were viable (83%), and after 18 days *in vitro*, the number of newly metamorphosed pediveligers was ~50,400 (96%). After 100 days, an estimated 7,232 individuals remain, ranging from 3 mm to 1.1 cm. Overall survival at 100 days was 9.4% for *L. cardium* and 11.4% for *L. fasciola.*
christopher.owen@ky.gov

Platform 65 **2:00 p.m.** **March 12, 2013**	**MULTIPLE USES FOR THE GENOA NATIONAL FISH HATCHERY STREAMSIDE MUSSEL REARING TRAILER.** Jorge Buening, Nathan Eckert. US Fish and Wildlife Service, Genoa National Fish Hatchery, Genoa, WI.

In response to the threat posed by exotic species and the variability associated with cage production in the Mississippi River Basin, the Genoa National Fish Hatchery (GNFH) has begun incorporating a streamside rearing facility into their freshwater mussel production strategies. The Mobile Aquatic Rearing Station (MARS) is a 20' cargo trailer which has been outfitted as a mobile flow-through culture unit. Water can be pumped from a wild source, filtered, passed through mussel tanks, and returned to the source. For the previous trials the MARS has been placed along the Mississippi River at Blackhawk Park near De Soto, WI. Substantial growth in juvenile mussels at or past their second growing season has been observed each year the trailer has been operational. Survival for sub-adult individuals has been greater than 90% during this time. This season three species of newly metamorphosed juveniles were recovered after growing throughout the summer. An experiment was also conducted comparing survival of newly metamorphosed juveniles in GNFH well water, GNFH pond water, and Mississippi River water via the MARS trailer. Preliminary results indicate a higher survival in the river water. The MARS trailer can also be used as a quarantine facility for potential host fish and genetically diverse brood fish during the disease certification process to assure that no pathogens are introduced to the hatchery.
Jorge_Buening@fws.gov

Platform 66 **2:20 p.m.** **March 12, 2013**	**EVALUATING FLOATING CAGES IN PONDS AS A POTENTIAL LOW-INPUT, HIGH-YIELD METHOD FOR CULTURING FRESHWATER MUSSELS.** Chris Eads, Luke Borst, Jennifer Hurley-Sanders, Jay Levine. North Carolina State University, College of Veterinary Medicine, Aquatic Epidemiology and Conservation Laboratory, Raleigh, NC.

Caging fish infected with freshwater mussel glochidia in ponds or lakes is a method of culturing mussels that requires relatively little effort but can yield favorable survival and growth in the right setting. After the juvenile mussels drop off the fish into the sand at the bottom of the cage, the fish are removed, and the cage is left in place for the duration of the growing season. We evaluated this method for mussel propagation in 11 different ponds ranging in size from 0.03 to 12.1 hectares with 7 different mussel species across a range of taxa and habitat preferences. Estimated survival in individual cages ranged from 0.0 to 41.1%, with marked differences between species and ponds. Mean length of mussels in the most productive ponds after one growing season (May-October) ranged from 15.1 ± 1.8 mm (*Fusconaia masoni*) to 41.5 ± 3.4 mm (*Lampsilis radiata*). *Lampsilis*

cariosa became reproductively mature and spawned at the end of two growing seasons (18 months old). We monitored temperature and other water quality parameters in each of these ponds and found that larger systems that were not overly eutrophic yielded the greatest survival and growth. This method could be used by government agencies in the absence of a dedicated mussel propagation facility or to supplement production by such a facility. Because so little time and resources are involved, potential exists to enlist volunteers, such as schools, environmental education centers or conservation groups in the propagation of freshwater mussels. Chris_Eads@ncsu.edu

SESSION 15	HISTOLOGY & PARASITOLOGY II Tuesday, March 12, 2013 | 3:20-5:00 p.m. Camellia Room
Platform 67 3:20 p.m. March 12, 2013	**TREMATODE PARASITE *PROSORHYNCHOIDES PUSILLA*: OCCURRENCE, LIFE CYCLE AND EFFECT ON REPRODUCTION OF UNIONIDS IN BATTLE RIVER, ALBERTA, CANADA.** Jouni Taskinen; University of Jyväskylä, Department of Biological and Environmental Science, Finland.

Trematode parasites of the family Bucephalidae, using unionid mussels as their 1st intermediate hosts, are known to decrease the reproductive output, or totally strerilize their mussel hosts. The objective of this study was to determine the occurrence of trematode parasites, their life cycles and their effects on reproduction of unionids of the Battle River, Alberta. Mussels (n=1,604) were collected by hand picking and quadrat-excavation from seven locations along a 27 km stretch of the river in May-October, 1993. Their gonads were examined microscopically for trematodes and gills for glochidia larvae. Fish were captured from Battle River and North Saskatchewan River and examined for bucephalids. Four unionid species were found (proportions of total catch in parentheses): *Lampsilis radiata siliquioidea* (54%), *Lasmigona complanata* (37%), *Lasmigona compressa* (0.5%) and *Pyganodon grandis grandis* (9%). Infection by the bucephalid trematode *Prosorhynchoides pusilla* was observed in 4.6, 3.2, 0.0 and 16.3% of the mussels respectively. Metacercariae of *P. pusilla* were observed in tissues of longnose dace and adult worms in gut of walleye. *L. radiata siliquioidea* beared glochidia seasonally throughout May-October except for early July. *Lasmigona complanata* and *P. grandis grandis* had glochidia only in autumn, September-October. Age at maturity was 4 years for all of the three species. The youngest age groups infected by *P. pusilla*, respectively, were 4, 7 and 2 years. Negative effect of *P. pusilla* infection on reproduction was evident in all mussel species. 58% of uninfected *Lampsilis radiata siliquioidea* (n=691) had glochidia while only 8% of infected mussels (n=36) were reproductive. In *Lasmigona complanata* the respective values were 42% (n=310) and 0% (n=8). For *P. grandis grandis* the figures were 33% (n=39) and 0% (n=10), respectively. Thus, in accordance with earlier results on budcephalid trematodes, *P. pusilla* can potentially harm its unionid mussel hosts by blocking their reproduction. jouni.k.taskinen@jyu.fi

Platform 68 3:40 p.m. March 12, 2013	**EXOTIC SNAIL SPECIES IN *SCHISTOSOMA* ENDEMIC AREAS OF NIGERIA.** Oyetunde Salawu[1,2], Alexander Odaibo[1]. [1]Parasitology Research Unit, Department of Zoology, University of Ibadan, Nigeria; [2]Department of Biosciences and Biotechnology, Babcock University, Ilishan-Remo, Nigeria.

The endemicity of schistosomiasis depends to a large extent on the presence of appropriate freshwater snail species with latent infection, and the quality of the microhabitat of the snails may favour or hinder their development and growth. This study evaluates the distribution of freshwater snails in *Schistosoma* endemic communities of Nigeria and the water quality of the snails' microhabitat. Monthly *in situ* determinations of water temperature, pH, total dissolved solid (TDS), conductivity and dissolved oxygen were carried out. Monthly sampling of snails was also conducted. Fifteen species of snails belonging to six orders and eight families were recovered from the water bodies. Of these, three species including *Bulinus camerunensis, B. jousseaumei* and *Sierraia whitei* were reported for the first time in Nigeria freshwater bodies. The relationships between freshwater snail fauna and the physico-chemical parameters of the river bodies varied with the species of the snails. There were significant positive relationships between water temperature and *B. globosus/Gyraulus costulatus,* dissolved oxygen and *Lanistes lybicus/Ferrissia* sp. ($P<0.05$). Significant negative relationship however occurred between TDS and abundance of *L. lybiscus* ($P<0.05$). None of the *B. globosus* examined shed cercariae, while 12.5% of *B. jousseaumei* shed cercariae. The occurrence of *B. jousseaumei* in this study proves its presence in Nigeria and suggests its combined roles with *B. globosus* in the transmission of urogenital schistosomiasis, thus increase the risk of disease in the endemic communities in Nigeria. Further studies on the geographical distribution of *B. jousseaumei* and origin of other exotic freshwater snail species are recommended. zootund@yahoo.com

Platform 69 **4:00 p.m.** **March 12, 2013**	**EFFECTS OF COAL PARTICLES IN AQUATIC SEDIMENTS ON ORGAN TISSUES OF RAINBOW MUSSELS, *VILLOSA IRIS*.** William Henley, Nels Johnson[2], Serena Ciparis[1], Shane Hanlon[3], Douglas Heffinger[3]. [1]Freshwater Mollusk Conservation Center, Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [2]Department of Statistics, Virginia Tech, Blacksburg, VA; [3]Southwestern Virginia Field Office, U.S. Fish and Wildlife Service, Abingdon, VA.

Two laboratory studies were conducted to determine the effects of coal particles in aquatic sediments on mortality and organ tissues of rainbow mussels, *Villosa iris* (Lea, 1929). First, mortality was assessed using treatments comprised of sand substrates with different percentages of pulverized coal, including 0%, 10%, 25%, and 50%. At the end of the 7-wk experiment, there were no significant differences in mortalities of *V. iris* among substrate treatments. Second, the histological effects of coal particles in substrate on organ tissues of *V. iris*, including gills, digestive glands, kidneys, and gonads, were assessed. Two sand substrates, containing 0% coal (control) and 50% coal (treatment), were tested. Organ tissues of five mussels from each of the treatment and control tanks were collected at 8, 16, and 20 wk. Sublethal alterations in organ tissues of coal-exposed mussels were observed. Fractions of gill filament termini without cilia and digestive gland cells with reduced cytoplasm were significantly greater compared to control mussels. Females from the coal treatment showed significantly higher fractions of acini containing resorbing oocytes than control females. Significantly higher fractions of lipofuscin in kidney diverticula of the coal-exposed mussels suggested that unidentified contaminants were present in the water. Further study of the effects of these contaminants on freshwater mussels are warranted given the co-occurrence of declining mussel populations and coal mining and processing operations in several Appalachian watersheds. whenley@vt.edu

Platform 70 **4:20 p.m.** **March 12, 2013**	**QUANTIFYING EFFECTS OF TEMPERATURE ON RESPIRATION OF SELECTED MUSSEL HOST FISH FROM THE TENNESSEE AND MOBILE RIVER BASINS.** Nathan Hartline, Dennis DeVries, Russell Wright, Department of Fisheries and Allied Aquacultures, Auburn University, AL.

Many freshwater mussels require specific host fish species to complete the parasitic portion of their complex life cycle. Despite this we know little about the abiotic requirements of many host fishes, likely because they are typically non-game species that have received far less research attention. Here we are using respirometry to quantify the influence of two abiotic factors as potential stressors on host fishes: temperature and dissolved oxygen. We are using respirometry to determine routine metabolic rates and the critical oxygen tension (dissolved oxygen concentration below which fish are unable to maintain basal respiration rate) of 10 fish species, 5 from the Tennessee River Basin (Greenside Darter, *Etheostoma blennoides*, Fantail Darter, *Etheostoma flabellare*, Log Perch, *Percina caprodes*, Scarlet Shiner, *Lythrurus fasciolaris*, and Banded Sculpin, *Cottus carolinae*) and 5 from the Mobile River Basin (Blackbanded Darter, *Percina nigrofasciata*, Bronze Darter, *Percina palmaris*, Greenbreast Darter, *Etheostoma jordoni*, Blacktail Shiner, *Cyprinella venusta*, and Redeye Bass, *Micropterus coosae)*. Combining intermittent flow with static respirometry allows us to measure oxygen consumption as a function of dissolved oxygen concentration, as well as the critical oxygen tensions, at three different temperatures (20°, 25°, and 30°). Results from this research will allow us to derive the functional relationships of respiration with body size, temperature, and dissolved oxygen for these species. These functions are critical to the determination of water quality standards (i.e. in the tailrace of hydropower facilities). Runs with Largemouth Bass, *Micropterus salmoides*, demonstrate that the techniques are appropriate, and preliminary results from several non-game host species will be presented.
devridr@auburn.edu

Platform 71 **4:40 p.m.** **March 12, 2013**	**THE EFFECTS OF INCREASING POPULATION SIZE OF ASIATIC CLAM, *CORBICULA FLUMINEA*, ON PREDATION BY AN OMNIVOROUS TURTLE, *STERNOTHERUS ODORATUS*.** Caitlin Wilhelm[1], Mike Plummer[2], Chris Barnhart[1]. [1]Missouri State University, Biology Department, Springfield, MO; [2]Harding University, Department of Biology, Searcy, AR. *STUDENT PRESENTATION*

Since its introduction to the United States, the Asiatic clam, *Corbicula fluminea*, has become a dominant species in many benthic communities. The introduction of *C. fluminea* is thought to influence many ecosystem dynamics including nutrient cycles and energy flow, macroinvertebrate community composition, and predator-prey interactions throughout the food chain. For example, a shift in dietary preference to feeding more heavily on invasive clams and mussels (*Corbicula, Dreissena*) has been well documented for molluscivorous turtles (*Graptemys spp., Sternotherus minor*). In the summer of 2010, we studied the benthic macroinvertebrate composition of Gin Creek, a small urban stream located in Searcy, Arkansas. We found *C. fluminea* to be the most abundant macroinvertebrate in the benthos. In 36 substrate samples, *C. fluminea* density ranged from 0–3,453 clams m^{-2} and constituted >90% of all macroinvertebrates by volume and dry mass. As a result of the large population size of *C. fluminea*, we also observed an apparent dietary shift toward molluscivory in the omnivorous musk turtle, *Sternotherus odoratus*, which was found to prey heavily on *C. fluminea* in Gin Creek. In addition, we found that sex

significantly influenced the tendency toward molluscivory with females consuming 34× more *C. fluminea* by volume than males. Preliminary results also show this dietary shift may be accompanied by changes in head morphology in this population of *S. odoratus*.
Wilhelm211@live.missouristate.edu

SESSION 16	PROPAGATION & CULTURE II Tuesday, March 12, 2013 | 3:20-5:00 p.m. Goldenrod Room
Platform 72 **3:20 p.m.** **March 12, 2013**	**PROPAGATION AND CAPTIVE CULTURE OF WESTERN PEARLSHELL, *MARGARITIFERA FALCATA*.** Beth Glidewell[1], Chris Barnhart[1], Jeanette Howard[2], Chris Ingersoll[3], Ning Wang[3]. [1]Missouri State University, Biology Department, Springfield, MO; [2]The Nature Conservancy, California, CA; [3]US Geological Survey, Columbia Environmental Research Center, Columbia, MO. *STUDENT PRESENTATION*

We report the successful propagation and culture of *M. falcata* for toxicology. Brooding females were collected on May 1 and May 6, 2012 from the South Fork Eel River, Mendocino County CA. Field water temperature was 9-13°C. The females were shipped in chilled source water to MSU, transferred to reconstituted water, matched for pH and hardness, and held in a refrigerated recirculating system at 11°C. No conglutinate release occurred during shipment. Brooded eggs sampled on May 2 contained unshelled embryos. Conglutinates with mature glochidia were released from both groups of mussels beginning on May 9. Rainbow trout were inoculated with glochidia suspensions on May 10 and held at 11 °C for 1 week, 13°C for 2 weeks and 15°C thereafter. Active juveniles were recovered beginning on June 9 and were cultured similar to methods used successfully for European *M. margaritifera*. Up to several hundred juveniles each were placed 1-L plastic boxes with 20mL sieved fresh sediment (<150 µm) and 500mL water (~5cm deep, with no aeration, ~20C). Culture sediment was obtained from a marsh and had high organic content. Water was river water with commercial microalgae added to ~2 ppm by volume. Juveniles were monitored weekly by sieving and then returned to fresh sediment and water with algae. No other supplemental feeding was provided. Other juveniles were reared in sediment-free downwellers (mucket buckets). The downweller cultures were terminated after 3 weeks because of damaged shells and low survival. Monthly survival rate in marsh sediment was 75% for the 1st month, 84% for the 2nd month, and > 80% for the 3rd and 4th months. Control survival in other sediments during 28-day toxicity tests ranged from 83-95%. Mean length increased linearly, and reached approximately 1mm at 12 weeks. We plan to culture a second cohort of *M. falcata* in 2013.
glidewell005@live.missouristate.edu

Platform 73 **3:40 p.m.** **March 12, 2013**	**EFFECTS OF GLOCHIDIA AGE ON JUVENILE CONDITION IN FRESHWATER MUSSELS.** Amy Maynard, Rowena Woode, Chris Barnhart. Missouri State University, Biology Department, Springfield, MO. *STUDENT PRESENTATION*

The brooding period of glochidia of *Lampsilis* can be extended to well over a year by holding females at low temperature (10° C), providing great flexibility in timing of captive propagation. An important question is whether aging of the glochidia affects the quality of the juveniles that develop from those larvae. Previous studies indicate that immature glochidia yield poor juvenile survival. We compared juveniles of fatmucket (*Lampsilis siliquoidea*) derived from mature glochidia differing in age by 1 year. We measured larval viability, attachment success, and metamorphosis success on host fish (*Micropterus salmoides*). We then observed the time to 50% mortality (LT50) of the newly metamorphosed juveniles during starvation as a measure of their condition. Two experiments were performed, each with 3 young (4 or 6 mo) and 3 old (16 or 18 mo) broods. In experiment #1 the juveniles were tested in water only. In experiment #2 they were tested in water and in 6 concentrations of NaCl as a stressor. In both experiments, young and old viable larvae were equally able to attach to the host, but old larvae were less likely to successfully metamorphose. In experiment #1, LT50 of starved juveniles was similar at 26 days for juveniles from both 6-mo and 18-mo old larvae. In experiment #2, LT50 in water only was 26 and 24 days for juveniles from 4-mo old and 16-mo old larvae, respectively. The 21-day LC50 of NaCl was 5.5 g/L for juveniles from 4-mo old larvae and 4.5 g/L for juveniles from 16-mo old larvae. These differences were statistically significant. Interestingly, NaCl lengthened juvenile survival in starvation at concentrations less than 4.5 g/L and shortened survival at higher levels. These data suggest that aging of *Lampsilis* glochidia over 1 year has minor effects on juvenile quality for propagation and toxicity testing. cravens212@live.missouristate.edu

Platform 74 **4:00 p.m.** **March 12, 2013**	**IS GLOCHIDIA VIABILITY INDICATIVE OF INFECTIVITY, THE ABILITY TO ATTACH AND METAMORPHOSE?** Robert Bringolf[1], Andrea Fritts[1], Chris Barnhart[2], Gregory Cope[3]. [1] University of Georgia, Warnell School of Forestry & Natural Resources, Athens, GA; [2] Missouri State University, Biology Department, Springfield, MO; [3] North Carolina State University, Department of Environmental and Molecular Toxicology, Raleigh, NC.

Freshwater mussels have a remarkable life cycle in which glochidia must attach to a fish host to metamorphose into the juvenile stage. Glochidia close in response to sodium chloride solution, and this closing response is widely used as a measure of viability to determine if glochidia are suitable for host fish suitability trials and as an endpoint for standard toxicity tests. We tested the assumption that glochidia viability, measured by the closing response to sodium chloride, is indicative of infectivity, the ability of glochidia to attach to a host fish and successfully metamorphose to the juvenile stage. We compared the durations of glochidia viability and infectivity in water for seven mussel species. Viability and infectivity were similar between 0 and 24 hours. However, infectivity of glochidia in water decreased rapidly after 24 h even when viability remained relatively high. The duration of viability and infectivity for glochidia of *P. occidentalis* was shorter in river water with sediment compared to reconstituted water. *Ptychobranchus occidentalis* releases membrane-bound conglutinates containing the glochidia. Glochidia in conglutinates remained infective longer indicating that conglutinates may provide protection from the external environment for at least four days. We also compared the viability and metamorphosis success of three mussel species after 24 h exposure to a toxicant (sodium chloride or copper). Viability decreased but metamorphosis success did not differ among the concentrations of toxicants. These results imply that the decrease in glochidia reproductive potential after exposure to a toxicant is attributed to a smaller number of glochidia that are open and able to attach to a host, rather than a decrease in metamorphosis success. Our results indicate that glochidia viability is a valid proxy for infectivity and an ecologically relevant endpoint for standard toxicity tests with freshwater mussels when conducted with a maximum test duration of 24 h. bringo@uga.edu

Platform 75 **4:20 p.m.** **March 12, 2013**	**PARTICLE SIZE, CAPTURE EFFICIENCY AND CLEARANCE RATES BY JUVENILE UNIONID MUSSELS.** Madeline Pletta, Chris Barnhart. Missouri State University, Biology Department, Springfield, MO. *STUDENT PRESENTATION*

The body size of unionid mussels can span 3-9 orders of magnitude between juvenile and adult, yet all free-living life stages appear to feed by similar mechanisms on suspended particles. We are examining the filter-feeding of juvenile mussels to investigate changes during growth and development and to compare different taxa. Allometric effects suggest that small juveniles could exhibit over 100 times higher feeding rates than adults. Previous studies found that unionids capture small (bacteria-size) particles less efficiently than larger ones, and that lake-dwelling unionids are generally less efficient at small particle capture than riverine species. Few data are available to show possible effects of body size on clearance rate and capture efficiency. We are using a coulometric particle counter and sizer to compare clearance by juveniles of different species. This approach allows simultaneous comparisons of capture efficiency versus particle size. Food suspensions were spiked with polystyrene microbeads to increase concentration in selected size classes. Preliminary tests with 1.5-cm long washboard (*Megalonaias nervosa*) showed that capture efficiency of 1-µm and 2-µm particles was 35% and 90%, respectively, relative to capture of 4-µm particles. Capture efficiency of 7.5-mm pink mucket (*Lampsilis abrupta*) was less affected by particle size, and was 58% and 97%, respectively, for 1-µm and 2-µm particles compared to capture of 4-µm particles. Clearance rate of 2-µm particles by 7.5 mm pink mucket was approximately 8L•gram dry tissue^{-1}•hour^{-1} at 25C. This result matches the clearance rate of 2-µm particles previously reported for adult *Dreissena* and exceeds that of adult *Toxolasma* by 100X. We hope that these investigations will improve understanding of the feeding ecology of different life stages and taxa of native mussels. pletta8@live.missouristate.edu

Platform 76 **4:40 p.m.** **March 12, 2013**	**USE OF GILL EXCISION TO IDENTIFY HOST FISHES FOR ELLIPTIO CRASSIDENS.** Michael Hart[1], James Stoeckel[1], Wendell Haag[2]. [1]Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, AL; [2]USDA Forest Service, Southern Research Station, Center for Bottomland Hardwoods Research, Oxford, MS.

Stream impoundment has significantly reduced or eliminated populations of migratory fish species such as skipjack herring (*Alosa chrysochloris*) and Alabama shad (*A. alabamae*). These fishes are suspected to be important hosts for several mussel species which also have declined in impounded streams. However, these relationships have not been confirmed because large-river fishes are difficult to maintain in captivity for use in host trials. We utilized large tanks and gill excision to evaluate the suitability of skipjack herring and Alabama shad as hosts for *Elliptio crassidens*. Fishes were inoculated in an aerated glochidial bath (4000 glochidia / liter) for 15 minutes and then transferred to 5000 L outdoor communal holding tanks (water temperature = 19°C). Every other day, gills from one to two individuals of each species were removed and placed in AHAB tanks with

105µm filters at the outflow (water temperature = 20°C). Filters were monitored for transformed juveniles for 8 weeks. Live, active juveniles were recovered from excised gills of Alabama shad and skipjack herring between days 14 and 41, and 19 and 26, post infestation, respectively. Interestingly, gill tissue from sacrificed fish did not decompose quickly, and juveniles could be collected from dead gills for 1-2 weeks following excision. Juveniles were also recovered from a communal holding tank containing live, intact fish, and siphoned on day 25. This is the first confirmation of host use for *Elliptio crassidens*, and its use of migratory fishes likely explains the lack of recent recruitment seen in many populations. Gill excision may be a valuable technique for host studies or propagation involving fishes that are difficult to maintain in captivity. The recovery of apparently viable juveniles from excised gills suggests that glochidia of at least some mussel species are able to metamorphose even after death of the host. hartmic@auburn.edu

SESSION 17	RECOVERY I Wednesday, March 13, 2013 | 8:20-10:00 a.m. Camellia Room
Platform 77 **8:20 a.m.** **March 13, 2013**	**FRESHWATER MUSSEL POPULATION RESTORATION AND AUGMENTATION IN WESTERN NORTH CAROLINA.** Steve Fraley, T.R. Russ. North Carolina Wildlife Resource Commission, Marion, NC.

Improvements in water and habitat quality can restore suitable habitat for freshwater mussels; however, barriers may exist to natural colonization where mussels are extirpated or demographics of relict populations may be less than ideal for population recovery. Multiple opportunities to restore mussel populations were identified and prioritized in western North Carolina, and strategies were developed and implemented for seven species and six stream reaches. Captive propagation conducted at the Conservation Aquaculture Center (CAC) at Marion State Fish Hatchery and by partners at NC State University is a part of the restoration strategy for *Alasmidonta raveneliana, A. varicosa, Lampsilis fasciola, Villosa iris,* and *V. delumbis*. Translocation is used to help restore *A. raveneliana, A. viridis,* and *Elliptio complanata* (complex) populations. The Cheoah River (Little Tennessee R. system), a regulated river recently improved by FERC mandated flow and substrate restoration, is the focus of efforts to both augment an existing relict population of *A. raveneliana* and to reintroduce *L. fasciola* and *V. iris*. A reach of the Pigeon River (French Broad R. system), where historical point source pollution is reduced, was assessed for potential to support *L. fasciola*, and reintroductions are underway there. Experimental translocation of *A. raveneliana* to a recovering reach of the Cane River (Nolichucky River system) is hopefully a prelude to larger release of propagated individuals. Only one population of *A. viridis* remains in the upper French Broad River system (Mills River), but its abundance is supporting translocations to establish a second population in the nearby Little River. On the Atlantic Slope, opportunities to restore mussel populations to the upper South Fork Catawba River system were identified in Jacobs and Henry Forks. Translocations of common species began in 2012 and less common species will be propagated at the CAC for reintroductions to both streams. stephen.fraley@ncwildlife.org

Platform 78 **8:40 a.m.** **March 13, 2013**	**REINTRODUCING A FEDERALLY ENDANGERED SPECIES TO OHIO – THE NORTHERN RIFFLESHELL MUSSEL.** Thomas Watters[1,2], Trisha Gibson[1], Clarissa Bey[1], Kody Kuehnl[3], Howard Albin[4]. [1]Department of Evolution, Ecology, and Organismal Biology, Ohio State University, Columbus, OH; [2]Columbus Zoo and Aquarium, Powell, OH; [3]Department of Social and Natural Sciences, Franklin University, Columbus, OH; [4]Columbus Metro Parks, Westerville, OH.

The Northern Riffleshell (NRS), *Epioblasma torulosa rangiana* (Lea, 1838), is a federally endangered species previously occurring in the Ohio River system including a few Great Lakes drainages. Once common in the Big Darby Creek system in central Ohio, that population declined beyond detection or was extirpated in the 1980s, probably the result of water quality issues. Water quality has significantly improved there, with ample evidence of recruitment of many species in the past decades. Perhaps the only remaining reproducing population of NRS is in the upper Allegheny River in Pennsylvania. In 2008 a test population of 50 NRS was moved from the Allegheny to Battelle-Darby Creek Metro Park. In 2009, 47 of those individuals were recovered. This success allowed the introduction of an additional 1,773 NRS that year, all outfitted with Passive Integrated Transponder (PIT) tags for monitoring purposes. Additional relocations were conducted in 2010 (1,696 NRS) and 2012 (2,646 NRS). To date, 6,165 NRS, all outfitted with PIT tags, have been moved, the largest reintroduction of an endangered species in the history of Ohio. Populations now occur in Battelle-Darby and Prairie Oaks Metro Parks in 13 places along ca. 19 km of creek. Recovery (excluding the new 2012 individuals) is ca. 30% (varying from 0–54%). Many apparently have been washed downstream by high water events. In 2013 the first efforts will be made to locate juveniles from these introductions. watters.1@osu.edu

Platform 79 **9:00 a.m.** **March 13, 2013**	**REINTRODUCTION OF THE FEDERALLY-ENDANGERED NORTHERN RIFFLESHELL (*EPIOBLASMA RANGIANA*) AND CLUBSHELL (*PLEUROBEMA CLAVA*) IN ILLINOIS.** Jeremy Tiemann[1], Robert Szafoni[2], Joseph Kath[3], Kevin Cummings[1]. [1]Illinois Natural History Survey, Champaign, IL; [2]Illinois Department of Natural Resources, Office of Resource Conservation, Springfield, IL; [3]Illinois Department of Natural Resources, Division of Natural Heritage, Springfield, IL.

Northern riffleshell (*Epioblasma rangiana*) and clubshell (*Pleurobema clava*) are two federally-endangered freshwater mussels that were historically present throughout the upper Ohio River and Lake Erie drainages. The joint recovery plan, approved by the U.S. Fish and Wildlife Service (USWFS) in 1994, listed an objective of establishing viable populations of the mussels in various river drainages throughout the species' ranges. The plan stated that population augmentations and reintroductions would be needed to achieve this objective, and it was agreed that the Vermilion River (Wabash River drainage) in Illinois was a potential location for reintroduction. Beginning in 2005, state agencies in Illinois partnered with the USFWS and state agencies in Ohio and Pennsylvania and began planning the reintroduction of these species into the Vermilion River. Efforts included selecting potential sites based on suitable habitats (e.g., free-flowing gravel riffles) and fish hosts (e.g., darters) and the presence of a diverse mollusk assemblage. A salvage project in Pennsylvania on the Alleghany River has provided an opportunity for the translocation of both species. This presentation summarizes the results of the project through February 2013. jtiemann@illinois.edu

Platform 80 **9:20 a.m.** **March 13, 2013**	**QUANTITATIVE ASSESSMENT OF MUSSEL FAUNA RECOVERY IN THE DUCK RIVER, TENNESSEE.** Don Hubbs. Tennessee Wildlife Resources Agency, Camden, TN.

The Duck River is a globally important repository of biological diversity with approximately 151 species of fish, 56 species of mussels, and 22 species of aquatic snails. The mussel population of the Duck River has been surveyed sporadically over the last century. Beginning in 1979, TVA surveyed the upper river at 22 quantitative sites for monitoring associated with the Columbia Dam project. TVA revisited some but not all of these sites and added others in 1988 when monitoring ceased and Columbia Dam was dismantled in 1999. Since 1991, reservoir release improvement measures implemented by TVA at Normandy Dam have resulted in higher dissolved oxygen and minimum flows in the downstream river reach. Point source regulation and riparian habitat restoration are also considered to be instrumental factors influencing the river's recovery. Periodic quantitative mussel population sampling is necessary in order to monitor endangered species and document the status of the river's mussel fauna. Six sites were selected within a 118 mile reach of the river. Sample size was set at 80, 0.25 meter quadrats per site. Data were collected by systematically placing quadrat samples along transect lines. A total of 2,091 mussels representing 37 species were collected from the six sites, yielding a mean density of 17.43 mussels per m^2. Results indicated federally listed endangered mussel species in the Duck are experiencing exponential population increases. The improvement of the mussel resources in the Duck River is an extraordinary accomplishment. The importance of the increases seen in the populations of two endangered mussel species, Duck River darter snapper (*Epioblasma ahlstedti*) and Cumberland monkeyface (*Quadrula intermedia*), cannot be over stated, as they have literally been brought back from the brink of extinction. tnmussels@aol.com

Platform 81 **9:40 a.m.** **March 13, 2013**	**MONITORING RECOVERY OF MUSSELS IN THE ELK RIVER DOWNSTREAM OF TIMS FORD DAM.** Chuck Howard[1], Don Hubbs[2], Stephanie Chance[3], Paul Johnson[4]. [1]Tennessee Valley Authority, Biological and Water Resources, Knoxville, TN; [2]Tennessee Wildlife Resources Agency, Camden, TN; [3]US Fish and Wildlife Service, Cookeville, TN; [4]Alabama Dept. of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, AL.

The Tennessee Valley Authority, in cooperation with other federal and state agencies, has modified water releases from Tims Ford Dam on the Elk River (TN/AL) since 2007 to promote recovery of federally listed mussels and fish, while continuing support of an artificial trout fishery and numerous demands for water. Modifications to dam releases included minimum flows, warming tailwater temperatures, and reducing peak flow events. In 2012, mussels were surveyed using 100 excavated quadrats ($0.25m^2$) in a five-grid systematic sample design at each of six monitoring sites within an 85-mile reach of the tailwater. Survey results are evaluated relative to 2008 and earlier historical data. Mussels at all three downstream sites showed increases in density, up to 2.5 times those estimated in 2008. Evidence of recent mussel reproduction at the downstream sites was evident, including many young individuals of the federally endangered cracking pearlymussel (*Hemistena lata*) and snuffbox (*Epioblasma triquetra*) at two sites. The cracking pearlymussel had not been found alive in the Elk River for many decades until recent changes to Tims Ford Dam releases. Although relatively few mussels were found at the three upstream sites, TVA's warm-water fish community index showed notable improvements. Improvements in Elk River habitat, particularly downstream of Fayetteville, TN and Harms Mill (low-head) dam appear to be supporting recovery of the mussel fauna. Early improvements have encouraged state agencies to stock lab-cultured individuals of the extremely rare Alabama lampmussel (*Lampsilis virescens*) into the lower Elk River. cshowar1@tva.gov

SESSION 18	POPULATION DEMOGRAPHICS I Wednesday, March 13, 2013 | 8:20-10:00 a.m. Goldenrod Room
Platform 82 **8:20 a.m.** **March 13, 2013**	**DECLINES IN IMPERILED SPECIES CAN BE MASKED BY COMMUNITY CHANGES: ELUCIDATING CHANGES USING ORDINATION.** Daelyn Woolnough, Jennifer Bergner. Biology Department and Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI.

In our changing environment ecological relationships are complex and this is especially true for host-parasite relationships. With the additional effects of climate-related change this complex struggle for existence can be accentuated. Unionids are unique because of although their adult stage is relatively sessile their parasitic stage can be extremely motile because of their requirement to use a fish as a host prior to development into a juvenile. In the last 40-50 years in Michigan there have been significant changes in mussel communities which can be correlated with changes in host availability, fish community change, and temperature changes. We show that over 80% of the rivers in the study have a decline in the number of unionid species in the last 40-50 years. However, the decline in more evident when overall community shift is evaluated. Non-Metric Multidimensional Scaling (NMDS) analysis shows how the community shift correlates with the use of host fish and how unionid genera can predict changes of unionid communities over time. Significant axes from the NMDS analysis show how different groups of unionids have followed certain patterns of change. These unionid groups include: specialists, generalists, intolerant, tolerant, active lure users, thin shelled, and unionids that use "large river" hosts. Further, multi-response permutation procedure (MRPP) was used to test the statistical validity of the NMDS ordination. Using ordination analyses we found was useful in understanding and elucidating changes in unionid communities and is likely to aid in the conservation of these organisms in the Laurentian Great Lakes basins. wooln1d@cmich.edu

Platform 83 **8:40 a.m.** **March 13, 2013**	**OCCUPANCY, DETECTION, AND HABITAT RELATIONSHIPS OF UNIONIDS IN THE LOWER FLINT RIVER, GEORGIA.** Jason Wisniewski[1], Nicole Rankin[2], Deborah Weiler[1], Bradley Strickland[1], Houston Chandler[1]. [1]Georgia Department of Natural Resources, Wildlife Resources Division, Nongame Conservation Section, Social Circle, GA; [2]US Fish and Wildlife Service, Warm Springs Fish Technology Center, Warm Springs, GA.

Flint River in southwestern Georgia is historically known for its diverse and abundant unionid fauna. However little is known about the current status of the unionid assemblages in the river due to a paucity of recent sampling effort. In 2006 and 2008, two presumed extirpated or extinct unionid species were rediscovered in the river further exemplifying the need for a large-scale survey of the river. We utilized an occupancy modeling approach to document the presence/absence of unionids at 39 locations along a 119 km reach of the lower Flint River between Lake Seminole and Albany Dam. Twenty unionid species were collected, and evidence of recent reproduction was documented for 10 species. Mean detection probabilities among species ranged from 0.01 to 0.69 whereas occupancy ranged from 0.03 to 0.90. We also fitted models relating site-level and reach-level habitat characteristics to detection and occupancy for 3 species of conservation concern. Estimated occupancy across all species was on average 26% greater than naïve occupancy. Detection probability for *Elliptio nigella* was strongly and positively related to searcher experience, water depth, and water velocity. Detection of *Elliptoideus sloatianus* was negatively related to percent clay substrate and percent bedrock. Similarly, *Quadrula infucata* occurred more frequently at sites having clay substrates and detection was negatively related to the proportion of bedrock and gravel substrates. The occupancy modeling approach used in our study was a useful and efficient method to assess the status and distribution of unionids in the lower Flint River. We believe that similar model-based study designs may be of use to unionid researchers and managers who are interested in assessing population status, population trends, and habitat associations, particularly when sampling resources are limited. Jason.Wisniewski@dnr.state.ga.us

Platform 84 **9:00 a.m.** **March 13, 2013**	**USING STRUCTURED DECISION MAKING TO DEVELOP CONSERVATION STRATEGIES FOR DWARF WEDGEMUSSEL IN NORTH CAROLINA.** Dave Smith[1], Sarah McRae[2], Judy Ratcliffe[3], Rob Nichols[4], Chris Eads[5], Tom Augspurger[6], Tim Savidge[7], Art Bogan[8], Brett Hillman[7]. [1]US Geological Survey, Leetown Science Center, Kearneysville, WV. [2]US Fish and Wildlife Service; [3]NC Natural Heritage Program, Raleigh, NC; [4]NC Wildlife Resources Commission, Raleigh, NC; [5]North Carolina State University, Department of Veterinary Medicine, Raleigh, NC; [6]US Fish and Wildlife Service, Raleigh, NC; [7]The Catena Group Inc., Hillsboro, NC; [8]North Carolina Museum of Natural Sciences, Raleigh, NC; [9]US Fish and Wildlife Service, Concord, NH.

In North Carolina, the Dwarf Wedgemussel (*Alasmidonta heterodon*) persists as relatively small fragmented populations in the Tar River and Neuse River basins. Threats related to destruction, modification and curtailment of its habitat have severely affected Neuse River basin populations, and populations in the upper Tar River basin appear to have been

significantly affected by recent droughts. We worked through a structured decision making process to develop conservation strategies to increase viability of Dwarf Wedgemussels while considering the offsetting costs (staff and operating expenses) and uncertainty in management effectiveness. The conservation strategies were portfolios of management actions that differed by where management actions occurred on the landscape. A population model helped to inform requirements for population management. We formally compared 3 strategies: 1) a strategy that represents status quo management, 2) a strategy that focuses on protecting the best populations, and 3) a strategy that focuses on expanding the species' distribution. The strategy designed to expand the species' distribution maximized viability attributes compared to the other strategies; however, the cost was highest. The tradeoff between conservation benefit and cost led to the development of an additional strategy that focuses on reducing cost while maintaining the conservation benefit. We evaluated the sensitivity of the strategy comparison to uncertainty in the management effectiveness. Overall, the structured decision process is helping to identify the most promising strategies for Dwarf Wedgemussel recovery that will maximize conservation benefit given the allocation of limited funding. drsmith@usgs.gov

Platform 85 **9:20 a.m.** **March 13, 2013**	**NOW YOU SEE THEM, NOW YOU DON'T: APPLYING OCCUPANCY MODELING TO MONITOR A RARE AND CRYPTIC SPECIES.** Shane Hanlon[1], Brett Ostby[2], Steve Fraley[3]. [1]US Fish and Wildlife Service, Abington, VA; Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [3]North Carolina Wildlife Resources Commission, Western Region, Marion, NC.

Beech Creek (Hawkins County, Tennessee) harbors one of only four remaining populations of the federally endangered purple bean (*Villosa perpurpurea*). Detection rates for this small, cryptic species appear limited compared to co-occurring species and vary seasonally—improving in late winter and early spring when females are most often gravid. Moreover, this species can be locally rare. Thus, it is difficult to distinguish between true absence and failure to detect. We wedded semi-quantitative surveys and occupancy approaches in a study designed to 1) explicitly parameterize detection rates, 2) approximate site occupancy with better confidence, and 3) compare results to timed qualitative searches conducted 11 years earlier. Over the course of 4 sampling occasions (occurring in February, March, April and June), a total of 29 sites were surveyed at least once. Among all sites initially surveyed, we observed 135 individuals of purple bean representing 5.86% of the mussel fauna. There was no evidence to suggest that catch-per-unit effort for purple bean differed between 2001 and 2012. Likewise, the overall proportion of sites occupied by purple bean in 2001 (65%) and resampled in 2012 were comparable, though the spatial distribution had shifted. Detection was highest during February and March with mean time to initial detection (TID) at 0.67 person hours. Detection decreased through April to June with mean TID at 2.5 person hours among sites. We present and compare competing models that use covariates (e.g. % habitat scores, weather, flow, date) to better approximate site occupancy and detection probability. shane_hanlon@fws.gov

Platform 86 **9:40 a.m.** **March 13, 2013**	**STREAMLINING ENDANGERED SPECIES CONSULTATIONS UTILIZING THE USFWS IPaC AND CONSERVATION FRAMEWORK BUILDER WEB TOOLS.** Josh Seagraves[1], Mitch Wine[2], Randal Looney[3], John Fleming[1]. [1]Arkansas Highway and Transportation Department, Environmental Division, Little Rock, AR; [2]US Fish and Wildlife Service, Arkansas Field Office, Conway, AR; [3]Federal Highway Administration – Arkansas Division, Little Rock, AR.

The United States Fish and Wildlife Service (USFWS) and Arkansas State Highway and Transportation Department (AHTD), in cooperation with the Federal Highway Administration – Arkansas Division Office (FHWA), are participating in a pilot project using the USFWS' Information Planning and Consultation (IPaC) web based decision support system. The use of the IPaC web tool, in conjunction with the Conservation Framework Builder, can improve species conservation results by providing a streamlined and predictable approach to Endangered Species Act consultations that can begin in the early stages of project planning. The project spatially displays proposed transportation projects, assesses the effect of these projects on pilot species and their habitats, and delivers avoidance, minimization and mitigation measures early in the project planning process. Originally, six threatened and endangered species were selected as pilot species including four freshwater mussels; Arkansas fat mucket (*Lampsilis powellii*), fat pocketbook (*Potamilus capax*), pink mucket (*Lampsilis abrupta*), and winged mapleleaf (*Quadrula fragosa*). A seventh species, the rabbitsfoot (*Quadrula cylindrica*), has been added following the proposal by the USFWS to list the species as threatened. josh.seagraves@ahtd.ar.gov

SESSION 19	RECOVERY II Wednesday, March 13| 10:20 a.m.-12:00 p.m. Camellia Room
Platform 87 **10:20 a.m.** **March 13, 2013**	**USING MARK-RECAPTURE SAMPLING TO ASSESS POPULATIONS OF THE ENDANGERED JAMES SPINYMUSSEL (*PLEUROBEMA COLLINA*).** Brian Watson[1], Brett Ostby[2], Caitlin Carey[2]. [1]VA Department of Game & Inland Fisheries, Forest, VA; [2]Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA.
Determining the viability of freshwater mussel populations is necessary in developing and implementing conservation and recovery plans. However, empirical data regarding population sizes and critical parameters such as survival and recruitment rates are lacking, limiting our ability to assess population viability and determine factors driving population growth and decline. Mark-recapture sampling and modeling allows for estimation of these parameters, while also approximating and accounting for variable detection probabilities. While mark-recapture techniques are widely used in ecology, they are rarely used to assess mussel populations. The federally endangered James spinymussel (*Pleurobema collina*) is predominantly found in the James River Basin in Virginia and West Virginia and a significant population was discovered in Little Oregon Creek, Craig County, VA, in 2010, allowing us the opportunity to implement mark-recapture sampling. A 100-m reach of Little Oregon Creek was chosen due to the numbers of James spinymussel present. The reach was divided into four 25-m sections and initially sampled in August and revisited five times thru September, with all mussels uniquely marked with a Hallprint™ tag. Sampling techniques involved three surveyors crawling on hands and knees using the naked eye to flag all mussels, along with random tactile surveys by hand raking. Two sections were sampled with traditional quadrat excavation for comparison. A total of 1,399 James spinymussel were tagged with 760 recaptured at least once. Population estimates using programs MARK and CAPTURE ranged from 1,769 to 1,909 with 375-575 per section. Quadrat population estimates were not significantly different, but had broader confidence intervals. Detection probabilities varied by section and date from 10-30% and were similar to those determined from quadrat sampling, both lower than expected. Because these initial results received recognition as a source of vital demographic information, we have continued sampling through 2012 and secured funding to sample through at least 2014. Brian.Watson@dgif.virginia.gov	
Platform 88 **10:40 a.m.** **March 13, 2013**	**REINTRODUCTION OF MUSSELS INTO THE CALDERWOOD BYPASS OF THE LITTLE TENNESSEE RIVER; A CASE OF FRATERNIZING WITH THE ENEMY?** Kendall Moles[1], James Layzer[2]. [1]Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville TN; [2] US Geological Survey, Tennessee Cooperative Fishery Research Unit, Tennessee Technological University, Cookeville TN.
The Little Tennessee River once harbored a diverse mussel fauna but with the construction of a series of dams for flood control and hydroelectric generation, the Little Tennessee River changed from a lotic to a largely lentic system with limited riverine habitat available. Calderwood Dam is the third dam in a series of dams on Little Tennessee River. Water from the dam is diverted via pipeline downstream to the powerhouse. This diversion creates an approximately 1.6-km-long bypass reach that historically received little flow. With the institution of minimum flows in to bypass, we reintroduced adults of three mussel species, the fluted kidneyshell (*Ptychobranchus subtentum)*, the kidneyshell (*Ptychobranchus fasciolaris)*, and the Cumberland moccasinshell (*Medionidus conradicus*) from the Clinch River, Tennessee to 5 locations within the bypass reach to assess the suitability of the habitat for mussel reintroduction activities within the bypass reach. All individuals were fitted with uniquely numbered tags and growth and gravidity were assessed over of 5 year period. When we assessed the long-term survival and condition of the translocated mussels we found dissimilar results among species. Retention, growth, and gravidity of fluted kidneyshells and kidneyshells decreased dramatically over time with less than 15 percent of mussels persisting for the duration of the study and no individuals exhibiting growth or spawning after 3 years. Conversely, the retention, the percent of individuals exhibiting growth, and the percent of females becoming gravid of the Cumberland moccasinshells remained relatively high during the duration of the study. Collection of young individuals of a remnant population of mountain creekshell (*Villosa vanuxemensis*) indicated recent recruitment (< 5 years) in the bypass reach. These contrasting findings suggest different environmental requirements among mussel species. Additionally, yearly recruitment of rainbow trout (Oncorhynchus mykiss) was documented in the bypass reach. KMoles@tntech.edu	
Platform 89 **11:00 a.m.** **March 13, 2013**	**PARTNERSHIPS PROTECTING THE PAINT ROCK WATERSHED.** Paul Freeman[1], Doug Fears[1], Traci Wood[2]. [1]The Nature Conservancy in Alabama, Birmingham, AL; [2]Alabama Department of Conservation and Natural Resources, Alabama Wildlife and Freshwater Fisheries, 64 N. Union St., Suite 658 Montgomery, AL.

Since 2000, the Paint Rock River and its 294,000 acre watershed in northeast Alabama and southeast Tennessee has been a priority for conservation activities including protection, restoration, and enhancement of upland forest, riparian, wetland, cave, and in-stream habitats. To date, over 38,000 acres have been included for permanent protection, conservation easements, or restoration activities. Over 27 million dollars have been spent on acquisition of lands, easements, or on the ground restoration. The funding has been provided by a wide range of partners and programs and includes eleven public programs, and seven private foundations and corporations. Additionally, over 36 partners have contributed with monitoring, planning, and in-kind support. The Nature Conservancy has been directly involved in 26 stream and riparian restoration projects including bank stabilization, stream channel restoration, sediment and erosion control, barrier removal, buffer installation, hardened stream crossings, alternative water sources for livestock, cave clean ups, and source water protection. These projects have resulted in over five miles of new buffer, five miles of cattle fencing, and 60,000 native hardwood trees planted. The mussel fauna in this stream is remarkably diverse with 50 of the 59 historic species extant. Ten federally protected species are present and this stream has benefited from the augmentation and reintroduction efforts led by the Alabama Aquatic Biodiversity Center. The collaborative efforts of federal and state agencies, private landowners, and non-governmental organizations in this watershed serves as an example of conservation at a scale to reach long-term water quality, habitat and species benefits.
pfreeman@tnc.org

Platform 90 **11:20 a.m.** **March 13, 2013**	**RESTORING THE FRESHWATER MOLLUSK COMMUNITY FOLLOWING A TOXIC EVENT: PART I – ASSESSING THE DAMAGES AND DEVELOPING A RESTORATION PLAN.** Patricia Morrison[1], Janet Clayton[2]. [1]US Fish and Wildlife Service, Ohio River Islands NWR, Williamstown, WV; [2]West Virginia Division of Natural Resources, Elkins, WV.

In 1999, the middle Ohio River experienced a significant aquatic mortality event due to an alleged discharge of toxic materials from a metal plating plant. Over 1 million mussels and over 12 million snails perished. A concurrent fish kill occurred, affecting over 8600 fish, mostly (> 96%) freshwater drum. Fish and mollusk kill assessments were done in 1999 and 2000. The pre-existing mussel community was comprised of 35 species, with three species of snails. An interjurisdictional team of state, federal, and academic investigators pieced together the likely pathway of injury and brought a claim for Natural Resources Damages under CERCLA. The case eventually settled for $3.2 million, of which $2.04 million was set aside for natural resources restoration. A restoration trust fund was established, managed by an interagency Trustee Council. On-the-ground restoration is accomplished through a Technical Committee that advises the Council, partners with cooperators, and implements annual work plans. Cooperators use a combination of techniques to restore the aquatic fauna including translocation of adult mussels, propagation and stocking of tagged juveniles, setting and relocation of snail egg traps, and release of fish directly infested with mussel glochidea. The stated goal is to restore ecologically viable populations of mussel, snails, and fish within the affected area of the Ohio River within ten years of initiation of activities. For mussels, that goal is > 1 mussel per square meter, and a community represented by > 20 species. Patricia_Morrison@fws.gov

Platform 91 **11:40 a.m.** **March 13, 2013**	**RESTORING THE FRESHWATER MOLLUSK COMMUNITY FOLLOWING A TOXIC EVENT: PART 2 – RESTORATION ACTIVITIES AND SUCCESSES.** Janet Clayton[1], Patricia Morrison[2]. [1]West Virginia Division of Natural Resources, Elkins; [2]US Fish and Wildlife Service, Ohio River Islands NWR, Williamstown, WV.

In 1999, the Ohio River in West Virginia experienced a significant aquatic mortality event in which over 1 million mussels and over 12 million snails perished. The pre-existing mollusk community was comprised of 35 unionid and three snail species. Our goal is to restore ecologically viable populations of mussels, snails, and fish within the affected area of the Ohio River within ten years of initiation of activities. For mussels, that goal is > 1 mussel per square meter, and a community represented by > 20 species. Restoration activities have been undertaken by numerous cooperators using a combination of techniques. Our initial efforts targeted translocations of adults to establish a bed into which propagated juveniles would be stocked. Animals used for translocations were salvaged from areas within the Belleville Pool of the Ohio River, WV and the Allegheny River, PA. Propagation on this scale required the collection and holding of adult broodstock consisting of a few individuals for long term brooders and 50 or more for short term brooders. The collection and holding of a large number of host fish of different species can also be challenging. Propagation activities have included laboratory reared and cage cultured juveniles which have required four months to two years to reach taggable size. To date over 12,000 mussels of 21 species (adults and tagged juveniles) have been stocked into two restoration sites. Following 5 years of restoration activities, the 2012 assessment of the primary restoration site reported 21 unionid species, 14 of which are showing natural recruitment. This bed was completely killed in 1999 and, in 2012, the population density was estimated at 3.4 mussels per square meter. While limited snail restoration activities have been undertaken, two of the three snail species lost have shown some recovery and three additional species have appeared. The collection of the first naturally recruited federally endangered species, *Cyprogenia stegaria*, provides encouragement for moving forward with propagation and release of endangered species within the restoration areas.
Janet.L.Clayton@wv.gov

SESSION 20	SYSTEMATICS Wednesday, March 13, 2012 | 10:20 a.m.–12:00 p.m. Goldenrod Room
Platform 92 10:20 a.m. March 13, 2013	**DIVERGENT HAPLOTYES AND IMPLICATIONS FOR PHYLOGENY OF THE PLEUROCERIDAE USING MITOCHONDRIAL MARKERS.** Ellen Strong[1], Jeffrey Garner[2], Paul Johnson[3], Nathan Whelan[4]. [1] National Museum of Natural History, Smithsonian Institution, Washington, D.C.; [2] Alabama Department of Conservation and Natural Resources, Mussel Management, Florence, AL; [3]Alabama Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, AL; [4] Department of Biological Sciences, University of Alabama, Tuscaloosa, AL.
Pleuroceridae is the second most diverse family of freshwater gastropods in North America, and one of the most imperiled. Efforts to conserve them are hampered by a species-level taxonomy that is based primarily on features of their highly variable shells and reflects concepts about species variation and geographic distribution that are decades, if not centuries, old. Without question, many currently accepted species do not accurately reflect actual pleurocerid diversity. In recent years, the use of molecular tools has revolutionized our ability to address diversity and species circumscription of gastropods with a dataset independent of traditional shell characters. However, molecular approaches to understanding pleurocerid taxonomy and phylogeny have been flawed by limited taxon sampling and a single mitochondrial locus (COI or 16S) approach. Recently, several papers have reported that denser sampling reveals much higher levels of molecular diversity within species than would be expected given what is known about marine cerithioidean molecular evolution; this pattern has been attributed to incomplete lineage sorting or cryptic species. Thus far, we have assembled a data set of partial COI and 16S sequences for ~600 individuals from multiple populations and numerous species across the Pleuroceridae. This represents the largest dataset ever assembled for pleurocerids and has confirmed the widespread presence of highly divergent mitochondrial haplotypes across the family. Within any given species, these lineages differ from the modal, or common, haplotype and from one another, by as much as 20% (uncorrected *p*-distance). They can be recognized as long isolated branches, usually at the base of the tree, and do not correspond to geography nor do they correlate with any visible conchological characteristic. The implications for the use of mitochondrial markers in species-level taxonomy and for understanding phylogeny of the family will be explored. stronge@si.edu	
Platform 93 10:40 a.m. March 13, 2013	***VILLOSA* 2.0.** Thomas Watters[1], Kody Kuehnl[2]. [1]Department of Evolution, Ecology, and Organismal Biology, Ohio State University, Columbus, OH; [2]Department of Social and Natural Sciences, Franklin University, Columbus, OH.
The nominal genus *Villosa* Frierson, 1927, was reevaluated based on the results of phylogenetic (CO1 and/or NAD), conchological, and morphological characteristics. True *Villosa* is limited to four southeastern species; all other purported members of that genus belong to other genera, most currently lacking a valid name. *Unio fabalis* Lea, 1831, is shown to be a primitive lampsiline comprising an unnamed, monotypic genus. The "*iris*" group constitutes an unnamed genus composed of *Unio iris* Lea, 1829, in the upper Ohio and Tennessee systems, *Unio dactylus* Lea, 1840, in the Cumberland, Duck, and Green rivers, and four additional taxa. The "*lienosa*" group also constitutes an unnamed genus and is composed of the widely distributed *Unio lienosa* Conrad, 1834, and four other taxa. *Unio arkansasensis* Lea, 12862, is confirmed as an *Obovaria*, as is *Villosa choctawensis* Athearn, 1964. *Unio lienosus constrictus* Conrad, 1838, *Unio perpurpureus* Lea, 1861, and *Unio trabalis* Conrad, 1834, are moved to *Venustaconcha* Thiele, 1934. *Unio vaughanianus* Lea, 1838, *Unio subrostratus* Say, 1831, *Unio nasutus* Say, 1817, and an undescribed species are combined under a new genus; this action leaves *Ligumia* Swainson, 1840, as a monotypic genus containing *Unio recta* Lamarck, 1819. In all, four new genera and seven species or subspecies-level taxa are needed to accurately reflect the phylogeny of the groups studied. The zoogeography of these "*Villosa*" are explained by paleoriver system patterns and headwater stream capture. Many of the taxa are cryptic and occupy narrow ranges, making them prime candidates for conservation. Watters.1@osu.edu	
Platform 94 11:00 a.m. March 13, 2013	**NEW SPECIES OF NORTH AMERICAN PHYSIDAE (MOLLUSCA: GASTROPODA: BASOMMATOPHORA).** John Burch[1], David Hooper[2], Alexandria Moore[1], Thomas Duda, Jr.[1,3]. [1]Museum of Zoology, University of Michigan, Ann Arbor, MI; [2]United States Fish and Wildlife Service, Boise, ID; [3]Smithsonian Tropical Research Institute Balboa, Republic of Panamá.
The North American Physidae, a ubiquitous family of freshwater pulmonate snails, is readily distinguished from other families of aquatic snails in continental North America by being pulmonates with a spired, sinistral body and shell. Physid snails are common inhabitants of lentic waters, but they also may be found in the slow-flowing or standing waters	

at the edges of streams. Several species are more truly lotic, being found within the flowing waters of rivers, including on the river bottoms. Among our recently collected specimens are several species new to science. As time permits, we are studying these specimens in detail, using comparative conchology and anatomy, bolstered by molecular techniques. One of the species that has particularly interested us, is a species found in a canyon in Oregon. This species is the smallest physid yet known, our largest adult specimens measuring only 3 mm in shell length. Its globose shell, short obtuse spire, and relatively large aperture, would seem to relate it to *Petrophysa zionis* (Pilsbry 1926) of Zion Canyon, Utah. However, results from analyses of mitochondrial cytochrome oxidase 1 and nuclear internal transcribed spacer region sequences, and its reproductive anatomy indicate affinities with the genus *Haitia*, which is especially distinguished by its entirely muscular (non-glandular) penial sheath. The peculiar shell morphology of our new species, similar to that of *Petrophysa zionis*, would seem to be due to the two species occupying similar habitats, although the Owyhee River is not in a box canyon. We have named the new Oregon species after its location, the Owyhee River. jbburch@umich.edu

Platform 95 **11:20 a.m.** **March 13, 2013**	**GENUS *ELLIPTIO* IN THE GREATER FLORIDAN REGION: MAKING SENSE OF BEWILDERING VARIATION IN SHELL MORPHOLOGY.** James Williams[1], Robert Butler[2], Gary Warren[1], Nathan Johnson[3]. [1]Florida Fish and Wildlife Conservation Commission, Gainesville, FL; [2]US Fish and Wildlife Service, Ashville, NC; [3]U.S. Geological Survey, Caribbean Science Center, Gainesville, FL.

Elliptio is the largest genus of unionids in North America, with 38 currently recognized species. Relationship of species within the genus is poorly known and recent attempts to clarify the phylogeny using molecular techniques have thus far been unsuccessful. While there are only 2 *Elliptio, crassidens* and *dilatata*, in the entire Mississippi basin, 12 species are known to occur in the Greater Floridan Region in Alabama, Florida, and Georgia. Species of *Elliptio* are often the most common unionid in streams throughout the region. Their ability to survive, grow, and reproduce in a wide range of habitats has produced a plethora of shell morphologies, making it extremely difficult to impossible to delineate species based on conchological characteristics. We will present data to distinguish the "corrugate" *Elliptio* from the remainder of the genus. Distribution and morphological characters of the 12 species will be examined. Relationship of *Elliptio* in the Greater Floridan Region to species in adjacent regions on the Gulf and Atlantic Coasts will be discussed. fishwilliams@gmail.com

Platform 96 **11:40 a.m.** **March 13, 2013**	**PHYLOGEOGRAPHY OF FRESHWATER MUSSELS IN THE UPPER TALLAPOOSA DRAINGE (ALABAMA AND GEORGIA, USA).** Michael Gangloff, Erin Abernethy, Raymond Kessler IV, Michael Perkins, Lynn Siefferman. Appalachian State University, Appalachian State University, Boone, NC.

The Mobile River Basin (MRB) supports the second most species-rich temperate freshwater fauna on earth. Mollusk alpha and beta richness are high within and among sub-basins and many endemic taxa are highly range-restricted. The Tallapoosa River is presently believed to support the fewest mollusk taxa among major MRB tributaries likely because its ion-poor streams drain its ancient, metamorphic upland strata are isolated from much of the MRB by a series of rapids along the Piedmont-Coastal Plain Fall Line transition. The species-poor (15 species) mollusk fauna in the upper Tallapoosa River (UTR) upstream of the falls at Tallassee, Alabama is presently believed to include only one putatively endemic mussel, *Quadrula archeri*. We examined fragments of 2 mtDNA genes (COI and NDI) in UTR specimens of five taxa (*Elliptio arca*, *E. arctata*, *Hamiota altilis*, *Villosa lienosa* and *V. vibex*) believed to occur throughout the MRB as well as material from an un-described *Pleurobema* recently discovered in the UTR. We found substantial differences (2-4% pairwise divergence) between UTR specimens and putative MRB conspecifics suggesting several UTR taxa (including *Elliptio* sp. cf. *arca* and *Elliptio* sp. cf. *arctata*) may warrant recognition as distinct species. Analyses also revealed that the UTR *Pleurobema* taxon is sister to, but distinct from *Pleurobema decisum*. These data suggest that the UTR contains numerous cryptic mussel taxa and may warrant recognition as a previously un-recognized mollusk endemism hotspot in the MRB. gangloffmm@appstate.edu

SESSION 21	**HABITAT II** **Wednesday, March 12, 2013 | 1:40-3:00 p.m.** **Camellia Room**
Platform 97 **1:40 p.m.** **March 13, 2013**	**GROUND-TRUTHING MAXENT IN EAST TEXAS RIVERS.** David Ford[1], Ashley Walters[2], Judith Bilyea[1], Marsha Williams[1], Josh Banta[1], Neil Ford[1], Lance Williams[1]. [1]Department of Biology, University of Texas at Tyler, 3900 University Blvd Tyler TX; [2]Department of Zoology, Miami University, Oxford OH.

Unionid mussels are a guild of freshwater, sedentary filter-feeders, which play a critical role in freshwater systems. Mussels are currently experiencing a global decline in both species richness and abundance, due to invasive species, human alteration of water systems, and climate change. In North America, which is considered to have the highest global diversity of bivalve species, native mussels are currently declining rapidly with at least 37 species considered to already be extinct. If extant mussel species are to be preserved, then it is vital that conservation efforts be prioritized towards areas in which they are likely to be found. This is often done through ecological niche models. MAXENT for example uses the principle of maximum entropy on presence data and environmental variables to create a suitability score for a particular area, and is one of the most widely used of the ecological niche modeling programs. It has been used to make maps predicting the suitability scores for multiple species but very little ground-truthing to see if the maps are assigning the correct scores has been conducted. We ground-truthed the MAXENT program's suitability score from 30 samples for six threatened mussel species in the rivers of East Texas by visiting differently scored sites to determine if the MAXENT suitability scores were reflective of actual abundances. We recorded a total of 12, 664 mussels from 103 new sites on all four of the major river drainages in East Texas. The Neches had more species and more mussels than any of the others rivers, and had all six of the threatened species. Our ground truthing indicated that the high suitability sites were over-scored, and the low level suitability scored sites were under-scored. New presence-absence sites will be added to the MAXENT model to improve suitability maps. dffford@hotmail.com

Platform 98 **2:00 p.m.** **March 13, 2013**	**IMPACT OF A SPILLWAY AND A HYDROELECTRIC DAM ON UNIONID MUSSEL DIVERSITY AND ABUNDANCE IN THE SABINE RIVER.** Neil Ford[1], Charles Randklev[2]. [1]Department of Biology, University of Texas at Tyler, Tyler, TX; [2]Institute of Renewable Natural Resources, Texas A&M, College Station, TX.

Over 40,000 large dams have been constructed throughout the world and reservoirs dramatically alter conditions in rivers downstream. Depending on whether a dam is designed for hydroelectric generation or flood control and recreation, modification to downstream habitat typically includes changes to hydrology, sediment dynamics, water quality, and thermal regime. The ecological ramifications include the loss of aquatic biodiversity and stream productivity. For freshwater mussels (Family: Unionidae) changes to habitat brought about by river impoundment often result in extirpation of rare species and declines in abundance. In Texas, the impacts associated with river impoundment have been examined only cursorily and there is little recognition of the threat impoundments posed to mussel communities. Because of this we collected mussels from areas downstream of an overflow dam on the Upper Sabine River in northeast Texas and a hydroelectric dam on the same river at Toledo Bend. Sites surveyed were compared in number and species of live mussel and the type of shell sculpturing relative to distance from the dams. For both study areas we observed that species richness, including state-threatened species, and abundance increased with distance downstream from either dam. Sculpture type also varied with location such that smoothed shell species were more abundant at sites closest to either dam while sculptured species became more prevalent further downstream. These observations suggest that habitat near both reservoirs is more frequently disturbed compared to sites further downstream. While impacts to the mussel fauna in both study areas were similar, the degree to which mussels were impacted appeared disproportionate. Species richness and abundance recovered at much further distances in the lower Sabine compared to the upper Sabine. This observation indicates that while impoundments are detrimental, the degree to which a dam effects downstream mussel communities appears to be mediated primarily by its operational type. nford@uttyler.edu

Platform 99 **2:20 p.m.** **March 13, 2013**	**ARAGONITE SATURATION AND BED STABILITY CONSTRAIN THE DISTRIBUTION OF *ALASMIDONTA HETERODON* IN A TRIBUTARY OF THE UPPER DELAWARE RIVER.** Cara Campbell[1], Karen Prestegaard[2]. [1]US Geological Survey, Leetown Science Center, Northern Appalachian Research Branch, Wellsboro, PA; [2]Department of Geology, University of Maryland, College Park, MD.

Native freshwater mussels are among the most imperiled of North American freshwater fauna. Their complex life cycle makes them particularly vulnerable to changes in land-use or climate, which can alter flow regimes and thus bed stability and water chemistry. Freshwater mussels require stable streambeds, food sources, and appropriate water chemistry to live and grow. Development of effective conservation and restoration strategies for mussels requires identification of constraints on the distributions of individual mussel species. We examined whether the spatial distribution of the endangered *Alasmidonta heterodon* in Flat Brook, a tributary of the upper Delaware River, was constrained by water chemistry, bed mobility, or both. This question was evaluated with geomorphic and water chemistry measurements and analysis to determine bed mobility and saturation indices for aragonite at sites distributed along a 42 km reach. *A. heterodon* were bracketed between upstream sites with dilute water chemistry and downstream sites with mobile bed substrates. Summer baseflow chemistry of the upstream reach indicated dilute waters that were unsaturated with respect to aragonite. Although the downstream reach was saturated with respect to aragonite during summer baseflow, steep reaches near the mouth were mobile at bankfull and higher stages which appeared to limit the *A. heterodon*

distribution. Patterns in bed mobility and water chemistry along the length of Flat Brook have created an *A. heterodon* "habitat window" that supports an *A. heterodon* population. This habitat window could expand or narrow due to land-use or climate changes that affect base-flow chemistry or flood magnitudes. ccampbell@usgs.gov

Platform 100 2:40 p.m. March 13, 2013	**DEVELOPMENT OF A PROGRAMMATIC AGREEMENT FOR FEDERAL AND STATE ENDANGERED MUSSELS IN WESTERN PENNSYLVANIA FOR THE PENNSYLVANIA DEPARTMENT OF TRANSPORTATION BRIDGE PROGRAM.** Gregory Zimmerman. EnviroScience, Inc. Stow, OH.

Western Pennsylvania has a large concentration of several globally rare mussels including six federally endangered / threatened species (T&E species). These species are also recognized as endangered under the Pennsylvania code as endangered. Transportation improvement actions such as bridge replacements, culvert extensions/replacements, bridge preservation actions, and FEMA actions are fundamental components of PennDOT's annual portfolio. Conflicts with these species during the execution of these actions have been inevitable given the numbers of bridge structures within this region of the state. The Federal Highway Administration and PennDOT, in coordination with FEMA, the USACE, and PADEP prepared a biological assessment proposing a two-tiered consultation on the effects of PennDOT's Bridge Program over five years. The submitted Tier 1 BA estimated the overall take of the bridge program to T&E species, while subsequent Tier 2 "Mini-BAs" would be prepared for each specific project. The advantage of the two-tiered system for PennDOT was in greatly reduced review times and the flexibility to submit emergency projects. In return, the advantages for the agencies included PennDOT's commitment to standard BMPs and more field surveys in watersheds lacking data. Within the Tier 1 BA, take was determined for each scheduled project, as well as a small number of unplanned projects. PennDOT proposed to implement a different range of measures for avoidance, minimization, conservation and recovery in each of the 5 Management Units. Existing mussel survey data, water quality data, land use, and other physical attributes (e.g. drainage area) were evaluated in a GIS and assigned a Management Unit. The author, who was part of PennDOT's consultant team, will review the BA development process, resulting USFWS Biological Opinion, and current status of the programmatic agreement. gzimmerman@enviroscienceinc.com

SESSION 22	**POPULATION DYNAMICS II Wednesday, March 13, 2013: 1:40-3:00 p.m. Goldenrod Room**
Platform 101 1:40 p.m. March 13, 2013	**POPULATION ASSESSEMENT OF THE ENDANGERED FANSHELL, *CYPROGENIA STEGARIA*, IN THE LICKING RIVER, KENTUCKY, PRIOR TO AND AFTER REMOVAL FROM A FIXED LOCATION.** Monte McGregor[1], Adam Shepard[1], Fritz Vorisek[1], Travis Bailey[1], Chris Owen[1], Jacob Culp[2], Leroy Koch[3]. [1] Kentucky Department of Fisheries and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY; [2]Kentucky Division of Water, Frankfort, KY; [3]US Fish and Wildlife Service, Kentucky Field Office, Frankfort, KY.

Fifty-three species of freshwater mussels have been reported in the Licking River in Kentucky: 44 (83%) are still found today. Ongoing monitoring has discovered recruiting populations of the endangered fanshell, *Cyprogenia stegaria*, at multiple sites in the river. We assessed the natural recovery after removal of individuals from the survey site for a relocation project. In 2007, prior to fanshell removal, we estimated the population size at one site by randomly sampling a 20m x 50m area with 40 meter square grids. Twenty three species and an average of 29.9 mussels/m^2 were collected. Ten species were present at densities > 1.0/m^2 and four species were present at densities > 2.0/m^2: the latter include *Truncilla donaciformis, Elliptio dilatata, Truncilla truncata*, and *Cyprogenia stegaria.* Population estimates for each of these four species ranged from 30,750 to 84,000 (with total numbers for all species estimated at 437,625 mussels). Fanshells were found in 35 samples (densities up to 6/m^2). In 2010, we surveyed a 5 x 5 m area (25 samples) where all mussels were removed, measured, and returned (except the fanshell) to the original grid. Twenty four species and 36.5/m^2 were collected. Ten species were present at densities > 1.0/m^2 and six species were present at densities > 2.0/m^2. Fanshell densities averaged 4.2/m^2 (104 individuals). In 2012, the grid was resurveyed to determine immigration of new individuals of fanshells into the grid. Post survey analysis revealed 24 species (one new species and one undetected) and 32.4 mussels/m^2. While 104 fanshells were removed, which lowered the number to 808-a new density of 32.3/m^2 in 2010, 30 new fanshells immigrated into the grid (28.8% recolonization in 2 years). Total densities of all species were within normal variation over a 5 year monitoring period. monte.mcgregor@ky.gov

Platform 102 **2:00 p.m.** **March 13, 2013**	**CAN AN OPPORTUNISTIC MUSSEL BECOME ENDANGERED? THE CASE OF THE INFLATED HEELSPLITTER IN THE AMITE RIVER.** Kenneth Brown, Wesley Daniel. Department of Biological Sciences, Louisiana State University, Baton Rouge, LA.

We quantitatively sampled the threatened, Inflated Heelsplitter (*Potamilus inflatus*) in the Amite River, Louisiana, USA, and used shell sectioning to study its life history, as well as electrofishing the river to determine the relative abundance of its host fish. Inflated Heelsplitters are currently limited to a 20 Km stretch of the Amite River, east of Baton Rouge, although they are also found in two rivers in northwest Alabama. Densities were estimated as 0.1 m^{-2}, with an aggregated dispersion pattern. Inflated Heelsplitters were the sixth most abundant species out of 15 species found in quantitative samples. Thin sectioning of dead shells indicated Inflated Heelsplitters mature at an age of one year, live for 8 years, and have a high growth rate (K = 0.81/yr). The average life cycle length of 8 other mussels studied in the Amite River is 24 years, and average age at maturity is 3.6 years. Sexual dimorphism may also occur in Inflated Heelsplitters, with males reaching larger sizes. Inflated Heelsplitters have an opportunistic life history strategy (Haag 2012) which is well adapted to flashy rivers and low population densities. It is however a long term brooder, which has been linked to higher chances of extinction (Vaughn 2012). The Freshwater Drum, the host of the Inflated Heelsplitter, was the 17th most abundant out of 44 fish species sampled in the Amite River. Its relatively rare host fish, anthropomorphic disturbances from upstream gravel mining, or increased urbanization of the watershed may also be important in explaining the threatened status of the Inflated Heelsplitter. kmbrown@lsu.edu

Platform 103 **2:20 p.m.** **March 13, 2013**	**LONG-TERM CHANGES IN THE DISTRIBUTION RANGE AND POPULATION SIZE OF TEXAS HORNSHELL *POPENAIAS POPEII.*** Alexander Karatayev[1], Lyubov Burlakova[1], Thomas Miller[2]. [1]Great Lakes Center, Buffalo State College, Buffalo, NY; [2]Environmental Science Center, Laredo Community College, Laredo, TX.

Popenaias popeii, Texas hornshell, is a regional endemic known from the Rio Grande drainage in Texas, the Black River in New Mexico, and several Mexican tributaries of the Rio Grande. This species has been recently added to the state's list of threatened species, and is currently considered as a candidate for listing under the federal Endangered Species Act. During 2001-2013 we sampled over 200 sites in *P. popeii* historical range in Texas using time searches, quadrats, and mark-and-recapture methods. Only one recently dead shell of *P. popeii* was found in the Pecos River, and 11 live mussels in the Devils River. In 2011 we discovered above Laredo (Texas) the largest extant population of *P. popeii* in the lower Rio Grande River (over 8000 live mussels) ever reported from Texas, New Mexico or Mexico. *Popenaias popeii* was most commonly found in crevices under flat boulders, resting on the bedrock. In 2012 mussels were found at an additional 15 sites with suitable substrate in a 70 km stretch of the Rio Grande above Laredo; however, no live *P. popeii* were found in the 50 km stretch of the river below the North Laredo and Nuevo Laredo sewage treatment plants, in spite of an abundance of suitable substrates. Comparison of the current distribution range with the historical data showed that, although the Rio Grande itself still supports the largest population of *P. popeii* ever reported, the species has faced decline in distribution range, range fragmentation, and local extirpations. Several streams and rivers of the Rio Grande drainage have lost *P. popeii*, including Las Moras Creek and the Pecos River. Among the environmental factors responsible for the degradation of unionid assemblages, the most important are impoundments, habitat degradation, salinization, pollution, and water over-extraction. karataay@buffalostate.edu

Platform 104 **2:40 p.m.** **March 13, 2013**	**ASSESSING POPULATION AND HABITAT VIABILITY OF DWARF WEDGEMUSSEL (*ALASMIDONTA HETERODON*) IN SWIFT CREEK, ASSOCIATED WITH SECTION 7 CONSULTATION FOR A MAJOR HIGHWAY PROJECT IN NORTH CAROLINA.** Tim Savidge, Tom Dickinson. The Catena Group Inc., Hillsborough, NC.

The Triangle Expressway, a proposed toll road on new location, will be the final section of an outer loop around the Raleigh Metropolitan area of North Carolina. The road will impact Swift Creek, a major tributary of the Neuse River Basin, which supports the federally endangered Dwarf Wedgemussel (*Alasmidonta heterodon*), a population that has been identified as essential for the recovery of this species. The Swift Creek watershed has experienced fairly rapid urbanization in the last 20 years. As a result, the population has been reported to be in decline, and its long term viability has been in question. However, nearly all of the population data was generated from "informal" sampling designs, which are generally considered to be ineffective for evaluating population trends. Further, the species appears to have always been rare in the stream since it was first discovered in 1991. To address these issues, a probability-based design to generate detection probabilities was developed to evaluate population trends of all 17 mussel species that occur in Swift Creek. Quantitative in-stream habitat measurements to characterize habitat suitability were also incorporated into the study. Preliminary results demonstrate that while

there is an overall declining trend for most species in the stream, the Dwarf Wedgemussel continues to persist in low numbers; and there is evidence of recent reproduction and recruitment. The habitat component of the study demonstrates that while some sections of Swift Creek have significant levels of degradation, pockets of high quality habitat remain throughout. tsavidge@thecatenagroup.com

SESSION 23	RECOVERY III Wednesday, March 13, 2013 | 3:20-5:00 p.m. Camellia Room
Platform 105 3:20 p.m. March 13, 2013	**MUSSEL RESTORATION IN THE LOWER OSAGE RIVER.** Bryan Simmons[1,4], Andy Roberts[1], Tracy Divis[2], Stephen McMurray[3], Chris Barnhart[4]. US Fish and Wildlife Service, Columbia, MO; [2]Kansas City Zoo, Kansas City, MO; [3]Missouri Department of Conservation, Columbia, MO; [4]Missouri State University, Department of Biological Sciences, Springfield, MO.

The Lower Osage River Protection and Enhancement Program was established by the U.S. Fish and Wildlife Service, AmerenMissouri, and the Missouri Department of Conservation, as part of a Settlement Agreement filed with the Federal Energy Regulatory Commission. This agreement was written into AmerenMissouri's new project license for operation of Bagnell Dam, issued by FERC in 2007. New license articles included conservation enhancements for the lower Osage River including improved minimum flows, dissolved oxygen, flow ramp-down rates, fish protection measures at the dam, mussel and fish propagation, erosion control, mussel monitoring and habitat restoration to occur within the 80 miles below Bagnell Dam (Lake of the Ozarks). In this program's initial stages, we are developing and expanding mussel propagation facilities at Missouri State University and the Kansas City Zoo. Propagation and initial culture takes place in laboratory systems at Missouri State, with subsequent grow-out in raceway upwellers at the Zoo. These upweller systems, utilizing lagoon water as a source of food, have been highly successful in producing rapid growth and high survivorship with minimal maintenance and expense. Over 12,000 federally endangered pink mucket (*Lampsilis abrupta*) were cultured in 2011-12 and released in the lower Osage River upon reaching 3-6 cm. Each mussel was laser engraved with a unique identification number and systematically placed in gridded release plots to facilitate monitoring of survivorship, growth and movements. Preliminary monitoring of mussels released in 2011 resulted in 82% recovery after 9 months. Several thousand federally endangered scaleshell (*Leptodea leptodon*) were also produced in 2010 and 2011 and await stocking pending ongoing genetic studies. Bryan_Simmons@fws.gov

Platform 106 3:40 p.m. March 13, 2013	**CONSERVATION AND RESTORATION OF EUROPEAN FRESHWATER MUSSEL POPULATIONS.** Jurgen Geist. Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technische Universitaet Muenchen, Freising, Germany.

Freshwater mussels are in decline throughout their ranges and several measures have been initiated to conserve and restore their populations in Europe. Conservation management has to take difficult decisions concerning the definition of conservation targets, prioritization of populations, and the selection of appropriate conservation measures. This contribution compares the factors determining successful and unsuccessful conservation and restoration measures in European freshwater mussel habitats. It also suggests how conservation and restoration efforts may become more effective in the future. Currently, efforts largely vary in terms of intensity, scale and duration, and they include approaches from artificial culturing of specific populations in ark projects to restoration of entire catchment areas. This contribution proposes a step-wise conservation and restoration approach which includes the long-term objective of reestablishing functional priority populations by catchment management and habitat quality improvement, as well as remediation action such as supportive breeding. This integrative approach requires the integration and combination of genetic, ecological and socioeconomic aspects as well as evaluation and adaptive management. An assessment of past conservation and restoration projects suggest that failure or limited success are often associated with poor definition of conservation targets, exclusion of scientific evaluation criteria or important stakeholders, as well as with limited duration of conservation action. Out of the European freshwater mussel restoration projects, only those addressing catchment processes can be considered successful. Limited knowledge on the habitat requirements of mussel species other than the freshwater pearl mussel (*Margaritifera margaritifera*) and the thick-shelled river mussel (*Unio crassus*) as well as limited public interest and funding currently hamper successful conservation and restoration for the majority of European Unionids. geist@wzw.tum.de

Platform 107 **4:00 p.m.** **March 13, 2013**	**PROPAGATION, RELEASE, AND MONITORING OF MUSSELS TO RESTORE POPULATIONS IN THE CLINCH AND POWELL RIVERS, TENNESSEE AND VIRGINIA.** Dan Hua[1,3], Jess Jones[1,2,3], Tim Lane[1,3], Yan Jiao[3], Richard Neves[1,3]. [1]Freshwater Mollusk Conservation Center, [2]US Fish and Wildlife Service, [3]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA.

The recent success in developing propagation and grow-out technology for an increasing number of mussel species has proven to be a feasible approach to augment and reintroduce populations. Larger-sized (20-40 mm) juvenile and sub-adult mussels of 13 species have been propagated and cultured at the Freshwater Mollusk Conservation Center. A range of cost-effective methods was used to culture 15,000-30,000 juveniles to tag-able size (>15-20 mm) for annual release. These methods included an open-water recirculating system utilizing pond water, a closed-recirculating aquaculture system (RAS) utilizing 20-gallon glass aquaria with sediment (1-2 mm) filled bottoms, and a Barnhart bucket system with continuous feeding technology. The survival and growth rates of juvenile mussels varied among culture systems, and were likely affected by different environmental factors, such as food supply, water quality, and invertebrate predators. Juvenile mussels had the greatest growth rate in open-water recirculating systems with a direct supply of pond water, and the greater survival rates in the RAS and bucket systems with a continuous algae supply. During the last two years, a total of 27,000 sub-adult mussels have been released at 13 sites in the Clinch and Powell rivers in Tennessee and Virginia. Release and monitoring methods include holding mussels in cages and silos, and releasing mussels with PIT tags. Released PIT-tagged sub-adults of *Epioblasma brevidens* exhibited fast growth (average increment of 22.2 mm in two years) and high survival rate (>95%) with high recapture rate (>95%). huad@vt.edu

Platform 108 **4:20 p.m.** **March 13, 2013**	**REDISCOVERY OF THE FEDERALLY ENDANGERED ALABAMA LAMPMUSSEL (LAMPSILIS VIRESCENS) IN EMORY RIVER, MORGAN COUNTY, TENNESSEE.** Gerald Dinkins, Hugh Faust, Steven Ahlstedt. Dinkins Biological Consulting LLC, Powell, TN.

On 4 April 2011, while searching for the federally endangered Purple Bean (*Villosa perpurpurea*) in the upper Emory River near the community of Gobey, Morgan County, Tennessee, two live individuals of the federally endangered Alabama Lampmussel (*Lampsilis virescens*) were collected, photographed, and returned alive to the river channel where they had been found. The U.S. Fish and Wildlife Service was contacted immediately, and on 11 May 2011, a team of researchers from Dinkins Biological Consulting and the U.S. Fish and Wildlife Service, accompanied by representatives of The Nature Conservancy, convened at the site to collect additional specimens and obtain non-invasive tissue swab samples. Three live individuals were collected and swab samples were taken. These samples were sent to the Conservation Genetics Laboratory at the U.S. Fish and Wildlife Service's Warm Springs Fish Technology Center. At the laboratory, DNA was extracted from the tissue swabs using standard organic extraction procedures, and the results were compared to DNA obtained from *L. virescens* propagated from individuals collected from the Paint Rock River, Alabama. The DNA analysis confirmed the previous identification. This discovery was the first confirmed collection of *L. virescens* in the upper Emory River system since the late 1920's. In response to this discovery, The Nature Conservancy funded a survey to assess the presence and status of *L. virescens* in the upper Emory River drainage, defined herein as the Emory River drainage upstream of the confluence with the Obed River. This assessment included the main channel Emory River and the lower reaches of the upper Emory River's three largest tributaries: Rock, Greasy, and Campground creeks. biodink@frontiernet.net

Platform 109 **4:40 p.m.** **March 13, 2013**	**REINTRODUCTION OF *LAMPSILIS VIRESCENS* (ALABAMA LAMPMUSSEL) INTO THREE MIDDLE TENNESSEE RIVER BASIN TRIBUTARIES – AN EXAMPLE OF FRESHWATER MUSSEL RECOVERY.** Todd Fobian[1], Michael Buntin[1], Jeff Powell[2], Don Hubbs[3], Jeff Garner[1], Paul Johnson[1]. [1]Alabama Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, AL; US Fish and Wildlife Service, Daphne, AL; [3]Tennessee Wildlife Resources Agency, Camden, TN.

Lampsilis virescens (Lea, 1858), Alabama Lampmussel, was listed as endangered by the USFWS in June 1976. A middle Tennessee River Basin endemic, *L. virescens* historically ranged from the lower Clinch River to the lower end of Muscle Shoals in northwestern Alabama. It was previously believed to have been reduced to one population in upper Paint Rock River system, Jackson Co., Alabama. In 2010, a previously undetected population of *L. virescens* was discovered in the upper Emory River (Morgan Co., Tennessee). However, the species occupies a total ≈ 32 km of stream distance and both populations are apparently small, with only a few live individuals recovered at each locality in the last decade. State resource agencies (ADCNR and TWRA) and USFWS (Cumberlandian Region Mollusk Restoration Committee) have identified *L. virescens* as a priority for recovery through artificial propagation and reintroduction. Initiated in 2010, this recovery effort has successfully propagated and reintroduced 10,361 *L. virescens* to six separate localities in three

different Tennessee River tributaries. Reintroduction site selection followed flow restorations in both the Elk River and Bear Creek in 2007. Additional reintroduction activities were carried out in the lower Paint Rock River, where habitat restorations have been ongoing for more than a decade. Paint Rock reintroductions were > 30 km down river from extant populations. Visual monitoring of tagged mussels was completed after 1-year. Timed searches verified survivorship and growth for reintroduced mussels at all reintroduction sites. Additional stockings were completed / planned in an effort to establish self-sustaining populations and improve genetic diversity. Another tributary, Limestone Creek (Limestone Co., Alabama) is under consideration for *L. virescens* reintroduction. These efforts are intended to establish viable populations outside of the upper Paint Rock and Emory systems. The USFWS recovery plan stipulates that five persisting populations are required for species down-listing. Todd.Fobian@dcnr.alabama.gov

SESSION 24	BIOLOGY III Wednesday, March 13, 2013 | 3:20-5:00 p.m. Goldenrod Room
Platform 110 3:20 p.m. March 13, 2013	**PATTERNS IN FISH PREDATION ON ZEBRA MUSSELS (*DREISSENA POLYMORPHA*) IN THE LOWER ST. CROIX RIVER.** Steve Zigler[1], Michelle Bartsch[1], Lynn Bartsch[1], William Richardson[1], Byron Karns[2], Brenda Moraska Lafrancois[3]. [1]US Geological Survey, Upper Midwest Environmental Sciences Center. La Crosse, WI. [2]National Park Service, St. Croix Falls; [3]National Park Service, St. Croix Watershed Research Station, St. Croix, MN.

Zebra mussels (*Dreissena polymorpha*) threaten native mussel populations in the St. Croix National Scenic Riverway (SACN). However, benthivorous fish may use zebra mussels as a food source, thereby potentially decreasing zebra mussel colonization within this system. As part of a larger study to assess potential threat and control of zebra mussels in the SACN, we sampled benthivorous fish species for gut analyses in each of the four sub-basins in the lower St Croix River. Fish were sampled using electrofishing and gill nets at 3 locations in each sub-basin during daylight hours during one week in June, August, and October 2010 and in August 2011. Captured fish were euthanized by a blow to the head, and digestive tracts were excised and preserved in ethanol. In 2010, common carp (*Cyprinus carpio*), freshwater drum (*Aplodinotus grunniens*), quillback carpsucker (*Carpiodes cyprinus*), bluegill (*Lepomis macrochirus*), shorthead redhorse (*Moxostoma macrolepidotum*), silver redhorse (*M. anisurum*), and golden redhorse (*M. erythrurum*) were all confirmed to prey on zebra mussels. However, zebra mussels only constituted a significant portion of the diet volume of common carp (36%), freshwater drum (36%), and shorthead redhorse (16%). The proportion of benthivorous fish consuming zebra mussels decreased in a gradient from downstream to upstream reaches in 2010. In 2011, only common carp, freshwater drum and golden redhorse had zebra mussels present in their diet, and consumption of zebra mussels was an inconsequential portion (<5% volume) of the diet of all species in all basins. This shift in the diets of benthivorous fish may be related to high discharge during that year and a decline in the zebra mussel population in the SACN. szigler@usgs.gov

Platform 111 3:40 p.m. March 13, 2013	**LANDMARK ANALYSIS OF SHELL MORPHOLOGY IN SILT SNAILS OF THE GENUS FLORIDOBIA.** Timothy Roberts[1], Jason Bond[2], Alicia Schultheis[1]. [1]Biology Department, Stetson University, DeLand, FL; [2]Department of Biological Sciences and Auburn University Museum of Natural History, Auburn University, Auburn, AL.

The genus Floridobia comprises a group of freshwater hydrobiid gastropods endemic to Florida. Eleven of the 13 species in the genus are recorded from a single freshwater spring. Floridobia species were described based on shell and verge morphology and grouped into the floridana or vanhyningi species group based on these characters. Preliminary studies using the mitochondrial COI gene found little molecular divergence between species. The objective of our study was to analyze the shell structures using geometric morphometric analysis (landmark analysis). We compared Type I and II landmark features of twelve different species within the genus using MorphoJ software. Due to the plasticity of shell shape in mollusks, we hypothesized that shell characters would not provide a reliable characteristic for species delimitation. The landmark data led to surprisingly accurate discrimination between individuals within the floridana group. Members of the vanhyningi group were not as easily distinguished, which is understandable since these species were partially described using genital morphology. However, landmark analyses did differentiate between the two different groups of species. This suggests that although shell shape may provide a tool for specimen identification, at least in the floridana group, it may not provide an accurate guide to phylogeny. aschulth@stetson.edu

Platform 112 4:00 p.m. March 13, 2013	**THIRTY YEARS LATER, HOW ARE THE MUSSELS DOING IN TWELVE-POLE CREEK, WV?** Thomas Jones, Erica Thompson, Nathan Hoxie. Marshall University, Integrated Science and Technology, Huntington WV.

In 1980, 28 sites on Twelve-Pole Creek were sampled for freshwater mussels as a portion of a thesis. Sampling techniques included bank walking, handpicking, snorkeling, brailing, clam raking, and limited SCUBA. Twenty-three species of mussels were located in the watershed. Each species was listed as rare, moderately common or common by site. Four sites had eight or more species with an average of 3.6 species per site. In 2010/2011, 25 historical sites were revisited for a one hour timed search using snorkeling, bank walking, and hand picking. Thirteen species were located at the sites, all in low numbers. The mean number of species per site fell to 2.4. *Corbicula fluminea* was the only species found alive in 14 of 25 sites. Many of the other sites exhibited no recent reproduction with very large, highly eroded living individuals or only dead shells. Based on very brief habitat descriptions we see some evidence of conversion of riffle-run habitat into sand dominated streams. An additional data set was collected on first to third order streams by West Virginia Department of Environmental Protection. Fifteen years of data collection with three distinct randomly sampled events, show an increasing quality to the watershed by both habitat measures and benthic invertebrates. To exclude a site bias a second set of 30 randomly selected sites were sampled. That data supported the widespread loss of species and numbers within the watershed. Does current biomonitoring protocols miss the continued, widespread loss of mussel diversity in 4th order to great river habitats?
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Platform 113 **4:20 p.m.** **March 13, 2013**	**LOOK BEFORE YOU LEAP: NEW INFORMATION ON HABIAT AND HOST FISH REQUIREMENTS OF *UNIO* CRASSUS IMPLIES NEW CONSERVATION MANAGEMENT PRACTICES.** Katharina Stöckl, Jürgen Geist. Aquatic Systems Biology Unit, Department of Ecology and Ecosystem Management, Technische Universität München, Freising, Germany.

The thick shelled river mussel *Unio crassus* is one of the most endangered large freshwater bivalve species in Central Europe. To date, the main factors for the dramatic decline still remain unclear, owing to a lack of information on the autecological and synecological requirements of the species. Herein, we present an integrative approach to identify key habitat parameters of Unionoid freshwater bivalves and to assess the host fish suitability of different fish species, using the example of *U. crassus.* Physicochemical substratum and water quality was measured in a stream with recent recovery and recruitment of the *U. crassus* population, using cost-effective and fast tools such as sediment traps and vacuum syringes for withdrawal of interstitial water. Host fish suitability was assessed in artificial infestation experiments using different fish species. At the same time, fish communities in functional *U. crassus* populations were examined to test host availability under natural conditions. The results in this study suggest that *U. crassus* is more tolerant to eutrophic habitat conditions than previously expected. Fine sediment deposition was high with 19.4 kg/m^2*month at sites with juvenile recruitment. Redox potentials in the interstitial zone varied around 300 mV in functional stream sites, which constitutes the boundary value between oxic and anoxic conditions. Results of chemical water analyses indicated high nitrogen loads in a range of 4.1 to 6.5 mg NO3-N/l. The laboratory infestations identified 7 host fish species for *U. crassus*, with host specific glochidial development times. In natural *U. crassus* streams, sixteen fish species were found and fish community structure and densities were highly variable. Consequently, the evaluation of host fish requires the inclusion of standardized laboratory experiments and field validation. The greater tolerance of *U. crassus* to adverse substratum and water chemical conditions suggests that conservation management should more strongly emphasize fisheries management. Katharina.Stoeckl@mytum.de

Platform 114 **4:40 p.m.** **March 13, 2012**	**ASSESSING THE EFFECT OF OIL AND GAS WELL WASTEWATER DISCHARGES ON ENDANGERED FRESHWATER MUSSELS.** Kathleen Patnode[1], Robert Anderson[1], Lora Zimmerman[1], Elizabeth Hittle[2]. [1]US Fish and Wildlife Service, Pennsylvania Field Office, State College, PA; [2]US Geological Survey, Pennsylvania Water Science Center, Pittsburgh, PA.

Advances in drilling technology and high energy prices have exponentially increased the extraction of natural gas from previously unexplored watersheds with mussel habitat. In Pennsylvania, millions of gallons of wastewater (often referred to as brinewater) from oil and gas drilling have been discharged to streams and rivers through waste treatment facilities that are not equipped to treat the high salinity wastewater. The potential effects of this discharge on freshwater mussels have not been fully considered. The USFWS, EPA, and USGS designed a multi-pronged study to assess potential effects of treated natural gas wastewater on the freshwater mussel fauna in the Allegheny River, Pennsylvania. Water quality parameters, river hydraulics, mussel fauna abundance and distribution, and in-situ toxicity of wastewater effluent on juvenile Northern riffleshell *(Epioblasma torulosa rangiana)* were evaluated to determine the potential impacts and extent of the affected area downstream of a brinewater treatment facility. The triad approach (physical and chemical characterization of the surface water, in situ toxicity testing, and mussel surveys) provided definitive evidence that treatment methods at facilities accepting gas drilling wastewater are not adequate to protect freshwater mussels, including endangered species. lora_zimmerman@fws.gov

FMCS 2013 GUNTERSVILLE SYMPOSIUM POSTER SESSION

Grand Ballroom – Guntersville State Park

Sunday March 10 – Monday March 11, 2013

Author's Present 6:00 – 9:00 p.m.- Monday, March 11, 2013

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

Poster 1 *Student Poster*	**IS POPULATION FRAGMENTATION OCCURING WITHIN SOUTHEASTERN STREAMS BISECTED BY SMALL DAMS?** Erin Abernethy, Erin Singer, Lynn Siefferman, Michael Gangloff. Appalachian State University, Department of Biology, Appalachian State University, Boone, NC.

Freshwater mussel declines are believed to be strongly linked to dam construction. Dams alter stream habitats, form migration barriers, and have contributed to widespread extinction of mussels in the Southeastern U.S. However, few studies have assessed the impact of dams on freshwater mussel gene flow. We examined mussel gene flow patterns in 2 small streams with >150 y old mill dams. If the focal dams act as barriers, we predicted that haplotype segregation and low gene flow between mussel populations up and downstream of the dams should occur. Using fragments of the mitochondrial ND1 and CO1 genes, we examined the genetic structure of populations of *Elliptio arca* and *Elliptio complanata* in Alabama and North Carolina. We found very few haplotypes were restricted to reaches up or downstream from the dams. High gene flow and interbreeding parameters suggest that these small dams have a minimal effect on freshwater mussel population genetic structure. Our data indicate that relatively little genetic divergence has occurred between these populations despite substantial temporal isolation. Because these dams are small (height <5 m), they are attractive targets for stream restoration projects, but increasing evidence suggests these dams may enhance freshwater mussel population persistence and growth rate. Our study coupled with this recent research suggests that some dams should be passed over for removal in favor of more clearly detrimental structures. Limited conservation resources may be better spent on maintaining or improving water quality, designation and protection of critical habitat, and control of invasive species in these rural Piedmont catchments.

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Poster 2 *Student Poster*	**MORTALITY OF FAUCET SNAILS EXPOSED TO FREEZING.** Sabin Adams[1], Jared House[1], Charlotte Roy[2]. [1]Department of Biology, Bemidji State University, Bemidji, MN; [2]Bemidji State University, Department of Natural Resources, Bemidji, MN.

The faucet snail, *Bithynia tentaculata,* is an invasive species that acts as an intermediate host for many digenetic trematodes which pose a threat to North American waterfowl. The faucet snail can resist desiccation in dry containers for >7 days and in mud for more than a month, increasing the risk of transport of viable organisms among water bodies. To prevent spread to new water bodies, proper decontamination is essential for equipment used in infested waters. Currently accepted methods of decontamination involve exposing equipment to water heated to 50°C for 1 minute, or exposure to Hydrothol 191 for 24 hours, both of which may not be practical for the average recreational boater and some types of equipment. Many individuals however, have access to large freezers where equipment could be placed for decontamination. The objective of this study was to determine the amount of time needed to achieve 100% mortality of faucet snails in and out of water at -5 ± 3°C. Snails were subjected to four time period treatments (10, 30, 60, and 120 min) within the freezer. Our results show that 100% mortality is achieved for snails outside of water for all time period treatments, compared to 11% mortality in control snails not subjected to freezing. Snails placed in water had 99% mortality in the 60 and 120 min time periods, but lower mortality in other treatments. Results indicated that in order to kill all faucet snails, equipment should be dried and placed in a freezer for a minimum of 10 min or wet equipment should be frozen longer.

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Poster 3 *Student Poster*	**POPULATION GENETIC ANALYSES REVEAL POTENTIAL MICRO-ENDEMISM IN "*PHYSA ACUTA*" IN A CHIHUAHUAN DESERT SPRING SYSTEM.** Kofi Ansah[1], Kentaro Inoue[2], Makiri Sei[2], Brian Lang[3], David Berg[1]. [1] Department of Zoology, Miami University, Hamilton, OH;[2] Department of Zoology, Miami University, Oxford, OH; [3] New Mexico Department of Game and Fish, Santa Fe, NM.

The Chihuahuan Desert is one of the most biologically diverse arid regions in the World. Spring systems in this area harbor many endemic species. Previous studies have shown that each spring system has unique evolutionary entities. We used a wide-ranging snail, *Physa acuta,* to investigate the unique spring communities in this region. The objective of this study is to examine local and regional population genetic structure of *Physa* in the northern Chihuahuan Desert. We analyzed two populations from Bitter Lake National

Wildlife Refuge (BLNWR), Roswell, New Mexico and three populations from the Toyah Basin near Balmorhea, Texas, using eight microsatellite loci. We examined 16 individuals from each population. We quantified genetic diversity within populations and conducted an analysis of molecular variance (AMOVA) to determine genetic partitioning among regions. The mean allelic richness and observed heterozygosity for BLNWR populations was higher than in the Toyah Basin populations. The inbreeding coefficient was higher in the Toyah Basin populations than BLNWR populations. AMOVA revealed that 17.4% of genetic variation was found between regions and 12.5% of genetic variation among populations. A Mantel test revealed that there is isolation by distance. Although *Physa acuta* is widespread globally, our analyses suggested that isolated springs in this area likely harbor undescribed endemic *Physa* species and high genetic differentiation between the two regions. Additional taxonomic studies are required to understand patterns of endemism of this widespread snail group in the Pecos River basin.

Poster 4 *Student Poster*	**THERMAL SENSITIVITY OF FRESHWATER MUSSELS: INCORPORATING BENTHIC ECOLOGY INTO LABORATORY MESOCOSM EXPERIMENTS.** Jennifer Archambault[1], Gregory Cope[2], Thomas Kwak[3]. [1] North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, NC State University, Raleigh, NC; [2] Department of Environmental and Molecular Toxicology, NC State University, Raleigh, NC; [3] US Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, NC State University, Raleigh, NC.

Quantitative information on lethal temperatures (LT) to native freshwater mussels (Order Unionida) is currently limited to approximately 10 species, and these few studies have been restricted to the water-only standard method for toxicity testing. Results of these prior studies indicate that some species may be living near their upper thermal tolerances; however, evaluation of the thermal sensitivity of these benthic organisms has never been conducted in sediment. Thus, we sought to increase the ecological realism of laboratory exposures of freshwater mussels to acute thermal stress by including factors that affect mussels in natural systems, including sediment, flow regime, and a vertical thermal gradient. We developed a method for assessing thermal sensitivity of freshwater mussels in sediment, and, using these testing protocols, evaluated the relative sensitivities of juveniles of four species (*Amblema plicata, Lampsilis abrupta, Lampsilis cariosa,* and *Lampsilis siliquoidea*) and adults of one species (*Lampsilis fasciola*) to a range of temperatures common during summer in streams with low flow and drought conditions, using two temperature acclimation (22 and 27°C) and surrogate flow regimes (low water and dewatered treatments). We then added a vertical temperature gradient to the sediment and evaluated the thermal sensitivities of two species (*Lampsilis abrupta* and *Lampsilis radiata*). Acute (96-h) median lethal temperatures (LT50s) ranged from 29.9 to 37.2°C, with a grand mean of 34.8°C, indicating a narrow range of upper thermal sensitivity, regardless of test type, species, life stage, or conservation status. LT50s from sediment tests generally did not differ from water-only tests, suggesting that any stream thermal refuge would emanate from other ecological or physical habitat interactions. Our findings suggest that rising stream temperatures and altered hydrologic flows from climate change and other anthropogenic factors may directly impact freshwater mussel diversity. jmarcham@ncsu.edu

Poster 5	**VARIABILITY IN ABIOTIC AND BIOTIC CONDITIONS IN STREAMS WITH IMPERILED MUSSELS AND DIVERSE ASSEMBLAGES IN MARYLAND.** Matthew Ashton. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD.

Much of the focus in freshwater mussel ecology has centered on factors that explain species distribution and potential causes of their decline over spatial gradients. Less attention has been paid to understanding the temporal dynamics of streams with abundant populations, diverse assemblages, and imperiled species. The variability in physiochemical and biological data was examined in six streams that arguably have the most important unionid resources in Maryland. The coefficient of variation for physiochemical variables and biological communities was predominantly low (<25%) over a six year period, even though climatic patterns (seasonal Palmer Drought Severity Index) were quite variable. Host richness and abundance were also stable over time. Nutrient concentration, discharge, and discharge-dependent habitat metrics (e.g., riffle-run quality) exhibited the greatest annual variability. These changes were correlated with the direction and magnitude of PDSI. Multiple measures indicated that the physiochemical conditions and living resources found in study area streams were of high quality and conservation status. Overall, these streams exhibited relatively little change in their abiotic and biotic conditions, in spite of multiple stochastic events. These findings provide a quantitative baseline for a suite of stressors to aquatic life measured in streams with diverse and abundant freshwater mussel populations. Pairing mussel surveys with stream ecological assessments would increase the power of such analyses to understand physiochemical and biological drivers of mussel population dynamics and better define conditions correlated with the persistence of their populations.
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Poster 6	**CONDITIONS IN THE PATAPSCO RIVER FOLLOWING THE DAM REMOVAL: ARE THEY SUITABLE FOR REINTRODUCTION OF EASTERN ELLIPTIO?** Matthew Ashton, William Harbold, Jay Kilian, Scott Stranko. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD.

Dam removal is increasingly being employed to restore stream ecosystems. This is particularly true where dams block migratory fishes, some of which are hosts for unionid mussels in their reproductive cycle. Still, the effects of dams and their removal on mussels are poorly understood. We examined associations in host-fish (American eel) and physiochemical variables among dam removal sites in the Patapsco River, Maryland and nearby streams where *Elliptio complanata* was present and apparently absent. Although improving fish passage was a main objective of the dam removal, pre- and post-removal eel densities were comparable to each other and to densities in streams with *E. complanata*. Using principal components analysis, we identified a subset of variables that accounted for 73% of the variation in abiotic conditions across sites with *E. complanata*. We used these variables to examine patterns among stream classes (sites with and without *E. complanata*, pre- and post-dam removal sites). Physical habitat metrics best explained the variation (66%) in abiotic conditions across stream classes. However, substantial overlap among classes indicated that habitat metrics could not account for the distributional patterns of *E. complanata*. Post-hoc ANOVAs of standardized PC scores further supported this hypothesis. We could not ascertain whether dam removal made conditions in the Patapsco River suitable for *E. complanata*, because the variables we examined did not differ after dam removal when compared to streams with mussels. However, dam removal may allow host-fish to disperse into areas where abiotic conditions are currently suitable for other mussels. Poor water quality (high specific conductance) often associated with urbanization and low American eel density seemed to influence the distribution of *E. complanata* in Piedmont streams of Maryland. This study also highlights the need to conduct adequate pre-removal monitoring to set appropriate objectives. mashton@dnr.state.md.us

Poster 7	**METHODS FOR CULTURE AND PROPAGATION OF THE BLACK SANDSHELL AND ENDANGERED PINK MUCKET FOR RESTORATION IN THE GREEN RIVER, KY.** Travis Bailey[1], Adam Shepard[1], Monte McGregor[1], Ben Davis[1], Fritz Vorisek[1], Jacob Culp[1], Bob Carson[2], Leroy Koch[3]. [1]KDFWR, Center for Mollusk Conservation, Frankfort, KY; [2]Mammoth Cave National Park, Mammoth Cave, KY; [3]US Fish and Wildlife Service, Frankfort, KY.

The Green River in Kentucky is home to 71 species of freshwater mussels, 11 of which are currently federally endangered. In 2011 and 2012, the Center for Mollusk Conservation (CMC) initiated propagation efforts with the endangered pink mucket (*Lampsilis abrupta*), and the non-listed black sandshell (*Ligumia recta*) for augmentation in the Green river. The pink mucket glochidia were obtained from the Tennessee River and brought to the CMC. The glochidia were infested on 275 largemouth bass (*Micropterus salmoides*). Black sandshell adult females were collected from the Green river near Munfordville, KY and brought back to the CMC. Glochidia were extracted from the black sandshell and pipetted on the gills of 3 sauger (*Sander canadensis*). For initial grow out, all juveniles were held in Barnhart "mucket bucket" systems and were fed a diet of marine and freshwater algae. After mussels reached 4-6 mm in length, they were transferred to a re-circulating bowl system. The bowl system consists of 14 five liter bowls that have been partially filled with pool sand. Each bowl has a 3 L/minute flow and a center stand pipe. The 416 liter oval sump has 2 power heads, a chiller, heater, and water supply. Water is exchanged 20% of total volume per day and the system is fed a diet of cultured algae. When the mussels reached a size of 12mm or greater in length, they were tagged. On September 14, 2012, both species were released at two sites in the Green River. Two hundred sixteen pink muckets (avg. length ~14.0 mm) and 82 black sandshells (avg. length ~22.9 mm) were released upstream of Mammoth Cave National Park. One hundred six pink muckets (avg. length ~14.4 mm) and 99 black sandshells (avg. length ~22.9 mm) were released in the Green River in Mammoth Cave National Park. travis.bailey@ky.gov

Poster 8	**RECENT PRECIPITOUS DECLINES OF FRESHWATER MUSSELS IN THE CLINCH RIVER: INFLUENCE OF SEDIMENT AND WATER QUALITY STRESSORS.** Christine Bergeron[1], Matthew Johnson[2], Angela White[3], Jennifer Rogers[2], Peter Lazaro[4], Jess Jones[5], Braven Beaty[6], Brain Evans[7], Steven Alexander[8], Gregory Cope[1]. [1]Department of Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC; [2]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [3]North Carolina Cooperative Fish and Wildlife Research Unit, North Carolina State University, Raleigh, NC; [4]Department of Biology, North Carolina State University, Raleigh, NC; [5]U.S. Fish and Wildlife Service, Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [6]The Nature Conservancy, Abingdon, VA; [7]US Fish and Wildlife Service, Abingdon, VA; [8]US Fish and Wildlife Service, Cookeville, TN.

The Clinch River watershed of Virginia and Tennessee supports one of the nation's greatest concentrations of freshwater biodiversity, but agricultural and mining practices, development, spills, and other anthropogenic activities have degraded habitat and water quality. Mussel populations in this watershed have declined in both species richness and

abundance, and there is a critical need to investigate the effects of chemical and physical habitat alterations. The overarching goal of this research is to understand the causes of ongoing declines and reduce the stressors adversely impacting imperiled mussels and their habitat by characterizing contaminants (metals and organics) and nutrients at mainstem and tributary sites. Our study began in June 2012 by deploying *in situ* juvenile mussels (~15 mm total length *Villosa iris*) in cages and silos at eight mainstem and four tributary sites (silos only), which span a range of population impact. Throughout the growing season, we collected samples for contaminant analyses in surface water, sediment, and adult resident mussel tissue. In October 2012, we retrieved the *in situ* juvenile mussels to determine survival, growth, and contaminant body burden. Passive sampling devices (PSD) deployed during July/August 2012 were analyzed for 48 current use pesticides, 28 chlorinated pesticides, 21 polychlorinated biphenyls (PCBs), and 50 polycyclic aromatic hydrocarbons (PAHs). Concentrations of analytes detected were generally near or below the quantitation limits. Juvenile mussel survival ranged from 50-95% in cages and from 88-99% in silos. These preliminary data on contaminant analyses in water, sediment, and mussel tissue will be used to inform toxicity tests with juvenile mussels planned for 2013. cmbergero@ncsu.edu

Poster 9
Student Poster

INFLUENCES OF STREAM GEOMORPHOLOGY ON MUSSEL ASSEMBLAGES IN THE DARBY BASIN, OH: CONSERVATION AND MANAGEMENT IMPLICATIONS

Clarissa Bey, Mazeika Sullivan. School of Natural Resources, The Ohio State University, Columbus, OH.

Freshwater mussels are currently recognized by the US Fish and Wildlife Service as the most imperiled group of animals in North America. A suite of individual biological, chemical, geographic, and physical characteristics of a stream and its watershed is known to influence mussel assemblages. However, comparatively little is known relative to the role of the composite effects of local-scale stream geomorphic characteristics and processes in structuring mussel communities. To that end, we conducted coordinated geomorphic-biotic surveys at ten paired study reaches in Big Darby Creek, OH (2011-2012). Each pair represented a high-quality and low-quality riffle-pool interfaces (RPIs). Geomorphic surveys included longitudinal and cross-sectional profiles, pebble counts, embeddedness, turbidity, and flow velocity. Mussels were sampled using a quantitative stratified survey. Our preliminary results indicate a significant difference in mussel densities between high-quality and low-quality RPIs. Substrate composition appears to be partly driving this relationship, whereby negative fines and sand were negatively related to mussel density (R^2 = 0.25, F = 6.05, p < 0.024). Channel dimensions and shear stress also influenced mussel richness (R^2 =0.14, F = 3.18, p < 0.09). Our work builds current understanding of geomorphic-biotic linkages in streams and we anticipate that our results will help inform conservation and reintroduction efforts in the region. bey.22@osu.edu

Poster 10
Student Poster

HOST FISH SUITABILTY TESTS AND FRAGMENTATION ASSESSMENT FOR SNUFFBOX, *EPIOBLASMA TRIQUETRA*, FROM LAURENTIAN GREAT LAKES BASINS.

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Freshwater mussel populations have declined through increased fragmentation of habitat (e.g., construction of dams and introduction of invasive species) and changes in host communities. With an increasing number of state and federally listed mussels, host fish suitability information and understanding how fragmentation influences host and mussel distribution can help direct management practices. This study will test if the origin of host fish impacts the number of successful transformations of juvenile mussels. Recent research shows that there are multiple species of mussels that exhibit two genetically distinct populations in lower Michigan: the Lake Erie basin and the lakes Michigan and Huron basins. The main objective of our study is to quantitatively determine if logperch, *Percina caprodes,* and blackside darters, *Percina maculata*, from the Michigan, Erie and Huron basins are equally suitable hosts for the snuffbox, *Epioblasma triquetra.* An additional goal of the project is to better understand how fragmentation by dams and invasive species influence the snuffboxes' ability to access host fish species. Logperch (n=59) and blackside darters (n=54) from the Great Lakes basins were infested with viable glochidia of snuffboxes from the Erie and Michigan basins and data were collected over a minimum of 40 days. We hypothesize that fish and freshwater mussels from the same basin will show the highest level of compatibility and may show trends that reflect their genetic background. Knowing the most effective way to optimize juvenile transformations can make reintroductions of *E. triquetra* more successful. We used GIS to determine fragmentation of the target rivers by establishing proximity of dams to mussel and host populations. Further, considering fragmentation, we quantified invasive dreissenids and corbiculids by using quadrat surveys in the target rivers. These data will help in developing recovery strategies for *E. triquetra* in the Laurentian Great Lakes. caldw1ml@cmich.edu

Poster 11	**FRESHWATER MOLLUSKS IN THE PALEONTOLOGICAL RESEARCH INSTITUTION COLLECTIONS.** David Campbell[1], Greg Dietl[2], Warren Allmon[2], Judith Nagel-Myers[2]. [1]Department of Natural Sciences, Gardner-Webb University, Boiling Springs NC; [2]Paleontological Research Institution, Ithaca, NY.

The Paleontological Research Institution (Ithaca, NY; www.museumoftheearth.org) collections house a diverse set of modern and fossil freshwater mollusks. Recent rehousing and reorganizing of the systematic mollusk collections (NSF BRC-0847118) makes these collections much more accessible. PRI was founded in 1932, but its freshwater mollusk collections contain material collected as early as the mid-1800s, including recently extinct or extirpated populations. The Wesley Newcomb collection includes exchanges from major 19th-century freshwater mollusk workers, including Isaac Lea, J. G. Anthony, W. H. Benson, Geoffrey Nevill, and Temple Prime. Some specimens have dried tissue in addition to the shell. The collections are strongest in North American forms for both fossil and Recent, but include worldwide material. The fossils include a wide range of ages. All fossil mollusks and all modern gastropods, except most terrestrial pulmonates, are organized to family following the recent Bouchet *et al*. classifications in *Malacologia*, and then alphabetized by genus within the family. Modern bivalves have received preliminary organization to genus and some of the unionoid genus names have been updated. The type specimen catalogue is available online (www.pricollectionsdatabase.org). In addition to types originally deposited with PRI (primarily fossils), several lots from the 1800's are labeled as types. Most probably merely represent specimens identified by the original author, but a few may be actual paratypes or syntypes. Some represent manuscript names. The general systematic collections include, for Recent mollusks, 29 drawers of unionoids, alphabetized by the genus on the label, 2 drawers of other freshwater clams, with good representation of the major taxa worldwide, and 16 drawers of freshwater gastropods representing 21 families and 111 genera. Fossils in the general systematic collection include 4 drawers of freshwater bivalves, representing 11 families and 53 genera, and 7 drawers of freshwater snails, representing 18 families and 67 genera. pleuronaia@gmail.com

Poster 12 *Student Poster*	**DEMOGRAPHIC ASSESSMENT OF A REINTRODUCTED POPULATION OF THE ENDANGERED OYSTER MUSSEL (*EPIOBLASMA CAPSAEFORMIS*) IN THE UPPER CLINCH RIVER, VIRGINIA**. Caitlin Carey[1], Jess Jones[1,2], Robert Butler[3], Eric Hallerman[1], Marcella Kelly[1]. [1]Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA; [2]US Fish and Wildlife Service; [3]US Fish and Wildlife Service, Ashville, NC.

Federal and State recovery plans for listed freshwater mussel species have identified the translocation of adult mussels and the release of laboratory-propagated juveniles as approaches to increasing the viability of existing populations or to reintroduce species to historically occupied sites. In 2002, the Virginia Department of Game and Inland Fisheries designated an approximately 9.6-km reach of the upper Clinch River as an augmentation reach for the federally endangered oyster mussel (*Epioblasma capsaeformis*). As of 2010, three reintroduction techniques have been applied to separate locations within this reach including the translocation of adults and release of laboratory-propagated sub-adults (Site 1), the release of 8-week old laboratory-propagated juveniles (Site 2), and stream-side infestations (Site 3). The objective of this study was to determine the success of the three release strategies through population monitoring at each release location. Demographic data were collected in 2011 and 2012 by systematic quadrat sampling to estimate population size and density of *E. capsaeformis* at each location. Estimated population size and density of translocated and laboratory-propagated sub-adult *E. capsaeformis* at Site 1 were 2,579 (SE = 150) individuals and 0.51/m^2 (SE = 0.03) in 2011, and 2,345 (SE = 664) individuals and 0.46/m^2 (SE = 0.06) in 2012. No *E. capsaeformis* were discovered at reintroduction Sites 2 and 3 where the release of 8-week old laboratory-propagated juveniles and stream-side infestation techniques were applied. In addition, mark-recapture sampling was performed at Site 1 so as to compare survey methodologies, which produced similar population size estimates of approximately 2,410 individuals. Our results indicate that the translocation of adults and release of laboratory-propagated sub-adults are the most effective techniques for establishing populations of *E. capsaeformis*. We suggest that management should focus efforts on the release of larger individuals for the purposes of augmenting vulnerable or reestablishing extant populations of freshwater mussels. cscarey@vt.edu

Poster 13	**DATA NEEDED FOR CONSERVATION STATUS ASSESSMENTS OF PETITIONED MOLLUSKS IN THE SOUTHEAST.** Stephanie Chance. US Fish and Wildlife Service, Cookeville, TN.

In 2010, the Center for Biological Diversity (CBD) petitioned the US Fish and Wildlife Service (Service) to list 404 aquatic and riparian species in the Southeast. Of particular interest to the Freshwater Mollusk Conservation Society, the petition included 34 mussel species and 43 snail species. After our initial review, the Service determined that the petition presented substantial scientific or commercial information indicating that federal listing may be warranted for 374 of the 404 petitioned species. Therefore, the Service will be initiating status reviews to determine if listing is warranted for these species. To ensure that the status reviews are comprehensive, the Service is soliciting scientific and commercial data and other information regarding the status of and threats facing these species throughout their ranges. Data on distribution and abundance, genetics, ongoing

conservation efforts, and species habitat needs and/or threats are needed. All information will be evaluated by the Service to perform threats assessments and five factor analyses necessary to determine if federal listing is warranted for these species. A summary of the petition's major taxonomic groups is provided. A detailed list of mollusk species is provided for each Ecological Services Field Office with the lead biologist's contact information. Species lists for other taxonomic groups or additional information about the petition can be obtained by contacting the authors or by visiting http://www.fws.gov/southeast/candidateconservation/. stephanie_chance@fws.gov

Poster 14	**APPLICATION OF HABITAT EQUIVALENCY ANALYSIS (HEA) ON THE UPPER MISSISSIPPI RIVER FOR MITIGATING IMPACTS TO FRESHWATER MUSSELS.** Mike Coffey[1], Jon Duyvejonck[1], Scott Gritters[2], Bernie Schonhoff[2]. [1]US Fish and Wildlife Service; [2]Iowa Dept. of Natural Resources.

There are more than 70 species of freshwater mussels that are federally listed as threatened or endangered. Mitigation alternatives for both listed and non-listed species have consisted primarily of avoidance and relocation. Relocation may "save" individuals, but still results in a net loss of mussel habitat. Mitigation banks for off-setting wetland impacts have been employed for many years, but mitigation banks for freshwater mussels are relatively uncommon. Recent success in the hatchery propagation of some mussel species offers a better option if funding can be secured. Perhaps the biggest challenge in establishing mussel mitigation banks is calculating the monetary value of the mussel resource lost/impacted. One potential methodology is Visual Habitat Equivalency Analysis (HEA) which is a computer application developed by the National Coral Reef Institute in Florida. HEA is a restoration scaling technique that compares the value of habitat lost to the value of habitat gained through various restoration measures. HEA can account for multiple mitigation measures (e.g. relocation, augmentation, propagation). HEA is attractive because it can account for differences in species composition, abundance, legal status, and different temporal and spatial scales. It is adaptable to all mussel habitat types and regions of the country. The HEA framework has been successfully applied on the Upper Mississippi River (UMR) to calculate monetary damages to freshwater mussels caused by contaminants spills and development. In this paper we provide examples of HEA applied to mussel bed impacts on the Upper Mississippi River. Michael_Coffey@fws.gov, Jon_Duyvejonck@fws.gov

Poster 15 *Student Poster*	**A PRELIMINARY SURVEY OF FRESHWATER SNAIL SHELL MICROBES FROM BAYOU BARTHOLOMEW, MOREHOUSE PARISH, LOUISIANA.** Charles Creech, Debra Jackson, Russell Minton. Department of Biology, University of Louisiana at Monroe, Monroe, LA.

The diversity and ecology of bacteria in freshwaters have been studied extensively. However, less is known about bacteria from low-flow, soft bottom systems like those found in the Mississippi Alluvial ecoregion of North America. In these systems, freshwater mollusk shells are frequently one of the most common hard substrates for microorganisms to colonize on. In an effort to better understand both the microbiota utilizing mollusk shells and the relationship between mollusk species and the bacterial species they harbor externally, we sampled the bacterial communities growing on individual snail shells from two benthic taxa, *Campeloma decisum* and *Pleurocera canaliculatum*, collected from Bayou Bartholomew near Bastrop, LA. Shells were swabbed and bacteria were grown on R2A media, brought to pure culture, and analyzed using a variety of biochemical tests. Biofilms from shells were removed using sterile razor blades, and DNA was isolated from each sample. Samples were analyzed using next-generation sequencing methods to estimate the richness and abundance of microbes on each shell. Using traditional biochemical tests, we confirmed that *Klebsiella ozaenae*, *Pantoea agglomerans*, and *Serratia liquefaciens* were found on both species, along with putative species in the genera *Bacillus, Enterococcus, Pasturella, Staphylococcus,* and *Streptococcus.* Results from the next-generation sequencing and subsequent bioinformatics analYses will be presented, along with a discussion of snails as mobile microbial carriers. creechcc@warhawks.ulm.edu

Poster 16 *Student Poster*	**LIFE HISTORY AND BEHAVIORAL ADAPTATIONS OF UNIONID MUSSELS ALONG A RIVER GRADIENT.** Wesley Daniel, Kenneth Brown. Dept. of Biological Sciences, Louisiana State University, Baton Rouge, LA.

We studied how life history traits and behavior may be involved in determining the distribution of mussels in the rivers of south-eastern Louisiana. The literature suggests mussels in headwaters should have smooth, thin shells, possess opportunistic life history traits, and use visual displays to attract fish hosts, while those in larger rivers should have thick, ornamented shells. We worked with 3 cosmopolitan and 6 big river unionid species from rivers in the Ponchartrain basin north of New Orleans. We thin sectioned shells to estimate life history traits, and used laboratory experiments to look at the role of movement rates and shell morphology in allowing mussels to escape lowering water levels, or high flows, respectively. We used a laboratory flume to study effects of shell morphology on erosion of sediments and mussel dislodgment. Finally, we used a PCA to separate mussel groups by life history, behavior and host fish use. We found mussels were separated into cosmopolitan species with opportunistic life history traits

(rapid growth, early maturation and short life cycles), but the ability to move quickly and track water levels, and big river species, which had more equilibrium life histories, and had thick, ornamented shells that protected them from dislodgement. Taken together, life history and behavioral differences clearly separate the cosmopolitan and big river species. Habitats in relatively flashy tributaries in these systems appear to favor mussels with rapid growth, early maturity, and thin shells, but higher movement rates to track variable water levels. Higher river order environments instead favor mussels with slower growth, delayed maturity and longer life cycles, but heavier, ornate shells that resist dislodgement. kmbrown@lsu.edu

Poster 17	**PRELIMINARY FINDINGS OF COMPREHENSIVE UNIONID MUSSEL SURVEYS IN THE LOWER PORTIONS OF ATLANTIC SLOPE RIVERS OF VIRGINIA.** Tom Dickinson, Tim Savidge. [1]The Catena Group, Inc., Hillsborough, NC

Knowledge of the mussel fauna in the lower portions of the Atlantic Slope river basins in Virginia has been limited to scattered locales, largely in smaller tributaries, and shallow water habitats. Many of the mussel species known from these watersheds have been identified in the Virginia Wildlife Action Plan (VWAP) as of conservation need. In an attempt to update and fill major gaps in the knowledge of this mussel fauna, The Catena Group in conjunction with VA Department of Game and Inland Fisheries conducted qualitative mollusk surveys in all the lower Atlantic Slope River Basins; The Potomac, Rappahannock, York, James, Chowan, and Roanoke, in Virginia. Surveys have been conducted at 123 sites to date. SCUBA was used to sample the deepwater habitats. All habitat types at each survey location were evaluated to determine preferential use by species/assemblage. The general transition zone from freshwater to estuarine invertebrate fauna was also identified. At least 15 mussel species, including 11 listed on the VWAP were located during 2011-2012 efforts. Surveys will continue through spring 2013. tdickinson@thecatenagroup.com

Poster 18	**MOLECULAR PHYLOGENY REVEALS CRYPTIC SPECIES IN THE AFRICAN FRESHWATER OYSTER, *ETHERIA ELLIPTICA* (LAMARCK, 1807).** Curt Elderkin[1], Roland Schultheiβ[2], Christian Albrecht[2], Thomas Wilke[2]. [1]The College of New Jersey, Department of Biology, Ewing, NJ; [2]Department of Animal Ecology & Systematics, Justus Liebig University Giessen, Giessen, Germany.

Within the Etheriidae, the species *Etheria elliptica* (freshwater oyster) is widespread and common and exists in most of the major African drainages. The taxonomy of these organisms has been revised many times over the past 200 years and they have recently been lumped into a mono-specific genus. The past and current taxonomic status of African freshwater oysters has been based on shell characters, however, the phenotypic plasticity of these and other bivalves has established that these evolutionary relationships are biased. *E. elliptica* shell morphology is highly variable and will change with different attached substrates or crowding, where the oysters will cement the lower valve to any hard substrate including other bivalves. The lower (cementing) valve may be either the left or the right, and is usually thicker. The structure of the nacre is a "blistered or cellular" structure and otherwise valves lack internal structures. Recent molecular approaches to taxonomy have led to a steady increase in the classification of so called sister or cryptic species. Our objective is to determine if *Etheria elliptica* from the Chambeshi River, in Zambia Africa, (where the Chambeshi forms the eastern most part of the Congo drainage) are correctly classified as a single species. We analyzed the genetic diversity at a single mitochondrial locus (COI), and using phylogenetic and DNA barcoding techniques identified at least two cryptic taxa within these collections. Branch support of a Bayesian inference tree was very high (1.0), and mismatch analysis revealed a discrete 10% base pair difference between the two clades. In future studies we hope to increase the number of sample locations, and sample multiple drainages. In conclusion, *E. elliptica's* taxonomic history makes finding cryptic taxa unsurprising, however molecular studies such as this one may finally help resolve the number of species with this genera. curtelderkin@gmail.com

Poster 19	**RESTORATION OF FRESHWATER UNIONID POPULATIONS OF THE MONONGAHELA RIVER, WEST VIRGINIA FOLLOWING TURN OF THE 20th CENTURY ACID MINE DRAINAGE IMPACTS.** Michael Everhart, Janet Clayton. West Virginia Division of Natural Resources, Elkins, WV.

The Monongahela River, with historically diverse aquatic communities, was severely impacted by acid mine drainage (AMD) during the turn of the 20th Century. Though limited historical records are available it is believed unionid populations and diversity mirrored that of the Allegheny River. Water quality reports revealed very low pH values for decades, persisting into the 1970s and 80s. Passage of the Clean Water Act, reclamation efforts directed toward AMD and recovery of other aquatic communities over the past few decades indicate that it may be possible to reintroduce unionids and begin reestablishing viable populations within the system. A previous study indicated that water quality has improved and that unionid habitat still exists within the river, however, the lack of nearby resident broodstock has restricted natural recovery. The objective of this study is to determine if

the river can now support a viable community of unionids. Initial restoration attempts conducted in 2006 and 2007, in cooperation with the Pennsylvania Fish and Boat Commission and the United States Fish and Wildlife Service, salvaged over 2,200 unionids of eleven species from a bridge construction project on the Allegheny River. These animals were translocated into two historical unionid bed locations downstream of Opekiska and Hilderbrand Locks and Dams on the Monongahela River. Quantitative surveys conducted five years after stocking reveal that these stocked populations are surviving. Six additional species of unionids, that were not translocated, have been discovered. Three of these species were not known from historical records. No evidence of reproduction from stocked populations was observed. Results indicate that suitable habitats exist and water quality has recovered to adequately support further restoration efforts and unionids are re-colonizing naturally. Zebra mussels have not found a secure niche within the system and currently show little potential to harm future restoration efforts. mike.e.everhart@wv.gov

Poster 20 *Student Poster*	**REARING OF THE THICK-SHELLED RIVER MUSSEL (*UNIO CRASSUS*) – FIRST RESULTS.** Tanja Eybe[1,2], Frankie Thielen[2], T. Bohn[3], B. Sures[1]. [1]University Duisburg-Essen, Essen, Germany; [2]Natur & Ëmwelt, Heinerscheid, Luxembourg; [3]CRP-Gabriel Lippmann, Belvaux, Luxembourg.

The Thick-Shelled River Mussel (*Unio crassus*) is endangered in many European river systems. Major concerns include the loss of natural habitats, eutrophication, introduced predators, decline of resident fish stocks and sedimentation of the river bed interstitial inhabited by juvenile mussels. In rivers without recruitment, lab rearing of juveniles might bring young mussels to a size at which their survival in the wild becomes more likely. Accordingly, we investigated possible optimization strategies for rearing conditions of *Unio crassus*. As a first step minnows (*Phoxinus phoxinus*) were infected with glochidia and the collected juvenile mussels were reared in plastic boxes containing 500 mL of river water. The mussels were fed algae and detritus once a week during water exchange. We analysed the excystment period (duration, number of mussels), the length of the mussels directly after excystment and after 110 days, the survival rate after 110 days and the linear growth according to the time of dropping during the excystment period. Mussels collected after day 2 during the dropping period were best suited for rearing. They reached a length between 1.27 mm and 1.72 mm after 110 days and their survival rate ranged between 43-100%. Mussels that excysted earlier (within the first two days of the dropping period) grew slower (0.6-1.07 mm), not linear and had lower survival rates (27%) after 110 days. Our results show that it is possible to rear *Unio crassus* successfully in plastic boxes for the first 110 days. Furthermore, this work explains all important breeding steps: From infection of host fishes to the harvesting of juvenile *Unio crassus*. Tanja.Eybe@gmx.de

Poster 21	**INNOVATIONS AND ADVANCES IN FRESHWATER MUSSEL PROPAGATION AND RECOVERY AT THE AQUATIC WILDLIFE CONSERVATION CENTER, VIRGINIA.** Joe Ferraro[1], Amanda Duncan[1], Mike Pinder[2], Megan Bradley[1], Brian Watson[3]. [1] Aquatic Wildlife Conservation Center, Virginia Department of Game and Inland Fisheries, Marion, VA; [2] Virginia Department of Game and Inland Fisheries, Blacksburg, VA; [3] Virginia Department of Game and Inland Fisheries, Forest, VA.

Freshwater mussels are some of the most threatened taxa in North America and more than 80 species were once found in Virginia with 42 extant and 7 extirpated species in the Tennessee River drainage in Virginia. Following a spill in the Clinch River in 1998 the Aquatic Wildlife Conservation Center was built to recover species lost or impacted in this drainage. Since its construction, the facility has strived to develop new techniques to first propagate then culture these rare species. Recent innovations include a move towards increased seasonal use of natural sources of food through ½ and ¼ acre pond systems. These include systems within the ponds (Floating Upweller Systems and baskets) that accommodate animals greater than 8 mm in length and external systems that employ filtration and can hold both newly transformed juveniles and larger sub-adults. The external systems include upwellers, downwellers and substrate based tanks. Juvenile culture has been significantly improved by the outdoor systems resulting in faster growth and good survival. The systems (OT) accommodating newly transformed juveniles have resulted in the first successful culture of *D. dromas* and *L. rimosus* at AWCC. Survival and growth have also been improved through the transition from flow-through to recirculating RU (rearing units) systems for the over-wintering of juvenile mussels. Megan.Bradley@dgif.virginia.gov

Poster 22 *Student Poster*	**THE USE OF PROBIOTICS FOR IN VITRO PROPAGATED FRESHWATER MUSSELS.** Tom Fox[1], Jay Levine[1], Korinn Saker[1], Len Stefanski[1], Benedetto Sicuro[2]. [1]Aquatic Epidemiology and Conservation Laboratory, College of Veterinary Medicine, North Carolina State University, Raleigh, NC; [2]University of Torino, Italy.

The *in vitro* propagation of freshwater mussels is a technique that bypasses the need for an obligate fish host and facilitates transformation of juveniles in an artificial media. Although the transformation percent of juveniles cultured in vitro can greatly exceed that of juveniles reared on fish hosts, the physiological health and survival of in vitro

transformed juveniles is often poor. Almost all animals contain beneficial gut flora that promote good health and aid in the digestion of food. Juveniles propagated in vitro are held in a completely sterile environment and do not have access to potentially important bacterial species that would colonize their gut. We hypothesized that feeding a species of bacteria that has been isolated from the gut of unionids would serve as a probiotic and increase growth and survival of in vitro propagated juveniles. In this study, a series of experiments were conducted feeding the bacteria *Bacillus subtilis* at four different levels to *Alasmidonta raveneliana*, *Lampsilis fasciola*, and *Villosa delumbis*. Over a 30-day period the *A. raveneliana* juveniles that were fed algae and a high concentration of *B. subtilis* exhibited increased growth and survival when compared to the other treatments. *L. fasciola* and *V. delumbis* showed a decrease in survival and growth for the juveniles that were fed only *B. subtilis* and no algae. *Bacillis subtilis*, may be a beneficial addition to the diet of captive reared juvenile *A. raveneliana.* Tom_Fox@ncsu.edu

Poster 23	***ANODONTA ANATINA* COI MTDNA PHYLOGEOGRAPHY: STARTING POINT OF THE SPECIES' EVOLUTIONARY HISTORY DISENTANGLING.** Elsa Froufe[1], Carina Sobral[1,4], Amílcar Teixeira[2], Ronaldo Sousa[1,3], Simone Varandas[4], David C. Aldridge[5], Manuel Lopes-Lima[1,6]. [1]CIIMAR-UP – Interdisciplinary Centre of Marine and Environmental Research, University of Porto, Porto, Portugal; [2]CIMO-ESA-IPB - Mountain Research Centre, School of Agriculture, Polytechnic Institute of Bragança, Campus de Santa Apolónia, Bragança, Portugal; [3]CBMA - Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Campus de Gualtar, Braga, Portugal; [4]CITAB-UTAD - Centre for Research and Technology of Agro-Environment and Biological Sciences, University of Trás-os-Montes and Alto Douro, Forestry Department, Vila Real, Portugal; [5]Aquatic Ecology Group, Department of Zoology, University of Cambridge, Cambridge, United Kingdom**;** [6]ICBAS - Institute of Biomedical Sciences Abel Salazar, University of Porto, Porto, Portugal

The duck mussel, *Anodonta anatina*, has been assessed as Least Concern in most European countries as this species has been described as one of the most abundant mussel species across its range and yet nothing is known regarding genetic diversity within this species. As a preliminary analysis we determined variation within the Cytochrome Oxidase 1 (CO1) mitochondrial gene from specimens from Portugal in the West, to Ukraine in the East, and Sweden in the North. High levels of genetic diversity were found that presented geographical coherence. Three major mtDNA lineages were retrieved: one includes all the individuals from Iberia, except the ones from the Ebro basin (Clade 1); the second, all the European non-Iberian and non-Italian samples (Clade 2); and the third lineage includes all the individuals from Italy and from the Ebro basin in Iberia and is basally related to all the other *A. anatina* samples (Clade 3). The divergence between them (uncorrected distances) varied from 3.2% between and Clade 1 and Clade 3 and 1.9% between Clade2 and Clade 3. Within each of the major clades, several geographical-related haplogroups were also retrieved. This study indicates that a detailed morphological and molecular revision is needed for this species. lopeslima.ciimar@gmail.com

Poster 24	**CONBI: BIODIVERSITY AND CONSERVATION OF BIVALVES OF IBERIA (SOUTHERN EUROPE) –ECOGEOGRAPHIC, GENETIC AND PHYSIOLOGICAL INFORMATION.** Elsa Froufe[1], Amílcar Teixeira[2], Anabela Lopes[1,3], Joana Cardoso[1], Joaquim Reis[4], Jorge Machado[1,3], Mariana Hinzmann[1,3], Miguel Fonseca[5], Rafael Araujo[6], Ronaldo Sousa[1,7], Carina Sobral[8], Simone Varandas[8], Rui Cortes[8], Manuel Lopes-Lima[1,3,4]. [1]CIIMAR-UP, Porto, Portugal; [2]CIMO-IPB, Campus Santa Apolónia, Bragança, Portugal; [3]ICBAS-UP, Porto, Portugal**;** [4]IPM, Zoomarine, Albufeira, Portugal**;** [5]CIBIO, Campus Agrário de Vairão, Vairão, Portugal**;** [6]Museo Nacional de Ciencias Naturales, CSIC, Madrid, Spain; [7]CBMA - University of Minho, Campus de Gualtar, Braga, Portugal; [8]CITAB-UTAD, Vila Real, Portugal.

The Unionidae (Mollusca) is the largest of six freshwater mussel families being among the most endangered fauna in the world and globally in decline. Basic life history data, estimates of population size and structure, and assessments of population genetic structure are lacking or sparse worldwide, including Iberia. The project CONBI with a multidisciplinary team of experts was recently funded by FCT (Portuguese Science Ministry) and aims to fill the gap of knowledge on the status of the Unionidae family in the Iberia, in the wide context of biodiversity conservation. It is drawn in a new and complementary way: by considering the complex genetic interactions among different species from the same habitats, comparing their (genetic) relationships with the European populations, and also by describing (and including the obtained information in the overall analysis) their main biological features such as distribution, environmental requirements, population structure, reproductive season, larval stage and host fish. From a conservation and management perspective, the goals of this project can be used to the development of future conservation strategies by the identification of Evolutionary Significant Units (ESUs) and Management Units (MUs). Several outcomes are already achieved, e.g., the isolation and characterization of microsatellite loci for *A. anatina, Potomida littoralis* and *Unio delphinus* and the growth rates, reproductive cycles and host fishes of *Anodonta anatina*, *A. cygnea*, *Potomida littoralis* and *Unio delphinus*. Others are currently being developed e.g., microsatellite markers for and the evaluation of genetic diversity of *P. littoralis* and *U. delphinus* in their whole distribution range. amilt@ipb.pt

Poster 25 *Student Poster*	**EFFECTS OF ELEVATED WATER TEMPERATURES ON THE PHYSIOLOGICAL RESPONSES OF ADULT FRESHWATER MUSSELS.** Alissa Ganser[1], Teresa Newton[2], Roger Haro[1]. [1]University of Wisconsin–La Crosse, River Studies Center, La Crosse, WI; [2]U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI.

Native freshwater mussels face multiple environmental stressors, many of which pose serious conservation challenges to this diverse assemblage of invertebrates. Of these stressors, elevated water temperature may be the most ubiquitous, and could be placing many mussel populations dangerously close to their thermal maxima. We tested the hypothesis that elevated water temperatures (20, 25, 30, and 35°C) adversely affected physiological responses in four species of adult mussels (*Amblema plicata*, *Elliptio complanata, Fusconaia flava,* and *Lampsilis cardium)* in 21-d laboratory tests. Survival exceeded 95% across species and treatments. Ammonia excretion rates varied significantly with temperature in *E. complanata* and generally increased with increasing temperatures. Oxygen consumption rates varied with temperature in all species and were generally positively correlated with water temperature. The amount of oxygen consumed relative to nitrogen excreted (O:N ratio) varied significantly with temperature in *A. plicata*, *E. complanata*, and *F. flava.* The tissue condition index, an indicator of physical condition, varied among temperatures and species. These data suggest that elevated temperatures can alter metabolic rates in native mussels, and may decrease the amount of energy that is available for key biological processes, including survival, growth, and reproduction. More information on thermal effects in native mussels is urgently needed because elevated water temperatures, from global climate change, industrial effluents, drought, or land development, may further challenge already imperiled mussel communities. amgans01@louisville.edu

Poster 26 *Student Poster*	**A MULTI-BASIN HOST FISH APPROACH TO *LAMPSILIS CARDIUM* DISTRIBUTION IN RIVERS OF THE LAURENTIAN GREAT LAKES.** Adrienne Gibson[1], David Zanatta[1,2], Daelyn Woolnough[1,2]. [1]Biology Department, Central Michigan University, Mount Pleasant, MI; [2]Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI.

Understanding optimum host fish use and respective unionid distributions are fundamental to the conservation of these highly imperiled organisms. Using host fish testing, we applied a multi-basin approach to understand how fish paired with mussels from the same basin compare to mussels from a different basin in the Laurentian Great Lakes, USA. We used a common and ubiquitous unionid, the plain pocketbook (*Lampsilis cardium*), with known hosts: largemouth bass, smallmouth bass, bluegill, and rock bass. Mussels and fish were collected from rivers of three basins: Lake Michigan, Lake Erie, and Lake Huron. Fish lengths were also recorded and compared, in an attempt to determine the optimal fish length for juvenile transformation. Data were collected in a quantitative manner, with the number of glochidia and metamorphosed juveniles that became excised from the fish recorded on a daily basis. Metamorphosis rates of fish test were: 41% for largemouth bass, 33% for smallmouth bass, 11% for bluegill, and 9% for rock bass. Fish collected from the Lake Michigan basin showed the highest number of juveniles, followed by the Lake Huron Basin, with the Lake Erie basin showing the least number of juveniles. We will present the cross-basin testing of hosts which determines whether hosts could successfully be optimized from various Great Lakes basins. This research appears to support a link between the basin of origin of fish and mussels and therefore the basin of origin can influence juvenile transformation. Our host testing study supports previous research showing that Lake Huron and Lake Michigan fish and mussels are more genetically similar than those from the Lake Erie basin. Future work will include the surveying of rivers in Michigan to make recommendations and predictions on mussel recruitment based on fish lengths. amagibson@gmail.com

Poster 27	**DETERMINATION OF DISPERSAL AND GENE FLOW AT MULTIPLE SCALES IN UNIONIDS: FROM SPERM TO SPECIES.** Isabel Hannes[1], Howard Lasker[1,2], Lyubov Burlakova[3]. [1]University at Buffalo, *Graduate Program in Evolution, Ecology and Behavior*, Buffalo, NY; [2] University at Buffalo, Geology Department, Buffalo, NY ; [3]Buffalo State College, Great Lakes Center, Buffalo, NY.

Gene flow is the transfer of genetic material between subpopulations; however gene flow can also occur between closely related species. Furthermore, gene flow within a species can occur at different spatial scales. Unionids in NY State dispersed into Lake Erie and Lake Ontario from Ohio and Mississippi River Basins (Interior Basin) or the Atlantic slope over 18,000 years ago after glaciers retreated. Species range expansions led to contact between closely related species such as *Lampsilis siliquoidea* (Interior Basin) and *L. radiata* (Atlantic slope) which are hypothesized to hybridize. The overall objective of the proposed study is to determine dispersal, gene flow and genetic diversity of *L. siliquoidea* and *L. radiata* at the species and population level. Species boundaries, potential hybridization and population structure of *L. siliquoidea* and *L. radiata* will be determined using mitochondria and nuclear molecular markers: COI (mtDNA) and 9 previously developed microsatellite loci. Population structure of each species will be assessed at different spatial scales: 1) between Lake Erie and Lake Ontario watersheds; 2) among tributaries within these watersheds; 3) within tributaries (between mussel beds). Understanding interspecific

and intraspecific gene flow at different spatial scales has important ecological and management implications. Lastly, studies on genetic structure and connectivity among populations are relevant for understanding their genetic variability and ability to withstand environmental perturbations. isabelha@buffalo.edu

Poster 28 *Student Poster*	**ISOLATION, CONNECTIVITY, AND GENE FLOW IN FRESHWATER MUSSEL COMMUNITIES.** Andrew Harris[1], Caryn Vaughn. University of Oklahoma Biological Survey, Norman, OK.

My research will focus on understanding the roles spatial connectivity of mussel beds and between-bed communities play in determining genetic structure and facilitating gene flow. I will address four broad questions in my research.

(1) How important are the sparsely populated habitats between large mussel beds in maintaining gene flow?
(2) How much reproduction results in within-bed recruitment vs. movement of genes between beds?
(3) Is genetic structure most strongly related to (a) distance between mussel beds, (b) connectivity of the network of mussel beds or (c) density of between-bed habitats?
(4) Is successful juvenile recruitment related to mussel density/diversity already present in the bed?

To address these questions, I will sample communities in the Kiamichi River in Southeastern Oklahoma. Continued monitoring of several sites over the past 20 years has provided information on the location and community composition of most mussel beds in these systems. I will quantify between-bed mussel densities and develop connectivity indices for the mussel beds of this stream. I will then determine population genetic structure using microsatellite markers in three mussel species: *Amblema plicata* – a common and dominant species, *Lampsilis cardium* – a common species of moderate density, and *Ptychobranchus fasciolaris* – a relatively rare species. To determine if the intact mussel community facilitates or inhibits juvenile recruitment, I will construct 25 0.5m x 0.5m enclosures to be secured in the streambed. Mussel communities varying in density and diversity will be placed in a factorial design in a single large mussel bed. Recruitment will be assessed after two years by removing all enclosures and sampling all adult and juvenile mussels. andrew.harris@ou.edu

Poster 29 *Student Poster*	**IMPACTS OF LAND USE PRACTICES ON COMMUNITY ECOLOGY OF FRESHWATER MUSSELS IN EAST TEXAS RIVERS.** Kirian Heffentrager, Neil Ford, Marsha Williams, Lance Williams. University of Texas at Tyler, Department of Biology, Tyler, TX.

The impacts of anthropogenic activities such as agriculture, urbanization, and impounding in watersheds have significantly increased the need for methods of stream health evaluation in East Texas. Here, we evaluate two watersheds that exhibit a stream in its natural state, the Cypress Creek, and a stream in a state of severe alteration, the Sulphur River, respectively. To assess the effects alteration of the landscape has on the quality of streams we utilized an animal model known for its sensitivity to changes in the aquatic environment, the freshwater mussel (Unionidae). Freshwater mussels have long been regarded as valuable indicators of lotic system health because they are often the first organisms to exhibit a response to changes in their environment. By comparing GIS derived land use and land cover data to mussel diversity and abundance from each river we can predict the impact that alterations to the landscape may have on the quality of streams. Although species richness was the same in both streams (21 species), species composition differed between these systems. The Sulphur River sites were primarily composed of species that tolerate shifting habitat conditions (e.g. *Lampsilis teres*). The Cypress River exhibited more diversity at each site with decreasing diversity at sites that were impacted by habitat alterations in the surrounding watershed. The Texas Pigtoe (*Fusconia askewi*), a state threatened species, was found in both watersheds and a range extension for the White Heelsplitter (*Lasmigona complanata*) was produced on the lower Sulphur River. Our results suggest that altering habitat in the surrounding watershed of a stream can decrease the quality of stream health. kheffentrager@patriots.uttyler.edu

Poster 30 *Student Poster*	**EFFECTS OF LANDUSE CHANGE ON FEDERALLY ENDANGERED DWARF WEDGEMUSSEL (*ALASMIDONTA HETERODON*) IN THE TAR RIVER, NORTH CAROLINA.** Jordan Holcomb[1], Michael Gangloff[1]. Appalachian State University Biology Department, Boone, NC.

Native freshwater mussels (family Unionidae) are among the most the most imperiled organisms in the world. Habitat loss and degradation are likely the strongest factors influencing species declines. Conversion of forest into agricultural and urban land has resulted in impacts to streams via reduced shade, increased sedimentation, pollution, and altered flow regimes. Despite this, few studies have quantified landuse change and the impact it has on freshwater mussel populations. We used Landsat 5 TM multispectral imagery to examine changes in landuse in 9 headwater drainages that support dwarf wedgemussel (*Alasmidonta heterodon*) populations. We classified imagery from 1983, 1990, 2000 and 2010 into 6 major landuse categories. The study reaches considered were 3 each of areas where *A. heterodon* populations were extirpated, declining, and seem to be

stable. We hypothesized that watersheds with the greatest prevalence of disturbed habitats (i.e., larger percentages of agriculture, logging, etc.) would be less likely to support *A. heterodon* compared to watersheds with moderate and little to no change in landuse. Alternately, we hypothesize stable *A. heterodon* populations should be more common in reaches adjacent to primary forest stands with little history of disturbance. Relationships between landuse and population change were examined using PCA and ANOVA. Preliminary results indicate greater percentages of logging (cutover and planted pine) in watersheds with declining and extirpated populations of *A. heterodon*. These data suggest that forested tracts in catchments with extant *A. heterodon* populations should be high conservation concerns. Future perturbations to these catchments may jeopardize extant *A. heterodon* populations. holcombjm@email.appstate.edu

Poster 31 *Student Poster*	**COMPARISON OF METABOLIC RATES OF UNINFECTED *BITHYNIA TENTACULATA* TO THOSE RECENTLY INFECTED WITH THE TREMATODE *SPHAERIDIOTREMA SPP.*** Jared House[1], Debbie Guelda[1], Charlotte Roy[2]. [1]Department of Biology, Bemidji State University, Bemidji, MN; [2]Department of Natural Resources, Bemidji, MN.

Bithynia tentaculata is a gastropod that is an intermediate host to several digenetic trematodes including *Sphaeridiotrema spp.* Lesser and Greater scaup (*Aythya affinis* and A*. marila*) are common definitive hosts and die-offs of these species in excess of 7000 individuals have occurred in northern Minnesota where the trematode and snail are non-indigenous. Necropsies show the cause of death in these die-offs to be verminous hemorrhagic ulcerative enteritis caused by trematodiasis. Waterfowl impacts and life cycles of both parasite and host have been well documented with little emphasis on the snail/parasite relationship. However, it has been reported that snail growth increases upon infection. The objective of this study is to compare the metabolic rates of *Bithynia tentaculata* infected with Sph*aeridiotrema spp* to that of uninfected *Bithynia tentaculata*. F1 generation snails will be infected with *Sphaeridiotrema spp*. miracidia, which will be hatched from eggs collected from a dead bird. Metabolic rates of infected and uninfected snails will be assessed by closed chamber respirometers every 48 hours for 2 weeks and will be compared to determine possible metabolic rate changes associated with infection. We hypothesize that metabolic rates will increase within infected *Bithynia tentaculata*. JHouse@bemidjistate.edu

Poster 32 *Student Poster*	**DETERMINING HABITAT RELATIONSHIPS FOR MUSSEL AND SNAIL COMMUNITIES ALONG AN URBAN-RURAL GRADIENT.** Heather Howell, Allison Bohlman, Helen Czech. Department of Biological and Environmental Sciences, Alabama A&M University, Normal, AL

This work is part of a larger examination of the relationship between habitat and communities of aquatic organisms along an urban-rural gradient. The presence and diversity of mussels and snails at 19 sites was determined through extensive walking surveys, quadrat collection, and transect excavation. The relationship of this data to water quality, land cover, and habitat structure was explored through CCA (canonical correspondence analysis). Unsurprisingly, mollusk taxa are negatively correlated with developed land cover, although there are some tolerant taxa. Even in exurban areas, mussel species numbers and densities are quite low. This indicates that mussels are very intolerant of development. The habitat changes associated with development that most likely impact mussels are changes in flow, substrate composition, and stability. heather.howell@aamu.edu

Poster 33 *Student Poster*	**QUANTITATIVE ANALYSES OF SURVIVAL AND GROWTH OF RELEASED FEDERALLY ENDANGERED FRESHWATER MUSSEL CUMBERLANDIAN COMBSHELL (*EPIOBLASMA BREVIDENS*) IN POWELL RIVER, TENNESSEE.** Dan Hua, Yan Jiao, Richard Neves, Jess Jones. Freshwater Mollusk Conservation Center, Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA.

Propagation mussels to stocking sizes ensured feasibility of augmentation and reintroduction of endangered populations. Quantitative analysis of released individuals is essentially needed to assess the efficiency of propagation and to monitor the recovery progress. The goal of this study was to monitor and estimate survival and growth of laboratory-reared sub-adult mussels of an endangered species *E. brevidens* released at Brooks Bridge in the lower Powell River, Tennessee. Monitoring techniques using PIT tags and cages were developed and tested over 2-year period in this study. Released mussels were sampled seasonally. A Bayesian approach was applied to model the growth and survival of this released mussel population using a mark-recapture technique. Individual growth of recaptured mussels was analyzed based on a transformed von-Bertalanffy growth function. Survival and recapture rates of the released mussels were analyzed based on mark-recapture models. Our study found that released *E. brevidens* exhibited a seasonal growth with an annual growth rate of 0.14 (k), asymptotic length of 87.95 mm (L_∞) and a period of 12 month seasonality. Released *E. brevidens* had high survival rate (posterior mean 99%/month) and high probability of being detected with a PIT tag (posterior mean 98%/yr). These results indicated that Brooks Bridge as a release site in the lower Powell River of Tennessee is suitable for conducting large-scale population augmentations of endangered *E. brevidens* to implement its recovery. huad@vt.edu

Poster 34	**METABOLIC EVIDENCE OF USE OF *BACILLUS SUBTILIS* AS A FOOD SOURCE IN *ELLIPTIO COMPLANATA*.** Jennifer Hurley-Sanders[1,2,3], Jay Levine[1], Stacy Nelson[3] , Mac Law[1], William Showers[3], Michael Stoskopf[1,2]. [1]College of Veterinary Medicine and [2]Environmental Medicine Consortium, North Carolina State University, Raleigh, NC; [3] Department of Forestry and Environmental Resources, College of Natural Resources, North Carolina State University, Raleigh, NC.

Algae and bacteria are generally understood to make up the bulk of the freshwater mussel diet. In captivity mussels are often fed a mixture of commercial and laboratory-grown food items in an effort to mimic the diet of wild mussels. However, which algae and bacteria species are food and which are commensal or incidental organisms found in the gut is difficult to determine. The specific identification of food items would allow improved feeding for reproduction and growth in captivity as well as assessment of habitat quality. To this end, we applied nuclear magnetic resonance (NMR) spectroscopic techniques to better understand the nutritional needs of *Elliptio complanata.* Metabolic profiles, isotopic labeling of carbon sources, and comparison of metabolic responses to variation in feeding practices were assessed. The common soil bacterium, *Bacillus subtilis*, was grown on ^{13}C-labeled glucose and fed to *E. complanata*. The resulting ^{13}C-NMR spectra suggest that *E. complanata* does incorporate carbons from *B. subtilis* into adductor muscle tissue. *Elliptio complanata* were then fed *B. subtilis* for one week and compared to a cohort that was not fed. Adductor muscle was analyzed using ^{1}H-NMR spectroscopy and principal components analysis was used to identify characteristic differences between the treatments. Preliminary comparison of fasted *E. complanata* to individuals fed only *B. subtilis* for one week suggested a shift in amino acid and carbohydrate concentrations. Increases in lactic and acetic acids suggest a shift to gluconeogenesis through the catabolism of amino acids and proteins. Increased levels of creatine/creatinine pathway metabolites were seen in fasted individuals. *Elliptio complanata* had prominent amounts of putrescine, a polyamine, and may use metabolism of putrescine to form α-ketoglutarate, an important component of energy production. jlhurley@ncsu.edu

Poster 35	**CHROMOSOME NUMBERS IN FRESHWATER MUSSELS AND OTHER BIVALVES.** John Jenkinson. Clinton, TN.

Over the last 30 years, an increasing number of studies have included counts of the chromosomes present in the cells of bivalve mollusks, including some species of freshwater mussels. As part of a larger project concerning the chromosomal characteristics of North American mussels, I have searched the recent literature for chromosome counts of both freshwater and marine bivalve mollusks. The results of this search indicate that chromosome numbers vary surprisingly little within most bivalve orders, and that a diploid number of 38 chromosomes is fairly common throughout this molluscan class. Most freshwater mussel species that have been studied so far – but not all of them – also have a diploid set of 38 chromosomes. This poster will present the bivalve chromosome numbers I have found in the literature and those determined during my own research on freshwater mussels. This poster also will start the process of exploring the role that chromosomal characteristics could play in understanding evolutionary and taxonomic relationships among all of the groups of freshwater mussels. jjjenkinson@hotmail.com

Poster 36	**FRESHWATER MUSSELS AS BIOLOGICAL INDICATORS: ACCUMULATION AND DETECTION OF VIRAL HEMORRHAGIC SEPTICEMIA VIRUS.** Vera Kazaniwskyj[1], Y. Zhang[2], Thomas Watters[3], Kody Kuehnl[3,4], Barbara Wolfe[1]. [1]Deptartment of Veterinary Preventive Medicine, The Ohio State University, Columbus, OH; [2]Ohio Department of Agriculture, Reynoldsburg, OH; [3]Department of Evolution, Ecology, and Organismal Biology, The Ohio State University, Columbus, OH; [4]Department of Social and Natural Sciences, Franklin University, Columbus, OH.

Viral hemorrhagic septicemia virus (VHSV) is a devastating rhabdovirus affecting freshwater fishes worldwide. In 2005, a new genotype of VHSV (IVb) was discovered in Lake St. Clair and has consequently spread throughout the Laurentian Great Lakes. While it is widely known that freshwater fishes are hosts and transmitters of VHSV, little is known about the ability of invertebrates to take up and carry the virus. Our objective in this study was to investigate the ability of freshwater mussels to accumulate and transmit VHSV by using two commonly occurring freshwater mussel species (*Corbicula fluminea* and *Amblema plicata)* and to assess the efficacy of freshwater mussels as bioindicators of viral presence. Experiments used inoculations of 100 and 200 Tissue Culture Infective Dose units of VHSV. Mussel tissues were tested for VHS at 72h, 120h, and 168h post-exposure using rt-PCR. Initial results indicate that freshwater mussels have the ability to harbor the VHS virus, especially when inoculated with high doses, and thus can serve as valuable indicators of viral presence. Our results also indicate mussels are not likely to maintain VHS long term within their tissues, and are therefore not likely vectors of the disease. kazaniwskyj.1@buckeyemail.osu.edu

Poster 37	**PHYLOGEOGRAPHY OF ANODONTOIDES RADIATUS AND PLEUROBEMA STRODEANUM ON THE EASTERN GULF SLOPE.** Raymond Kessler IV[1], Nathan Johnson[2], Michael Gangloff[1], Sandy Pursifull[3]. [1]Appalachian State University, Department of Biology, Boone, NC; [2]US Geological Survey, Southeast Ecological Science Center, Gainesville, FL; [3]US Fish and Wildlife Service, Panama City, FL.

Pleurobema strodeanum and *Anodontoides radiatus* are two cryptic, small-bodied freshwater mussels endemic to eastern Gulf Slope drainages. *Pleurobema strodeanum* is a threatened species found in the Choctawhatchee, Escambia, and Yellow drainages in Alabama and Florida. *Anodontoides radiatus*, a candidate for federal protection, is more widespread and occurs from the Apalachicola Drainage in Georgia and Florida west to the Lake Pontchartrain Drainage in Louisiana and Mississippi. In 2012, we began work on a USGS-funded project to assess phylogeographic variability in these taxa. We examined material in several museum collections and procured tissue for DNA analysis. Unfortunately, museum specimens produced few useable sequences, likely due to poor preservation methods and age of specimens. Surveys in 2012 targeted sites in the range of these taxa to produce tissue from additional specimens. Future surveys will target type localities and high-quality reaches of known occurrence to produce tissues for molecular analyses. Out-group material will be collected from Mobile and Apalachicola drainage congeners (or other closely-related taxa) and used to anchor parsimony networks and calibrate estimates of intra and inter-specific diversity. kesslerr1@gmail.com

Poster 38	**GENETIC VARIATION IN THE FRESHWATER MUSSEL, PYGANODON GRANDIS IN LAKE ERIE AND LAKE ST.CLAIR.** Robert Krebs[1], Brian Allen[1], Na'Tasha Evans[1], David Zanatta[2]. [1]Department of Biological, Geological and Environmental Sciences, Cleveland State University, Cleveland, OH; [2]Institute for Great Lakes Research, Department of Biology, Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI.

Genetic variation was assessed for a total of 261 *Pyganodon grandis* individuals that were sequenced for a fragment of the mtDNA CO1 gene. These samples came from four bathymetrically different regions within the Lake Erie watershed: the western basin (N=96), the central basin (N=31), Sandusky Bay (N=64), and Lake St. Clair (N=59), with an additional of 11 samples from the Niagara River region. A total of 32 different haplotypes of 260 were found for *P. grandis*, however, only two were shared among all areas sampled. One of those two represented a common haplotype (81.5% of all individuals) within Lake Erie and no other haplotype exceeded 2.3%; many were found only once. One individual from the Lake St. Clair region was identified genetically as *P. lacustris*, a species not identified in the shell surveys. The pattern of haplotype variation suggests that for *P. grandis*, refuges were sufficient to preserve genetic diversity, although an historical bottleneck possibly contributed to the current dominance of one haplotype in the lake populations. krebs.r@gmail.com

Poster 39	**UNEXPECTED DIVERSITY AND ABUNDANCE IN HIGHLY IMPACTED SEGMENTS OF THE TRINITY RIVER IN DALLAS, TEXAS.** Jean Krejca, Brian Cowan, Krista McDermid. Zara Environmental, LLC., Manchaca, TX.

Divers sampled segments of the Trinity River not considered likely to have habitat for a notable diversity or abundance of mussels, but found 11 species, including a range extension for the state listed Texas pigtoe, *Fusconaia askewi*. In one place, divers encountered as many of 60 individuals per square meter of common species. These segments of river are extensively manipulated with levees. The Texas Commission on Environmental Quality lists these areas as impaired for bacteria and polycyclic aromatic hydrocarbons (PAHs), and is of "concern" for several other constituents. Krista@zaraenvironmental.com

Poster 40	**LONG-TERM MONITORING AND DEMOGRAPHIC ASSESSMENT OF FRESHWATER MUSSEL POPULATIONS IN THE UPPER CLINCH RIVER, TENNESSEE.** Tim Lane[1], Jess Jones[2], Brett Ostby[1]. [1]Department of Fish and Wildlife Conservation, Virginia Tech University, Blacksburg, VA. [2]US Fish and Wildlife Service, Blacksburg, VA.

Historically, the upper Clinch River in Tennessee (TN) supported populations of >50 mussel species. Although large sections of the river in Virginia have suffered severe declines in densities and richness over the past 30 years, the lower section in Tennessee continues to support a healthy and diverse assemblage of at least 38 species, to include 15 extant species listed as federally endangered or proposed endangered. Random systematic 0.25 m^2 quadrat sampling was conducted at three sites in this section from 2004-2012. Sites were chosen to represent the upper, middle and lower portion of this unique river reach. Community structure and densities are being monitored from year to year to better understand how a healthy mussel assemblage should function. Demographic metrics currently being investigated include sex ratios, recruitment rates and population age-class structures. Average mussel density across all sites increased from 22.9 m^{-2} in 2004 to 34.2 m^{-2} in 2012. A species of particular interest, the federally endangered oyster mussel (*Epioblasma capsaeformis*) saw densities at Frost Ford (CRKM 291) increase from 31.4 9 m^{-2} in 2004 to 50.0 m^{-2} in 2012. Total species richness has varied from 11 to 26 species across all sites over the course of the study. Ecological covariates such as flow and temperature are being analyzed to understand how these environmental variables affect fluctuations in mussel density and community structure. twln@vt.edu

Poster 41 *Student Poster*	**DISRUPTING THE STEROID HORMONE CASCADE: EFFECTS OF THE AROMATASE INHIBITOR FADROZOLE HYDROCHLORIDE ON THE UNIONID MUSSEL *LAMPSILIS FASCIOLA*.** Jeremy Leonard[1], Gregory Cope[1], Christopher Barnhart[2], Robert Bringolf[3]. [1]Department of Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC; [2]Department of Biology, Missouri State University, Springfield, MO; [3]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA.

Androgenic effects of endocrine disrupting chemicals (EDC) may be seen less often than those caused by estrogenic compounds because of the relatively high substrate-specificity of androgen receptors compared to estrogen receptors. However, androgen-induced masculinization of females poses concerns for population stability. We evaluated the effects of sub-chronic exposure of fadrozole hydrochloride, a model aromatase (enzyme that converts testosterone to estradiol) inhibitor used as a therapeutic drug to treat breast cancer, on the condition, metabolism, and reproductive status of the unionid mussel *Lampsilis fasciola*. Mussels of both sexes were exposed to a control and 3 concentrations of fadrozole (2 µg/l, 20 µg/l, and 50 µg/l) and samples of gill tissue were taken on days 0, 4 and 12 for metabolomic analysis. Mussel behavior was observed daily, including mantle display, siphoning and larval (glochidia) releases. The highest concentrations resulted in fewer instances of glochidia releases as well as higher larval mortality rates. Unlike our previous study with the synthetic estrogen 17α-ethinylestradiol, treatment concentrations did not appear to alter foot extension of either sex or mantle display of females. Metabolomic analysis revealed 240 known biochemicals in mussel gill tissue. Glycogen-related metabolites declined in exposed mussels, while both glucose-6-phosphate and fructose-6-phosphate increased, suggesting utilization of glycogen into glycolysis for energy during early exposure. Enzymatic end-products of estradiol and esterone resulting from aromatase activity were below detection limits, making it difficult to identify conclusive biomarkers of aromatase inhibition in these mussels. However, subtle, significant sex-specific differences were detected in aromatic and branched-chain amino acid metabolism, as well as ornithine metabolism. Our observations indicate recovery of female-specific effects after a few days of exposure and, therefore, would suggest few adverse impacts of fadrozole on natural mussel populations. jaleonar@ncsu.edu

Poster 42 *Student Poster*	**ASSESSING ACUTE AND CHRONIC BIOCHEMICAL AND REPRODUCTIVE EFFECTS OF THE SYNTHETIC ESTROGEN 17a-ETHINYLESTRADIOL ON THE UNIONID MUSSEL *ELLIPTIO COMPLANATA*.** Jeremy Leonard[1], Gregory Cope[1], Christopher Barnhart[2], Robert Bringolf[3]. [1]Department of Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC; [2]Department of Biology, Missouri State University, Springfield, MO; [3]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA.

Surface water concentrations of the synthetic estrogen 17α-Ethinylestadiol (EE2) as low as 5 ng/l have been shown to cause adverse reproductive effects in fish under both acute and chronic exposure conditions. Generally, much greater concentrations or prolonged exposure periods are required to elicit adverse effects in freshwater mussels, possibly due to differences in susceptibility throughout the reproductive cycle. In this study, we examined reproductive and biochemical effects of environmentally relevant concentrations (5 ng/l or 50 ng/l) of EE2 on the unionid mussel *Elliptio complanata* under acute and chronic exposure conditions and over the span of their reproductive cycle. Adult mussels were collected from an uncontaminated stream in February 2012 and placed into aquaria for 180 d (duration of primary reproductive cycle), collected monthly from February through July 2012 and placed into aquaria for 28 d (chronic), or collected monthly and directly injected with solvent-dissolved EE2 and sampled after 4 d (acute). Siphoning behavior was measured daily, and any conglutinate releases and larval (glochidia) mortality were recorded. Gonad, foot, hemolymph, and gonad fluid samples were taken for biochemical analysis after exposures, and vitellogenin-like proteins (VTG) were analyzed in gonad, hemolymph, and gondad fluid samples through the alkaline labile phosphate (ALP) method. Gonad fluid was also used to microscopically determine sex. An increase in ALP was measured in the hemolymph of both sexes from February through April, followed by a decline to lowest levels in July. Lower levels of ALP were observed in males compared to females in control treatments, with no differences observed after low and high EE2 exposures, suggesting possible sex-specific effects. Our preliminary results indicate little to no acute adverse biochemical effects of EE2 on *E. complanata* at environmentally relevant levels, although chronic exposure resulted in ALP increases in both sexes, which may require additional examination. jaleonar@ncsu.edu

Poster 43 *Student Poster*	**ZEBRA MUSSEL (*DREISSENA POLYMORPHA*) *COLONIZATION* AND DISTRIBUTION AMONG NATIVE FRESHWATER MUSSELS IN POOL 12 OF THE MISSISSIPPI RIVER.** Shelby Marr[1], Adam Hoffman[1], Gerald Zuercher[1] Lisa LaBudde[1]. [1] Department of Natural and Applied Science, University of Dubuque, Dubuque, IA.

Zebra mussels (*Dreissena polymorpha*) have been implicated as a factor in the decline in diversity and number of freshwater mussel species. *D. polymorpha* attach to virtually every surface in aquatic systems, including native mussels where they hamper the reproduction and feeding effectiveness of the native mussels. As infestation levels of *D. polymorpha* approach 100 per freshwater mussel mortality can occur. Mussel population distribution at nine sites were studied in 2010 thru 2012 field seasons near 9-Mile Island

in Pool 12 of the Mississippi River. Mussels were collected by pollywogging along twenty five meter transects of randomly selected quadrants around the island and were checked for *D. polymorpha*. *D. polymorpha* infestation was measured on a scale of 0 to 4, depending on the amount of colonization on the freshwater mussel. A total of 2255 mussels, representing 21 species, were cataloged and it was found that (6.8%) of the native mussels had zebra mussels associated with them. The two most abundant species, *Amblema plicata* (threeridge; n= 1468) and *Fusconaia flava* (wabash pigtoe; n = 954), varied widely in *D. polymorpha* colonization as 16.9% of *A.plicata* had associated *D. polymorpha* while only 7.5% of the *F. flava* had associated *D. polymorpha*. Reattachment rates were examined and it was found that large temporal variations exist. Implications of *D. polymorphic* colonization in pool 12 and other pools of the Mississippi River will be discussed. Smarr@dbq.edu

Poster 44
Student Poster

GROWTH RATE VARIATION AMONG NATIVE FRESHWATER MUSSELS IN POOL 12 OF THE MISSISSIPPI RIVER. Shelby Marr[1], Jenna Skopek[1], Adam Hoffman[1], Gerald Zuercher[1]. [1]Department of Natural and Applied Sciences, University of Dubuque, Dubuque, IA.

Mussels are extremely important biological indicators in freshwater systems. Issues such as environmental contamination, pollution, or presence of invasive species can be discovered as the diversity of the ecosystem can quickly become adversely affected. Mussel population distribution near 9-Mile Island in Pool 12 of the Mississippi River was studied for three field seasons (2010 to 2012). Mussels were collected by pollywogging along twenty five meter transects of randomly selected quadrants around the island. In addition to live mussel captures, dead mussels were collected in the same manner and at the same sites for further analysis. Ten year growth rate curves were calculated using annual data both from recovered and dead mussels was created for the most common mussels species in pool 12 of the Mississippi River, including *Amblema plicata* (threeridge) and *Fusconaia flava* (wabash pigtoe). Dead mussels (n = 100) were analyzed using growth band counting to determine the approximate age at death as well as growth rate of the mussels. Recaptured mussels (n = 231) were measured for shell length, width, and height, which was used to determine growth rate of the mussels. Growth rates between dead mussels and recaptured mussels allowed for a quantitative comparison between methods. Differences in mussel densities were explored to determine if differences occurred due to an increased growth rate or elongated lifespans. This baseline data will be used to compare growth rates in contrasting aquatic environments in and around the Mississippi River Pool 12 area. Smarr@dbq.edu

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Student Poster

QUANTIFICATION OF GLOCHIDIA ON HOST FISHES IN THE SABINE AND SULPHUR RIVERS IN EAST TEXAS. Nathaniel Marshall[1], Brandy Murray[1], Lance Williams[1], Marsha Williams[1], John Placyk, Jr.[1]; [1]University of Texas at Tyler, Dept. of Biology, Tyler, TX.

Fish play a vital role in the development of Unionid mussels. A mussel starts its life as an obligate ectoparasite, known as glochidia, which must attach to a fish species to survive. Yet, even with these vital ecological interactions, little is known about fish host specificity among mussel species. Fish collections were made in September 2012 in the Sabine River and in October 2012 in the Sulphur River in East Texas to observe glochidia on their naturally infected fish host. Fish were preserved in 95% ethanol and returned to the lab for further inspection. Under a compound light microscope, glochidia were found on two of the twelve fish species captured in the Sabine and on none of the fish captured in the Sulphur. Sixty-one percent of Red shiners (*Cyprinella lutrensis*) were infected with 27% of the infected fish having 20 or more glochidia, while 14.75% of the bullhead minnows (*Pimephales vigilax*) were infected with 11% of the infected fish having 20 or more glochidia. Morphological features of the glochidia were the same between the two fish hosts. Glochidia were semielliptical, hookless, and attached to gill filaments of the host fish. Morphometrics were taken on measureable glochidia for height, length, and hinge length. The measurements were, respectively, 124 µm, 103.5µm, and 103.5µm. Infected fish gills were preserved in 95% ethanol and further analysis will be conducted, using molecular genetic techniques, to determine the mussel species of the preserved glochidia. nmarshall@patriots.uttyler.edu

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HABITAT CHARACTERIZATION AND SURVEY METHODS FOR MUSSELS IN DEEP WATER HABITATS. Krista McDermid. Zara Environmental, Manchaca, TX.

In 2012, Texas' freshwater surface water supply consists of 8.4 million acre feet with nearly 200 major reservoirs already built. With the state listing and federal candidate status of 16 species of Texas mussels, land managers will increasingly need to assess impacts in deep water through the use of SCUBA-based mussel surveys. Unfortunately, information on the use of deep water by Texas mussel species is severely lacking, and in fact very few papers in the entire body of freshwater mussel literature discuss use of deep (i.e.-greater than 3 meters) water by mussels. Much of what is known about Texas mussel species comes from regulatory actions (listing) and a small selection of peer reviewed articles. Zara Environmental has been performing deep water mussel surveys using SCUBA since 2010. Surveys were performed within twenty five 25 m^2 quadrats arranged at random within designated survey areas. Our results indicate that Texas mussel species do utilize habitat that is three or more meters deep. Specific results have not been calculated, but factors that will be considered and presented at the meeting include search effort, depth, substrate, and species. krista@zaraenvironmental.com

Poster 47	**DEVELOPMENT OF CULTURE SYSTEMS AND PROTOCOLS FOR LARGE-SCALE PRODUCTION OF FRESHWATER MUSSELS IN CLOSED, RE-CIRCULATING SYSTEMS.** Andrew McDonald, Christopher Owen, Monte McGregor, David Cravens, Adam Shepard, Travis Bailey, Fritz Vorisek. Center for Mollusk Conservation, Kentucky Dept. of Fish and Wildlife Resources, Frankfort, KY.

The restoration and recovery of endangered species of mussels in Kentucky via captive propagation and grow-out of these species is becoming an important component of the state-wide mussel conservation strategy. Due to degraded water quality in much of the state (and, in fact, the nation), it is important to be able to grow these animals in re-circulating systems with controlled water exchange. We have constructed various closed, recirculating systems which are capable of producing ~200,000-400,000 mussels per year to a taggable or stockable size for release. The challenge of raising large numbers of these small sensitive animals has led to the development of advanced recirculating systems with system checks and low maintenance requirements. Particle counts are monitored to maintain appropriate feeding levels and cultured freshwater and commercially-available saltwater algae as well as bacterial cultures are fed continuously throughout the day. The standard "Mucket bucket" design has been altered for flow-through recirculation from a sump to improve water quality and ease maintenance. New larger-scale acrylic downweller systems have been designed and fabricated. Large-scale upweller systems and sand-substrate bowl systems are also designed for grow-out of larger-sized juveniles. UV and mechanical filtration have been integrated into the design of the systems to control nuisance and disease organisms. Many functions of each system are automated including water changes and feeding. As the animals grow, moving them onto larger screens and increasing the grow-out area is essential. Flow rates are maintained at specified levels in all systems and daily maintenance and monitoring is performed. Currently, ~30,000 mussels are growing in these systems, ranging in size from 2mm to 10mm. Water quality results from these methods are presented. Hatchery protocols, system design, and water quality parameters are presented to assist those who may wish to culture mussels in closed systems. andy.mcdonald@ky.gov

Poster 48 *Student Poster*	**EGGS AND NYMPHS OF *UNIONICOLA* CF. *TUMIDA* AS POTENTIAL THREATS TO PROPAGATION AND STOCK ENHANCEMENT OF THE ALABAMA CREEKMUSSEL (*STROPHITUS CONNASAUGAENSIS*).** Andrew McElwain[1], Stephen Bullard[1]. [1]Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, AL.

There are three species of *Strophitus* (Unionidae) whose members were once geographically widespread in eastern North America. The Alabama creekmussel (*S. connasaugaensis*) is a species of special concern in Alabama and is propagated at the Alabama Aquatic Biodiversity Center for stock enhancement. While studying tissues of *S. connasaugaensis* for a unionid histological atlas, we observed eggs and nymphs of *Unionicola* cf. *tumida* (Acari: Unionicolinae) embedded in tissues. *Unionicola* spp. are cosmopolitan parasites of unionids (Unionidae). Females of *Unionicola* spp. oviposit into gill or mantle followed by three successive larval stages (larva, nymph, deuteronymph), each nymph stage may invade tissue and form a chrysalis. Therefore, a single mite may infect a host throughout its life cycle and invade a tissue repeatedly. Considering the minute size of their eggs and larvae, direct lifecycle, and conservation status of unionids we are assessed infections by these mites in *S. connasaugaensis* from Terrapin Creek and Shoal Creek (Coosa River tributaries), to determine the potential pathogenicity of mites in captivity. Based upon a May 2012 survey of unionids from Shoal Creek, we have putatively identified specimens of *U. tumida* (Wolcott 1898) having a prevalence of 90% (n=10) from *S. connasaugaensis* comprising 15 adults, 21 nymphs, and 23 larvae. On one side of the body, infected mussels may conservatively have at least 100 eggs deposited in mantle and 50 eggs in the gill. Histological sections from 11 specimens of *S. connasaugaensis* from Terrapin Creek (n=6) and Shoal Creek (n=5) indicated that 9 individuals were infected. Mite larvae typically infected blood vessels and connective tissue of gill. Hence, it seems likely that *U*. cf. *tumida* could be brought into captivity with adult broodstock. azm0034@tigermail.auburn.edu

Poster 49 *Student Poster*	**APPROACHING TROPHIC BOTTLENECKS TO CULTURE AND STOCK ENHANCEMENT OF FRESHWATER MUSSELS WITH A HISTOLOGICAL MAP OF THE DIGESTIVE TRACT OF THE ALABAMA RAINBOW (*VILLOSA NEBULOSA*).** Andrew McElwain[1], Paul Johnson[2], Stephen Bullard[1]. [1]Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, AL; [2]Alabama Aquatic Biodiversity Center, Alabama Department of Conservation and Natural Resources, Marion, AL.

Alabama is a biodiversity focus for freshwater mussels with 182 nominal species. According to Alabama Department of Conservation and Natural Resources, there are 24 extinct, 26 extirpated and an additional 74 species that are imperiled with priority conservation status. Presently, mussels are cultured at the Alabama Aquatic Biodiversity Center to support research, recovery, and reintroduction activities. Efforts to propagate mussels are met with varying success and survivorship of some species appears hinge upon strict dietary requirements. In an effort to understand bottlenecks related to feeding habits of freshwater mussels, we described the morphological and cellular features of the digestive

tract of the Alabama Rainbow (*Villosa nebulosa*), a species with a high level of culture success. Generally it is accepted that digestive tract of freshwater mussels includes the ventral food groove of inner gill, labial palp, esophagus, digestive gland tubules, stomach, crystalline style sac, and intestine. Fine structure of digestive tract consisted of a series of repeating ciliated folds from gill to intestine, blind-ended tubules near the stomach that may produce lytic enzymes, a large collecting chamber comprising stomach, an elaborate mucosa and bolus producing crystalline style sac, and a long, pleated intestine. By studying a species with high culture potential such as *V. nebulosa*, we have produced a template that could be used to address potential interspecific morphological differences in the digestive tract of members of Unionidae. Such differences may be evidence of interspecific differences in feeding habits and we may therefore be a better position to improve in culture methods. azm0034@tigermail.auburn.edu

Poster 50 *Student Poster*	**CHARACTERIZING GENETIC VARIABILITY AND POPULATION STRUCTURE OF THE FRESHWATER WRINKLED MARSHSNAIL (*STAGNICOLA CAPERATA*) IN HIGH AND LOW ALTITUDE POPULATIONS.** Cayla Morningstar[1], Kentaro Inoue[2], Brian Lang[3], David Berg[1]. [1] Department of Zoology, Miami University, Hamilton, OH; [2] Department of Zoology, Miami University, Oxford, OH; [3] New Mexico Department of Game and Fish, Santa Fe, NM.

The wrinkled marshsnail (*Stagnicola caperata*) is a freshwater pulmonate listed as endangered in New Mexico. The New Mexican populations reside in areas where cryptic species have been documented among other freshwater invertebrate taxa. Furthermore, morphological variation among populations of this species at differing altitudes has been observed in New Mexico and West Texas. We are conducting an assessment of the genetic structure, morphological variation, and phylogeny of the three populations of *S. caperata* in New Mexico and west Texas. Given the isolation of the populations and mountain ranges as possible dispersal barriers, we expect to see that populations of similar altitude are more closely related. We sequenced the mitochondrial 16S rRNA gene of eight individuals from each population. We estimated genetic variation within populations and genetic divergence among populations. Population structure was examined using an analysis of molecular variance (AMOVA). We recovered a total of ten haplotypes; nine of which were found in the low elevation populations, and a single haplotype in the high elevation population. Nucleotide diversity was 0.0048 in the low elevation populations. Genetic divergence between the two elevations was 2.3%, and divergence between the two low elevation populations was 0.7%. AMOVA revealed genetic variation between the two elevations was 17.3%, and 10.5% was found between the two low elevation populations. Low diversity in these populations would mean that they are of a greater conservation concern, because low genetic diversity increases extinction risk. In the future, we will include nuclear gene sequences, morphological data, and an examination of penal morphology from these populations and those of this species type locality. mcabeecr@muohio.edu

Poster 51	**THE ST. CLAIR DELTA: A REFUGE NO MORE?** Todd Morris[1], 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 its discovery in 1999, the St. Clair River delta in the area around Walpole Island First Nation (WIFN) has been viewed as a significant and important refuge for native freshwater mussels from the devastating effects of the dreissenid invasion. While native mussels had been nearly eradicated from the open waters of Lake St Clair by 1999, the Canadian waters of the delta were still home to relative high densities of animals from 23 different species including many federally listed species. Work undertaken by Environment Canada and WIFN between 2001 and 2004 established a series of high quality monitoring stations and provided an initial assessment of each site. In 2011, Fisheries and Oceans Canada and WIFN undertook to resurvey 8 of the best sites identified during the earlier sampling using identical methods to those employed during the initial surveys. Sites were sampled by snorkelling along predefined transects until a mussel was detected. Once detected, the location was marked and circle 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. Although average dreissenid mussel burden declined significantly, a comparison of the 2011 sampling with the earlier effort revealed significant declines at 7 of the 8 stations. On average, site abundance declined by 63% while average species richness declined by 3 species. Six of 18 species collected during the earlier period, including 4 species at risk, were not collected in 2011. Our results lead us to question the long term viability of the St. Clair delta as a refuge for freshwater mussels. Todd.Morris@dfo-mpo.gc.ca

Poster 52	**OHIO RIVER MUSSEL RESTORATION PROJECT (NRDAR PROJECT 0237).** Patricia Morrison[1], Craig Zievis[1], Janet Clayton[2], Mike Everhart[2]. [1]Ohio River Islands NWR (U.S. Fish and Wildlife Service) Williamstown, WV; [2]West Virginia DNR, Elkins, WV.

In 1999, there was a series fish kills reported between miles 175 and 185 on the Ohio River. Subsequent benthic surveys uncovered a massive mussel kill. Conservative estimates put the losses at ~1 million native mussels of up to 35 species. The density in the affected area was previously between 3 to 5 mussels per m^2. After the cause of the kill was

determined (acute toxic discharge) and corrected, the job of restoring the site remained. To restore the site, a density of >1 mussel per m^2 is required to yield an ecologically sustainable community. This goal will be achieved by stocking ~375,000 individual mussels of at least 20 different species over a period of 10 years. Selection of species to be actively restored was based on rarity, broodstock availability, host fish (knowledge, availability, hardiness in captivity), and distance to next known population. Restoration is being accomplished through the translocation of adults from source communities, release of glochidia infested fish and the propagation of juveniles. Further restoration to previous densities relies upon natural recolonization from the surrounding river and the successful reproduction by the newly introduced community. The reintroduction site area is quantitatively monitored on 4 occasions during recovery. The first was a pre-reintroduction survey to establish if conditions were suitable to receive reintroduced mussels (as evidenced by natural recruitment occurring at the site). After this, the site is monitored every five years (twice during reintroductions and once more 5 years after the last stocking event). Between 2007 and 2011, a total of 11,671 mussels (7,992 adults and 3,679 juveniles) of 24 species have been restored within the affected area of the river. At present, there are still 5 target species that have yet to be reintroduced. One species, *Elliptio dilatata*, has already exceeded restoration goals. At the 5 year mark now, the project will be reassessed to determine the stocking strategy for the future. The team may adjust its approach for the species that appear to be recruiting at a high rate on their own, and for those which have yet to be reintroduced in significant numbers. Patricia_Morrison@FWS.gov, Craig_Zievis@fws.gov

Poster 53 *Student Poster*	**INCREASED TURBIDITY DOES NOT DECREASE THE ABILITY OF MANTLE DISPLAYING MUSSELS TO TRANSFER GLOCHIDIA TO VISUAL FISH HOSTS.** Alexandra Neal [1], Andrew Gascho Landis [2], Michael Hart [2], James Stoeckel [2]. [1]University of Dayton, Department of Biology, Dayton, OH; [2]Auburn University, Department of Fisheries and Allied Aquacultures, Auburn, AL.

Successful transfer of glochidia to fish by mantle lure displaying mussels is thought to require fish hosts to first observe and then attack displaying mussels. Decreases in water clarity due to widespread increases in suspended solids throughout North America may inhibit fish's ability to observe mussels and disrupt this host-parasite relationship. We examined the influence of turbidity (1 – 95 NTU) on bluegill (*Lepomis macrochirus*) reaction distances to actively displaying pondmussels (*Ligumia subrostrata*) and assessed whether declines in reaction distance translated into fewer juveniles produced. We also compared largemouth bass (*Micropterus salmoides*) reaction distance to bluegill at low and high turbidity. We created a range of turbidity levels in aquaria and mesocosms and quantified female display activity, number of fish strikes, number of glochidia released with and without a strike, level of infestation, and number of juveniles produced. Bluegill reaction distance declined exponentially with increasing turbidity, with reaction distances decreasing to ≤6 cm at turbidities ≥18 NTU even though there was no change in mussel display activity between low (2 NTU) and high turbidity (89.7 NTU). Decreases in reaction distances between low and high turbidities did not result in concurrent decreases in juvenile production. Bluegill and bass reacted similarly to increasing turbidity with no interspecific differences in reaction distances found at either high or low turbidities. We also observed juvenile production in the absence of a fish strike (n = 1 of 2 largemouth bass). Our results suggest that high turbidity does not inhibit transfer of glochidia to fish by mantle lure displaying mussels. The apparent ability of mantle-lure displayers to transfer glochidia even in the absence of fish strikes may play an important role in minimizing effects of decreased water clarity. andrewmgl@gmail.com

Poster 54	**FRAGMENTS OF MOLLUSK SHELLS TO MAKE TOOLS AND ORNAMENTS: INVESTIGATION OF ARCHAELOGICAL FINDINGS IN EASTERN OREGON.** Donna Nez[1], Gene Shippentower[1], Christine O'Brien[2]. [1]Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fish & Wildlife Programs, Pendleton OR; [2]Browns River Environmental Consultants, Waynesville, NC.

In 2005, a status survey of the Umatilla River indicated many of the mussel species were in low number or were absent from the system. As part of the current mussel restoration efforts this project was initiated to first determine what types of mollusk shells were historically used by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and second, determine what mussel species were historically found in the Umatilla River system. Freshwater and marine mussels were important to CTUIR tribal members because they used their shells to make tools and ornamentation. The mussels were also consumed as food during the winter months. In 2009, a project to catalog shell material collected from Umatilla, Oregon located at the Mid-Columbia Archeology Society site (35UM35) was started. A total of 7,243 shell and shell ornaments have been cataloged. Most of the material inspected was identified as the western pearlshell Bivalvia: Unionidae *Margaritifera falcata* and only nine shells had evidence they were used to make ornamentation. Eight shell fragments were identified as the western ridgemussel Bivalvia: Unionidea *Gonidea angulata* and two were identified as Anodonta sp. Several small snail shells found were made into beads. Nine oyster shells were uncovered at the site. These findings suggest that shells from the western pearlshell were utilized the most for consumption and/or making tools and ornaments. Information collected during this study will help guide the restoration efforts currently underway in the Umatilla River Basin. Donnanez@ctuir.com

Poster 55	**GLOCHIDIAL SHELL DESCRIPTIONS FOR *ANODONTA CALIFORNIENSIS*, *A. OREGONENSIS*, and *A. NUTTALLIANA,* USING SCANNING ELECTRON MICROSCOPY.** Christine O'Brien[1], Jayne Brim Box[2], Donna Nez[2]. [1]Browns River Environmental Consultants, Waynesville, NC; [2]Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Fish & Wildlife Programs, Pendleton, OR.

In 2008 a genetic study of the *Anodonta* species in western North America found that the genus *Anodonta* was represented by two major clades (*A. oregonensis*/*A. kennerlyi* and *A. californiensis*/ *A. nuttalliana*). In order to better understand differences between the two clades, we compared glochidial shell morphologies, using scanning electron microscopy, for the following species: *A. californiensis* (California floater), *A. oregonensis* (Oregon floater) and *A. nuttalliana* (winged floater). Photos were taken of the flange region, shell shape, and shell surface sculpturing for each species. Glochidial shell descriptions for *A. kennerlyi* (western floater) were provided by Hoggarth (1999). Glochidial shells of all four *Anodonta* species are hooked and sub-triangular and their shell sizes ranged from 210 to 300 μm. Differences in glochidial shell surface features varied between the two clades, in that the glochidial shell surface feature of *A. californiensis* is rough and pitted, *A. nuttalliana* is loose-looped texture, and the glochidial shell surface of *A. oregonensis* and *A. kennerlyi* is intermediate between beaded and loose-looped. Based on the similarities in glochidial shell surface features, *A. oregonensis* and *A. kennerlyi* can be grouped into the current clade (*A. oregonensis*/*A. kennerlyi*). Differences in glochidial shell morphologies can aid in ongoing efforts to reassess the taxonomic and systematic placement of western *Anodonta* species. christine.amblema@gmail.com

Poster 56	**SEMI-QUANTITATIVE SURVEYS OF THE FRESHWATER MOLLUSK ASSEMBLAGES IN THE LITTLE RIVER, VIRGINIA.** Brett Ostby[1], Paul Angermeier[1], Michael Pinder[2]. [1]U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [2]Virginia Department of Game and Inland Fisheries, Blacksburg, VA

The Little River in southwestern Virginia remains a relatively undeveloped and understudied tributary of the biologically diverse Clinch River. In 2010 and 2011, we conducted semi-quantitative mollusk surveys at 22 sites distributed along an approximately 55 km contiguous reach of stream, of which 15 were sampled 20 years earlier during the only comprehensive survey this basin. Sampling efforts were measured by area searched (m^2) to better approximate our ability to detect rare species. Multiple 1-m-wide transects were systematically distributed from random starting points and searched using mask and snorkel, view scope or unaided visual inspection. A minimum of 1,200 m^2 of suitable habitat was searched at each site. At least 11 native mussel species continue to inhabit the Little River, 3 more than were found live or fresh-dead 20 years earlier. Only 6 species demonstrated recent recruitment. We confirmed that 14 mussel species inhabited this river in the recent past and found records for as many as 18 species in database searches. The Little River currently supports at least 6 snail species, members of the family Sphaeriidae and the non-native *C. fluminea* (which were observed at more sites than 20 years earlier). The apparent increase in live mussel richness likely reflects our more intensive and focused sampling approach rather than improved ecological health. Spatiotemporal variation in mussel richness and relative abundance were associated with river kilometer and seemed to respond negatively to an abrupt increase in urban development, a waste water treatment plant, intense cattle grazing and a major road crossing all coinciding in the middle of the basin. The Little River supports a mollusk fauna comparable to other tributaries of the Clinch River; however, given its size and relatively low degree and extent of disturbance, we expected to find more high-density assemblages and greater richness. bostby@vt.edu

Poster 57 *Student Poster*	**EFFECTS OF PHYSICOHEMCIAL HABITAT PARAMETERS ON APPALACHIAN ELKTOE (*ALASMIDONTA RAVENELIAN*) POPULATIONS IN THE UPPER NOLICHUCKY RIVER DRAINAGE, NORTH CAROLINA.** Gary Pandolfi, Michael Gangloff. Biology Department, Appalachian State University, Boone, NC.

The Appalachian elktoe, *Alasmidonta raveneliana*, is endemic to upper Tennessee River Drainage streams draining the Blue Ridge Physiographic Province in North Carolina and Tennessee. Recently, Appalachian elktoe populations in some Western NC streams have undergone dramatic, yet enigmatic declines and few parsimonious mechanisms have been proposed to explain the near complete extirpation of this already rare mussel from its key strongholds in high-quality streams. In North Carolina's upper Nolichucky River Drainage, *A. raveneliana* is extant in the North Toe, South Toe and Cane rivers. Populations are strongest in the largely forested South Toe whereas the more developed North Toe and Cane appear to support smaller and more peripheral populations. Beginning in Fall 2012 we deployed water temperature loggers and began monitoring DO, conductivity, pH, Redox potential and salinity at 2 week intervals at 15 sites in the Nolichucky Drainage. Reaches with Appalachian elktoe populations had significantly higher oxygen saturation levels and lower Redox potential compared to sites without elktoe populations. These data suggest that water chemistry parameters, possibly related to human-mediated landuse change, may be important predictors of Appalachian elktoe population viability. Ongoing monitoring of water chemistry parameters and elktoe populations will help elucidate linkages between watershed-scale landuse changes and mussel population declines. pandolfigs@appstate.edu

Poster 58	**MODELING ENVIRONMENTAL EFFECTS ON THE OCCUPANCY OF COMMON AND IMPERILED FRESHWATER MUSSELS AT MULTIPLE SPATIAL SCALES.** Tamara Pandolfo [1], Thomas Kwak [2], Gregory Cope [3], Ryan Heise [4], Rob Nichols [5]. [1] North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, NC State University, Raleigh, NC; [2] U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, NC State University, Raleigh, NC; [3] Department of Environmental and Molecular Toxicology, NC State University, Raleigh, NC; [4] North Carolina Wildlife Resources Commission, Creedmoor, NC; [5] North Carolina Wildlife Resources Commission, Raleigh, NC.

Freshwater mussels, order Unionida, are among the most sensitive and rapidly declining faunal groups globally, and especially in North America. The effects of climate and land use changes may exacerbate the decline of already threatened freshwater mussels, and this possibility remains to be explored. The Tar River Basin of North Carolina supports a diverse mussel assemblage that includes a number of imperiled species, including the federally endangered Tar River spinymussel (*Elliptio steinstansana*) and dwarf wedgemussel (*Alasmidonta heterodon*), and is therefore an ideal system to investigate the potential effects of climate and land use change on mussels. We selected 20 sites within the Tar River Basin that longitudinally span a broad range of environmental conditions for intensive study. Each site was surveyed for common and imperiled mussels and fish. Microhabitat and macrohabitat scale parameters were measured at base flow conditions at all sites, and watershed scale parameters were quantified using Geographic Information Systems. Occupancy modeling, combining mussel detection and occupancy probabilities, and an information theoretic approach were used to identify the most parsimonious relationships that relate physical and biological parameters to the occurrence of five species of mussels at the 20 surveyed sites, *Alasmidonta heterodon*, *Elliptio icterina*, *Elliptio steinstansana*, *Fusconaia masoni*, and *Villosa constricta*. Physical and biotic environmental covariates at all three spatial scales were included in the most plausible mussel occupancy models, including measures of riparian land use, stream depth and substrate, water temperature, and fish assemblage parameters. Mussel detection probability was most often related to instream microhabitat characteristics. These ecological associations and identification of environmental variables that potentially influence the distribution of freshwater mussels are valuable information to guide future research and inform the conservation and management of these imperiled organisms in the context of global change. tjpandol@ncsu.edu

Poster 59 *Student Poster*	**CLAMMING UP: HOW ARE FRESHWATER MUSSELS AFFECTED BY A TAR SANDS OIL SPILL?** Samantha Parker[1,2] Daelyn Woolnough[1,3]. [1]Biology Department, Central Michigan University, Mount Pleasant, MI; [2] Honors Program, Central Michigan University, Mount Pleasant, MI; [3]Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, MI.

In July 2010, a pipeline ruptured and spilled over 3 million liters of tar sands/shale oil into the Kalamazoo River watershed, Michigan, USA. Tar sands oil is becoming a concern as large pipelines are being proposed to increasingly exploit this form of oil. This study determined whether the spill had any effects on the freshwater mussel populations in the Kalamazoo River. Ten quadrat and twelve random transect surveys were performed at twelve sites. Sites were upstream of the spill (n=5), in the spill area (n=4), and downstream of the spill (n=3), i.e. past the point where the oil was intersected by clean-up. Species, number of live mussels, lengths, number of shells, and gravidity data for sexually dimorphic species were collected. These data were analyzed to compare differences among sites, regions and to limited historic data. Ten species of live mussels were found in the upstream region, seven in the spill region, and thirteen in the downstream region. One site in the spill region was sampled in 2000 and four species were found, which was consistent with our sampling of this site. Size class distributions of the most commonly found species, *Elliptio dilatata*, show significant differences among sites ($p < 0.05$) and exhibited differences among regions sampled. We also considered whether recruitment may have been affected by the spill, these data will be presented. The questions asked in this study are important to improve our understanding of how mussels, organisms that provide important ecological functions, can withstand oil spills. Studies suggest that mussels have effective mechanisms of tolerating pollution by detecting toxins and controlling their intake of water. However, it is possible that heavy pollution like oil spills can affect mussel population demographics and recruitment, which could damage the health of the mussel population and ecology of the water body. parke2ss@cmich.edu

Poster 60 *Student Poster*	**USE OF MOLECULAR BAR-CODING TO DIAGNOSE CRYPTIC MUSSEL DIVERSITY IN A CENTRAL FLORIDA RIVER.** Michael Perkins, Raymond Kessler IV, Michael Gangloff. Biology Department, Appalachian State University, Boone, NC.

Morphological diagnosis of cryptic or endangered freshwater mussel taxa can be problematic. We used a bar-coding approach to identify cryptic diversity within and potentially differentiate *Elliptio* morphotypes collected from three sites in the Santa Fe River in central Florida. A secondary goal was to ensure that a similar-appearing but endangered species, *Pleurobema pyriforme*, was not being overlooked while sorting through large numbers of *Elliptio*s. Specimens were collected from a variety of habitat types and we identified three distinct morphotypes. Total genomic DNA was extracted from tissue swabs and from putative *P. pyriforme* and *Elliptio* morph tissue samples. We amplified

portions of the COI and NDI genes. Maximum likelihood and Bayesian inference were performed to examine differences between morphs and assess phylogenetic placement of any unknown taxa. No *Pleurobema* sequences were identified from among some 50 individuals sampled. Comparisons to other Gulf of Mexico Drainage taxa suggest that Santa Fe *Elliptio*s form a well-supported clade that is sister to *E. pullata*. These data will be used to supplement on-going research into the phylogeography of Gulf Elliptio taxa. perkinsma@appstate.edu

Poster 61 *Student Poster*	**ASSESSMENT OF A POND MESOCOSM DESIGN TO STUDY CHRONIC THERMAL STRESS ON FRESHWATER MUSSELS.** Samantha Perkins[1], Paul Johnson[2], Matthew Jenny[1]. [1]Department of Biological Sciences, University of Alabama, Tuscaloosa, AL; [2]Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center, Marion, AL.

Freshwater mussels are among the most imperiled organisms on the planet. One potential cause of this decline that cannot be immediately rectified is the ongoing threat of global warming. This threat could become particularly disastrous for species already documented to be living at their upper thermal tolerance limits. Many studies attempting to understand how thermal stress might influence freshwater mussel populations suffer due to restricted spatial and temporal scaling. If the goal is predicting freshwater mussel response to future warming scenarios, then designs incorporating environmentally relevant chronic heat shocks in realistic environments are necessary. A pilot study was done in order to test the applicability of this design for future warming experiments. The design utilized two ponds located at the Alabama Aquatic Biodiversity Center in Marion, Alabama. One pond was left at ambient temperature while the warmed pond was maintained at 3°C±1°C above the ambient pond temperature for a total of 4 months. Two species of mussel, *Villosa lienosa* and *Villosa nebulosa,* were utilized due to hypothesized discrepancies in robustness and thermal tolerance. Both species were sampled in each pond twice a month for condition, growth, glycogen, triglycerides, and tissue for gene expression analysis. Current results show that thermal regimes in the warm pond successfully tracked ambient pond regimes. Further, the two species responded differentially to the warmed pond compared to the ambient pond in condition and glycogen content, while growth only differed between the species. Further analyses will include triglyceride content and gene expression profiling. slperkins@crimson.ua.edu

Poster 62	**DEVELOPING A STRATEGIC RESTORATION PLAN FOR WATERSHEDS IN ALABAMA**. Jeff Powell[1], Pat O'Neil[2], Paul Johnson[3], Allison Jenkins[4]. [1]US Fish and Wildlife Service, Alabama Ecological Services Field Office, Daphne, AL; [2]Geological Survey of Alabama, Ecosystems Investigations Program, Tuscaloosa, AL; [3]Alabama Department of Conservation and Natural Resources, Fisheries Section, Alabama Aquatic Biodiversity Center, Marion, AL; [4]Alabama Clean Water Partnership, Wetumpka, AL.

The U.S. Fish and Wildlife Service in conjunction with the Alabama Department of Conservation and Natural Resources and the Geological Survey of Alabama have selected watersheds and river segments in the five HUC-4 subregions in Alabama to focus conservation activities for managing, protecting, restoring, and recovering populations of rare fishes, mussels, snails, and crayfishes. These areas which are called, Strategic Habitat Units (SHUs) and Strategic River Reach Units (SRRUs), include a substantial part of Alabama's remaining high-quality rivers and streams. The SHUs were selected based on the number and presence of federally listed and state imperiled species, potential threats to the species, designation of critical habitat, and the best available information about the essential habitat components required by these aquatic species to survive. The SRRUs were selected based on the historical and/or current presence of rare species and include river reaches where species restoration and recovery actions are planned for the future or are already underway. The purpose of this project is to facilitate and coordinate watershed management and restoration efforts as well as to focus funding to address habitat and water quality issues. jeff_powell@fws.gov

Poster 63	**TRACKING RECOVERY: EVALUATION OF THE ONTARIO MUSSEL PROTOCOL.** Scott Reid[1], Todd Morris[2]. Aquatic Research and Development Section, Ontario Ministry of Natural Resources, Peterborough, ON, Canada; [2] Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, Burlington, ON, Canada.

Since 2003, members of the Ontario Freshwater Mussel Recovery Team (OFMRT) have been implementing a standardized protocol for assessing the current status, distribution and demographics of freshwater mussel Species at Risk (SAR) in southern Ontario. In addition, data collected through this protocol are intended to provide baseline levels to be used to track changes in these parameters to assist with monitoring recovery and to facilitate future reassessments. This protocol involves the quantitative sampling of a 400 m^2 site using 1 m^2 quadrats arranged following a systematic sampling design employing three random starts within each 15 m^2 (3 m x 5 m) block. To date this protocol has been

implemented at over 25 sites in 6 rivers in southern Ontario. Using these data, as well as a second dataset consisting of a complete excavation of one 400 m^2 site, we employed resampling techniques to investigate the power of this protocol to provide meaningful information on changes in population parameters through time. Preliminary results indicate that data collected using this protocol are adequate for assessing assemblage level changes but likely inadequate for assessing changes at the species level. Large increases in effort (2 – 5 fold) are required to effectively track changes in most SAR. Todd.Morris@dfo-mpo.gc.ca

Poster 64	**CONSERVATION GENETICS OF THE THREATENED YELLOW LAMPMUSSEL, *LAMPSILIS CARIOSA*.** Brianna Reilly, Victoria Hotz, Tyler Vitone, Curt Elderkin. The College of New Jersey, Department of Biology, Ewing, NJ.

Many mussel taxa in the Atlantic slope fauna are considered of-concern to imperiled to extinct across their range. This is further exacerbated in northern areas where population were reduced in size during the Pleistocene by the approaching glacier, and then later negatively impacted by habitat fragmentation/degredation before northern populations were fully recovered. Also, fish (and mussels) may have been split into several isolated coastal areas during the Pleistocene and returned has habitats became more suitable. The yellow lampmussel, *Lampsilis cariosa*, is a member of the Atlantic Slope fauna and is listed from vulnerable to extirpated in many northeastern states. However, *L. cariosa* occurs frequently in the Susquehanna River drainage in eastern Pennsylvania, especially in the main channel and the larger tributaries. Mitochondrial DNA from the COI gene was amplified, sequenced, and compared, among populations from the Susquehanna River tributaries (N = 110 from 14 populations). Results thus far indicate that 98% of genetic variation occurs within-population and the population structure among populations is minimal (F_{st} = 0.012). Genetic diversity within these populations is relatively low compared to other mussel taxa (14 haplotypes). However, preliminary analysis of 7 Microsatellite (MS) loci using the same individuals is continuing and may illuminate any recent isolation among these populations. We hope to compare these results to populations outside the Susquehanna drainage to determine if Susquehanna River populations have relatively low genetic diversity, high population structure, and if they repopulated these areas from more than one glacial refuge. curtelderkin@gmail.com

Poster 65	**QUANTIFYING THE INTER-ANNUAL VARIATION IN RECRUITMENT OF FRESHWATER MUSSELS, AND EXPLORING POSSIBLE RELATIONS WITH HYDROLOGIC EVENTS.** Patricia Ries[1], Teresa Newton[1], Steve Zigler[1], Mike Davis[2], Roger Haro[3]. [1]USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI; [2]Minnesota Department of Natural Resources, Lake City, MN; [3] University of Wisconsin–La Crosse, River Studies Center, La Crosse, WI.

Overall abundance of native mussels has substantially declined in the Upper Mississippi River (UMR) leading to the extirpation of many species. One potential reason for declines in mussel populations is the lack or slowing of recruitment. Minimal research on variations in recruitment of native mussels is available which limits our ability to evaluate population stability. Our objective was to estimate the inter-annual variability in recruitment of mussels and conduct preliminary analyses exploring potential relations between recruitment and hydrologic conditions. We used a quantitative dataset with annual population data for a mussel assemblage in a reach of the UMR during 2008-2011 from the MN DNR. We used three methods to assess the inter-annual recruitment of the three most dominant tribes of mussels (Amblemini, Lampsilini, Pleurobemini): direct assessment, catch-curve analysis, and cohort analysis. Direct assessment of the mussel assemblage revealed a recent decline in mussel densities; dropping from 11.0 mussels/m^2 in 2009 to 5.9 mussels/m^2 in 2011. This decrease was primarily the result of lack of recent recruitment in this assemblage. The catch-curve analysis using weighted residuals was the most successful method and provided evidence of strong or weak year classes for all three tribes. Strong year classes of Lampsiline mussels generally occurred during years that had higher than average discharge during June to early July, whereas discharges were lower than average during the same time period. Strong year classes of Amblemini and Pleurobemini mussels occurred during two years of strong spring flood pulses, whereas weaker flood pulses were evident in years with weak year classes. This research aims to determine if the spatial and temporal variation in recruitment is a sensitive and accurate means of assessing population health of native mussel populations. pries@usgs.gov, tnewton@usgs.gov

Poster 66 *Student Poster*	**ASSESSING THE SUB-LETHAL EFFECTS OF CHLORIDE ON ADULT *VILLOSA IRIS* USING HISTOLGICAL EVALUATIONS**. Jennifer Rogers[1], William Henley[1], Amanda Graumann[1], Jess Jones[2], Gregory Cope[3]. [1]Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA; [2]US Fish and Wildlife Service, Department of Fish and Wildlife Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA; [3]Department of Environmental and Molecular Toxicology, North Carolina State University, Raleigh, NC.

Once supporting a diverse assemblage of mussels, the North Fork Holston River (NFHR) has seen drastic declines in its mussel fauna. Historical industrial activities at Saltville, Virginia, as well as continued pollution of the river from ongoing sources, are believed to be significant causes of these declines. Seepage waters from these polluted areas add high concentrations of various ions, including sodium and chloride, to the river and are suspected of negatively impacting mussel populations. The objective of this study is to assess the health of adult *Villosa iris* exposed to environmentally relevant concentrations of chloride (Cl) determined from the existing U.S. EPA water quality criterion and measurements of surface water taken from the NFHR. Histological evaluations of organ tissues, including gills, digestive glands, kidneys, and gonads, will be used to assess non-lethal, chronic effects of Cl (as sodium chloride; NaCl) on mussel tissues. Fifteen small water-recirculating aquaculture systems (19 L downweller buckets) were built for this experiment. Treatments consisted of a bank of five separate replicate systems, each containing eight adult *V. iris*. Stock solutions were created using pond water filtered through a 200 µm nylon monofilament bag and reagent grade NaCl. In the low level treatment, solutions were created to expose mussels to 230 mg/L Cl, which is the U.S. EPA aquatic life chronic criterion. The high level treatment, 705 mg/L Cl, was determined from measurements of water samples taken in the NFHR near Saltville. There was one bank of five control systems which contained pond water with no additional ions. During this still ongoing 3-month study, higher mortality has occurred in the high chloride treatment compared to the low level treatment and control. Results of histological evaluations are pending completion of this study and will be presented in March along with conclusions. jrogers1@vt.edu

Poster 67 *Student Poster*	**ASSESSMENT OF MORPHOLOGICAL AND MOLECULAR GENETIC VARIATION OF FRESHWATER MUSSEL SPECIES BELONGING TO THE GENERA *FUSCONAIA*, *LEXINGTONIA* AND *PLEUROBEMA* IN THE TENNESSSEE RIVER DRAINAGE**. Daniel Schilling[1], Jess Jones[2], Andrew Phipps[1], Michael Pinder[3], Eric Hallerman[1]. [1]Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [2]United States Fish and Wildlife Service, Department of Fish and Wildlife Conservation, Virginia Tech, Blacksburg, VA; [3]Virginia Department of Game and Inland Fisheries, Blacksburg, VA.

Since the late 1600s, freshwater mussels have been assigned taxonomically based primarily on shell morphology. Approaches to classification have changed as authors have incorporated additional characters from soft anatomy, larval morphology and life history traits. Since the advent of molecular DNA techniques, mussel classification systems have undergone additional reorganization at the family, genus and species levels. The objective of this study is to improve accuracy of field survey identifications by assessing the morphological and genetic variation of difficult-to-identify mussel species belonging to the genera *Fusconaia, Lexingtonia* and *Pleurobema*. Species in these genera appear similar morphologically and can be difficult to identify reliably. The species of interest in this study are generally distributed in the Tennessee, Cumberland and Ohio river systems. We collected mussels of these genera from the Clinch, Powell and Holston river drainages of the upper Tennessee River basin, and from the Duck River in the lower Tennessee River system for a comprehensive analysis of morphological and genetic variation. We sequenced the first subunit of the mitochondrial NADH dehydrogenase (*ND1*) gene to assess phylogenetic relationships and establish a genetic basis for observed morphological variation. Morphological characters included foot color, periostricum texture and color, maximum length, height and width. Geometric morphometrics were used to analyze external shape differences among species. dschilli@vt.edu

Poster 68 *Student Poster*	**TESTING HYPOTHESES OF ATLANTIC COASTAL ORIGIN FOR THE ENDANGERED EASTERN PONDMUSSEL, *LIGUMIA NASUTA*, IN THE GREAT LAKES**. Mariah Wild Scott, David Zanatta. Central Michigan University, Biology Department and Institute for Great Lakes Research, Mount Pleasant, MI.

Most freshwater mussels, native to North America, post-glacially repopulated the Great Lakes region (GLR) from the Mississippi River system. In contrast, the Eastern Pondmussel, *Ligumia nasuta,* dispersed to the GLR from rivers on the Northern Atlantic coastal region (NACR). It is currently unclear which specific region of the NACR *L. nasuta* populations have directly descended from. It is hypothesized that the *L. nasuta* dispersed into the GLR via a connection to the Mohawk and Hudson rivers. *Ligumia nasuta* is an imperiled species throughout its range (e.g., Endangered in Canada and three U.S. states) because of population declines caused by the invasive dreissenid mussels. Therefore, it is particularly important to understand the genetic lineage of remaining *L. nasuta* populations, so future repopulation efforts are properly managed. This study surveyed the genetic diversity of the *L. nasuta* in the GLR and NACR using mitochondrial DNA CO1 and ND1 regions. This study examines 54 field collections from 25 remaining habitats in the GLR and rivers in the NACR. DNA sequences from all collection sites were compared to the hypotheses of the evolutionary history with respect to geography and post-glacial origin. Only a single haplotype was found for the CO1 region and three haplotypes for ND1. The very low genetic variation found across the range of *L. nasuta* is consistent with a single post-glacial introduction into the GLR. It was not conclusive which Atlantic coastal population acted as the source for the GLR. This suggests that *L. nasuta* populations in the GLR and NACR can be treated as a single population in terms of conservation and management. Future studies using microsatellite markers are recommended to further elucidate the fine-scale genetic structure in this species. Scott2MW@cmich.edu

Poster 69	**PROPAGATION AND AUGMENTATION OF TWO FEDERALLY ENDANGERED CUMBERLANDIAN MUSSEL SPECIES, THE CUMBERLAND BEAN AND THE CUMBERLAND ELKTOE**. Adam Shepard[1], Monte McGregor[1], Fritz Vorisek[1], Travis Bailey[1], Christopher Owen[1], Andrew McDonald[1], Jacob Culp[2]. [1]Kentucky Department of Fisheries and Wildlife Resources, Center for Mollusk Conservation, Frankfort, KY; [2]Kentucky Division of Water, Frankfort, KY.

We determined suitable host, propagated and reared juveniles of two federally endangered freshwater mussel species at the Center for Mollusk Conservation (CMC): the Cumberland Bean (*Villosa trabalis*) and the Cumberland (*Alasmidonta atropurpurea*). Adult female mussels of both species were collected gravid from the wild and transported to the CMC in Frankfort, Kentucky. Two females of *Villosa trabalis* were collected in 2007 from Sinking Creek, Laurel County, Kentucky, and five female *Alasmidonta atropurpurea* were collected in 2011 from North White Oak Creek, Scott County, Tennessee. The glochidia of *Villosa trabalis* were exposed to striped darters (*Etheostoma virgatum*) and the glochidia of *Alasmidonta atropurpurea* were exposed to northern hogsuckers (*Hypentilium nigricans*). For initial growout, juveniles of *Villosa trabalis* were held in down-welling air lift systems and *Alasmidonta atropurpurea* were held in Barnhart "mucket bucket" systems. After reaching a size of more than 2 mm, *Villosa trabalis* were transferred to a re-circulating "mini-riffle" system and *Alasmidonta atropurpurea* juveniles were transferred to a re-circulating bowl system which they were held until reaching a stockable size. In September of 2009, forty-two *Villosa trabalis* (mean length ~ 16.7 mm) were released into Sinking Creek near the adult collection site. In April of 2012, we found one male and six females of tagged *Villosa trabalis* and all females were gravid. In August of 2012, eighty *Alasmidonta atropurpurea* (mean length ~17.5 mm) were released into North White Oak Creek in the Big South Fork Cumberland River system. adam.shepard@ky.gov

Poster 70	**14 YEARS UNDERWATER – DOCUMENTING THE DIVERSITY AND STATUS OF FRESHWATER MUSSELS IN MINNESOTA**. Bernard Sietman[1], Mike Davis[2], Nicole Ward[1]. [1]Minnestoa Department of Natural Resources, St. Paul, MN; [2]Minnestoa Department of Natural Resources, Lake City, MN.

We designed and implemented a comprehensive statewide survey to inventory and assess the status of freshwater mussels in Minnesota. Entire drainages were sampled, from lakes and headwaters to large rivers, covering all of the state's major river systems. During 14 field seasons, we sampled for over 3,900 hours at 2,819 sites and collected over 300,000 live mussels. Fifty species were documented from the state (two from literature and museum specimens only); 46 species are extant, two of which are in imminent threat of extirpation and six are critically imperiled due to their extreme rarity or severely reduced range, and four species are presumed extirpated. The St. Croix, Mississippi headwaters (above St. Anthony Falls), Red River of the North, Lake of the Woods, and Lake Superior drainages have retained their historic species assemblages, whereas the Minnesota, Missouri, and upper Mississippi (below St. Anthony Falls) drainages have lost 7 - 44% of their species. These drainages show a gradient of mussel richness, abundance, and species loss, with agriculture dominated regions in southern Minnesota suffering the greatest mussel declines compared to regions with more intact wetland and lake complexes. Freshwater mussels are a powerful biological indicator of watershed condition, and these data are being used to help guide water resource strategies for conserving biodiversity across the state. bernard.sietman@state.mn.us

Poster 71	**DOCUMENTING THE PAST: THE MUSEUM OF FLUVIATILE MOLLUSKS.** Jamie Smith, Arthur Bogan. North Carolina State Museum of Natural Sciences, Research Lab, Raleigh, NC.

Amassed over its 133-year history, the North Carolina State Museum of Natural Sciences (NCSM) houses over three million specimens, making it one of the largest natural history collections in the southeastern United States. During the past century, the focus has shifted from a multipurpose institution displaying agricultural and natural resources to a natural sciences museum concentrating on documenting and preserving the state's biological diversity, promoting environmental awareness, and relating the natural sciences to everyday life. The mission of NCSM is to "enhancement of the public's understanding and appreciation of the environment in ways that emphasize the natural diversity of North Carolina, the southeastern United States and relate the region to the world as a whole." Through steady growth and continuous incorporation of orphaned collections, like the Herbert D. Athearn (Museum of Fluviatile Mollusks), the museum maintains comprehensive collections that document the region's natural history. Although absorption of an orphaned collection comes with increased curatorial responsibility, the potentially high value of many of these collections to science and society makes this a crucial undertaking for institutions housing collections. The Herbert D. Athearn Collection represents a success story of the adoption of a collection containing material significant for research dealing with ecological, environmental, and taxonomic questions, not to mention documentation of former distribution. Databasing efforts of the collection has focused largely on gastropods and globally ranked (G1, G2, G3) bivalves. A total of 11,427 lots (481,045 specimens) have identifications confirmed or corrected in accordance with the latest taxonomic research and all taxonomic history has been noted in the database. Over 3,700 lots represent species that are now extinct, endangered, or threatened. Herbert D. Athearn was an enthusiastic freshwater shell collector with a wide geographical interest. Although his studies mainly focused in the southeastern United States, his collection

includes specimens from 90 countries. Jamie.Smith@naturalsciences.org

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Student Poster

DEVELOPMENT OF MOLECULAR RESOURCES FOR DETECTION OF FRESHWATER MUSSELS USING ENVIRONMENTAL DNA AND NEXT GENERATION SEQUENCING TECHNOLOGY. Andrew Stump, Sara Larsen, David Hayes; Department of Biological Sciences, Eastern Kentucky University, Richmond, KY.

Environmental DNA (eDNA) is a method used for detection of aquatic species in water samples without direct observation. Sources for environmental DNA include (but are not limited to) feces, urine, sperm, eggs, epithelial cells, and decaying individuals. Most environmental DNA studies to date have focused on detection of single species, generally invasive or evolutionarily unique species, utilizing species-specific primers. Since eDNA is likely highly degraded, small regions are generally amplified (<150bp). Designing species-specific primers may be difficult or impossible when target species co-occur in a community of closely related species where known sequence divergences might be too small to design species-specific primers. This poses a challenge for the utilization of eDNA as a detection tool for freshwater mussels as many assemblages contain closely related taxa. Next generation sequencing technology (NGS) allows for the amplification and sequencing of mixed samples, thus eliminating the need for species-specific primers. While several universal primers have been published, these primers also amplify many non-mussel taxa, thus reducing sequence signal from the target group. The purpose of this research is to develop molecular markers for freshwater mussels that will 1.) utilize NGS as a means of distinguishing closely related taxa and examining entire communities at once and 2.) develop markers that will selectively amplify mussels over non-mussels and cover taxonomically informative regions for identification. We used published CO1 sequences and employed a Sliding Window Analysis to identify short, taxonomically informative regions. No single region was informative across all mussels so we targeted each of the five tribes within the Unionidae and developed primer sets for each tribe. We are currently in the process of testing the performance of these primer sets on known tissue samples. Water samples will be taken from a mussel hatchery, amplified, and species detection ability assessed using NGS. andrew_stump1@mymail.eku.edu

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ELECTROFISHING AS A NEW METHOD TO FIND FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA*) POPULATIONS. Jouni Taskinen[1], Jouni Salonen[1], Marko Kangas[2], Pirkko-Liisa Luhta[3], Eero Moilanen[3]. [1]Department of Biological and Environmental Science, University of Jyväskylä, Jyväskylä, Finland; [2]Centre for Economic Development, Transport and the Environment of Lapland, Rovaniemi, Finland; [3]Metsähallitus / Natural Heritage Services, Pudasjärvi, Finland.

As many of freshwater mussel populations and species have declined, a challenge for conservation or restoration may be to find the remaining populations. The freshwater pearl mussel *Margaritifera margaritifera* is threatened throughout its range, but its occurrence has not been mapped in large areas in northern Europe. Traditionally pearl mussel populations have been searched by visual observation with diving. Aim of the present study was to test electrofishing of the fish host as a new method to search for unknown populations of *M. margaritifera*. Developed *M. margaritifera* glochidia should be observed by naked eyes by opening slightly the operculum of their fish host, brown trout *Salmo trutta* in early summer before their drop off. After short examination the fish with glochidia larvae could be released alive back to the river. The method was tested in June 2011 in two tributaries of River Iijoki, northern Finland, by comparing results of field assessment with microscopic examination. In the first tributary, infection status (infected/uninfected) assessed with a quick dip in the field was correct in 17 fish out of 18. In the second tributary, status was correct in 17 out of 22 fish. No false positive records were achieved, and the field-assessment was 100% correct in all cases in which the number of glochidia per fish was at least 20. We also report 2012 results on the application of the method applied to tens of northern Finnish rivers with no prior knowledge about the occurrence of pearl mussel, or host fish. The results indicate that electrofishing and quick check of host fish in the field could provide a cost-effective, non-destructive way to find new populations of the freshwater pearl mussel, or investigate occurrence in previously occupied sites. jouni.k.taskinen@jyu.fi

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MAPPING CRITICAL HABITAT IN SELECTED STRETCHES OF THE POWELL RIVER, CLAIBORNE COUNTY, TENNESSEE. Aggy Vanderpool[1], Joseph Candlish[2], Ron Caldwell[1]. [1]Cumberland Mountain Research Center, Lincoln Memorial University, Harrogate, TN; [2]Information International Associates, Oak Ridge, TN.

The Cumberland Mountain Research Center conducted georeferenced substrate mapping of the Powell River, River Miles 89-95 in 2010 and 2011. This reach contains critical habitat for federally listed freshwater mussels. The goal was to identify the best available quality habitat for recovery efforts for listed and sensitive species such as *Lemiox rimosus* and *Epioblasma capsaeformis*. River substrates were mapped using GIS technology and ArcGIS software. Undergraduate students and LMU faculty surveyed the river substrate on foot, using hand-held Garmin® GPSMAP 76CSx GPS units. Substrate types were mapped by walking the river bottom in transects spaced at 30 m. Waypoints were recorded at regular intervals according to changes among the river substrate types. A hand-drawn map of the river substrates was generated and used for later cross-referencing

of shapefiles. In water depths above 1.25 m or turbidity levels above 30 FTU, snorkel and mask were used to determine river substrate types. The close detail of this mapping methodology allowed for clear determinations of bottom and channel characteristics. The protocol used to identify the river substrate is adapted from the 2009 Obed Wild and Scenic River Habitat Mapping Project (Ayers and Hughes, 2009). The criteria established seven substrate types for mapping as follows: Fines, Small Gravel, Large Gravel, Cobble, Small Boulder, Large Boulder, and Bedrock. Macrohabitat mapping for riffle, run and pool segments of the river was also conducted and a second GIS map was generated. Calculations for area and percentages of each substrate type were made. Results are reflected in the habitat maps generated for River Miles 89-95 of the Powell River. Aggy.Vanderpool@lmunet.edu

Poster 75	**DEVELOPMENT OF AN ALGAL DIET FOR REARING JUVENILE FRESHWATER MUSSELS (BIVALVIA: UNIONIDAE).** Fritz Vorisek[1], Monte McGregor[1], James Tidwell[2], Adam Shepard[1], [1] KDFWR, Center for Mollusk Conservation, Frankfort, KY; [2] Kentucky State University, Frankfort, KY.

The decline of North American freshwater mussels in the past century has led to proactive research into propagation and culture. Rearing juvenile mussels to a stockable size is our current approach for mussel restoration in Kentucky. We used ozone (O_3) treated, 1 µm filtered well water to culture the green algae *Chlorella sorokiniana.* Starter cultures were obtained from the University of Texas (UTEX) culture bank. The cultures were inoculated in a liquid media with a commercial F/2 fertilizer, aerated and mixed with 3% CO_2 in 19 liter carboys and then scaled up to 473 and 757 liter fiberglass tanks. The species is cultured in direct sunlight supplemented with cool white florescent light for 4-6 days. Once the algae is ready for harvest (the end of the exponential growth phase), it is pumped to a cream separator to concentrate the algae into a paste. The paste is weighed and re-suspended in source water at a rate of 1 g/10ml. The algae concentrate is then refrigerated until needed. Experiments have shown that the algae may be dried for longer storage. We added a natural source of bacteria/periphyton to the algae concentrate to make a natural diet for juvenile freshwater mussels. Bacteria and periphyton were obtained from benthic rock scrapings from a local river and filtered through a 20 µm screen. The scrapings are obtained in the summer and frozen. To apply the feed, the diet mix is made weekly. The diet composition is 150ml bacteria/periphyton to 1000 ml *Chlorella* concentrate added to 19 liters of source water. This solution is added to Imhoff cones where it will mix for a few hours prior to being added to juvenile tanks. fritz.vorisek@ky.gov

Poster 76 *Student Poster*	**USING MAXENT TO PREDICT HABITAT SUITABILITY OF STATE-THREATENED UNIONID SPECIES IN EAST TEXAS.** Ashley Walters[1], Marsha Williams[2], Josh Banta[2], Neil Ford[2], Lance Williams[2]. [1]Department of Zoology, Miami University, Oxford, OH; Department of Biology, University of Texas at Tyler, Tyler, TX.

The population decline of mussel belonging to the family *Unionidae* has become an important conservation issue. The sandbank pocketbook, *Lampsilis satura*, southern hickorynut, *Obovaria jacksoniana*, Louisiana pigtoe, *Pleurobema riddellii*, and Texas pigtoe, *Fusconaia askewi*, are Texas state-threatened mussels that occur throughout East Texas. However, little information is known about the population ecology of these species. Ecological niche modeling was used along with biotic environmental data layers to predict the habitat suitability in east Texas Rivers. Soil and vegetation type were the most important predictors of habitat quality. Through the use of this software, we were able to determine locations and quantities of similar habitat and geomorphology in the east Texas Rivers to help describe the amount of available habitat for these species and predict their probability of occurrence. addunithan@gmail.com

Poster 77	**ACUTE SENSITIVITY OF FRESHWATER MUSSELS TO SELECTED CHEMICALS WITH DIFFERING TOXIC MODES OF ACTION.** Ning Wang[1], Chris Ingersoll[1], Chris Ivey[1], Bill Brumbaugh[1], Ed Hammer[2], Candice Bauer[2], Tom Augspurger [3], Sandy Raimondo[4], Burt Shephard[5], Joe Bartoszek[6], Chris Barnhart[7], Nathan Eckert[8]. [1]US Geological Survey, Columbia, MO; [2]US Environmental Protection Agency, Chicago, IL; [3]USFWS, Raleigh, NC; [4]US Environmental Protection Agency, Gulf Breeze, FL; [5]US Environmental Protection Agency, Seattle, WA; [6]USFWS, Burbank, WA; [7]Missouri State University, Springfield, MO; [8]US Fish and Wildlife Service, Genoa, WI.

The objectives of this ongoing study are (1) to evaluate sensitivity of several species of mussels, snails, and commonly tested invertebrate species in acute water exposures with 10 chemicals (Tier 1 testing), and (2) to "screen" acute sensitivity to additional chemicals with a commonly tested mussel species (Tier 2 testing). This poster describes the Tier 1 testing with mussels selected to be representative of four tribes of the family Unionidae widely distributed in the midwestern and the southeastern United States, and the family Margaritiferidae in the Pacific Northwest. The chemicals were chosen based on the US Environmental Protection Agency (USEPA) ambient water quality criteria (AWQC), availability of toxicity data for non-mollusks, other non-unionid mollusks sensitivity to the chemicals, and toxic mode of action. The EC50s for each of the 10 Tier 1 chemicals

generally differed by less than a factor of 2 among the different mussel tribes or families. Species mean acute values for mussels based on the current study and previous studies were mostly in the lower 30th percentiles of the species sensitivity distributions for all tested chemicals, except for metolachlor. The ranks of mussels in the species sensitivity distribution were generally similar among different tribes or families. The ammonia, sodium chloride, and nickel EC50s for mussels were about equal to or less than the final acute value used to derive USEPA AWQC. The preliminary results of this study indicate that (1) mussels representing different tribes or families have similar sensitivity to the tested chemicals despite differing toxic modes of action, (2) mussels are sensitive to 9 of the 10 tested chemicals, (3) the AWQC may not be protective of mussels from acute exposures of ammonia, chloride, and nickel, and (4) AWQC may need to be derived or updated for sodium chloride, potassium chloride, and sulfate, common pollutants to which mussels are sensitive. nwang@usgs.gov

Poster 78	**NOCTURNAL MANTLE DISPLAY BEHAVIOR IN THREE LAMPSILINE MUSSELS**. Nicole Ward, Bernard Sietman. Minnesota Department of Natural Resources, Saint Paul, MN.

Mantle lures are a common host-attraction strategy in lampsiline Unionids. Previous studies have shown that mantle display activity can vary between night and day. We studied the temporal mantle display pattern of three sympatric lampsiline mussels (*Lampsilis cardium, Lampsilis siliquoidea*, and *Ligumia recta*) in four shallow, clear-water streams in Minnesota. We used two sampling approaches: 1) marking individual mussels and observing them during daytime and nighttime, and 2) counting mantle displays along pre-established transects during daytime and nighttime. All three species exhibited distinct temporal differences in displaying activity, each being more active at nighttime. Nighttime displaying behavior may increase the likelihood of mussel-host interactions because fish may be more easily deceived or be more active at night. nicole.ward@state.mn.us

Poster 79	**ATLANTIC SLOPE FRESHWATER MUSSEL PROPAGATION AT THE VIRGINIA FISHERIES AND AQUATIC WILDLIFE CENTER** Brian Watson[1], Michael Odom[2], Brett Flower[1], Ryan Niccoli[3], Dave Peterson[2]. [1]VA Department of Game & Inland Fisheries, Forest, VA ; [2]Harrison Lake National Fish Hatchery, US Fish & Wildlife Service, Charles City, VA; [3]VA Department of Game & Inland Fisheries, Charles City, VA.

Over the past decade, propagation of freshwater mussels has become a vital component in the effort to conserve and recover this critically imperiled fauna. Once conducted at a few universities alongside other unionid-related research, now no less than 15 facilities operate at universities and state and federal facilities ranging across the United States from the Midwest to the Mid-Atlantic to the Southeast and extending to Europe. However, little effort has been directed at the Atlantic Slope fauna, most likely since the number of threatened and endangered species is not as numerous as other major drainages like the Ohio and Tennessee. To help fill this gap, the Virginia Department of Game & Inland Fisheries and the U.S. Fish & Wildlife Service partnered to start the cooperative Virginia Fisheries and Aquatic Wildlife Center (VFAWC) at Harrison Lake National Fish Hatchery in 2007. Starting in a 500 square-foot building, we expanded to include a 2nd, 1,000 square-foot building in 2012. Over the past five years, VFAWC has worked with nine species, producing over 1.8 million mussels. Starting at just over 12,000 juveniles in our first year of production in 2008, we produced nearly 765,000 in 2011. Most propagation and grow out systems we use are similar to other facilities like Aquatic Habitat Units and Barnhart buckets but we also have developed unique systems. While most species propagated are not threatened or endangered, all are identified as Species of Greatest Conservation Need in Virginia and VFAWC is the only facility to produce tidewater mucket (*Leptodea ochracea*) and alewife floater (*Anodonta implicata*). Over 25K mussels have been released since 2009, all of which were Hallprint tagged and a number of which have spawned in the wild. Work is done without a dedicated staff as we use a mix of biologists from the Agencies and volunteers. Brian.Watson@dgif.virginia.gov

Poster 80 *Student Poster*	**A PRELIMINARY SURVEY OF THE DISTRIBUTION OF *ELIMIA SPP*. IN LOWER ETOWAH RIVER BASIN TRIBUTARIES**. Ellen Winant, Amy Mundell William Ensign. Department of Biology and Physics, Kennesaw State University, Kennesaw, GA.

Pleuroceridae (Cerithioidea) is one of the most diverse families of gastropods in the Southeastern United States and the genus *Elimia* is the most speciose genera within Pleuroceridae. *Elimia* diversity is high in the Mobile Basin, and in particular the Coosa River watershed. Conservation efforts that focus on protecting this diverse fauna are compromised by limited information on distribution and uncertain taxonomic relationships. To begin to address gaps in our distributional knowledge, *Elimia* were collected from sites in the upper and lower reaches of five creeks in the lower portion of the Etowah River watershed, the easternmost Coosa River subbasin. Sample sites are located in the Piedmont, Ridge and Valley and Blue Ridge ecoregions and have watershed areas ranging from 21 km^2 to 375 km^2. Initial results based on conchological characters indicate that up to eight different forms may be present in the ten sites. Diversity ranged from a low of one form in the Blue Ridge tributary to a high of three forms in the largest and

southernmost Ridge and Valley tributary. Future work will be focused on association of forms with currently recognized types and fine-scale and coarse-scale determination of distributional patterns. bensign@kennesaw.edu

Poster 82	**THE MUSSEL-FISH RELATIONSHIP: A POTENTIAL NEW TWIST IN NORTH AMERICA?** Jason Wisniewski[1], Katherine Bockrath[2], John P. Wares[2], Andrea Fritts[3], Matthew Hill[1]. [1]Georgia Department of Natural Resources, Wildlife Resources Division, Nongame Conservation Section, Social Circle, GA; [2]Department of Genetics, University of Georgia, Athens, GA; [3]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA.

North American freshwater mussels are a critically imperiled taxa with complex life histories. Although numerous studies have focused on services provided to mussels by fishes, fewer have examined services provided by mussels. During sampling of Altamaha River, GA, we observed eggs occurring within body cavities of native mussels across a 253 km reach of the river basin. Eggs were recovered from 6% of the 757 mussels examined among 7 sites with 17% and 18% of examined mussels having eggs at 2 sites. Using molecular techniques, eggs were identified as American shad (*Alosa sapidissima*). This discovery appears to be the first documented occurrence of native fish eggs in North American mussels. The nature of this relationship is uncertain, but does not appear to be coincidental. Further research into this relationship is warranted as American shad are a recreationally and commercially important fish of conservation concern and may potentially benefit from dense mussel assemblages. jason_wisniewski@dnr.state.ga.us

Poster 83	**EVALUATION OF THE FRESHWATER MUSSEL COMMUNITY IN THE WEISS BYPASS REACH OF THE COOSA RIVER, ALABAMA.** Dennis DeVries, Department of Fisheries and Allied Aquacultures, Auburn University, AL.

We sampled the mussel communities within four reaches of the Weiss bypass area of the Coosa River (i.e., between the spillway dam and the powerhouse dam on Weiss Lake) during June-July 2011. Two study reaches (Reaches 1 and 2) were between the spillway dam and Terrapin Creek, and two study reaches (Reaches 3 and 4) were downstream of Terrapin Creek. Sampled quadrats were identified within a random design transect-grid system, and were sampled with a suction dredge. The dredge proved to be an effective sampling approach, allowing us to quantify not only large mussel density, but also allowing the sampling of much smaller individuals (as small as 9 mm) that are more difficult to locate visually. The most upstream site (Reach 1, near the spillway dam) appeared to have suitable substrate beneath flocculent sediment, but essentially no mussels were present (only 4 were collected in 81 quadrats). In Reach 2, an abundance of mussels were found (more than 3 individuals/m^2); however, they were nearly all individuals from a single species and were all tolerant forms. Small individuals were collected (10-24 mm), suggesting that reproduction is occurring near this reach, but the absence of any large individuals suggested that these individuals were not surviving in this reach. Substrate was suitable for mussels in this reach, so a continual flow through this reach should allow for the establishment of a viable mussel community. Reaches 3 and 4 (downstream of Terrapin Creek) both had viable mussel communities with 7-8 species present, reasonable densities, and a range of sizes indicating reproduction was occurring. Substrate was suitable throughout both reaches. Overall, these results lead to the conclusion that a minimum flow would be beneficial to the mussel community of the Weiss bypass reach, particularly for the area above the confluence with Terrapin Creek. devridr@auburn.edu