PO 01*

INNOVATIONS IN THE PROPAGATION OF FRESHWATER MUSSELS (UNIONIDAE). Bradley, Megan E., M.C. Barnhart, B.R. Bosman, and A.L. Cravens**.** Missouri State University Biology Department. Springfield, MO, USA 65897, (540) 354-5154, Bradley2011@live.missouristate.edu

Freshwater mussels (Family Unionidae) are a widespread and ecologically significant group of bivalve mollusks that are particularly diverse in North American rivers (Strayer et al. 2004, Graf & Cummings 2007, Bogan 2008). At least 26 and probably more than 40 North American species have become extinct in the last 100 years (Haag 2009) and 70 species are currently classified as federally threatened or endangered in the US (USFWS 2010). There are a variety of tools for protection of these species; including habitat protection, regulation of commercial harvest, and captive propagation. Propagation continues to advance with new ideas and technologies being applied. In laboratory culture, 15-L volume recirculating systems (mucket buckets) fed with micro-algal suspensions have proven useful for early grow-out, but require significant investment to maintain water quality and food levels. The use of larger indoor systems shows great promise- an 80-L recirculating system has been successful with less frequent maintenance and feeding. Long-term growth and survival are enhanced by moving to outdoor systems and natural food supply. New methods permit pond-culture of riverine species. The use of pond culture decreases the investment in artificial foods and increases the amount of biomass that may be held for grow out. Systems designed to accommodate mussels in ponds (passive floating baskets and pump-driven floating upwellers) have been applied economically and show improved growth and survival rates relative to lab culture. Ten species have been successfully grown for up to 3 years with excellent growth and survival using these systems.

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PO 02*

THE INFLUENCE OF DIFFERENT FOOD MIXTURES ON SURVIVAL AND GROWTH OF JUVENILE FRESHWATER PEARL MUSSELS (*MARGARITIFERA MARGARITIFERA*). Eybe T.[1], Thielen F.[1], Bohn T.[2], Sures B.[3] [1]Natur & Ëmwelt, Kierchestrooss 2, 9753 Heinerscheid, Luxembourg. [2]CRP-Gabriel Lippmann, 41, rue du Brill, 2244 Belvaux, Luxembourg . [3]Universität Duisburg-Essen, Angewandte Zoologie/Hydrobiologie, Universitätsstr. 5, 45117 Essen, Germany

The last remaining population of *Margaritifera margaritifera* in the Our River (Luxembourg, Europe) has come close to extinction. It consists predominantly of adult animals and will disappear within a few years without assistance. Especially juvenile mussels cannot survive in the river interstitial, which is clogged by fine sediments.

The **objectives** of this work were to elucidate best food conditions for juvenile mussels in order to raise them in the laboratory to a size when survival in the river is more likely.

Different food mixtures (algae, seston and pestled red bloodworms (Chironomidae)) were fed to juvenile mussels (1 day postmetamorphosis) in plastic boxes containing 500 ml river water (500 mussels/box) during 110 days.

To follow the development of nitrate, nitrite and ammonium concentrations, these ions were analyzed once over a period of 8 days in boxes.

Best **results** were achieved with a food combination of seston and algae (Shellfish diet1800 and Nanno3600 (commercial algae): The mussels grew 189% (up to 1.13 mm (SD ±0.30) /box) with a survival rate of 80% (101 dead mussels (SD ±163.71) /box).

When seston (25 ml) was added to the boxes, nitrite and ammonium were reduced by more than 50% compared to the initial value within eight days. Without seston, ion concentrations increased noticeable (nitrite >150%, ammonium >50%).

Conclusions: Juvenile mussels showed good survival and growth when fed with algae and seston. Seston functions not only as food source but also as biological filter and reduces harmful ions such as ammonium and nitrite in boxes.

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PO 03*

HOST FISH ASSESSMENT AND GRAVIDITY FOR THE MUSSEL *ELLIPTOIDEUS SLOATIANUS.* Andrew Hartzog Environmental Science Program Columbus State University
4225 University Avenue Columbus, Georgia 31907

Studies of mussels from the family Unionidae have become increasingly important to biologists due to the large number of species that are threatened or endangered. Identifying host fish for imperiled freshwater mussel species is a critical component of conservation efforts. The primary objective of this study was to identify potential host fish for the federally endangered mussel Elliptoideus *sloatianus* whose common name is Purple bankclimber. Secondary objectives were to determine its preferred habitat, document its distribution and observe its period of gravidity. Populations of *E. sloatianus* were located in the Flint River in the Apalachicola-Chattahoochee-Flint Rivers Basin. From July 2009 - July 2010 mussel populations were inspected for gravidity on a weekly to bi-monthly basis. Data on habitat characteristics and water quality parameters were also collected. Potential host fish for *E. sloatianus* were identified using laboratory infection of 13 species of fish. Of these species, six successfully transformed glochidia into juveniles, suggesting that they are potential host fish. Period of gravidity was determined to be from late-March through mid-June with water temperatures ranging from 15^{o}C to 25^{o}C. Interestingly, juveniles transformed on fish species that did not transform in previous studies. Conversely, some fish species that were apparent hosts in previous studies did not serve as hosts in the present study.

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PO 04

DOES SURVIVAL AND GROWTH INCREASE WHEN THE JUVENILE OYSTER MUSSEL (*EPIOBLASMA CAPSAEFORMIS*) IS FED BIOFLOCS PRODUCED FROM TILAPIA WASTEWATER? Meghann E. Vincie[1], Richard J. Neves[2], Steven R. Craig[1], Catherine M. Gatenby[3], Ewen McLean[1]. [1]Department of Fisheries and Wildlife Sciences, Virginia Tech University, Blacksburg, VA 24061-0321; [2]Virginia Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, Department of Fisheries and Wildlife Sciences, Virginia Tech University, Blacksburg, VA 24061-0321; [3]U.S. Fish and Wildlife Service,White Sulphur Springs National Fish Hatchery, White Sulphur Springs, WV 24986

Due to the significant decline of *Epioblasma capsaeformis*, a study was conducted to develop a diet for propagating this endangered species under captive conditions in an effort to eventually restore extirpated populations. Two feeding trials were conducted in this study to evaluate effect of commercial and non-commercial diets on growth and survival of juvenile oyster mussels. Juvenile mussels were placed in separate culture vessels in a recirculating aquaculture system and randomly assigned a dietary treatment. In trial 1, growth was significantly higher in those juveniles fed the triple concentration algae mix (62,076 cells/ml) than all other diets tested in this trial, with juveniles achieving a mean length of 813 µm. Survival was significantly higher in those juveniles fed the algae mix supplemented with bioflocs with a survival rate of 9.92%. In trial 2, growth was significantly higher in those juveniles fed algae mix supplemented with bioflocs, with juveniles achieving a mean length of 685 µm. Survival was significantly higher in those juveniles fed algae mix supplemented with bioflocs, with a two-fold increase in survival at a rate of 19.67%. Results of both feeding trials indicated that bioflocs enhanced survival of juvenile oyster mussels. An algae mix diet fed at a higher concentration supplemented with bioflocs could improve growth and survival of juvenile oyster mussels and should be tested.

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PO 05

GROWTH AND SURVIVAL OF JUVENILE PAPER PONDSHELLS, *UTTERBACKIA IMBECILLIS*, REARED ON BACTERIAL BASED DIETS ISOLATED FROM THE ENVIRONMENT. Catherine Frederick[1], Christopher Owen[1], Robert Durborow[1] Aquaculture Research Center, Kentucky State University, 103 Athletic Road, Frankfort, Kentucky 40601[1]

Propagation of juvenile freshwater mussels is dependent upon proper diet and nutrition. Studies have observed that plankton, algae, bacteria, and suspended organic matter are siphoned and selected by juvenile mussels. However, the portion of siphoned particles assimilated by individuals is poorly understood. Algal diets are primarily used in current propagation techniques, yet isotopic studies have suggested that environmental bacteria are also a primary food source for juvenile mussels. The aim of this study is to identify different environmental bacteria and determine if they play a role in the diets of metamorphosed juvenile mussels. Bacterial samples will be isolated from sediment and water column samples from a pond that is known to support a population of *Utterbackia imbecillis.* Brood stock will be collected from the same pond and will be used to propagate juveniles for experiments. Using bacterial diets and combined diets of bacteria and algae, growth and survivorship of these juveniles will be evaluated.

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PO 06

PROPAGATION, RELEASE AND MONITORING OF JUVENILE MUSSELS OF TWO ENDANGERED MUSSEL SPECIES *EPIOBLASMA CAPSAEFORMIS* AND *EPIOBLASMA BREVIDENS* IN THE CLINCH AND POWELL RIVERS, TENNESSEE AND VIRGINIA. Dan Hua, Jess Jones and Richard J. Neves. Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and Sate University, Blacksburg, Virginia 24061

Propagation and release of mussels to their natal rivers has been recommended as a primary strategy to recover and restore populations of endangered species. In our current study, several monitoring approaches were used to evaluate the success of recent release efforts in the Clinch and Powell Rivers. During past two years, juveniles of *Epioblasma capsaeformis* and *E. brevidens* were propagated and grown to 20-30 mm at the Freshwater Mollusk Conservation Center at Virginia Tech. They were tagged with Hall-print tags and Bio-mark PIT tags and released at 6 sites to determine their survival and growth. Three release and monitoring methods were used, including mussels held in either cages or silos, and those that were free released with PIT tags. Juveniles of *E. capsaeformis* held in silos exhibited significant differences in growth among the sites. Juveniles of *E. capsaeformis* grew faster at sites in the lower Clinch River, TN compared to those held in silos at sites in the upper Clinch River, VA or to those in the Powell River, TN. PIT tagged juveniles of *E. brevidens* released in the Powell River were recaptured at a rate of 100% (dead or alive), with a survival rate of 98%. Juveniles of *E. brevidens* held in cages grew 15 mm in 16 months from June 2009 to October 2010.

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PO 07*

NEW INVESTIGATIONS INTO THE NATURE AND FUNCTION OF THE CRYSTALLINE STYLE IN FRESHWATER MUSSELS, WITH A REVIEW OF NELSON (1918). Andrew McDonald, Center For Mollusk Conservation, Frankfort, KY

After observing the dearth of information regarding the nature of the crystalline style in freshwater mussels, work was undertaken to investigate this structure, and its role in the digestive system of *Villosa taeniata*. Thurlow C. Nelson's excellent work on the style from 1918 was also reviewed, and found to be a wealth of excellent observation and information. Multiple mussels (Villosa taeniata) were dissected, and the internal structures photographed using a dissecting scope with connected camera and imaging software. Color photographs of the crystalline style and its orientation in the digestive system of the mussel are available for the first time (to the author's knowledge). An updated, more detailed diagram of the digestive system of unionid mussels is also presented. The role of the crystalline style and a full understanding of the digestive process within Unionids may greatly contribute to successful captive holding and propagation.

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PO 08*

IMPLICATIONS OF PHYLOGEOGRAPHIC STRUCTURE IN THE ELLIPSE MUSSEL (*VENUSTACONCHA ELLIPSIFORMIS)* AND THE OZARKIAN ENDEMIC BLEEDINGTOOTH MUSSEL (*V. PLEASII*). Andrew T. Harris and David T. Zanatta. Central Michigan University, Biology Department, Mount Pleasant, MI USA 48859

Following the retreat of the last Pleistocene glaciers ~10,000 years before present, aquatic organisms re-colonized previously uninhabitable regions from various glacial refugia. These events caused major impacts on the genetic diversity and population structure of organisms throughout North America. Knowledge of this genetic population structure is critical for successful conservation programs involving an increasingly threatened freshwater fauna. Due to variations in life history and ecology, species-specific planning may be the most effective method for preserving rare or threatened species. The relatively widespread Ellipse mussel (*Venustaconcha ellipsiformis*) is listed as threatened or of special concern throughout much of its range in the central United States. Extant populations are found in several tributaries of the Missouri River portions of the upper Mississippi drainage, and tributaries of Lake Michigan and Lake Huron. CO1 and ND1 mtDNA regions were amplified to conduct genetic analyses of Ellipse and the closely related Bleedingtooth (*V. pleasii*). Phylogenetic analyses and construction of a spanning haplotype network was used to determine variations among extant populations and to assess population genetic structure and hypothesize locations of glacial refugia for northern Ellipse populations. Lack of genetic structure among various geographically distant Ellipse populations and low haplotype diversity suggest that these populations be treated as a single management unit. In contrast, Bleedingtooth samples collected from the White River drainage (southern slope of the Ozarks) show much higher haplotype diversity, relative to much broader sampling of Ellipse on the northern slope of the Ozarks and beyond. Phylogeographic patterns of these two species follow common trends observed in several fish species that likely utilized an Ozarkian glacial refugium.

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PO 09

WESTERN PIGTOES: A PRELIMINARY MOLECULAR ANALYSIS OF *FUSCONAIA* AND *PLEUROBEMA* (UNIONIDAE) FROM WEST OF THE MISSISSIPPI RIVER.

David M. Hayes[1,2], Kentaro Inoue[2,3], Jeanne Serb[4], John L. Harris [5], Alan D. Christian [6] [1] Department of Biological Sciences, Eastern Kentucky University, 521 Lancaster Avenue, 235 Moore Building, Richmond, Kentucky 40475 USA. [2] Environmental Sciences Program, Arkansas State University, P.O. Box 877, State University, Arkansas 72467 USA. [3] Department of Zoology, Miami University, 700 E. High Street, 212 Pearson Hall, Oxford, Ohio 45056 USA. [4] Department of Ecology, Evolution, and Organismal Biology, 245 Bessey Hall, Iowa State University, Ames, Iowa 50011 USA. [5] Department of Biological Sciences, Arkansas State University, P.O Box 599, State University, Arkansas 72467 USA. [6] Department of Biology, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA 02125 USA.

The Pleurobemini (Unionidae) represent almost one-third of mussel diversity from North America. This group is particularly challenging due to widespread morphological convergence and phenotypic plasticity with regards to shell morphology. We examined COI sequences from 127 individuals of *Fusconaia* and *Pleurobema* from drainages occurring west of the Mississippi River. Phylogenetic analyses revealed two possible cryptic species, including a unique lineage of *Fusconaia* from the western Ozarks and a unique lineage of *Pleurobema* from the southern Ouachitas. The results also indicated the presence of the presumed Texas endemic, *P. riddellii* in the Little River in Arkansas. Our results did not find support for the recognition of *F. askewii* and *F. lananensis* as two distinct taxa, nor did we find support for the recognition of *P. sintoxia* and *P. rubrum* as two distinct taxa. We suggest that future work examine additional markers and population genetic analyses of these taxa to rule out incomplete lineage sorting before they are synonymized.

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PO 10*

PHYLOGENETIC AND MORPHOMETRIC ANALYSES REVEAL PHENOTYPIC PLASTICITY IN FRESHWATER MUSSELS: SYNONOMY OF *VILLOSA ARKANSASENSIS* AND *OBOVARIA JACKSONIANA*.

Kentaro Inoue [1,2], David M. Hayes [1,3], John L. Harris [4], Alan D. Christian [5] [1] Environmental Sciences Program, Arkansas State University, P.O. Box 877, State University, Arkansas 72467 USA. [2] Department of Zoology, Miami University, 700 E. High Street, 212 Pearson Hall, Oxford, Ohio 45056 USA. [3] Department of Biological Sciences, Eastern Kentucky University, 521 Lancaster Avenue, 235 Moore Building, Richmond, Kentucky 40475 USA. [4] Department of Biological Sciences, Arkansas State University, P.O Box 599, State University, Arkansas 72467 USA. [5] Department of Biology, University of Massachusetts Boston, 100 Morrissey Boulevard, Boston, MA 02125 USA.

We conducted the first comprehensive systematic analyses of *Obovaria jacksoniana* and *Villosa arkansasensis* using molecular phylogenetic and morphometric techniques. Phylogenetic analyses showed four distinct lineages in *O. jacksoniana* and *V. arkansasensis*, differentiated by drainages rather than traditional (morphological traits) species assignments. In contrast, morphometric analyses showed two distinct clusters, corresponding to traditional species identifications rather than phylogenetic lineages, with a small proportion of overlap between them. Morphological distance was correlated with geographic distance within drainages, but there was no evidence of isolation-by-distance using molecular markers. Since *V. arkansasensis* inhabits headwaters and *O. jacksoniana* inhabits more downstream sites, these results suggest phenotypic plasticity, with the *O. jacksoniana*-morphotype and *V. arkansasensis*-morphotype occupying different habitat types. Thus, we conclude that *O. jacksoniana* and *V. arkansasensis* are morphological variations of one species and that there are multiple lineages corresponding to major drainages. Since each lineage has distinct genetic divergence, further analyses of phylogenetic and morphometric assessments are needed to clarify taxonomic status of these clades across their entire ranges.

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PO 11*

MISIDENTIFICATION OF FRESHWATER MUSSEL SPECIES (BIVALVIA: UNIONIDAE): CONTRIBUTING FACTORS, MANAGEMENT IMPLICATIONS, AND POTENTIAL SOLUTIONS.

Colin P. Shea[1], James T. Peterson[2], Jason M. Wisniewski[3], and Nathan A. Johnson[4,5] [1]Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA. [2] U.S. Geological Survey, Georgia Cooperative Fish and Wildlife Research Unit, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA. [3] Georgia Department of Natural Resources, Wildlife Resources Division, Nongame Conservation Section, Social Circle, GA. [4] U.S. Geological Survey, Southeast Ecological Research Center, Gainesville, FL. [5] School of Forest Resources and Conservation, University of Florida, Gainesville, FL.

Surveys of freshwater mussel populations are frequently used to inform conservation decisions by providing information about the status and distribution of species. Generally, not all mussels or species are collected during surveys, and incomplete detection of individuals and species can bias data and affect inferences. Considerably less attention has been given to potential effects of species misidentification. To evaluate the prevalence of and potential reasons for species misidentification, we conducted a laboratory-based identification exercise and quantified relations between mussel species characteristics, observer experience, and misidentification rate. We estimated that misidentification was fairly common, with rates averaging 27% across all species and ranging from 0% to 56%, and was related to mussel shell characteristics and observer experience. Most notably, species with shell texturing were 6.09 times less likely to be misidentified than smooth-shelled species. Misidentification rates declined with observer experience, but risk of misidentification averaged more than 10%, even for observers with moderate levels of experience (5-6 years). There was substantial variability in misidentification rate among observers after controlling for experience. Our results suggest that species misidentification may be common in field surveys of freshwater mussels. Misidentification rates could potentially be reduced through workshops, certification programs, and archived specimens in museum collections.

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PO 12*

GENETIC DIVERSITY AND CRYPTIC SPECIATION OF *PHYSA* SPECIES (GASTROPODA: PHYSIDAE) IN THE CHIHUAHUAN DESERT.

Megumi G. Sugita[1], Kentaro Inoue[1], Brian K. Lang[2], David J. Berg[3] [1] Department of Zoology, Miami University, Oxford, Ohio 45056 USA [2] Conservation Services Division, New Mexico Department of Game and Fish, Santa Fe, New Mexico 87507 USA. [3] Department of Zoology, Miami University, Hamilton, OH 45011 USA

DNA barcoding is a common method used to observe relationships among organisms that are not morphologically distinct. Physid snails (Gastropoda: Physidae) are one of the most widely distributed freshwater snails throughout the world, and recent phylogenetic studies show multiple synonymous and cryptic species. Since isolated spring systems often harbor unique assemblages of narrowly endemic biota, we collected *Physa* species from springs in the Chihuahuan Desert located in western Texas and southeastern New Mexico. We examined sequences of the 16S rRNA mitochondrial gene for at least five individuals from each of eleven spring populations. Phylogenetic analyses revealed three distinct lineages in the region. Organisms acquired in the Toyah basin split into two distinct lineages: one included *Physa acuta,* which has a cosmopolitan distribution, and another unknown lineage of a possibly new species. The third lineage was comprised of a geographically isolated monophyletic clade, most closely related to *P. carolinae*. We are in the process of sequencing a second mitochondrial DNA gene, COI, to compare geographic patterns of 16S and COI. If the patterns are similar, it will suggest the presence of several local endemic *Physa* and the cosmopolitan *P. acuta* in this region.

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PO 13

THE HERBERT D. ATHEARN SPHAERIIDAE COLLECTION OF THE NORTH CAROLINA STATE MUSEUM OF NATURAL SCIENCES. J.M. Smith and A.E. Bogan. North Carolina State Museum of Natural Sciences, Research Lab, MSC 1626, Raleigh, NC, 27699-1626.

The Invertebrate Collection of the North Carolina State Museum of Natural Sciences (NCSM) has a growing collection of freshwater mussels and other Mollusks. This collection has expanded primarily through the donation of specimens collected by state agency personnel and the donation of private collections. In June 2007 NCSM received the privately held Herbert D. Athearn, Museum of Fluviatile Mollusks (MFM), collection of over 23,000 catalogued lots. We have begun databasing this collection into our MS Access based relational database. The following families are currently being databased: Amnicolidae, Ampullariidae, Bithyniidae, Chilinidae, Cocculinidae, Cochlipidae, Corbiculidae, Hydrobiidae, Hyriidae, Iridinidae, Lithoglyphidae, Margaritiferidae, Mycetopodidae, Neritidae, Pachychlidae, Physidae, Planorbidae, Pleuroceridae, Pomatiopsidae, Semisuclospiridae, Unionidae, Valvatidae, and Viviparidae. This tremendous collection is comprised of approximately 50% freshwater bivalves. The family Sphaeriidae, including specimens in the genera *Eupera*, *Musculium*, *Pisidium*, and *Sphaerium* (totaling 1, 310 lots and 52,074 specimens) has been completely databased. While the majority of the specimens in the family Sphaeriidae are from the United States and Canada, there are also specimens from Albania, England, Mexico, and Poland. This invaluable collection has provided the opportunity for us to document significant gaps and further investigate the historic distribution of multiple genera of aquatic mollusks.

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PO 14

DETERMINATION OF STRATEGIC HABITAT UNITS FOR LISTED MUSSELS IN THE MOBILE RIVER BASIN Patrick E. O'Neil, Stuart W. McGregor, and E. Anne Wynn (Geological Survey of Alabama), and Jeffrey R. Powell (USFWS)

USFWS has designated 26 stream segments (units) totaling 1,093 miles in the Mobile River Basin (MRB) as critical habitat (CHUs) for listed mussels. Although a small portion of each species' historic range, the CHUs include significant parts of the MRB's remaining high-quality, free-flowing, streams and reflect the variety of habitats once occupied by these species. The USFWS, Geological Survey of Alabama (GSA), Alabama Aquatic Biodiversity Center, and Alabama Clean Water Partnership recently initiated efforts to provide strategic management opportunities for imperiled species in the MRB. Through the establishment of Strategic Habitat Units (SHUs), the watersheds that encompass the CHUs, these partners hope to recover and restore imperiled species. A critical part of the SHU initiative is development of SHU-specific watershed information. For imperiled species recovery to proceed systematically and with reasonable expectation of success, watersheds must be understood from biological, water quality, and land use perspectives. GSA has long conducted such watershed-based investigations resulting in data that can be used to guide selection of projects to improve habitat and water quality conditions. Current SHU-related investigations focus on the North River, Big Canoe Creek, Terrapin Creek and Sipsey River watersheds. End products of these investigations will be a current biological assessment of each watershed using the fish community Index of Biological Integrity method, current assessment of mussel population status, historic and current land cover/land use analysis, compilation of historical and current water-quality information, habitat analyses at selected locations, and collection of primary water quality data as needed. These data will then be synthesized into interpretive posters, reports, and presentations to be used for action plan development in selected SHUs.

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PO 15

STUDENTS SAVING SNAILS: USING GASTROPODS TO CONNECT KIDS WITH NATURE. Michael J. Pinder[1], M. Suzie Gilley[2], and Amanda E. Duncan[3]. Virginia Department of Game and Inland Fisheries, [1]2206 South Main Street, Blacksburg, Virginia 24060, [2]4010 West Broad Street, Richmond, Virginia 23230, [3]1724 Buller Hatchery Road, Marion, Virginia 24354.

Freshwater gastropods are the most at-risk group of animals in North America. Over 319 are listed imperiled with an estimated 60 already extinct. Very few programs are actively propagating and releasing freshwater snails especially when compared to their bivalve counterparts. For these efforts to be successful, there must be support by the public where these species live. In this light, the Virginia Department of Game and Inland Fisheries (VDGIF) began a program in 2008 called Students Saving Snails. The program partners with elementary schools in watersheds containing rare species to raise the spiny riversnail (*Io fluvialis*) in their classroom. Snails are excellent learning tools because they can be handled, are active, and have minimal upkeep. In Virginia, *I. fluvialis* is listed as a state threatened species and is endemic to the upper Tennessee River drainage. The species is currently propagated by the Department's Aquatic Wildlife Conservation Center, Marion, Virginia. Each 4th or 5th grade classroom is equipped with an aquarium, filter, pump etc. and four two-year old spiny riversnails. Teachers are provided learning assignments that focus on the species, its habitat, threats and conservation. Students gain hands-on experience to monitor snail growth, behavior, diet, and water quality. They use this information to help and support conservation measures in their local rivers. In 2010, students participated in the first release of captive-raised snails into the Clinch River. The program has expanded from three schools in 2008 to six schools in 2011.

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PO 16

HABITAT RESTORATION MEASURES FOR THE FRESHWATER PEARL MUSSEL (*MARGARITIFERA MARGARITIFERA*) IN THE LOW MOUNTAIN RANGE OF THE ARDENNES IN LUXEMBOURG. Thielen F, Eybe T, Muller T, Molitor M, Arendt A. Natur & Emwelt, Project Life Nature Freshwater Pearl Mussel, Kierchestrooss 2, 9753 Heinerscheid, Luxembourg

Freshwater mussels belong to the most imperiled animals worldwide. Particularly the long lived species, *Margaritifera margaritifera;* shows a dramatic decline within its distribution area. Many local populations have become extinct or are close to extinction.
Eutrophication and siltation of the river due to anthropogenic changes in the catchment area are the main factors responsible for the non functional populations of *M.m.* showing little to no recruitment. Propagation programmes can help avoid the complete disappearance of local populations. The only sustainable way to protect a mussel population is to restore the habitat, although this process may last many years.
In order to protect the last existing Freshwater Pearl Mussel population in the river Our in northern Luxembourg (Europe) a LIFE NATURE project commenced in 2005. The aim of this project is to enhance the declining population by captive breeding and restoring its habitat.
The following habitat restoration measures have been completed within the project so far:
To reduce the amount of fine sediment entering the river 6.2 hectares of inappropriate spruce forest was removed. Four hectares of deciduous forest have been planted. To reduce the impact of cattle on the river banks, 2.5 km of fence, ten watering facilities and five cattle bridges were constructed. As the natural transport of gravel in the river system is still disturbed by 3 smaller dams, 500 m^3 of gravel has been added into the river during the past five years. To aid the host fish (brown trout) reaching their spawning grounds; twelve migration obstacles were removed in smaller creeks.

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PO 17*

TEAM ESTONIA MUSSEL PROJECT: STUDENTS MONITORING FRESHWATER MUSSEL GROWTH AND SURVIVAL ON A BIOLOGICALLY DIVERSE RIVER. Teresa Vencil, Two students (to be determined). St. Paul High School,- 3207 Deacon Drive, Saint Paul, Virginia 24283

The Clinch River is well recognized as one of the most biologically diverse system in the world for freshwater mussels. Water quality impacts from agricultural, residential, and industrial sources continue to threaten this unique system. In particular, freshwater mussels in the Clinch River from Carbo (Rm 267.3) to St. Paul (Rm 255.2), Virginia have been impacted by chemical spills in the early 1970's. To restore mussel populations in this section, there must be support from local residents that reside near the resource. St. Paul High School is located in Wise County, Virginia less than one mile from the Clinch River at river mile 255. In 2010, students from St. Paul High School's Team Estonoa initiated a mussel monitoring program in the Clinch River. Between August and October, Barnhart silos containing a total of 400 juvenile wavy-rayed lampmussels (*Lampsilis fasciola*) were deployed at three sites in the impact section and one at an upstream control. Mussels were donated by the Virginia Department of Game and Inland Fisheries' Aquatic Wildlife Conservation Center and were checked monthly for growth and survival. Findings over the five month project indicated high mussel survival at all sites. Mussel growth was highest at St. Paul, the lowest most site. Mussel growth was highest during August and lowest in October. Even more than these finding, this project provided a mechanism for students to learn about the condition of their local river and what can be done to improve it. In 2011, Team Estonoa plans to expand their research efforts to Clinch River sections downstream of St. Paul.

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PO 18*

EFFECT OF A SMALL DAM ON *ELLIPTIO ARCA* POPULATION GENETICS IN AN ALABAMA STREAM. ERIN F. ABERNETHY, ERIN E. SINGER, LYNN M. SIEFFERMAN, AND MICHAEL M. GANGLOFF. Biology Department, Appalachian State University, 572 Rivers Street, Boone, NC 28608-2027

Dams are widely believed to fragment freshwater populations via reduced migration and restricted gene flow. However, few studies have examined their effects on freshwater mussel populations. Because freshwater mussels are dependent on fish hosts for upstream dispersal, we predict that evidence of fragmentation may include both large pairwise differences between sub-populations and the presence of haplotypes downstream from the dam that are absent from upstream populations. We examined genetics of putative *Elliptio arca* populations from Sandy Creek, a small Piedmont stream near a ~175 year old mill dam in Chambers County, Alabama. We extracted DNA and amplified the NADH1 gene for 49 mussels from sites located upstream (n = 18), immediately downstream (n = 14), and ~5 km downstream (n = 17) from the dam. We examined intra-specific divergence by comparing uncorrected p-distances between the three populations. We also examined p-distances between Sandy Creek and published *E. arca* mtDNA sequences. Comparisons with published gene sequences suggest our study organisms are genetically distinct from *Elliptio arca* (mean = 4.1% uncorrected p-distance). Within-stream divergence was low (mean = 0.3%, range = 0-1.3%). Visual examination and preliminary phylogram construction revealed 8 haplotypes. Only 2 haplotypes were shared between up-and-downstream populations. Four haplotypes were unique to downstream populations and 2 haplotypes unique to upstream populations. These data suggest that even small dams may substantially alter the genetic structure of freshwater mussel populations. Additionally, sequence divergences suggest that mussels previously identified as *Elliptio arca* in Sandy Creek and throughout the upper Tallapoosa River Drainage may warrant recognition as a distinct, endemic taxon.

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PO 19*

TEMPERATURE EFFECTS ON BURROWING BEHAVIOR OF *POTAMILUS ALATUS*, PINK HEELSPLITTER, A FRESHWATER MUSSEL ABUNDANT IN KENTUCKY LAKE. Jennifer E. Block, Department of Biology, Murray State University. Gary W. Gerald, Department of Biology, Nebraska Wesleyan University. Todd D. Levine, Hancock Biological Station/Watershed Studies Institute, Murray State University

Temperature affects biological processes, especially in ectotherms. Various processes in mussels' life histories are temperature-dependent. Mussels' ability to burrow is important in their life histories and may be affected by ambient temperature. We studied the effects temperature has on success in, latency to and duration of burrowing in *Potamilus alatus*, a freshwater mussel. We collected *Potamilus alatus* from Kentucky Lake and subjected them to repeated measures trials at temperatures of 10˚C, 20˚C, and 30˚C. Each treatment took place in a temperature regulated aquarium preceded by a minimum of 24 hours of acclimatization. The time it took for each mussel to begin to burrow (latency) and the time it took for the mussel to burrow from the beginning of the burrowing to the end (duration) was recorded. The percent of mussels that failed to burrow within a 3 hour time period was significantly higher in low (10˚C) temperatures than the warmer temperatures. Mussels tended to begin to burrow sooner at a moderate temperature of around 20˚C, but took less time to finish burrowing at higher temperatures. However our preliminary results did not identify significant differences (p= 0.31 and 0.39, respectively) in burrowing performance. It is important to understand how burrowing may be affected by ambient temperature for the management of mussel populations. Choosing temperatures at which mussels are able to re-burrow will help ameliorate the effects of surveys. Anthropogenic changes to ambient temperatures through manipulation of rivers, such as by dams, and through climate alteration might affect mussel burrowing.

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PO 20*

REPRODUCTIVE BIOLOGY AND HOST FISHES OF 4 UNIONIDS FROM THE PONCHARTRAIN BASIN, LOUISIANA. Wesley M. Daniel [1], Kenneth M. Brown [1], William Kelso [2], and Gerald George [3] [1] Biological Sciences Department, Louisiana State University, Baton Rouge, LA 70803. [2] School of Renewable Natural Resources, Louisiana State University, Baton Rouge, LA 70803. [3] Symbiotics Energy, 2950 SE Stark St. Portland, OR 97214

Host fishes, fecundity estimates, and gravid periods were identified for four species of freshwater mussels from the Ponchartrain basin, Louisiana. Two of the mussel species had broad distributions in the Mississippi drainage and in Louisiana: *Villosa lienosa lienosa* (Conrad, 1834), and *Lampsilis teres anodontoides* (Rafinesque, 1820). The other two species had more narrow distributions both in Louisiana and nationally: *Quadrula refulgens* (Lea, 1868) and *Lampsilis ornata* (Conrad, 1835) a species of concern in Louisiana. Of the 23 species of fishes tested as potential hosts, we found 4 previously unknown fish hosts for *Villosa lienosa: Lepomis megalotis, Lepomis humilis*, *Lepomis microlophus* and *Lepomis cyanellus*, and confirmed two already documented host fishes: *Lepomis macrochirus* and *Micropterus salmoides. Villosa lienosa* was gravid from April till June and had a fecundity estimate of 38,562 $\pm$ 3,073. For *Lampsilis ornata* we established a mussel-host-fish relationship with *Luxilus chrysocephalus,* and confirmed *Micropterus salmoides* as a host. *Lampsilis ornata* was gravid from February till April and had a fecundity estimate of 451,214 $\pm$ 27,239. *Lampsilis teres* was gravid from April till September and had a fecundity estimate of 407,333 $\pm$ 24,727. We confirmed three hosts for *L. teres*: *Micropterus salmoides, Pomoxis annularis, Lepomis humilis*, and established two new fish hosts: *Lepomis microlophus* and *Notropis venustus*. Only a single *Quadrula refulgens* was found gravid in late June and fecundity was estimated at 32,450; a mussel-host-fish relationship was established with *Pylodictis olivaris.* Survey data from the Florida parishes, LA suggest that most of the host fishes have cosmopolitan distributions and are not limiting the dispersal of the mussels.

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PO 21

EXPERIMENTAL STOCKING OF AMERICAN EELS IN THE SUSQUEHANNA RIVER WATERSHED.

Julie Devers[1], Steve Minkkinen[1], William Lellis[2], and Heather Galbraith[2]. [1]Maryland Fishery Resources Office, USFWS, 177 Admiral Cochrane Dr., Annapolis, MD 21401. [2]Leetown Science Center, Northern Appalachian Research Laboratory, USGS, 176 Straight Run Road, Wellsboro, PA 16901.

American eel populations have been declining along the Atlantic coast. Conowingo Dam, at mile 10 of the Susquehanna River, blocks American eels from accessing 43% of previously available habitat in the Chesapeake Bay watershed. Following the construction of large mainstem dams in the Susquehanna River, eels were stocked sporadically until 1980. In addition to very low abundance of eels found in the Susquehanna River watershed, *Elliptio complanata*, common in most mid-Atlantic streams and rivers, is relatively low in abundance. Laboratory tests conducted by USGS, Northern Appalachian Research Laboratory and USFWS, Maryland Fishery Resources Office (MFRO) suggest that American eels are the most effective host for *E. complanata* found in the Susquehanna River. MFRO has been working since 2006 to assess the best methods for capturing eels below Conowingo Dam and transporting them to upstream tributaries in the Susquehanna River Basin. Following baseline fish and mussel surveys, experimental eel stockings in two tributaries began in 2010 and will continue through 2012. Fish and mussel populations will be monitored until 2019. If eels are the missing link to abundant *E. complanata* populations in the Susquehanna River, restoring eels could also restore this fauna and result in improved water quality.

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PO 22*

THE RELATIONSHIP BETWEEN *LAMPSILIS RADIATA LUTEOLA* ON DIFFERENT SIDES OF OHIO'S NORTHERN DIVIDE.

Evans, N. and R. A. Krebs. Dept. of Biological, Geological and Environmental Sciences, Cleveland State University, 2121 Euclid Ave, Cleveland OH

After the last glaciers receded in northern Ohio, Lake Erie rose forming numerous potential connections to streams located to the south and southwest. Unionid mussels subsequently migrated into Lake Erie, but points of origin are poorly understood. To better identify relationships between *Lampsilis radiata luteola* on different sides of Ohio's northern divide, genetic sequences for mitochondrial genes were obtained for mussels high in the watersheds of several Ohio River tributaries in northern Ohio, and these sequences were compared to sequences obtained from individuals from diverse streams in the Lake Erie watershed. Two Cytochrome Oxidase 1 genes (CO1) were contrasted, one of maternal origin (N=14) and the other of paternal origin (N=10), and these were compared to a larger data set on individuals from the Lake Erie watershed. South of the divide, variation was observed at nine base pair positions among the maternally inherited sequences and at five positions in the paternally inherited copy of the gene. A combination of analyses on the two haplotype groups suggest that the genetic variation present in these Ohio River tributary populations represent just a subset of the variation present in the Lake Erie system, but they show a clear connection to the fauna of Lake Erie.

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PO 23*

HIODON HOST FOUND FOR ESTRANGED EBONYSHELL. Ben R Bosman Missouri State University, 901 S. National Ave. Springfield, MO 65897.

Ebonyshell mussels (*Fusconaia ebena*) once dominated large river mussel communities throughout the Mississippi Drainage. However, this species is currently listed at some level of endangerment in seven states, and is likely extirpated from Iowa. Overharvest during the pearl-button rush of the late 1800's-early 1900's, habitat degradation through intensive land use, water pollution, and river navigation infrastructure all contribute to the species' decline. Specifically, lock and dam systems have disrupted the migratory habits of skipjack herring (*Alosa chrysochloris*), previously the only documented host for ebonyshell. Recently, goldeye *(Hiodon alosoides)* have successfully metamorphosed juvenile ebonyshell in lab trials, challenging old assumptions about extirpation, and providing conservationists new avenues for population restoration. Ongoing research focuses on documenting additional fish hosts and reproductive characteristics necessary for improved conservation of this commercially and ecologically valuable natural resource.

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PO 24

EFFECT OF ENHANCED SHELL STRUCTURE ON FUNCTIONAL BURROWING TRAITS IN *POTAMILUS ALATUS.* Todd D. Levine, Hancock Biological Station/Watershed Studies Institute, Murray State University. Gary W. Gerald, Haeley Hansen, Department of Biology, Nebraska Wesleyan University

Movement is an important trait that is critical for the survival of many animals. Because of their sedentary lifestyle, studies examining the movement capabilities of freshwater mussels are relatively limited. However, the ability to move and burrow into the substrate and, conversely, the capacity to resist dislodgement despite hydrologic forces and attempts by predators to remove them are likely crucial components of their behavior. Performance of such behaviors is likely to be directly linked to survival and fitness. Likewise, performance of these tasks is likely to be affected by the presence and nature of shell ornamentation which can vary widely within and among species. Studies of marine bivalves suggest that shell ornamentation introduces a tradeoff between their ability to burrow effectively and to remain stationary when an extrinsic force attempts to dislodge them from the substrate once buried. We examined the effect of the presence and size of shell ornamentation on the burrowing performance and force required to dislodge buried mussels by artificially creating shell ornamentation on a relatively smooth-shelled species (*Potamilus alatus)*. Mussels were videotaped in laboratory aquaria to quantify burrowing sequences. Dislodgement force was also measured in these aquaria. Interestingly, in our preliminary analyses, we found that shell ornamentation had no significant effect on any of the burrowing performance measures. However, the presence of artificial ridges significantly increased the force required to dislodge buried mussels. This suggests that varying amounts of shell ornamentation present in mussels help individuals resist dislodgement from the substrate by abiotic or biotic forces without substantial inhibition of burrowing abilities.

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PO 25

BROODING BEHAVIOR AND HOST SPECIFICITY ON FRESHWATER DRUM IN FOUR UNIONID SPECIES. Bernard E. Sietman[a], Mark C. Hove[b], and J. Mike Davis[c] [a]Minnesota Department of Natural Resources, 500 Lafayette Road, Saint Paul, 55155. [b]University of Minnesota, 1980 Folwell Avenue, Saint Paul, 55108. [c]Minnesota Department of Natural Resources, 1801 South Oak Street, Lake City, 55041

Freshwater drum (*Aplodinotus grunniens*) is a known or suspected host for species of *Ellipsaria*, *Leptodea*, *Potamilus*, and *Truncilla*, but the specificity of this relationship has not been examined thoroughly and glochidia transfer mechanisms are unknown. We tested host fish suitability and describe glochidia brooding behaviors for *Ellipsaria lineolata*, *Leptodea fragilis*, *Potamilus alatus*, and *Truncilla truncata*. Of the 53 to 62 fish species exposed to each mussel, glochidia transformed exclusively on freshwater drum, and *T. truncata* and *L. fragilis* grew significantly while attached to gills. The mantle of brooding females shielded a prominent valve gape which was positioned ventrally in *E. lineolata* and *T. truncata* and posterio-ventrally in *L. fragilis* and *P. alatus*. Species varied in their orientation while displaying; *E. lineolata* were upside down with the ventral side facing up, *L. fragilis* were vertical with the posterior facing up, *P. alatus* were mostly emerged with the ventral margin down, and *T. truncata* were variable, but frequently fully emerged and laying on their side. Mantle movement consisted of minor pulsations or twitches, and *E. lineolata* and *T. truncata* fully retracted the mantle in response to touch, exposing the glochidia charged marsupia. Foraging drum may perceive these displays as food and extract glochidia during an attack, similar to the glochidia transfer mechanisms of other mantle displaying lampsilines.

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PO 26

EARLY LIFE HISTORY AND DISTRIBUTION OF *TRITOGONIA VERRUCOSA* IN MINNESOTA AND WISCONSIN. Mark Hove[a,b], Bernard Sietman[c], Josh Bakelaar[c], Jennifer Bury[b], David Heath[d], Vanessa Pepi[b], Jennifer Kurth[b], Mike Davis[c], and Daniel Hornbach[a] [a] Macalester College, 1600 Grand Avenue, Saint Paul, Minnesota 55105. [b] University of Minnesota, 1980 Folwell Avenue, Saint Paul, 55108. [c]Minnesota Department of Natural Resources, 500 Lafayette Road, Saint Paul, 55155. [d]Wisconsin Department of Natural Resources, 3550 Mormon Coulee Road, La Crosse, 54601

We conducted a series of studies to improve our understanding of *Tritogonia verrucosa* life history and distribution in Minnesota and Wisconsin. Pistolgrip are found in central and southeastern US but are declining in several locations. Surveys conducted between 1980 and 2009 showed the geographic range of pistolgrip has decreased in Minnesota and Wisconsin. It is extirpated from the Minnesota River and nearly so in the Mississippi River, although it may be recolonizing in the Mississippi River above the mouth of the St. Croix. The largest populations were in the lower reaches of the St. Croix, Chippewa, Black, Wolf and Wisconsin rivers (WI). In the St. Croix River we observed animals biweekly from May-Nov. 1997, April-Oct. 1998 and nearly biweekly during May-July 2004-2007. We found gravid females between late April-July. Females held mature glochidia in a large mantle magazine that was significantly more inflated at night. Of 65 fish species (18 families) exposed to pistolgrip glochidia, only flathead catfish (*Pylodictis olivaris*) and brown (*Ameiurus nebulosus*) and yellow (*A. natalis*) bullheads were suitable hosts. Flathead catfish showed the strongest host response. Glochidia grew significantly while attached to fish (>400%). In light of the apparent close association between pistolgrip and flathead catfish, we recommend pistolgrip conservation efforts include sustainable flathead catfish management along with habitat improvement to support expansion of remaining pistolgrip populations.

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PO 27

SNAIL SPECIES RICHNESS AND A MUSSEL POPULATION ASSESSMENT IN THE FRESH WATERS OF ACADIA NATIONAL PARK. Bruce J. Stephen University of Nebraska Department of Natural Resources

Freshwater mollusks were surveyed throughout Mount Desert Island, Maine primarily within the borders of Acadia National Park (ANP). Aquatic snails were sampled from shallow waters of 30 habitats in June 2007. The mussel population study examined 10 water bodies in July 2010. This area has not previously been surveyed for aquatic snails but has been surveyed for fresh water mussels, however no population assessment was done. Thus these studies provide a starting point to assess the conservation status of freshwater mollusks within ANP. Snails were found at sixteen of thirty water bodies. Eight species of snail, one prosobranch and seven pulmonates, were collected for a total of 32 records. Species richness for the sixteen snail positive sites ranged from one to four. Four sites were found to house one species while only one site was found with four species. The most common species encountered was *Helisoma campanulatum* found at ten sites. Three species, *Laevapex fuscus*, *Lymnaea megasoma* and *Micromenetus dilatatus* were each found at only one site. Mussels were found in five of ten water bodies. Three water bodies, Echo Lake, Long Pond, and Seal Cove Pond housed both of the species found on the island; the eastern floater (*Pyganodon cataracta*) and the eastern elliptio (*Elliptio complanata*). The Tarn and Lake Wood housed only eastern floaters. Echo Lake had the densest array of mussels with 2.7 per square meter. Eastern floaters in Echo Lake averaged 6.9 (SD ± 2.4) years old and 64.8 (SD ± 10) mm in length.

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PO 28

WHY ARE MUSSELS LARGER AND POPULATIONS DENSER IN THE SUNRISE RIVER THAN IN THE ST. CROIX RIVER? Daniel J. Hornbach[1], Elise Griffin[1], Brandon Sansom[2] and Mark C. Hove[1]. [1]Departments of Biology and Environmental Studies, Macalester College, St. Paul, MN 55105. [2]Department of Biology, Washington and Jefferson College, Washington, PA 15301

Some studies show that small low-head dams benefit and increase growth rates for downstream filter-feeding guilds. This study examines the difference in population density, mussel size and growth rate in the freshwater mussel, *Actinonaias ligamentina* below a small low-head dam in the Sunrise River (MN) and below a larger hydroelectric dam in the St. Croix River (MN/WI). Mussels were collected quantitatively and measured from 1998-2010 to assess trends in population density and demography. For a sample of mussels taken in 2010, annual growth rings were measured for each mussel to assess past growth rates using Ford-Walford plots. We found that *A. ligamentina* populations were denser in the Sunrise compared to the St. Croix (55 vs. 1.4 mussels per m^2), reached a larger average size (L_∞ - 132 vs. 120 mm) and grew at a faster rate (growth rate coefficient = 0.08 vs. 0.06 yr^{-1}). The causes for these differences are unknown. A comparison of limited temperature data showed that water was actually warmer in the St. Croix than in the Sunrise. Preliminary analyses of total suspended solids and chlorophyll levels (indicators of food quantity and quality) showed no statistical difference between rivers. It is essential to understand how dams may benefit, degrade and alter river mechanisms and habitat characteristics that determine the well being of mussel communities so that we can better make intelligent and informed decisions about dam construction and removal where mussels and other aquatic species reside.

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PO 29

EFFECTS OF FOOD QUALITY ON JUVENILE UNIONID MUSSEL SURVIVAL AND GROWTH IN THE ST. CROIX NATIONAL SCENIC RIVERWAY. Michelle Bartsch, William Richardson, Lynn Bartsch, Jon Vallazza, and [1]Brenda Moraska Lafrancois. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603. [1]National Park Service, St. Croix Watershed Research Station, Marine on St. Croix, MN 55047.

Recent increases in nutrient and sediment loading have caused observable shifts in algal composition and have potentially altered the quality of mussel food in the St. Croix National Scenic Riverway. Juvenile *Lampsilis cardium* and *L. siliquoidea* were deployed in cages for 28 d at four riverine and four lacustrine sites. Mussel tissue and food resources (seston and surficial sediment) were analyzed for total lipids (TL) and quantitative fatty acid (FA) composition. Riverine sites were dominated by Chlorophyta, whereas Cyanophyta generally dominated lacustrine sites. Overall mussel survival was 95%. *Lampsilis cardium* did not exhibit growth (-9 and -7 µm/d for riverine or lacustrine sites, respectively). The mean growth rate of *Lampsilis siliquoidea* was 25 µm/d at riverine and 11 µm/d at lacustrine sites. Growth of *L. siliquoidea* was negatively correlated with cyanobacteria biovolume ($r = -0.62$, $P < 0.01$) and nitrate-nitrate concentration in the water column ($r = -0.68$, $P < 0.01$); and positively correlated with total phosphorus concentration in the water column ($r = 0.83$, $P < 0.001$). Total lipids were similar between mussel species and sites (averaged 10.5 ± 1.1%); however, seston TL ranged from 5.6 to 11.0% at riverine and 11.7 to 14.3% at lacustrine sites. Sediment TL averaged 0.031% at riverine and 0.047% at lacustrine sites. Mussel growth may be more dependent on dietary lipid quality than quantity. The quality of lipids based on the FA composition will be discussed.

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PO 30

RECORDING FIELD DATA CRITICAL FOR CONDUCTING CONSERVATION STATUS REVIEWS OF IMPERILED UNIONOID MUSSELS Bob Butler, U.S. Fish and Wildlife Service, 160 Zillicoa Street, Asheville, NC 28801

The current high rate of imperilment among North American freshwater mussels (order Unionoida) continues to increase. While most narrowly endemic species are already considered imperiled, an increasing number of wide-ranging species formerly considered common are developing traits of imperilment (e.g., declines in abundance, increasingly disjunct and isolated populations). Compared with narrow endemics—which dominate the U.S. Endangered Species Act list—compiling status review information of wide-ranging species is more complex for various reasons. Coupled with the prohibitive cost for range-wide status surveys, status review information must necessarily be garnered primarily from literature reviews and museum records. In addition to survey work, any study with a field component involving the sampling of mussel populations is a potentially important source of data useful for generating status assessments. Unfortunately, many published papers and particularly unpublished reports neglect to include “extraneous” data and comprehensive field notes, thus missing important opportunities for generating status information. Recording and publishing accurate and comprehensive data while conducting any field work is critical for assessing the population status of imperiled species and does not necessarily add substantial field time or effort to a study. Important data includes recording precise collection localities and dates, habitat conditions, negative data for sites and imperiled species, sampling means and effort, numbers collected live and dead, shell condition of dead specimens, vouchers retained, relative abundance of all species collected, shell measurements and evidence of recent recruitment (not just gravidity), and localized landuse patterns and obvious threats. Researchers are urged to consider including such data in their studies, which ultimately aids in prioritizing sites for conservation while fostering wise management of the imperiled mussel fauna.

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PO 31

RECOVERING THE RIFFLESHELL: THE PROPAGATION AND TRANSLOCATION OF A FEDERALLY ENDANGERED FRESHWATER MUSSEL TO OHIO. G.T. Watters, T. Gibson, C. Lawlis, J. Cecil. Department of Evolution, Ecology and Organismal Biology. The Ohio State University, 1315 Kinnear Road, Columbus, OH 43212 USA. & H. Albin Columbus Metro Parks, 1069 West Main Street, Westerville, OH 43081 USA

The Northern Riffleshell, *Epioblasma torulosa rangiana*, is a federally endangered freshwater mussel. Once common in the Darby Creek system of Ohio, the population experienced a decline in the 1980-1990s. However, based on the current abundance of other mussels exhibiting recruitment it is believed that the creek has recovered sufficiently to support the Riffleshell again. In August 2007, 44 individuals were moved from the Allegheny River of Pennsylvania to Big Darby Creek and fitted with passive integrated transponders (PIT) tags. These populations were recovered in 2007 and 2008 with only 4% mortality. Based on this trial success, in 2008 1,773 Riffleshells were collected from the Allegheny River, tagged, and moved to Big Darby Creek. Eight individuals died in transit or before release (0.5% mortality). Experimental populations were established at six sites within Battelle-Darby Metro Park. Sixty-nine individuals had been used for propagation work that resulted in ~700 juveniles that were released as well. The hosts for this propagation (rainbow darters) were raised from eggs specifically for the project. Monitoring in 2009 found an overall 49% of the released individuals. Monitoring in 2010 showed an average 27% recapture, although equipment failure reduced documentation of the actual number encountered. In 2010, 1,696 additional individuals were tagged and released at new sites in Big Darby Creek within the Prairie Oaks Metro Park.

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PO 32*

HYDROGEOMORPHIC LEGACY OF A MASS-EXTINCTION EVENT: HABITAT ECOLOGY OF MUSSELS IN THE EAST FORK TOMBIGBEE RIVER. Hamstead, B.A.[1], Hartfield, P.D.[2], and Gangloff, M.M[1]. [1] Appalachian State University, Biology Department, Rankin Life Sciences, Boone, NC 28606-2027. [2]U.S. Fish and Wildlife Service, 6578 Dogwood View Parkway, Suite A Jackson, MS 39213-7856

The East Fork Tombigbee River (EFTR) originates in northeastern Mississippi, (Itawamba County) and ends in the Tennessee-Tombigbee Waterway (TTW) at the convergence of the East Fork and Town Creek near TTW RM 366 (Monroe County). Until the construction of the TTW in 1972, the EFTR was undammed and supported a diverse aquatic fauna. Increased sedimentation associated with diminished flows degraded much of the EFTR's mussel habitat. Historically, 46 mussel species, including 10 federally-listed taxa, were reported from the EFTR. In 2004, USFWS designated 26 km from the confluence of Mill Creek and MS Highway 278 as critical habitat for 4 mussels. Comprehensive mussel surveys of the EFTR were last conducted in the late-1980s. Hartfield and Jones used quadrats and timed searches to sample at 68 sites (226 quadrats) and reported 35 species. In 2010, we began to re-sample the EFTR to assess mussel population changes and have completed quantitative sampling at 26 sites (131 quadrats). We found 31 species (15 alive) including 4 federally-listed species (*Epioblasma penita*, *Pleurobema decisum*, *P. taitianum* and *Potamilis inflatus)*. *Quadrula asperata* and *Truncilla donaciformis* were the most abundant species and comprised 31.6% and 23.3% of the assemblage, respectively, compared to 22.41% and 16.57% in 1988. *Pleurobema decisum* relative abundance increased from 0.38% to 6.02%. Mussel density was greatest in clean, stable gravel substrates and declined dramatically as the proportion of sand and silt increased. Subsequent research will examine effects of substrate, channel morphology and flow conditions on the EFTR's highly fragmented yet resilient mussel fauna.

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PO 33*

SURVEY AND HABITAT USE OF THE MUSSEL FAUNA OF THE CLARKS RIVER, KY. Kelsa Mueller, S. Tyler Flynt, Department of Biology, Murray State University. David S. White, Todd D. Levine, Hancock Biological Station/Watershed Studies Institute, Murray State University

Mussels are a critical part of aquatic ecosystems and provide valuable ecosystem and economic services. The Clarks River is a north flowing, 5th-order tributary of the Tennessee River in Western Kentucky in a region of high mussel diversity. We have conducted extensive scouting on the Clarks River, recording mussel locations opportunistically. We surveyed 16 sites and collected habitat data from them. All sites selected were based on access and were at least 500 m apart. We searched for mussels and recorded habitat information within a 50 meter reach at each site. Two person hours were spent searching for mussels at each site. Habitat data were taken every ten meters using a 1 x 1 meter quadrat placed at a randomly determined distance from shore, and depth, percent cover, and particle size of the substratum were recorded. A chain width was taken at zero and fifty meters, which when compared with the surface width providing an index of river bed unevenness. A YSI sonde was used to measure pH, turbidity, temperature, dissolved oxygen, and oxidation-reduction potential. We have located 164 mussels of 14 species in the sites. Based on our preliminary data, there was a significant positive relationship between latitude and total mussel numbers and a significant decrease in mussel numbers with increasing particle size. Mussel numbers and species richness are particularly high near the confluence of the two forks and are expected to remain high immediately downstream. However, species are often non-overlapping in their ranges, suggesting a shift in dominant species.

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PO 34

NORTHERN RIFFLESHELL REINTRODUCTION IN ILLINOIS: SUMMARY OF ACTIVITIES FROM 2010. Jeremy S. Tiemann[1], Robert E. Szafoni[2], Joseph Kath[2], and Kevin S. Cummings[1]
[1]Illinois Natural History Survey – Institute of Natural Resource Sustainability at the University of Illinois, 1816 South Oak Street, Champaign, IL 61820. [2]Illinois Department of Natural Resources, 1 Natural Resources Way, Springfield, IL 62702

The recovery plan for the federally-endangered northern riffleshell (*Epioblasma rangiana*), approved by USFWS in 1994, listed an objective of establishing viable populations of the species in ten separate river drainages throughout its range. The recovery plan stated that population augmentations and reintroductions would be needed to achieve this objective, and listed the Vermilion River (Wabash River drainage) in Illinois as a potential location for reintroduction. Beginning in 2005, Illinois partnered with the USFWS and state agencies in Ohio and Pennsylvania and began planning the reintroduction of *E. rangiana* into the Vermilion River. After 5 years of planning, individuals were translocated into the Vermilion River watershed from the Alleghany River in Pennsylvania. This poster summarizes the results of the 2010 field activities.

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PO 35

MUSSEL MONITORING PROGRAM OF WISCONSIN, BEGINNINGS OF CITIZEN VOLUNTEER EFFORTS. Lisie Kitchel and Paul White, Wisconsin Department of Natural Resources

Over half of Wisconin's 50 native mussel species are listed as threatened, endangered or special concern. Declining water quality and habitat alterations, as well as invasive species threaten the existence of our native mussels. With limited resources to conduct statewide mussel surveys, the Mussel Monitoring Program of Wisconsin was established as a Citizen Monitoring effort to collect information on native mussels statewide in conjunction with ongoing citizen water quality sampling, and to use this existing network of volunteers to sample wadeable streams with historic mussel records. A statewide Mussel Atlas was compiled from existing mussel records and made available on a website so that volunteers could get a list all of the streams with mussel records and the species recorded from those sites. The purpose of the project is to 1) resample historically sampled streams and compare species assemblages over time, 2) augment species lists for streams not adequately sampled, 3) identify and sample streams not previously sampled, and 4) evaluate the data to identify streams with high diversity and rare species to promote conservation of those streams. Volunteers were trained in the field in collection and preliminary identification of shell material and the identifications verified by an expert. Live mussels were photographed and returned to the stream and photos submitted for verification. There has been active interest in the program and the response from citizen volunteers has been enthusiastic. The distribution of sampling efforts has been clustered and not all areas of the state have been evenly sampled. This was the first year, training will be ongoing and future efforts will direct citizen volunteers to areas identified as high priorities for sampling.

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PO 36*

POTENTIAL FACILITATION OF *CORBICULA FLUMINEA* BY UNIONIDS. Carla L. Atkinson and Caryn C. Vaughn. University of Oklahoma and the Oklahoma Biological Survey

One of the major goals of ecologists is to understand the distribution patterns of organisms including habitat expansions. Researchers are trying to understand the factors that underlie the ability for organisms to be invasive, the habitats that are conducive to invasion, and future changes that may lend to invasion. Diverse communities are believed to be less susceptible to invasion in comparison to species poor communities; yet this can co-vary with environmental factors. The role of invasive species and their influence on native fauna and ecosystems has been studied in detail, yet the influence of native fauna on invasive species is mostly unknown. Filter-feeding mussels historically comprised the majority of benthic biomass in many streams and are important for ecosystem functioning by linking the water column and benthic habitats. Presently, both native and non-native species coexist in many streams. Invasive aquatic bivalve species can alter community structure and ecosystem function due to rapid establishment and high filtering capacity. *Corbicula fluminea*, the invasive Asian clam, commonly co-occurs with native mussels. There is continued debate about whether native freshwater mussels and *C. fluminea* compete for space and food. I sampled quadrats at 18 sites in the Red River basin for native unionid mussels and *C. fluminea* in conjunction with another study. I found higher densities and biomasses of *C. fluminea* associated with higher densities of unionid mussels. Two possible mechanisms could explain this pattern. Positive correlations could arise from a similar response to the local environmental conditions by both native and the invasive species. Additionally, previous research has shown higher biomass of aquatic insects associated with mussel beds; the same mechanism may be lending to this trend.

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PO 37

A SURVEY OF FRESHWATER MUSSELS (UNIONOIDA) AND PLEUROCERID SNAILS IN FLOYDS FORK, A MEDIUM-SIZED STREAM NEAR LOUISVILLE, KENTUCKY. T. Travis Brown, P. Lee Droppelman, and Scott Slankard, Eco-Tech Consultants, Inc., 100 West Court Avenue, Suite 102, Jeffersonville, IN 47130.

We conducted surveys for freshwater mussels (Order Unionoida) and pleurocerid gastropods (Pleuroceridae) primarily in Floyds Fork, a tributary of the Salt River located near Louisville, Kentucky. Overall, we found 28 native freshwater mussel species and four species of pleurocerid snails by sampling 21 sites during 2008 and 2010. We compared a subset of seven sites sampled during the current study to seven sites sampled by Ralph W. Taylor in 1978 on the basis of species richness and community composition. In comparison to Taylor, who found 24 native mussel species, we found 27 species at seven comparable sites. Some species, such as *Strophitus undulatus* and *Quadrula pustulosa* were found at lower frequencies than during Taylor's study. The frequency of several species, such as *Alasmidonta viridis* and *Lampsilis cardium,* has remained relatively constant in comparison to Taylor's data. However, some species, such as *Amblema plicata*, *Elliptio dilatata*, and *Potamilus alatus*, were found at more than twice the frequency in the current study as was found by Taylor. Although sample effort discrepancies are inherent in this type of comparison, these data allow us to go a step beyond anecdotal description of changes in the Floyds Fork mussel community over thirty years.

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PO 38*

EFFECTS OF NATIVE FRESHWATER MUSSELS ON RIVER PHYTOPLANKTON. Carrie J. Miller-DeBoer and Caryn C. Vaughn. University of Oklahoma, Oklahoma Biological Survey

Sensitive to changes in both biotic and abiotic factors, phytoplankton community composition is reliant on the ability of phytoplankton species to compete for nutrients while resisting declines from herbivory. While the research community shows alterations to phytoplankton communities by invasive mussel species, impacts of native freshwater mussels on phytoplankton communities is little known. This study examines the impact of native freshwater mussel populations on the abundance and composition of river phytoplankton in the Kiamichi and Little Rivers in southeastern Oklahoma. The role of native mussels in top-down and bottom-up influences on phytoplankton is investigated.

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PO 39

A MUSSEL COMMUNITY ASSESSMENT TOOL FOR THE UPPER MISSISSIPPI RIVER. Heidi Dunn[1], Steve Zigler[2], and Teresa Newton[2]. [1]Ecological Specialists, Inc., O'Fallon, MO and [2]USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI

Managers in the Upper Mississippi River 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. Our approach is to evaluate a multi-metric index, and a series of statistically derived curves that plot the frequency distribution of different mussel metrics representing the categories of species composition, conservation status, abundance, age structure, mortality, and species richness. We calculated multiple metrics in each category using existing quantitative data from 25 surveys that spanned low to high quality mussel communities from Navigation Pools 2 to 25. Metrics in each category were evaluated for range, ecological significance, and sampling bias. Metrics selected for evaluation of redundancy include percent Amblemini, Pleurobemini, Quadrulini, Anodontini, Lampsilini; percent dominant species (*A. plicata* + *Q. quadrula* + *O. reflexa*); percent threatened and endangered species; percent fresh dead shells; percent ≤5 years old, 6-15 years old, and 15+ years old, 75% quartile density of ≤5 years old and >5 years old, and percent of species represented by individuals ≤5 years old; mean density and 75% quartile density; rarefaction richness at 100 individuals, number of species with density >0.01/m^2, and effective number of species (Hill's N1). Results of this analysis will be used to design a statistical approach for developing a mussel community assessment tool.

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PO 40

STATUS OF FRESHWATER MOLLUSKS IN THE SOUTH FORK KENTUCKY RIVER SYSTEM. Ryan Evans, Kentucky State Nature Preserves Commission, 801 Schenkel Lane, Frankfort, KY 40601

In 2008 and 2009, a status survey was conducted in the mainstem and tributaries of the South Fork Kentucky River. The goals of this study were to develop a longitudinal map of freshwater mollusk assemblages within the basin, determine if reproduction is occurring within the mussel fauna, examine community composition, and examine the influence of 303(d) impaired tributaries on the mussel fauna. Qualitative sampling using catch-depletion sampling was conducted at 79 sites. Systematic quantitative sampling was conducted at three sites chosen from the qualitative sampling phase that represented habitats typical of the lower Redbird River, and middle and lower South Fork Kentucky River mainstem. Twenty-six species of freshwater mussels were located, including evidence of reproduction of the snuffbox (*Epioblasma triquetra*) at 2 locations. Fourteen species of freshwater gastropods were located in opportunistic collections; this number includes five new records for the South Fork Kentucky River system, two of which are also Kentucky River basin records. A statistically significant negative effect from 303(d) tributaries on mussel assemblages was observed. The South Fork Kentucky harbors some of the last refuges in the Kentucky River system for certain mollusk species. Despite large holdings of federal land within the Daniel Boone National Forest, acute and chronic declines of freshwater mussels have occurred within the South Fork Kentucky River system.

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PO 41

FRESHWATER MUSSEL SURVEYS OF CONEWANGO CREEK IN PENNSYLVANIA, A UNIQUE TRIBUTARY OF THE ALLEGHENY RIVER. Elizabeth S. Meyer Pennsylvania Natural Heritage Program. Western Pennsylvania Conservancy, 800 Waterfront Drive, Pittsburgh, PA 15522, U.S.A.

The Allegheny River is globally important habitat for rare and endangered mussel species. Conewango Creek, a tributary of the upper Allegheny River known to support significant mussel populations, had not been comprehensively surveyed in Pennsylvania since Ortmann (1919). This survey complements recent surveys of the New York portion of Conewango Creek by the Nature Conservancy. A combination of two qualitative survey techniques were used to provide distribution information over a large area, to help detect rare or cryptic species, and to allow comparisons to other surveys in the Allegheny River basin. A total of 18 species of native mussels were found. *Amblema plicata* (three-ridge) was the most common species, comprising more than two-thirds of the mussels found. A small number of *Epioblasma torulosa rangiana* (northern riffleshell) were found. No *Pleurobema clava* (clubshell)*, Villosa fabalis* (rayed bean) or *Epioblasma triquetra* (snuffbox) were found. The species composition of Conewango Creek is unique in the Allegheny River basin, with a high proportion of species generally associated with slow flowing water. This survey adds to our knowledge of the distribution of mussel species in the Allegheny River system.

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PO 42*

EFFECTS OF BEAVER AND MILL DAMS ON SUSPENDED ORGANIC MATTER AND FRESHWATER MUSSELS IN NORTH CAROLINA PIEDMONT STREAMS. RACHAEL A. HOCH AND MICHAEL M. GANGLOFF. Department of Biology, Appalachian State University, Boone, North Carolina 28608 USA

Although once nearly extirpated, beaver (*Castor canadensis*) populations have rebounded in southeastern North America following the implementation of wildlife protection laws. Beavers, like humans, are ecosystem engineers and may dramatically alter lotic habitats and resource availability in small streams. Both beaver and human-constructed dams likely alter cycling of carbon, nitrogen, and other nutrients. Nutrient concentrations strongly affect freshwater mussel health and suspended organic matter (seston). The quantity, quality, and composition of seston are believed to be a key factor driving the growth, survival and fitness of mussel populations. We compared the effects of beaver and mill dams on seston quantity and quality (carbon to nitrogen ratio, C:N) in three 3rd -order streams in the Tar River Basin in eastern North Carolina known to support populations of federally endangered dwarfwedge mussel (*Alasmidonta heterodon*). We quantified seston levels by filtering water from beaver ponds, impoundments, and free-flowing reaches up-and downstream from beaver and mill dams. Filtered samples were freeze-dried and analyzed for C:N using a combustion analyzer. Analyses revealed little differences in water chemistry and seston C:N between beaver ponds, mill ponds, and control reaches. However, beaver floodplains had the lowest D.O. levels and the mill reach had the lowest C:N (highest quality) seston. Preliminary results suggest mill ponds export low quantities of high-quality seston whereas beaver dams export higher quantities of low-quality seston. Increased retention by human-constructed impoundments may alter seston dynamics and explain the abnormally rapid growth exhibited by mussels below some mill ponds. Subsequent work will assess the role of dams on mussel growth and survival using shell-sectioning and reciprocal transplant experiments.

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PO 43*

EFFECTS OF SMALL DAMS ON NORTH CAROLINA MUSSEL ASSEMBLAGES. Megan A. McCormick and Michael M. Gangloff, 572 Rivers Street, Biology Department, Appalachian State University, Boone, NC 28608-2027.

In the Mid-Atlantic Region, dam removals are a common component of stream restoration projects, however little is known about the potential effects of dam failure or removal on imperiled mussel populations. In 2009 we began a 3-year study examining the impacts of small dams and dam status on mussel populations and habitat conditions in three eastern North Carolina drainages. We sampled mussel assemblages using multiple timed-searches (n = 15) and quadrats (n = 80) at each site. In 2009 and 2010 we quantified mussel assemblages and stream physicochemical parameters at 30 sites (3 per dam) associated with 5 intact, 1 breached and 4 relict dams in the Tar and Roanoke river drainages. Surveys revealed moderately diverse Atlantic slope mussel assemblages ranging from 1 to 9 species (total richness = 16 taxa, mean richness = 4.1 taxa) at most sites. Mussel assemblages were dominated by *Elliptio complanata* and diversity (Shanon H') was low (overall mean = 0.25, range 0-1.14). Abundance ranged from 66 to 9861 mussels per site (mean = 1187 per site) and CPUE ranged from 3.7 to 386 mussels per hour (mean = 80.3 per hour). We found populations of 9 state-or-federally-listed mussels (*Alasmidonta undulata*, *Elliptio lanceolata*, *Elliptio roanokensis*, *Fusconaia masoni, Lampsilis cariosa, Lampsilis radiata, Pleurobema collina, Strophitus undulatus and Villosa constricta*) in study reaches. Although mussel abundance, CPUE, richness and H' all trended highest in the mill reaches of intact dams, additional power appears necessary to enhance statistical resolution. In 2011 we will sample at 17 additional sites in the Neuse, Tar and Roanoke drainages to increase the spatial and biological scope of our dataset.

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PO 44

DEVELOPMENT OF LABORATORY TESTS TO DETERMINE THERMAL TOLERANCE OF JUVENILE FRESHWATER MUSSELS IN SEDIMENT. Jennifer M. Archambault[1], W. Gregory Cope[2], Thomas J. Kwak[3], and Tamara J. Pandolfo[1]. [1] North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Box 7617, NC State University, Raleigh, NC 27695; [2] Department of Environmental and Molecular Toxicology, Box 7633, NC State University, Raleigh, NC 27695; [3] U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Box 7617, NC State University, Raleigh, NC 27695.

We are developing acute laboratory test methods to evaluate the temperature sensitivity of juvenile native freshwater mussels in sediments. We will conduct standardized tests to control sediment temperature, allowing evaluation of the presence of sediment on mussel thermal tolerance by directly comparing our results to those from water-only test results. In a second phase of testing, mussels will be exposed to test conditions that mimic vertical temperature gradients in water and sediment observed in natural streams. Using these sediment testing protocols, we will evaluate the relative sensitivity of juvenile native freshwater mussels to a range of common and extreme water temperatures that may be encountered during summer in streams with low flow and dewatered conditions in the southeastern and central United States. Additionally, we will conduct water-based laboratory temperature sensitivity tests with glochidia and juveniles. Our first objective is to expand the temperature suitability database for the early life stages of freshwater mussels. Second, we will compare results of the sediment tests with results of the water-only tests to determine whether sediments provide a partial thermal buffer. Third, we will compare results from the sediment test methods to evaluate their ecological relevance. Finally, our thermal tolerance data will be incorporated into regional mussel occupancy models to predict the response of imperiled mussels to changes in water temperature.

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PO 45

MULTISCALE MODELING TO ASSESS THE EFFECTS OF CLIMATE AND LAND USE CHANGES ON COMMON AND IMPERILED FRESHWATER MUSSEL OCCURRENCE IN THE TAR RIVER, NC AND THE ST. CROIX AND MISSISSIPPI RIVERS IN THE UPPER MIDWEST, USA.

Joseph A. Daraio[1] and Jerad D. Bales[2] [1]Department of Biology, Box 7617, NC State University, Raleigh, NC 27695; [2] U.S. Geological Survey, 11201 Sunrise Valley Drive, MS 436, Reston, VA, 20192.

A modeling framework has been developed to integrate watershed, river segment, and river reach scales to assess the potential impacts of land use and climate change on juvenile and adult freshwater mussels, with an emphasis on temperature. Downscaled General Circulation Models will be used to estimate potential changes in temperature and precipitation due to climate change. Watershed models (precipitation-runoff models) are being developed and multiple simulations run to estimate the hydrologic response of the river basins under various land use and climatic conditions. Ensemble modeling provides an estimate of probability distributions for flow and temperature responses within the rivers. Instream temperature models are used to estimate threshold temperature exceedence probabilities based on hydrologic simulations, field and laboratory data from Archambault et al., Ganser et al., and Pandolfo et al. (this meeting). Microhabitat data from Pandolfo et al. are used in conjunction with one-dimensional hydraulic models to describe and predict habitat suitability of freshwater mussels in the Tar River basin. These field, laboratory, and simulation data are used to estimate parameters in a hierarchical Bayesian model. A hierarchical Bayesian model allows for the integration of data from processes spanning a wide range of spatial and temporal scales, and for the quantification of uncertainty that propagates through the connected processes. It also provides a flexible means to incorporate new data and knowledge as new predictions on future climate become available.

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PO 46

EFFECTS OF SUB-LETHAL TEMPERATURES ON ADULT AND JUVENILE FRESHWATER MUSSELS.

A. Ganser[1], T. Newton[2], and R. Haro[1]. [1]University of Wisconsin–La Crosse, River Studies Center, La Crosse, WI. [2]USGS Upper Midwest Environmental Sciences Center, La Crosse, WI.

Freshwater mussels are a diverse, but imperiled fauna and may be especially sensitive to increasing water temperatures because of their patchy distribution, limited dispersal, limited mobility, spatial and temporal dependence of their larvae on host fish, and the fact that they already inhabit fragmented landscapes. Recent research suggests that many mussel species are currently living near their upper thermal limits and that increased temperatures may alter physiological traits of freshwater mussels. I plan to address the following objectives for my Master of Science research: (1) increased temperatures alter the timing of glochidial release in freshwater mussels; (2) glochidia released prematurely from mussels exposed to increased temperatures will have reduced viability; and (3) elevated temperatures will adversely affect physiological traits in adult and juvenile mussels. Because different species react differently to thermal stress, I will use the functional niche approach that has been developed for lotic macroinvertebrates to ensure that the breadth of species responses in this diverse faunal group is captured in the study design. Test endpoints include glochidial release, glochidial viability, oxygen consumption, nitrogen excretion, and heat shock protein in adults and heart rate, growth rate, and oxygen consumption in juveniles. These data, and those of a parallel study on lethal responses of mussels to elevated temperatures, will be used in a downscaled global climate change model. This research will provide an understanding of the thermal preferences of freshwater mussels that can be utilized by federal and state resource managers to forecast species responses to climate change and to develop adaptation strategies to mitigate any adverse effects.

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PO 47

MODELING EFFECTS OF CLIMATE AND LAND USE CHANGES ON COMMON AND IMPERILED FRESHWATER MUSSEL OCCURRENCE IN THE TAR RIVER BASIN, NORTH CAROLINA. Tamara J. Pandolfo [1], Thomas J. Kwak [2], W. Gregory Cope [3], Ryan J. Heise[4], and Rob B. Nichols[5]. [1] North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Box 7617, NC State University, Raleigh, NC 27695; [2] U.S. Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit, Department of Biology, Box 7617, NC State University, Raleigh, NC 27695; [3] Department of Environmental and Molecular Toxicology, Box 7633, NC State University, Raleigh, NC 27695; [4] North Carolina Wildlife Resources Commission, 1142 I-85 Service Road, Creedmoor, NC 27522; [5] North Carolina Wildlife Resources Commission, 1721 Mail Service Center, Raleigh, NC 27699.

The Tar River Basin of North Carolina supports a diverse mussel community that includes a number of imperiled species, including the federally endangered Tar spinymussel (*Elliptio steinstansana*) and dwarf wedgemussel (*Alasmidonta heterodon*). 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 (e.g., *Elliptio complanata*) and imperiled mussels and fish. Microhabitat parameters were measured at base flow conditions at all sites. These parameters, including depth, velocity, substrate, cover, and sediment compaction will be combined with habitat availability data to describe microhabitat suitability of freshwater mussels in the basin. We will then identify the physical and hydraulic parameters that best describe the occurrence of mussels by selecting the most parsimonious models that quantify these relationships. The resulting habitat suitability data and mussel occupancy models will be incorporated into watershed and instream biological response models for mussels that will be used to simulate scenarios related to climate and land use change to guide conservation efforts.

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PO 48

TOXICITY OF COAL-ASSOCIATED CONTAMINANTS IN SEDIMENT TO FRESHWATER MUSSELS AND COMMONLY TESTED BENTHIC INVERTEBRATES. Ning Wang, James Kunz, Chris Ingersoll, William Brumbaugh, USGS, Columbia, MO; Cindy Kane, USFWS, Gloucester, VA; Brian Evans, USFWS, Abingdon, VA; Steven Alexander, USFWS, Cookeville, TN; Craig Walker, OSM, Pittsburgh, PA; Steve Bakaletz, USNPS, Oneida, TN; R. Craig Lott, Virginia Department of Environmental Quality, Richmond, VA

Sediment toxicity tests were conducted to assess potential effects of coal-associated contaminants on mussels (*Villosa iris* and *Lampsilis fasciola*, 28-day exposure), and commonly tested amphipod (*Hyalella azteca* 28-day exposure) and midge (*Chironomus dilutus* 10-day exposure). Sediments were collected from 13 “high risk” sites with historical coal mining or gas well activities and with mussel communities classified as impacted, and from 5 reference sites with no or limited coal mining activities and with mussel communities classified as not impacted. Mean survival or growth of one or more test organisms was reduced in 9 of 13 sediments from the “high risk” sites relative to the response of organisms in 5 reference sites. Both mussel species had similar sensitivity to contaminants, and were equally or more sensitive compared to amphipods or midge. Concentrations of total recoverable metals and total PAHs in sediments did not exceed effects-based probable effect concentrations (PEC; sediment quality guidelines). However, mussel growth decreased with increasing metal PEC-quotient or with increasing concentrations of total PAHs. Mussel growth tended to decrease with increasing concentrations of major anions (sulfate, chloride) or major cations (sodium, potassium) in sediment pore-water, which was consistent with previous findings of reduced mussel survival in reconstituted waters with elevated concentrations of major anions and cations. Studies with additional field samples and reconstituted waters representing elevated major cations and anions in field sediment samples are needed to evaluate these concentration-response relationships and provide basis for developing site-specific toxicity thresholds.

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PO 49

USING METABOLOMICS TO INVESTIGATE ENDOCRINE STRESS IN *ELLIPTIO COMPLANATA*. Jeremy A. Leonard[1], W. Gregory Cope[1], M. Christopher Barnhart[2], and Robert B. Bringolf[3]. [1]Department of Environmental and Molecular Toxicology, Box 7633, NC State University, Raleigh, NC 27695; [2]Department of Biology, Missouri State University, 901 South National Ave. Springfield, MO 65897; [3]Warnell School of Forestry and Natural Resources, 180 E. Green St., University of Georgia, Athens, GA 30602.

Demonstrated effects of endocrine disrupting chemicals (EDCs) on aquatic organisms include feminization of male fish and the appearance of imposex gastropods. However, little is known regarding the sublethal effects of EDCs on freshwater mussels, including affected pathways and metabolic activities. Presently, ecotoxicology, environmental chemistry, and similar fields of study are utilizing high-throughput methods for sample analysis. One such method, metabolomics, involves the analysis of thousands of potential small metabolites that are influenced by changes in gene expression in response to physiological perturbations, such as a toxicant insult. The identification of endpoints such as reduced fecundity, delayed spawning, and altered sex ratios may be influenced by metabolic interactions able to be detected by advanced analytical platforms like metabolomics. A conceptual framework is presented here detailing the investigation of endocrine stress of the emerging contaminant and synthetic estrogen ethinylestradiol (EE2) on *Elliptio complanata* using environmental metabolomics and traditional endpoints for comparison. The objectives of this research are to identify biomarkers of endocrine stress in adult mussels and to determine negative impacts on adults, glochidia and juveniles. This research will lead to mesocosm and field studies to investigate the utility of the biomarkers identified in assessing the health and exposure of mussels to EDCs, as well as to provide insight into the metabolic pathways that might be adversely altered by such toxicants.

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PO 50

IDENTIFYING MICROBIAL PATHOGENS CAUSING DISEASE IN FRESHWATER BIVALVES IN KENTUCKY. Khamisi Campbell, Dr. Robert Durborow, and Dr. Christopher Owen. Kentucky State University, Aquaculture Research Center, Frankfort, KY.

Freshwater mussels are an important component of benthic communities, but are experiencing severe declines throughout North America. Conservation efforts are being made towards increasing mussel populations through hatchery propagation. As a result of these efforts, mussels are often held in high density, artificial tank systems and can be exposed to new species or the same species from different river systems, thereby increasing the risk of exposure to potentially pathogenic organisms. This exposure could result in increased hatchery mortality, as well as the spread of pathogenic microorganisms to new areas once the brood stock are returned to their collection site. We are investigating the role heterotrophic bacteria may play in mussel disease and hatchery survival. Using the common pond mussel, *Utterbackia imbecillis*, we will isolate and identify the bacteria from *in situ* mussels and then compare the bacterial fauna of mussels collected from the same site and held under hatchery conditions for 30 days. Bacteria will be identified using Rt-PCR methods. Healthy mussels will then be inoculated with potential pathogens to fulfill Koch's postulates. This study will hopefully demonstrate if microbial pathogens potentially may be a cause of disease and mortality in freshwater mussels.

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