The Freshwater Mollusk Conservation Society (FMCS) is an organization devoted to the advocacy for, public education about, and conservation science of freshwater mollusks, North America's most imperiled fauna. Membership in the society is open to anyone interested in freshwater mollusks who supports the stated purposes of the Society:

1) advocate conservation of freshwater molluscan resources,
2) serve as a conduit for information about freshwater mollusks,
3) promote science-based management of freshwater mollusks,
4) promote and facilitate education and awareness about freshwater mollusks and their function in freshwater ecosystems,
5) assist with the facilitation of the National Strategy for the Conservation of Native Freshwater Mussels (Journal of Shellfish Research, 1999, Volume 17, Number 5), and a similar strategy under development for freshwater gastropods.

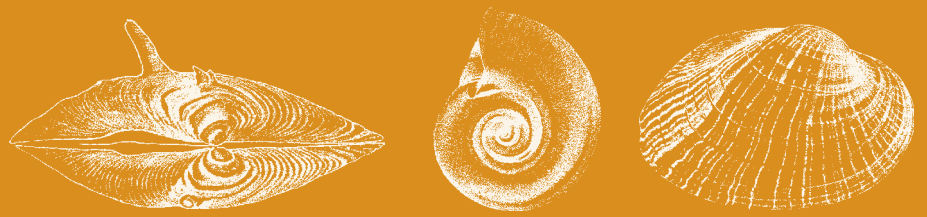
3rd Biennial Symposium

Freshwater Mollusk Conservation Society

March 16-19, 2003 • Sheraton Imperial Hotel • Durham, North Carolina, USA

"Connections... A Focus on Habitat Conservation"

A small army of professionals is constantly working to conserve the habitats of freshwater mollusks; however, the "scientific evidence" needed to support requirements associated with project related permits often isn't readily available. These folks need your help!



Meeting Program and Abstracts

Symposium Host Sponsors

NC Wildlife Resources Commission
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U.S. Fish and Wildlife Service

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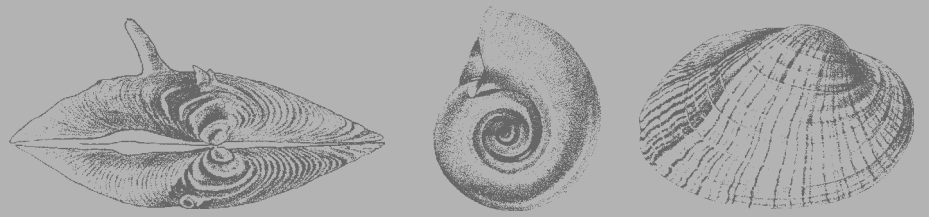
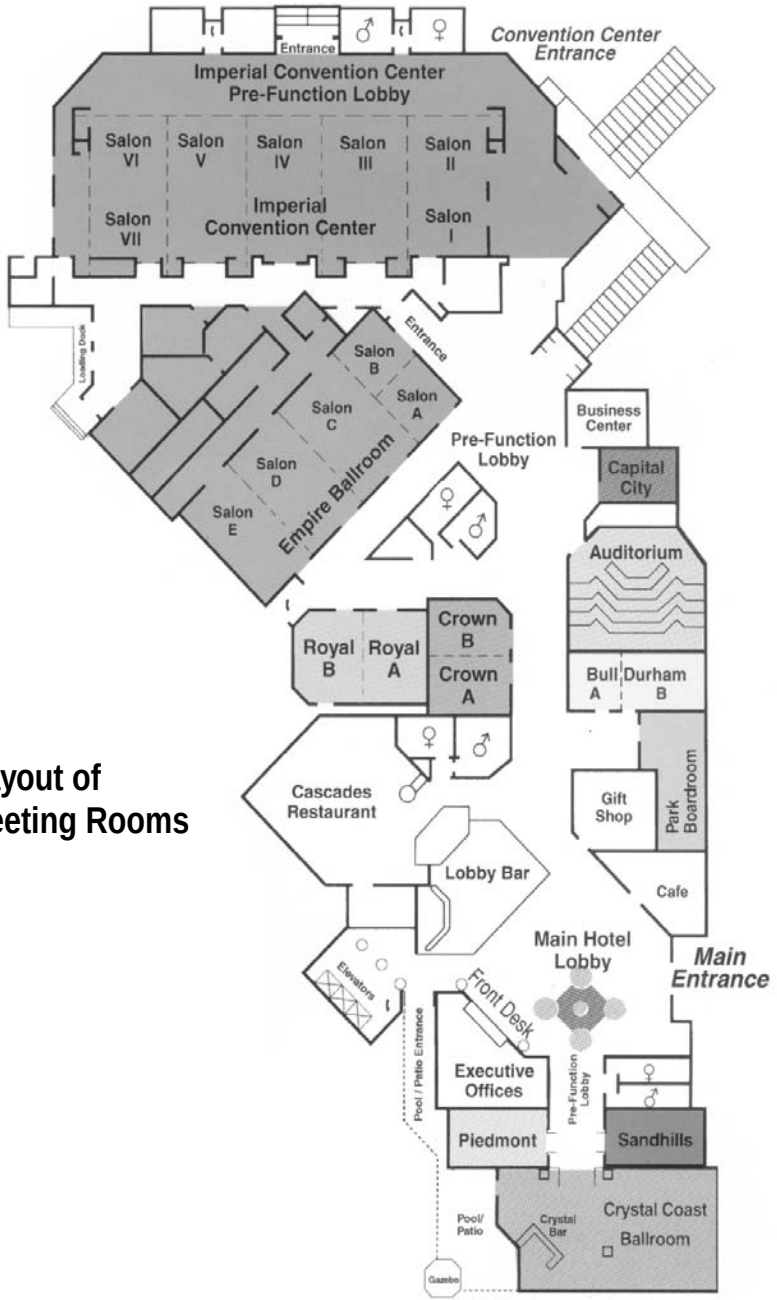


Meeting Program and Abstracts

Contents

Layout of Hotel Meeting Rooms



3RD Biennial Symposium of the Freshwater Mollusk Conservation Society

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"Connections... A Focus on Habitat Conservation"

Sunday, March 16, 2003

9:00 AM - 5:00 PM—FMCS Board Meeting. ..... Capital City

1:00 - 9:00 PM—Registration ..... Imperial Pre-Function Lobby

1:00 - 6:30 PM—Poster Setup. ..... Imperial Pre-Function Lobby

5:00 PM - 7:00 PM—Monday Platform Presenters to Turn in PowerPoint Files in Speaker Ready Room ..... Capital City

7:00 PM - 10:00 PM—Poster Session ..... Imperial Pre-Function Lobby

10:00 PM—Poster Judge's Meeting. ..... Capital City

7:00 - 10:00 PM—Speaker Ready Room Available ..... Capital City

Monday, March 17, 2003

7:00 AM - 5:00 PM—Registration ..... Imperial Pre-Function Lobby

7:00 AM - 5:00 PM—Speaker Ready Room Available ..... Capital City

8:00 AM - Noon—Welcome and Plenary Session ..... Imperial I, II, III

9:30 - 10:00 AM—Break. ..... Imperial Pre-Function Lobby

Noon - 1:00 PM—Lunch ..... Imperial IV, V, VI, VII

Noon - 1:00 PM—Committee Meetings ..... Imperial IV, V, VI, VII
- Gastropod Status & Distribution
- Mussel Status & Distribution
- Guidelines & Techniques / Commercial Information Exchange
- Water Quality, Habitat & Zebra Mussels

1:00 PM—Platform Session 1A: Status & Distribution I ..... Imperial I, II
Platform Session 1B: Evolution & Phylogenetics I ..... Imperial III

2:40 PM—Break ..... Imperial Pre-Function Lobby

3:20 PM—Platform Session 2A: Habitat & Conservation ..... Imperial I, II
Platform Session 2B: Contaminants I ..... Imperial III

5:30 - 7:30 PM—Tuesday Platform Presenters to Turn in PowerPoint Files in Speaker Ready Room ..... Capital City

5:30 PM—Busses depart for NC Museum of Natural Sciences ..... Convention Center Entrance

7:00 - 11:00 PM—BBQ Social & Tour of NC Museum of Natural Sciences ..... Downtown Raleigh

Tuesday, March 18, 2003

8:00 AM - 5:00 PM—Registration ..... Imperial Pre-Function Lobby

7:00 AM - 5:00 PM—Speaker Ready Room Available ..... Capital City

8:00 AM—Platform Session 3A: Life History & Ecology I ..... Imperial I, II
Platform Session 3B: Propagation & Reproduction I ..... Imperial III

9:40 AM—Break. ..... Imperial Pre-Function Lobby

10:20 AM—Platform Session 4A: Life History & Ecology II ..... Imperial I, II
Platform Session 4B: Relocation & Recovery ..... Imperial III

Noon - 1:00 PM—Lunch ..... Imperial IV, V, VI, VII

Noon - 1:00 PM—Committee Meetings ..... Imperial IV, V, VI, VII
Propagation, Restoration & Introduction
- Student Awards
- Symposium
- Outreach
- Other

1:00 PM—Platform Session 5A: GIS ... Imperial I, II
Platform Session 5B: Evolution & Phylogenetics II ..... Imperial III

3:00 PM—Break ..... Imperial Pre-Function Lobby

3:20 PM—Platform Session 6A: Status & Distribution II ..... Imperial I, II
Platform Session 6B: Contaminants II ..... Imperial III

5:00 PM—Platform Judge's Meeting .... Park Room

5:30 - 7:30 PM—Wednesday Platform Presenters to Turn in PowerPoint Files in Speaker Ready Room ..... Capital City

8:00 - Midnight—FMCS Business Meeting. ..... Imperial IV, V, VI, VII
- Awards Presentations
- Auction/Raffle & Mixer

Wednesday, March 19, 2003

8:00 AM - 10:00 AM—Registration ..... Imperial Pre-Function Lobby

7:00 AM - Noon—Speaker Ready Room ..... Available ..... Capital City

8:00 AM—Platform Session 7A: Status & Distribution III ..... Imperial I, II
Platform Session 7B: Monitoring ..... Imperial III

9:40 AM—Break. ..... Imperial Pre-Function Lobby

9:40 AM—Poster Take Down ..... Imperial Pre-Function Lobby

10:20 AM—Platform Session 8A: Propagation & Reproduction II ..... Imperial I, II
Platform Session 8B: Evolution & Phylogenetics III ..... Imperial III

Noon - 1:00 PM—Lunch ..... Imperial Pre-Function Lobby

Depart

Sunday, March 16, 2003
Poster Session

7:00 PM - 10:00 PM
Moderator: Chris Eads, NC State University
Location: Imperial Pre-Function Lobby

PO 1 **AQUATIC CONSERVATION PRIORITIES IN NORTH CAROLINA: DEFINING SIGNIFICANT AQUATIC NATURAL HERITAGE AREAS**
Sarah E. Kopplin

PO 2 **DOUBLE SAMPLING TO ESTIMATE DENSITY AND DISTRIBUTION OF RARE FRESHWATER MUSSEL POPULATIONS IN A LARGE FREE FLOWING RIVER**
R. Glenn Nelson

PO 3 **DEVELOPING A STANDARDIZED FRESHWATER MUSSEL SURVEY PROTOCOL FOR THE SOUTHEASTERN ATLANTIC SLOPE AND NORTHEASTERN GULF DRAINAGES IN FLORIDA AND GEORGIA**
Stacey L. Carlson

PO 4 **MUSSEL SAMPLING SITE GEOGRAPHIC INFORMATION SYSTEMS DATABASE**
Holly N. Blalock-Herod

PO 5 **SAMPLING STRATEGY TO MEASURE POPULATION TRENDS OF LOW ABUNDANCE MUSSEL SPECIES**
Daniel Hornbach

PO 6 **EFFECTS OF LAND USE AND LAND COVER ON FRESHWATER MUSSEL POPULATIONS IN THE UPPER NEUSE RIVER BASIN, NC: A GIS APPROACH**
Elizabeth F. Andersen

PO 7 **LONG TERM WATER TEMPERATURE MONITORING ON THE ST. CROIX NATIONAL SCENIC RIVERWAY**
Byron Karns

PO 8 **EVALUATION OF ABANDONED COMMERCIAL SAND AND GRAVEL DREDGE SITES ON THE LOWER TENNESSEE RIVER**
Don Hubbs

PO 9 **FRESHWATER MUSSEL RECOLONIZATION IN THE TWIN CITIES REACH OF THE UPPER MISSISSIPPI RIVER**
Bernard E. Sietman

PO 10 **CONSERVATION STATUS OF ELLIPTIO SPINOSA IN THE ALTAMAHA RIVER SYSTEM**
Christine O'Brien

PO 11 **STATUS ASSESSMENT FOR THREE IMPERILED MUSSEL SPECIES: SPECTACLECASE (CUMBERLANDIA MONODONTA), SHEEPNOSE (PLETHOBASUS CYPHYUS), AND RAYED BEAN (VILLOSA FABALIS)**
Robert S. Butler

PO 12 **FRESHWATER MUSSELS OF THE OCHLOCKONEE RIVER BASIN: YEAR 1**
Holly N. Blalock-Herod

PO 13 **STATUS OF PTYCHOBRANCHUS FASCIOLARIS, OBOVARIA SUBROTUNDA AND PLEUROBEMA SINTOXIA IN CANADA**
D.T. Zanatta

PO 14 **PURPLE LILLIPUT SURVEY, RESCUE AND RECOVERY PROGRAM FOR SOUTHEASTERN MICHIGAN, STATUS REPORT, 2002**
Douglas J. Sweet

PO 15 **PHYLOGENY OF NORTH AMERICAN AMBLEMINES**
David C. Campbell

PO 16 **HISTORICAL DISTRIBUTION AND TAXONOMY OF FRESHWATER MOLLUSKS OF THE WESTERN UNITED STATES**
Jayne Brim Box

PO 17 **WHICH IS THE APPROPRIATE FRESHWATER MUSSEL TISSUE FOR DNA ANALYSIS?**
Reverie A. Molina

PO 18 **MOLECULAR SYSTEMATICS OF THE FRESHWATER MUSSEL GENUS VILLOSA (BIVALVIA: UNIONIDAE)**
Jennifer E. Buhay

PO 19 **REDISCOVERY, SYSTEMATIC POSITION, AND RE-DESCRIPTION OF "LEPTOXIS" MELANOIDES (CONRAD, 1834) FROM THE BLACK WARRIOR RIVER, ALABAMA**
Russell L. Minton

PO 20 **GLYCOGEN CONTENT OF FRESHWATER MUSSELS HELD AT WHITE SULPHUR SPRINGS NATIONAL FISH HATCHERY, WEST VIRGINIA**
Julie L. Boyles

PO 21 **THE USE OF SHELL THIN-SECTIONS TO DETERMINE AGE AND GROWTH OF VILLOSA CONSTRICTA IN A NORTH CAROLINA STREAM**
Chris B. Eads

PO 22 **TESTING WISCONSIN'S MUSSEL STREAMS FOR PESTICIDE PRESENCE AND CONCENTRATIONS**
Ursula C. Petersen

PO 23 **AN EVALUATION OF THE VIABILITY OF GLOCHIDIA AFTER REMOVAL FROM MUSSELS**
Ning Wang

PO 24 **THE EFFECT OF PARTICLE CONCENTRATION ON CLEARANCE RATE AND THE PRODUCTION OF PSEUDOFECES IN ELLIPTIO COMPLANATA**
Ariel Capili

PO25 **JUVENILE DENSITY HAS DECREASED IN SELECT ST. CROIX RIVER MUSSEL COMMUNITIES OVER THE LAST 10 YEARS**
Mark Hove

PO 26 **FRESHWATER MUSSEL RESPONSE TO VARIOUS FLOW CONDITIONS**
Ashley S. McBride

PO 27 **THE MUSSEL DATABASE PROJECT**
Daniel L. Graf

PO 28 **THE NATURESERVE EXPLORER DATA SET: APPLICATIONS TO FMCS**
James R. Cordeiro

Monday, March 17, 2003

8:00 AM - Noon
Welcome and Plenary Session
Moderators: John Alderman, NC Department of Transportation and Judy Ratcliffe, NC Wildlife Resources Commission
Location: Imperial I, II, III

8:00-8:15 AM
Welcome and Introduction
John Alderman, NC Department of Transportation

8:15-8:45 AM
PE 1 **HUMAN POPULATION GROWTH IN THE U.S. DURING THE LAST HALF OF THE 20TH CENTURY**
Susan B. Hardy

8:45-9:15 AM
PE 2 **CHANNEL FORMING FLOWS AND BEDFORM DIVERSITY**
William A. Harman

9:15-9:45 AM
PE 3 **LOW IMPACT DEVELOPMENT: INNOVATIVE STORMWATER MANAGEMENT STRATEGIES FOR RESOURCE PROTECTION**
Neil A. Weinstein

9:45-10:15 AM – Break

10:15-10:45 AM
PE 4 **UNIONID FOOD WEB DYNAMICS- WHERE DO WE GO FROM HERE?**
S. J. Nichols

10:45-11:15 AM
PE 5 **EVERYTHING ADDS UP: MITIGATION OPTIONS FOR SECONDARY AND CUMULATIVE IMPACTS ON AQUATIC RESOURCES**
Danielle R. Pender

11:15-11:45 AM
PE 6 **THE MAKING OF TRADITIONAL NEIGHBORHOODS AND TRADITIONAL COMMUNITIES AS PLANNING TOOLS FOR SENSITIVE AQUATIC HABITATS: A STUDY OF TOWN PLANNING, SMART GROWTH AND WATER QUALITY**
Milt Rhodes

11:45-Noon – Questions & Discussion

Noon - 1:00 PM-Lunch
Noon - 1:00 PM-Committee Meetings
Gastropod Status & Distribution
Mussel Status & Distribution
Guidelines & Techniques/Commercial
Information Exchange Water Quality, Habitat & Zebra Mussels

Notes

Session 1A, Status & Distribution I

Moderator: Brian Watson, VA Department of Game and Inland Fisheries • **Location:** Imperial I, II

1:00-1:20 PM
PL 1 **RANGE, DISTRIBUTION WITHIN RANGE, AND HABITAT CHARACTERISTICS OF THE CAROLINA HEELSPLITTER (LASMIGONA DECORATA) —** John M. Alderman

1:20-1:40 PM
PL 2 **DISTRIBUTION SURVEY OF THE JAMES SPINYMUSSEL (PLEUROBEMA COLLINA) IN THE DAN RIVER DRAINAGE, VIRGINIA AND NORTH CAROLINA —** Tim Savidge

1:40-2:00 PM
PL 3 **THE STATUS OF FRESHWATER MUSSELS IN THE COOSA AND LOWER TALLAPOOSA RIVER DRAINAGES IN ALABAMA AND THE ROLE OF CHANNEL MORPHOLOGY, HYDROLOGY, AND LAND-USE —** Michael M. Gangloff

2:00-2:20 PM
PL 4 **RESULTS OF RECENT MUSSEL COLLECTIONS IN BEAR CREEK, ALABAMA AND MISSISSIPPI, WITH COMMENTS ON CHANGES IN ITS FAUNAL LIST —** Stuart W. McGregor

2:20-2:40 PM
PL 5 **A PARTIAL SURVEY OF MOLLUSK DISTRIBUTIONS WITHIN THE UPPER COOSA RIVER BASIN IN GEORGIA AND NORTHEAST ALABAMA —** Sabrina F. Novak

2:40-3:20 PM – Break

Session 1B, Evolution & Phylogenetics I

Moderator: David C. Campbell, University of Alabama • **Location:** Imperial III

1:00-1:20 PM
PL 6 **THE PHYLOGENETIC SPECIES CONCEPT AND ITS APPLICATION IN THE CONSERVATION OF FRESHWATER MOLLUSKS —** Charles Lydeard

1:20-1:40 PM
PL 7 **SOMETHING'S FISHY WITH VILLOSA VANUXEMENSIS, V. LIENOSA, AND V. ORTMANNI (BIVALVIA: UNIONIDAE): FISH HOST USAGE AND PHYLOGEOGRAPHIC ANALYSIS OF MORPHOLOGICALLY SIMILAR SPECIES —** Jennifer E. Buhay

1:40-2:00 PM
PL 8 **MOLECULAR PHYLOGENY OF THE ENDANGERED SPINY MUSSELS OF THE SUBGENUS CANTHYRIA (UNIONIDAE) —** Jeanne M. Serb

2:00-2:20 PM
PL 9 **PHYLOGENETIC SYSTEMATICS AND CONSERVATION STATUS OF THE PLEUROCERA OF THE MOBILE BASIN —** Jeffrey D. Sides

2:20-2:40 PM
PL 10 **TRACKING THE EVOLUTIONARY LEGACY OF THE BIOLOGICALLY INVASIVE, COSMOPOLITAN SPECIES- PHYSA ACUTA —** A.R. Wethington

2:40-3:20 PM – Break

Session 2A, Habitat & Conservation

Moderator: Leroy Koch, U.S. Fish and Wildlife Service
Location: Imperial I, II

3:20-3:40 PM
PL 11 **IT'S THE HABITAT, STUPID! (Or, practicable methods to preserve and protect the integrity of surface waters in the face of the onslaught of humanity)**
Kurt I. Welke

3:40-4:00 PM
PL 12 **LIFE HISTORY AND HABITAT CHARACTERIZATION OF THE FEDERALLY ENDANGERED FRESHWATER MUSSEL ARKANSIA WHEELERI**
Josh H. Seagraves

4:00-4:20 PM
PL 13 **RIPARIAN HABITAT AND FRESHWATER MUSSELS**
Mark H. Hughes

4:20-4:40 PM
PL 14 **CONSERVATION OF FRESHWATER MUSSEL HABITAT IN OHIO**
Randall E. Sanders

4:40-5:00 PM
PL 15 **CONSERVATION AND PROTECTION OF FRESHWATER MOLLUSCS IN CANADA**
Janice L. Metcalfe-Smith

Session 2B, Contaminants I

Moderator: Damian Shea, NC State University
Location: Imperial III

3:20-3:40 PM
PL 16 **EFFECTS OF LOWHEAD DAMS ON BENTHIC INVERTEBRATE ASSEMBLAGES IN THE NEOSHO RIVER**
Jeremy Tiemann

3:40-4:00 PM
PL 17 **EFFECTS OF ROAD-CROSSINGS ON FRESHWATER MUSSELS IN NORTH CAROLINA PIEDMONT STREAMS**
Chris B. Eads

4:00-4:20 PM
PL 18 **ASSESSMENT OF CONTAMINANTS IN HIGHWAY RUNOFF ON THE HEALTH OF FRESHWATER MUSSELS IN NORTH CAROLINA STREAMS**
Damian Shea

4:20-4:40 PM
PL 19 **MONITORING PAH TRANSPORT AND ACCUMULATION IN AN URBAN WATERSHED WITH TRANSPLANTED UNIONID MUSSELS AND PASSIVE SAMPLING DEVICES**
Waverly A. Thorsen

4:40-5:00 PM
PL 20 **CHARACTERIZATION AND MANIPULATION OF SEX STEROIDS AND VITELLOGNENIN IN FRESHWATER MUSSELS**
Nicola J. Kernaghan

Session 3A, Life History & Ecology I

Moderator: Gregory F. Zimmerman, EnviroScience, Inc. • **Location:** Imperial I, II

8:00-8:20 AM
PL 21 EFFECTS OF FRESHWATER MUSSELS ON SUBSTRATE STABILITY IN AN ARTIFICIAL STREAM — Gregory F. Zimmerman

8:20-8:40 AM
PL 22 ASSOCIATIONS BETWEEN RIVERINE MUSSELS AND OTHER SEDIMENT-DWELLING INVERTEBRATES — Caryn C. Vaughn

8:40-9:00 AM
PL 23 A FIELD EXPERIMENT EXAMINING THE EFFECTS OF FRESHWATER MUSSELS (FAMILY: UNIONIDAE) ON SEDIMENT ECOSYSTEM FUNCTION — Daniel E. Spooner

9:00-9:20 AM
PL 24 POPULATION DYNAMICS AND REPRODUCTIVE BEHAVIORS OF LAMPSILIS STRECKERI (FRIERSON 1927), IN A GEOGRAPHICALLY ISOLATED STREAM IN ARKANSAS — Rebecca Winterringer

9:20-9:40 AM
PL 25 LEVELS OF RECRUITMENT NECESSARY TO PRO-DUCE VIABLE FRESHWATER MUSSEL POPULATIONS — Wendell R. Haag

9:40-10:00 AM – Break

Session 3B, Propagation & Reproduction I

Moderator: Catherine M. Gatenby, Academy of Natural Sciences • **Location:** Imperial III

8:00-8:20 AM
PL 26 ACQUIRED RESISTANCE OF A HOST FISH TO GLOCHIDIA LARVAE AFTER MULTIPLE INFECTIONS — Constance L. Rogers

8:20-8:40 AM
PL 27 THE DISCOVERY OF THE PARASITIC GLOCHIDIUM: DEBATES, LOST CHANCES, AND SOUR GRAPES —G. Thomas Watters

8:40-9:00 AM
PL 28 DETECTION OF HERMAPHRODITISM AND EVALUATION OF GAMETOGENESIS IN GONADS OF UTTERBACKIA IMBECILLIS AND VILLOSA IRIS — William F. Henley

9:00-9:20 AM
PL 29 SEASONAL NUTRITIONAL DEMANDS OF MUSSELS AND A PROPOSED DIET FORMULA-TION FOR THEIR CAPTIVE CARE — Catherine M. Gatenby

9:20-9:40 AM
PL 30 A FEEDING REGIME FOR MAINTAINING THE PHYSIOLOGICAL CONDITION OF MUSSELS IN CAPTIVITY — Catherine M. Gatenby

9:40-10:00 AM – Break

Session 4A, Life History & Ecology II

Moderator: Richard A. Tankersley, Florida Institute of Technology • **Location:** Imperial I, II

10:00-10:20 AM
PL 31 FISH HOSTS AND POPULATION DEMOGRAPHICS OF LAMPSILIS CARIOSA AND LEPTODEA OCHRACEA (UNIONIDAE) IN MAINE — Philip C. Wick

10:20-10:40 AM
PL 32 CLEARANCE RATE OF WILD ELLIPTIO DILATATA, LASMIGONA COSTATA, AND ACTINONAIAS LIGMENATINA — Elizabeth A. Neal

10:40-11:00 AM
PL 33 WHAT'S FOR LUNCH? SEASONAL SESTON COMPOSITION OF TWO REGIONALLY DISTINCT FRESHWATER MUSSEL STREAMS — Alan D. Christian

11:00-11:20 AM
PL 34 SUSPENSION FEEDING BIODYNAMICS OF FRESHWATER MUSSELS: 1. ENDOSCOPIC INVESTIGATIONS OF PARTICLE CAPTURE AND PROCESSING IN FIVE SPECIES OF FRESHWATER MUSSELS — Richard A. Tankersley

11:20-11:40 AM
PL 35 SUSPENSION FEEDING BIODYNAMICS OF FRESHWATER MUSSELS: 2. EFFECT OF PARTICLE CONCENTRATION AND SILT LOAD ON PARTICLE SELECTION AND RETENTION — Richard A. Tankersley

Noon - 1:00 PM-Lunch
Noon - 1:00 PM-Committee Meetings • Propagation, Restoration & Introduction • Student Awards • Symposium • Outreach • Other

Session 4B, Relocation & Recovery

Moderator: Heidi L. Dunn, Ecological Specialists, Inc. • **Location:** Imperial III

10:00-10:20 AM
PL 36 RELOCATION VERSUS TRANSLOCATION: WHAT'S IN A NAME — W. Gregory Cope

10:20-10:40 AM
PL 37 RELOCATION SUCCESS AND SUBSEQUENT GROWTH RATE OF FRESHWATER MUSSELS IN THE MUSKINGUM RIVER NEAR DRESEDN, OHIO — James B. Spence

10:40-11:00 AM
PL 38 PROPAGATION AND CULTURE OF ENDANGERED JUVENILE FRESHWATER MUSSELS IN THE BIG SOUTH FORK NATIONAL RIVER AND RECREATION AREA OF THE CUMBERLAND RIVER, TENNESSEE — Rachel Mair

11:00-11:20 AM
PL 39 PROGRESS IN THE REPRODUCTIVE BIOLOGY, PROPAGATION, AND STOCKING OF THE NEOSHO MUCKET, LAMPSILIS RAFINESQUEANA — Christopher Barnhart

11:20-11:40 AM
PL 40 AN UPDATE ON THE FRESHWATER MOLLUSK PROPAGATION AND RECOVERY PRO-GRAMS OF THE TENNESSEE AQUARIUM RESEARCH INSTITUTE — Paul D. Johnson

Noon - 1:00 PM-Lunch
Noon - 1:00 PM-Committee Meetings • Propagation, Restoration & Introduction • Student Awards • Symposium • Outreach • Other

Session 5A, GIS

Moderator: Braven Beaty, The Nature Conservancy, VA • **Location:** Imperial I, II

1:00-1:20 PM
PL 41 **DEMOGRAPHIC CHARACTERISTICS OF FISH HOSTS AND UNIONID COMMUNITIES AT MULTIPLE SPATIAL SCALES IN THE UPPER MISSISSIPPI RIVER —** Daelyn Woolnough

1:20-1:40 PM
PL 42 **GIS APPLICATIONS FOR CONSERVATION AND MANAGEMENT OF FRESHWATER MUSSELS —** Carol J. Myers

1:40-2:00 PM
PL 43 **UNIONID COMMUNITY PATTERNS RELATED TO RIPARIAN LAND COVER PROPERTIES QUANTIFIED OVER MULTIPLE SPATIAL SCALES —** Reuben R. Goforth

2:00-2:20 PM
PL 44 **DEVELOPMENT OF LANDSCAPE MODELS FOR PROTECTION AND RESTORATION OF FRESHWATER MUSSELS IN LARGE RIVERS —** Teresa J. Newton

2:20-2:40 PM
PL 45 **A CASE STUDY IN THE NATURE CONSERVANCY'S APPROACH TO CONSERVATION PRIORITIZATION: A BALANCE BETWEEN THE SOUTHEAST'S DECLINING AQUATIC FAUNA AND "LAST GREAT PLACES" —** Ryan Smith

2:40-3:00 PM
PL 46 **USE OF A COMPLETE HABITAT SURVEY AND A GEOGRAPHIC INFORMATION SYSTEM (GIS) TO IDENTIFY SUITABLE RELEASE SITES FOR CAPTIVELY PROPAGATED FRESHWATER MUSSELS IN THE CLINCH RIVER, VIRGINIA —** Lora L. Zimmerman

3:00-3:20 PM – Break

Session 5B, Evolution & Phylogenetics II

Moderator: Bonnie S. Bowen, Iowa State University • **Location:** Imperial III

1:00-1:20 PM
PL 47 **COMPARISON OF HOST COMPATIBILITY IN TWO POPULATIONS OF WESTERN FANSHELL, CYPROGENIA ABERTI —** Nathan Eckert

1:20-1:40 PM
PL 48 **HIERARCHICAL ANALYSIS OF mtDNA VARIATION IN TWO WIDESPREAD MUSSEL SPECIES —** Curt L. Elderkin

1:40-2:00 PM
PL 49 **PHYLOGEOGRAPHY OF LAMPSILIS HIGGINSII (HIGGINS' EYE PEARLY MUSSEL), AN ENDANGERED SPECIES IN THE UPPER MISSISSIPPI RIVER BASIN —** Bonnie S. Bowen

2:00-2:20 PM
PL 50 **PATTERNS OF GENETIC DIVERSITY AMONG POPULATIONS OF FRESHWATER MUSSELS IN THE BONNEVILLE BASIN, UTAH —** J. Brim Box

2:20-2:40 PM
PL 51 **AN OVERVIEW OF THE FRESHWATER MOLLUSK COLLECTIONS CURATED AT THE DELAWARE MUSEUM OF NATURAL HISTORY —** Kevin J. Roe

2:40-3:00 PM
PL 52 **A PRELIMINARY EXAMINATION OF SYSTEMATIC RELATIONSHIPS WITHIN THE LAND SNAIL GENUS PRATICOLELLA (GASTROPODA: POLYGYRIDAE) —** Kathryn E. Perez

3:00-3:20 PM – Break

Session 6A, Status & Distribution II

Moderator: Paul D. Johnson, Tennessee Aquarium Research Institute • **Location:** Imperial I, II

3:20-3:40 PM
PL 53 **FRESHWATER MOLLUSK INVENTORY OF THE DUCK RIVER BASIN TENNESSEE - A PRELIMINARY REPORT —** Paul D. Johnson

3:40-4:00 PM
PL 54 **SPATIO-TEMPORAL PATTERNS OF DIVERSITY AND EXTIRPATION OF FRESHWATER MUSSELS IN THE CUMBERLAND RIVER BASIN —** Melvin L. Warren, Jr.

4:00-4:20 PM
PL 55 **A SURVEY OF THE FRESHWATER MOLLUSKS OF FORT STEWART, GEORGIA —** Kathryn E. Sukkestad

4:20-4:40 PM
PL 56 **STATUS REVIEW OF FRESHWATER MUSSELS (UNIONIDAE) OF THE RIO GRANDE, INCLUDING RECENT DISCOVERIES IN 2002 —** Robert G. Howells

4:40-5:00 PM
PL 57 **THE CONSERVATION STATUS OF NORTH AMERICAN FRESHWATER GASTROPODS —** Kenneth M. Brown

Session 6B, Contaminants II

Moderator: Teresa J. Newton, U.S. Geological Survey • **Location:** Imperial III

3:20-3:40 PM
PL 58 **EFFECTS OF SEDIMENTARY AMMONIA ON JUVENILE UNIONIDS IN LABORATORY AND FIELD STUDIES —** Teresa J. Newton

3:40-4:00 PM
PL 59 **EVALUATION OF WATER QUALITY CRITERIA FOR PROTECTION OF FRESHWATER MUSSELS (UNIONIDAE) FROM AMMONIA EXPOSURE —** W. Gregory Cope

4:00-4:20 PM
PL 60 **EFFECTS OF DRILLING AGENTS ON THE GROWTH AND SURVIVAL OF JUVENILE MUSSELS —** Robert G. Hudson

4:20-4:40 PM
PL 61 **TOXICOLOGICAL ASSESSMENT OF CONASAUGA RIVER SEDIMENTS —** Elizabeth Guthrie Nichols

4:40-5:00 PM
PL 62 **IMPACTS ON EARLY LIFESTAGES OF FRESHWATER MUSSELS FROM SEDIMENTS AND CONTRIBUTED METALS ASSOCIATED WITH SURFACE MINING IN SOUTHWEST VIRGINIA —** Mary T. McCann

Session 7A, Status & Distribution III

Moderator: Steve Fraley, NC Wildlife Resources Commission
Location: Imperial I, II

8:00-8:20 AM
PL 63 **STATUS, RANGE, AND HABITAT USE OF UNIONIDS IN SEVERAL LOWER MICHIGAN RIVERS —** Peter J. Badra

8:20-8:40 AM
PL 64 **WHY IS THE UNIONID FAUNA DIFFERENT AROUND THE CORNER FROM THE ST. CROIX? UNIONID RECOVERY IN MISSISSIPPI RIVER MARGINAL HABITAT, POOL 2, MINNESOTA —** Marian E. Havlik

8:40-9:00 AM
PL 65 **SURVEY OF UNIONOIDS IN REGULATED RIVERS IN SOUTHWESTERN MISSOURI —** Christian A.Hutson

9:00-9:20 AM
PL 66 **CONSERVATION INITIATIVE: ATTEMPTS TO IDENTIFY CAUSAL FACTORS OF DECLINE IN A MISSOURI MUSSEL ASSEMBLAGE —** Sue A. Bruenderman

9:20-9:40 AM
PL 67 **CURRENT AND HISTORICAL DISTRIBUTIONS OF MUSSELS IN THE MUSKEGON RIVER WATERSHED, MICHIGAN —** Stephanie M. Carman

9:40-10:00 AM – Break

Session 7B, Monitoring

Moderator: Jay F. Levine, NC State University
Location: Imperial III

8:00-8:20 AM
PL 68 **REFERENCE RANGES FOR HEMOLYMPH CHEMISTRIES FROM ELLIPTIO COMPLANATA OF NORTH CAROLINA —** Jay F. Levine

8:20-8:40 AM
PL 69 **DEVELOPMENT OF EXPECTED, NORMAL BACTERIAL FLORA DATABASES (FROM SELECTED UNIONIDS) AND THEIR USE TO IDENTIFY DISEASE CAUSING AGENTS —** Clifford Starliper

8:40-9:00 AM
PL 70 **COOPERATIVE MITIGATION DESIGN: A CASE STUDY, MULLET RIVER, GREENBUSH, WI —** Heidi L. Dunn

9:00-9:20 AM
PL 71 **A COOPERATIVE EFFORT TO REDUCE CONSTRUCTION AND OPERATION EFFECTS OF A BARGE LOADING FACILITY ON UNIONIDS IN THE OHIO RIVER**
Charles S. Howard

9:20-9:40 AM
PL 72 **REVIEW OF CHANNELED APPLESNAIL (POMACEA CANALICULATA) INTRODUCTIONS IN THE UNITED STATES —** Robert G. Howells

9:40-10:00 AM – Break

Session 8A, Propagation & Reproduction II

Moderator: Richard J. Neves, Virginia Tech University
Location: Imperial I, II

10:00-10:20 AM
PL 73 **FRESHWATER MUSSEL PROPAGATION: THE HARVEST IS GREAT BUT THE WORKERS ARE FEW —** Richard J. Neves

10:20-10:40 AM
PL 74 **FACTORS AFFECTING SURVIVAL AND GROWTH OF JUVENILE FRESHWATER MUSSELS (BIVALVIA: UNIONIDAE) CULTURED IN RECIRCULATING AQUACULTURE SYSTEMS —** Jess W. Jones

10:40-11:00 AM
PL 75 **PROPAGATION OF FRESHWATER MUSSELS IN KENTUCKY: APPLIED MANAGEMENT TO AN IMPERILED RESOURCE —** Monte A. McGregor

11:00-11:20 AM
PL 76 **THE USE OF FLOW-THROUTH AND RECIRCULATING SYSTEMS TO HOLD, PROPAGATE, AND GROW FRESHWATER MUSSELS —** Michael J. Pinder

11:20-11:40 AM – Open

Noon - 1:00 PM-Lunch
Depart

Session 8B, Evolution & Phylogenetics III

Moderator: Robert T. Dillon, Jr., College of Charleston
Location: Imperial III

10:00-10:20 AM
PL 77 **HIGH LEVELS OF MITOCHONDRIAL DNA SEQUENCE DIVERGENCE IN ISOLATED POPULATIONS OF THE FRESHWATER SNAIL, GONIOBASIS —** Robert T. Dillon, Jr.

10:20-10:40 AM
PL 78 **PHYLOGEOGRAPHY OF THE DWARF WEDGE MUSSEL, ALASMIDONTA HETERODON (UNIONIDAE) —** Cheryl L. Morrison

10:40-11:00 AM
PL 79 **SEARCH FOR CRYPTIC SPECIES IN THE PARAPHYLETIC GENUS LASMIGONA RAFINESQUE, 1831 (MOLLUSCA, BIVALVIA, UNIONIDAE) —** Morgan E. Raley

11:00-11:20 AM
PL 80 **A NEW LOOK AT THE GENUS ELLIPTIO OF THE SOUTH ATLANTIC SLOPE REGION (BIVALVIA: UNIONIDAE) —** Arthur E. Bogan

11:20-11:40 AM
PL 81 **TAXONOMIC COMPOSITION AND GEOGRAPHIC DISTRIBUTION OF VIRGINIA'S FRESHWATER GASTROPOD FAUNA: A REVIEW USING HISTORICAL RECORDS —** Timothy W. Stewart

Noon - 1:00 PM-Lunch
Depart

POSTER SESSION

Sunday, March 16, 7:00 - 10:00 p.m.

Sheraton Imperial Hotel
Imperial Pre-Function Lobby

PO 1 AQUATIC CONSERVATION PRIORITIES IN NORTH CAROLINA: DEFINING SIGNIFICANT AQUATIC NATURAL HERITAGE AREAS.

Sarah E. Kopplin, North Carolina Natural Heritage Program, 1615 MSC, Raleigh, NC 27699-1615.

Aquatic ecosystems are the most threatened of North Carolina's natural systems. The quality of our aquatic ecosystems is so degraded that nearly 30% of North Carolina's native freshwater species of fishes, mussels and crayfishes are threatened with extinction. Among just the freshwater mussels alone, more than 50% of the species occurring within North Carolina have been listed by either the state or federal government as threatened or endangered with extinction. Consequently, those few river segments that have excellent or substantial aquatic ecosystem value are of particular importance. They are the best (and sometimes the only) places for us to conserve these precious elements of our natural heritage. They also provide us with opportunities to learn the ways in which aquatic ecosystems function best. These sites represent habitats where excess nutrients or pollutants have not become a problem to our native species and natural ecosystems. North Carolina's Natural Heritage Program is challenged with defining those critical river segments that have excellent or substantial habitat to ensure the protection of the state's rare freshwater aquatic species. The criteria used to evaluate the aquatic ecosystem value of the selected river segments are based on a compilation of information from several state agencies, including the NC Natural Heritage Program, NC Division of Water Quality and NC Wildlife Resources Commission. Results of the application of the criteria to rivers and streams in North Carolina are presented, as well as inventory and conservation priority areas highlighted.

PO 2 DOUBLE SAMPLING TO ESTIMATE DENSITY AND DISTRIBUTION OF RARE FRESHWATER MUSSEL POPULATIONS IN A LARGE FREE FLOWING RIVER.

R. Glenn Nelson, Rita F Villella, and David R Smith. U. S. Geological Survey, Biological Resource Division, Leetown Science Center, 11700 Leetown Road, Kearneysville, WV

Recent relocation projects and surveys have revealed several large reproducing populations of both Pleurobema clava and Epioblasma torulosa rangiana in the upper Allegheny River. It is believed the Allegheny River supports some of the largest remaining populations of both federally listed species. Though both species are known to occur throughout the river, information does not exist to determine population abundance and identify important sources of recruitment to ensure the viability of these species. In the summer of 2002 we initiated a five-year effort to estimate density, abundance, and distribution of native freshwater mussel populations in the free flowing Allegheny River. The survey will provide data vital for estimating the magnitude and scale of viable unionid populations with emphasis on P. clava and E. t. rangiana. This information will enable resource managers to make reliable assessments in regard to site-specific disturbances. Phase one of the project included a qualitative survey of 35 randomly chosen sites within a 51.44 km section from Warren to Tionesta, Pa. Next summer we will begin a quantitative survey of a subset of these sites to estimate area and proportion of this section of river supporting reproducing populations of P. clava and E. t. rangiana. This poster describes a multi-stage sample design to survey rare mussels species in a large free flowing river to estimate population density both within sites and within the watershed.

PO 3 DEVELOPING A STANDARDIZED FRESHWATER MUSSEL SURVEY PROTOCOL FOR THE SOUTHEASTERN ATLANTIC SLOPE AND NORTHEASTERN GULF DRAINAGES IN FLORIDA AND GEORGIA.

Stacey L. Carlson[1], Alice G. Palmer[1], Holly Blalock-Herod[2], Katherine McCafferty[3]. U.S. Fish and Wildlife Service, [1]Georgia Ecological Services; [2]Fisheries Resources Office, Panama City, Florida 32405; [3]Georgia Department of Transportation, Office of Environment and Location, Atlanta, Georgia 30336.

Within the Southeastern Atlantic Slope and Northeastern Gulf Drainages of Florida and Georgia, the U.S. Fish and Wildlife Service and Georgia Department of Transportation have identified a need for a standardized mussel survey protocol that can be used across all three physiographic provinces. This protocol would be flexible for site-specific nuances and serve as a tool to determine if Federally protected species may be affected by proposed stream impacts. The process includes the dual purpose of meeting qualitative and quantitative objectives and the site-specific nature of surveying for mussels. The main objective of this effort is to determine the best method in detecting qualitative data (presence/absence of listed species within the project area) and gathering quantitative data (abundance, diversity, recruitment, etc.) where listed species are found. A literature review has been conducted and field malacologists have been interviewed to gather information on the most commonly used survey methodologies. The poster presents three possible methods of determining

survey lengths and a preliminary outline for standard operating procedures regarding mussel surveys. To determine survey lengths, we will evaluate the following methods: 1) using a multiplier factor based on average stream widths; 2) incorporating site-specific factors; and 3) analyzing data from previous surveys and/or sampling efforts. Specific protocols will be field tested during the summer of 2003. Please submit comments regarding the suggested protocols to the authors.

PO 4 MUSSEL SAMPLING SITE GEOGRAPHIC INFORMATION SYSTEMS DATABASE.

Wendy Gierhart[1], Holly N. Blalock-Herod[1], Carson Stringfellow[2], and James D. Williams[3]. [1]U.S. Fish and Wildlife Service, Fisheries Resources Office, 1601 Balboa Ave., Panama City, Florida, 32405; [3]Columbus State University, College of Science, 4225 University Ave., Columbus, GA 31907-5645; [3]U.S. Geological Survey, 7920 NW 71st Street, Gainesville, FL 32653

During the past two centuries, over 800 unique sites have been sampled for mussels from North Eastern Gulf (NEG) Coastal drainages in Alabama, Georgia, and Florida. These data are available in published and unpublished manuscripts, field notes, and museum records but have not been compiled in one uniform catalogue. In order to initiate freshwater mussel conservation actions in NEG aquatic systems, a consolidated approach was needed to track mussel sampling site locations. A GIS database was established to serve as a host for data from any sites sampled for mussels in NEG rivers to: 1) provide one system to combine records from various reports and published literature; 2) track ongoing survey sites; 3) identify locations of past and present communities that support(ed) Federally listed or other species considered imperiled; 4) determine where data gaps exist; and 5) aid in the decision-making process concerning habitat restoration, long-term monitoring, and permitting/consultation issues. The database consists of linked tables that contain locality, collection, and species information. QA/QC procedures and database maintenance are preformed by personnel at U.S. Fish and Wildlife Service, Panama City, Florida. Anyone may submit his or her records to the Service address above.

PO 5 SAMPLING STRATEGY TO MEASURE POPULATION TRENDS OF LOW ABUNDANCE MUSSEL SPECIES.

Daniel Hornbach[1], Mark Hove[1], Jill Medland[2] & Randy Ferrin[2]. [1]Dept. Biology, Macalester College, St. Paul, MN 55105; [2]St. Croix National Scenic Riverway, St. Croix Falls, WI 54024.

Measuring population trends for endangered species is difficult when low population density requires large sampling effort to detect change with confidence. In 980 0.25 m2 quadrat samples collected over 10 years in a St. Croix River location with winged mapleleaf (Quadrula fragosa), we observed only 5 Q. fragosa. To detect a significant change in density with reasonable certainty it would require collecting over 15,000 quadrat samples. We suggest a two-step sampling approach to monitor species in low abundance. 1. Sample the entire mussel community, quantitatively, to measure changes in density. 2. Qualitatively sample a portion of the community, including the rare species, in the same area. With this information you can assess how the rare species fraction of the community changes over time. To enhance sample size we would focus our qualitative sampling on Q. fragosa-like mussels (round and pustulose mussels). Using standard probability theory the relationship between statistical significance, power and sample size can be determined for changes in proportions. To examine this sampling strategy we studied another rare pustulose mussel species, Cyclonaias tuberculata, near a Q. fragosa population. During June-July 2002 we collected 5000 pustulose mussels in 160 diver hours and found that 3.6% of the pustulose mussels collected were C. tuberculata. A future sample of 5000 pustulose mussels will allow us to detect a 20% change in the proportion C. tuberculata constitutes in the population with 75% power and confidence of 90%. We plan to revisit this site and resample both quantitatively and qualitatively in 2-3 years to assess the suitability of this sampling procedure.

PO 6 EFFECTS OF LAND USE AND LAND COVER ON FRESHWATER MUSSEL POPULATIONS IN THE UPPER NEUSE RIVER BASIN, NC: A GIS APPROACH.

Elizabeth F. Andersen[1], Chris Eads[2], Hugh A. Devine,[1] and Jay F. Levine[2],. [1]Center for Earth Observation, North Carolina State University, Raleigh, NC 27695. [2]College of Veterinary Medicine, North Carolina State University, Raleigh, NC 27606.

Land use practices can adversely affect water quality and freshwater mussel populations. Water quality can become degraded by urbanization and agricultural practices by increasing nutrients, siltation, heavy metals and other toxins in runoff. The relationship between land use/land cover and freshwater mussel populations was investigated in the upper Neuse River basin in North Carolina. Mussel surveys (n=44) were conducted from April to August 2001 along 300-m transects upstream and downstream of bridges to examine the effect of bridges on mussel assemblages. Geographic Information Systems (GIS) were used to quantify land use/land cover within multiple spatial areas: upstream catchment, upstream riparian buffers (100 m and 250 m widths), and local riparian buffers (100 m and 250 m widths) immediate to the sample sites. Other environmental variables included stream slope, road density, water chemistry measures, and habitat quality assessment

scores. Detrended Correspondence Analysis (DCA) and Nonmetric Multidimensional Scaling (NMS) ordinations described some of the variation in the mussel community structure (67% and 46% of total variation respectfully). Both ordinations resulted in similar community structures and environmental gradients. Moderate associations (r>.5) were observed between DCA and NMS axis 1 and several environmental factors including drainage area, localized urban regions, and habitat scores. Strophitus undulatus (Creeper) and Pyganodon cataracta (Eastern Floater) were the most strongly associated with axis 1 environmental gradients. Further investigation is needed to determine the environmental factors that contribute to mussel community structure. Future mussel studies could benefit from GIS-based techniques to quanitify macrohabitat variables at landscape and regional scales.

PO 7 LONG TERM WATER TEMPERATURE MONITORING ON THE ST. CROIX NATIONAL SCENIC RIVERWAY.

Byron Karns[1] and Randy Ferrin[1], St. Croix National Scenic Riverway, National Park Service, P.O. Box 708, 401 Hamilton St., St. Croix Falls, WI 54024.

A key abiotic characteristic of the St. Croix River is water temperature. Temperature contributes to the amount of dissolved oxygen and other gases found in the water. It envelops plants and animals living in the river, driving the metabolic activity of any endothermic organisms. Different taxa tend to dominate at different temperatures. Water has a high heat capacity, does not change quickly, and most aquatic life has not evolved to withstand swiftly changing temperatures. The river's overall temperature is a reflection of length, volume and latitude, rather than depth or fetch as in a lake. Shallow, free-flowing rivers do not experience strong temperature gradients, but local conditions can produce a microcosm. Knowing temperature within a reach, along with other environmental elements may help identify important freshwater mussel habitat. These important aspects of water temperature highlight the interest river managers should take in monitoring temperature in aquatic systems. Human caused temperature changes should be considered habitat degradation. The causes may be hard to pinpoint, but include stream-bank vegetation removal, livestock use, timber/mining activity, industrial or agricultural water release, and watershed hydrology changes (increased impervious surfaces, dams, etc.). To aid river management in future decision-making and provide important data for aquatic research, a series of HOBO temperature monitoring devices have been placed in the St. Croix and Namekagon Rivers, from the headwaters to Stillwater, MN. For over three years these HOBOs have recorded temperature every 15 minutes from May through October. The data is analyzed annually (and graphically highlighted) to note changes and trends. This long-term activity will be used to help pinpoint possible changes in Riverway habitat.

PO 8 EVALUATION OF ABANDONED COMMERCIAL SAND AND GRAVEL DREDGE SITES ON THE LOWER TENNESSEE RIVER.

Don Hubbs, David McKinney, David Sims, and Susan Marden. Tennessee Wildlife Resources Agency, Nashville, Tennessee 37204.

The lower Tennessee River downstream of Pickwick Dam, from Tennessee River Mile (TRM) 195.0 to confluence with the Duck River at TRM 110 supports a diverse freshwater mussel community including federally listed endangered species. Commercial sand and gravel dredging is permitted on approximately 48 miles of this eighty five mile river segment. Resource extraction operations have been conducted on the Lower Tennessee River since at least the 1920's. The condition of abandoned dredge sites as aquatic habitat for benthic organisms, including freshwater mussels, is relatively unknown. Data and video from evaluation of mussel resources at nine abandoned dredge sites and four reference sites are presented. Selected dredge sites have not been dredged for periods ranging from twenty years to one year. Variables include river mile, dredge type, on river materials processing, resulting substraint, and depth related impacts.

PO 9 FRESHWATER MUSSEL RECOLONIZATION IN THE TWIN CITIES REACH OF THE UPPER MISSISSIPPI RIVER.

Dan Kelner,[1] Bernard E. Sietman,[2] and Mike Davis.[3] [1]U.S. Army Corps of Engineers, 190 5th Street East, St. Paul, MN 55101; [2]Minnesota Department of Natural Resources, 500 Lafayette Rd. St. Paul, MN 55155; [3]Minnesota Department of Natural Resources, 1801 S. Oak St., Lake City, MN 55041.

We sampled for freshwater mussels along 72 miles of the Upper Mississippi River through the Twin Cities during 2000 and 2001, and discovered a diverse community in the area reportedly decimated by pollution during the first half of the 1900's. Nearly 12,000 mussels of 28 species were collected, several of which are protected in Minnesota, and there was ample evidence of recent and ongoing recruitment. Zebra mussels were rarely encountered, unlike downstream pools where they are abundant and negatively affecting native mussel stocks. The recovery is likely due to improved water quality over the past 15-20 years, and ironically, the reach of the Upper Mississippi River between the Twin Cities and Hastings, MN, once nearly a dead zone, may now serve as a large river refuge for native mussels.

Recovery of the mussel community and the paucity of zebra mussels prompted us to begin reintroductions of rare and endangered mussels that were extirpated from this river reach.

PO 10 CONSERVATION STATUS OF ELLIPTIO SPINOSA IN THE ALTAMAHA RIVER SYSTEM.

Christine O'Brien' and Christopher E. Skelton[2], Browns River Environmental Consultants, 279 River Road, Underhill, VT 05489, [2]Department of Biological and Environmental Sciences, Georgia College & State University, Milledgeville, GA 31061

The Altamaha River is formed by the confluence of the Ocmulgee and Oconee rivers and drains nearly one-fourth of Georgia. A major tributary, the Ohoopee River, influences the lower half of the Altamaha. The Altamaha River system is known for its biodiversity and endemic species including six endemic unionid mussels. Over the past several decades surveyors have documented population declines in one endemic mussel species, the Altamaha spinymussel (Elliptio spinosa). This species was once widespread in the Altamaha River proper, and fairly common in the lower Ocmulgee and Ohoopee rivers. During fall of 2000 and 2001, surveys for E. spinosa were conducted to determine its current distribution and overall conservation status. A total of 32 historic sites and 40 new sites were surveyed in the Altamaha River system using grubbing, snorkeling, SCUBA diving, and raking methods. Live E. spinosa were found at only 5 of 32 sites representing an 84% reduction in its historic distribution. Only 6 of the 40 new sites surveyed had live individuals and shells were found at one additional site. A concurrent survey of the Ohoopee River indicates that E. spinosa is extirpated from that system. There is little information about the life history and habitat requirements of E. spinosa and the explanation for this drastic decline is difficult to determine. However, recent drought and direct habitat destruction may have had negative impacts on E. spinosa populations.

PO 11 STATUS ASSESSMENT FOR THREE IMPERILED MUSSEL SPECIES: SPECTACLECASE (CUMBERLANDIA MONODONTA), SHEEPNOSE (PLETHOBASUS CYPHYUS), AND RAYED BEAN (VILLOSA FABALIS).

Mollusk Subgroup, Ohio River Valley Ecosystem Team, Robert S. Butler, Subgroup Leader; U.S. Fish and Wildlife Service, Asheville Field Office, 160 Zillicoa Street, Asheville, NC 28801.

The Ohio River Valley Ecosystem Team, Mollusk Subgroup, conducted a cursory review of the status of numerous imperiled wide-ranging mussels centered in the Ohio River system. We surmised that status assessments for these species would be problematic for individual U.S. Fish and Wildlife Service field offices to conduct given their broad ranges. Detailed status assessments were undertaken for the spectaclecase (Cumberlandia monodonta), sheepnose (Plethobasus cyphyus), and the rayed bean (Villosa fabalis). The spectaclecase and sheepnose are large river species known from the upper portions of the Mississippi River system, while the rayed bean is a smaller stream species known from the Ohio River and middle Great Lakes drainages. Once known from 45 streams historically, the spectaclecase is extant in 20 streams. Seven of the 20 streams with extant spectaclecase populations are represented by single recent specimens, while viable populations occur in 8 streams. Currently, the sheepnose is known from 26 of the 77 streams of historical occurrence, and is thought to be viable in half of the streams with extant populations. The rayed bean was historically known from 106 streams, lakes, and canals, but the species is now found in only 22 streams and a single lake. Viable rayed bean populations occur in nine streams. Habitat alteration (e.g., impoundments, channelization, mining, pollutants, sedimentation) and the introduced zebra mussel (Dreissena polymorpha) are thought to have contributed to their collective imperilment. Based on these data, the Mollusk Subgroup recommends that the spectaclecase, sheepnose, and rayed bean be considered for elevation to candidate status under the Endangered Species Act.

PO 12 FRESHWATER MUSSELS OF THE OCHLOCKONEE RIVER BASIN: YEAR 1.

Holly N. Blalock-Herod, U.S. Fish and Wildlife Service, Fisheries Resources Office, 1601 Balboa Ave., Panama City, Florida, 32405.

A mussel survey was initiated in the Ochlockonee River basin of Florida and Georgia to assess the status of three endangered and one threatened species within the basin. Historical records (prior to 2000) were reviewed and 31 sites were identified as having supported one or more Federally protected mussel species. Tactile searches were used to detect the presence of adult mussels. Seventeen sites were revisited during 2002, all but one were located upstream of Lake Talquin. Unionid communities were present at all sites examined; however, listed species were found at only four (24%) sites. These four sites are confined to a 25-river mile reach of the main channel. Listed species detected were Elliptoideus sloatianus, Lampsilis subangulata, and Pleurobema pyriforme. Medionidus simpsonianus was not located.

PO 13 STATUS OF PTYCHOBRANCHUS FASCIOLARIS, OBOVARIA SUBROTUNDA AND PLEUROBEMA SINTOXIA IN CANADA.

D.T. Zanatta and J.L. Metcalfe-Smith, Environment Canada, National Water Research Institute, Burlington, Ontario, Canada L7R 4A6.

Six species of freshwater mussels are currently listed as nationally endangered or extirpated in Canada. Assessments of three more species; P. fasciolaris, O. subrotunda and P. sintoxia, are now complete. These species were historically known from the Grand, Thames, Sydenham and Detroit rivers, Lake Erie and Lake St. Clair. Ptychobranchus fasciolaris also occurred in the Niagara and Ausable rivers, P. sintoxia in the Niagara River, and O. subrotunda in the Welland River. Healthy populations of P. fasciolaris still occupy the Sydenham and Ausable rivers, and scattered specimens survive in nearshore areas off the St. Clair delta. The delta also supports the only significant population of O. subrotunda in Canada. This species has declined precipitously in the Sydenham River, with only a few live specimens found during recent surveys. Pleurobema sintoxia occurs and is reproducing in the St. Clair delta and Sydenham River, but the Grand River population appears to be declining and only a few relic specimens remain in the Thames River. Greenside and Johnny Darters, which are known hosts for P. fasciolaris in the U.S.A. are common in the Sydenham River. Obovaria subrotunda's host is unknown, but its pattern of decline closely matches that of the threatened Eastern Sand Darter. Several of the known hosts for P. sintoxia are common in southern Ontario, including the Bluegill, Spotfin Shiner, Bluntnose Minnow and Northern Redbelly Dace. Threats to these species include zebra mussel impacts, siltation, construction of impoundments, channel alteration, agricultural pollution, and municipal pollution. The Committee on the Status of Endangered Wildlife in Canada will assign status to P. fasciolaris and O. subrotunda in 2003 and P. sintoxia in 2004.

PO 14 PURPLE LILLIPUT SURVEY, RESCUE AND RECOVERY PROGRAM FOR SOUTHEASTERN MICHIGAN, STATUS REPORT, 2002.

Douglas J. Sweet, Belle Isle Aquarium, Detroit Zoological Institute, 8450 West Ten Mile Road, Royal Oak, MI 48068.

The purple lilliput mussel (Toxolasma lividus), a state endangered species, survives at one site in Michigan called Dawson's Mill Pond outlet between Sylvan Lake and Crystal Lake on the Clinton River. This watershed has been significantly affected by the recent (mid 1990s) invasion of the exotic zebra mussel. The remaining population of purple lilliputs was assessed in this study. The population size was estimated by a combination of quantitative and qualitative survey methods. The entire population of purple lilliputs at this site is estimated to contain 476 individuals. Although sample size of live purple lilliputs is small (N =18) preliminary demographic analysis suggests there is no reproduction. This very small, non-reproducing population, in a very localized area, is at high risk of extirpation. Continued studies of this population are warranted to determine its demographic viability. If further demographic analysis indicates an imminent collapse, then relocation of the remaining adult population and/or captive propagation and population augmentation may be needed to prevent extirpation.

PO 15 PHYLOGENY OF NORTH AMERICAN AMBLEMINES.

David C. Campbell[1], Jeanne M. Serb[1], Jennifer E. Buhay[2], Kevin J. Roe[3], Russell L. Minton[4], and Charles Lydeard[1]. [1]University of Alabama, Biodiversity and Systematics, Department of Biological Sciences, 425 Scientific Collections Building, Box 870345, Tuscaloosa, AL, 35487-0345; [2]Brigham Young University, Department of Integrative Biology, 401 Widtsoe Building, Provo UT 84602-5255; [3]Department of Biology, St. Louis University, 3507 Laclede Ave., St. Louis, MO 63103-2010; [4]Department of Zoology, Invertebrate Division, Field Museum of Natural History, 1400 S. Lake Shore Drive, Chicago, IL 60605.

Of the 51 unionoid genera recognized in North America, about 75% are assigned to Ambleminae. Although various taxa have been included in previous phylogenetic studies, these studies have highlighted the need for more extensive sampling due to widespread polyphyly of currently recognized taxa. The present study included over 134 species and subspecies, including all but 4 North American genera currently assigned to the Ambleminae. Three mitochondrial genes were sequenced, COI, 16S, and ND1, though not all genes amplified for all taxa. Phylogenetic analyses of these data support four major clades within Ambleminae, with the position of a few taxa poorly constrained. These clades correspond roughly to Quadrulini, Pleurobemini, Amblemini, and Lampsilini of previous workers, but many genera and some species appear polyphyletic.

PO 16 HISTORICAL DISTRIBUTION AND TAXONOMY OF FRESHWATER MOLLUSKS OF THE WESTERN UNITED STATES.

Jayne Brim Box and Jeff Kershner, National Aquatic Monitoring Center, Utah State University, Logan, Utah 84322

The western states contain at least six endemic mussel species, and many endemic snail species. Records of western freshwater mollusks date from the mid-1800s, but there is a dearth of current information on the distribution and abundance of western freshwater mollusks, in part because a comprehensive survey throughout their distributional ranges has not been done. There is also confusion regarding the taxonomic status of western species, and the exact number of valid species that occur in the region is not clear. Although several western states recognize that mollusk populations are declining, conservation and recovery efforts are hampered by the lack of basic information on western mollusk genetics, zoogeography, systematics and host fish. In addition, the conservation status for most western mollusks is unknown. The objectives of our work were to conduct a literature review to produce a database of all previously recognized western freshwater mollusk species and their historical distributions (and type localities where applicable), to produce a synonymy of western freshwater mollusks that includes all previously described western species, to compile a georeferenced distributional database for GIS coverage of all western mollusk mussels, and to recommend areas for further inventory and long-term monitoring. Data on western mollusks were complied from published literature, various museum collections and agency records. Data on historical occurrences, habitat, life history and other information were entered into a relational database. Distributional data were georeferenced, and special attention was given to nomenclature issues in order to determine whether some of the previously described western species deserve species-level status. Approximately 1,000 records of unionid mussels and 1,400 records of freshwater gastropods were compiled from over 180 publications. Maps of the historical distribution of gastropods and bivalves in western regions are presented, as well as recommendations for further inventories and research.

PO 17 WHICH IS THE APPROPRIATE FRESHWATER MUSSEL TISSUE FOR DNA ANALYSIS?

Reverie A. Molina[1], Morgan Raley[1,2], Arthur Bogan[2] and Jay F. Levine[1]. [1]College of Veterinary Medicine, North Carolina State University, 4700 Hillsborough Street, Raleigh, NC 27606; [2]North Carolina State Museum of Natural Sciences, 4301 Reedy Creek Road, Raleigh, NC 27607.

Different tissues of Elliptio complanata (Lightfoot, 1786) were utilized to determine the appropriate tissue for DNA analysis. Three tissue types (mantle, foot and adductor), as well as different methods of tissue handling (treatment), were tested. The treatments involved immediately extracting DNA from the tissues after removal from the animal (fresh treatment), freezing the tissues overnight (frozen treatment) and ethanol drying the tissues for three days (ethanol). Extraction of DNA was performed using the DNeasy extraction kit (QIAGEN Company). DNA size and concentration were determined based on the marker, Lambda DNA/HindIII. Regardless of treatment, the greatest number of supercoiled DNA bands was seen in foot tissue samples and absence of DNA bands was apparent in the adductor tissues. In terms of tissue treatment, freezing and immersion in ethanol seems to be better for mantle tissues as high molecular weight DNA bands appeared in these treatments. The appropriate tissue types to use for DNA analysis seems to be foot or mantle tissues. If a high molecular weight DNA is required, foot tissues seem to be a better choice than mantle because high molecular weight DNA appeared in all foot tissue samples, regardless of treatment.

PO 18 MOLECULAR SYSTEMATICS OF THE FRESHWATER MUSSEL GENUS VILLOSA (BIVALVIA: UNIONIDAE).

Jennifer E. Buhay[1] and Wendell R. Haag[2]. [1]Department of Integrative Biology, Brigham Young University, Provo UT 84602, USA. crayfish@email.byu.edu [2]USDA Forest Service, Center for Bottomland Hardwoods Research, Oxford MS 38655, USA. whaag@fs.fed.us

The freshwater mussel genus Villosa is currently comprised of 17 species, ranging across the eastern United States and Canada. Villosa is a member of the Lampsilini tribe, which is characterized by unique reproductive adaptations, such as mantle flaps and highly modified gills. Previous studies on the phylogenetic positioning of the genera within the Lampsilini revealed a lack of monophyly for Villosa. Our molecular phylogeny of 15 Villosa species, based on nucleotide sequences of the mitochondrial ND1 and 28S rRNA genes, confirms the polyphyly of this genus and reveals the existence of several major species groups. A group including V. constricta, V. trabalis and V. perpurpurea, is most closely related to the genus Epioblasma. The V. iris complex (V. iris, V. nebulosa, and V. taeniata) is sister to some members of the genus Lampsilis, including L. fasciola, L. ovata, and L. siliquoidea. A clade consisting of V. vanuxemensis, V. ortmanni, and V. lienosa is sister to the superconglutinate-producing species of Lampsilis (e.g., L. altilis and L. subangulata). In

general, our results support recognition of most species of Villosa. However, some currently recognized species, particulary V. vanuxemensis and V. iris, likely contain multiple evolutionary units.

PO 19 REDISCOVERY, SYSTEMATIC POSITION, AND RE-DESCRIPTION OF "LEPTOXIS" MELANOIDES (CONRAD, 1834) FROM THE BLACK WARRIOR RIVER, ALABAMA.

Russell L. Minton[1], Jeffrey T. Garner[2], and Charles Lydeard[3]. [1]Department of Zoology, Field Museum of Natural History, 1400 S. Lake Shore Drive, Chicago, Illinois 60605; [2]Alabama Fish and Game Division, P.O. Box 366, Decatur, Alabama 35602; [3]Department of Biological Sciences, University of Alabama, Box 870345, Tuscaloosa, Alabama 35487.

The rediscovery of Leptoxis melanoides, a pleurocerid snail from the Black Warrior River drainage of Alabama previously considered to be extinct, is presented. The radula of L. melanoides more closely resembles that of Elimia, and an analysis of 16S rDNA sequences positions the species within a monophyletic clade of Elimia. Therefore, we re-describe the species as E. melanoides, discuss issues with type designation, and illustrate the shell and radula.

PO 20 GLYCOGEN CONTENT OF FRESHWATER MUSSELS HELD AT WHITE SULPHUR SPRINGS NATIONAL FISH HATCHERY, WEST VIRGINIA.

Julie L. Boyles[1], Richard J. Neves[1], and Bruce C. Parker[2]. [1]Department of Fisheries and Wildlife, 100 Cheatham Hall, Virginia Tech, Blacksburg, VA 24061; [2]Biology Department, Virginia Tech, 2119 Derring Hall, Blacksburg, VA 24061

Due to the increased need to provide refugia to freshwater mussels impacted by anthropogenic activities, facilities and protocol need to be identified and developed for safely holding mussels in captivity. This study is being conducted to determine the feasibility of using the White Sulphur Springs National Fish Hatchery, White Sulphur Springs, WV as a refugium for adult freshwater mussels compromised by zebra mussels, and to sustain broodstock of threatened and endangered species for propagation. Three species of freshwater mussels, Actinonais ligamentina, Tritogonia verrucosa, and Cyclonaias tuberculata were held in a recirculating pond system at the hatchery. Mussels were held in gravel- filled confinement structures in the pond system. Pumps recirculated water through a branched PVC manifold simulating natural flow over the confinement structures. Commercial Nitrate and Phosphate fertilizer was added to the pond system to increase algal content. To assess food availability, water samples were collected periodically and analyzed for algal density and composition. Mantle tissue was collected from individuals of each mussel species approximately every two months. Glycogen content in the collected mantle tissue was compared over a period of one year to glycogen content in mantle tissue of mussels from wild populations. The continuation of this study will include comparisons of lipid content, protein content, and gametogenesis of mussels from the hatchery to those from the wild population.

PO 21 THE USE OF SHELL THIN-SECTIONS TO DETERMINE AGE AND GROWTH OF VILLOSA CONSTRICTA IN A NORTH CAROLINA STREAM.

Chris B. Eads[1], Heather E. Boyette[2], Arthur E. Bogan[3], Jay F. Levine[1], [1]North Carolina State University, College of Veterinary Medicine, 4700 Hillsborough St., Raleigh, NC 27606, [2]Embrex, Incorporated, Research Triangle Park, NC 27709, [3]North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Rd., Raleigh, NC 27607

Developing an understanding of basic life history information, including normal growth rates and life span, for individual species of freshwater mussels is crucial for their conservation. Counting growth lines in thin-sections of molluscan shells has been considered by many to be the most accurate way of aging these animals. We collected 71 shells (47 male, 24 female) of Villosa constricta from muskrat middens in a relatively unimpaired reach of the West Fork Eno River in Orange County, NC. We measured length, height and width, made notes on shell condition, and determined the sex of each shell. Then a low-speed, precision saw was used to cut two thin-sections through the umbo along the posterior ridge, and annual lines were used to determine age. Two readers separately aged each individual, and disagreements in shell age were settled through a collaborative effort between the readers. Shells ranged in length from 21 to 54 mm and ranged in age from 3 to 14 years. Length at age 3 was similar in males and females, but males grew faster over their lifetime compared to females. Since shells were clearly sexually dimorphic at age three, this suggests V. constricta are reproductively mature after three years in this stream. The oldest shells in this study were relatively large and heavily eroded suggesting 14 years is near the maximum age of this species at this location.

PO 22 TESTING WISCONSIN'S MUSSEL STREAMS FOR PESTICIDE PRESENCE AND CONCENTRATIONS.

Ursula C. Petersen, Wisconsin Department of Agriculture, Trade and Consumer Protection, PO Box 8911, Madison WI 53708.

The Wisconsin Department of Agriculture's Endangered Species Program seeks to protect listed species and their habitats from pesticide harm. We spot sampled surface and pore waters from the

best freshwater mussel streams in the state for two seasons. The samples were analyzed for various pesticide groups by our EPA-certified lab. It was determined that low concentrations of corn and soybean herbicides were present throughout the state's surface waters, similar to the findings of other researchers. Freshwater mussels are declining and many species are becoming listed. We are aware of the threats of water quality problems and invasives' competition. Our questions are: Do low concentrations of herbicides impact native freshwater mussels? If they do, what is the most vulnerable life stage or habitat in a given stream? What aquatic life criteria and guidelines are available to decide when mussel species are being jeopardized? What experiments need to be done to learn more about chronic impacts? What other questions need to be asked? The current knowledge about these issues is presented and discussed.

PO 23 AN EVALUATION OF THE VIABILITY OF GLOCHIDIA AFTER REMOVAL FROM MUSSELS.

Ning Wang[1], Eugene Greer[1], David Whites[1], Chris Ingersoll[1], Andy Roberts[2], Jim Dwyer[2], Tom Augspurger[3], Cindy Kane[4], and Cindy Tibbott[5]. [1]USGS, Columbia, MO 65201; [2]FWS, Columbia, MO 65201; [3]FWS, Raleigh, NC 27636; [4]FWS, Gloucester, VA 23061; [5]FWS, State College, PA 16801

A joint three-year research project between USGS, FWS, and EPA has been started to evaluate the methods for conducting toxicity tests with various life stages of freshwater mussels. One of the objectives of this research is to develop standardized guidance for conducting toxicity tests with glochidia. Multiple tests were conducted to assess the survival times of glochidia from different species, different individuals of the same species, or the same individual over the time. Glochidia were held in 24-well polystyrene tissue-culture plates, in crystallizing dishes, or in 300-ml beakers under flow-through conditions. There were no substantial differences in the survival times of glochidia held in various containers and treatments. Over 90% survival of glochidia was observed for 6 days with pink papershell (Potamilus ohiensis) and 4 to 5 days for fatmucket (Lampsilis siliguoidea). Repeated sampling of the same individual fatmucket over a period of several weeks resulted in >90% survival of glochidia for 2 to 3 days. In contrast, the survival of glochidia of other species was >90% for less than 1 or 2 days (e.g., mapleaf (Quadrula quadrula), rough pigtoe (Pleurobema plenum), pimpleback (Q. pustulosa), fragile papershell (Leptodea fragilis), and ellipse (Venustaconcha ellipsiformis)). These results suggest that the toxicity tests with glochidia of pink papershell and fatmucket can be conducted for 48 hours with a control survival of over 90% in tissue plates, in crystallizing dishes, or in beakers under flowing conditions. However, toxicity tests with other species may need to be conducted for shorter periods to maintain an acceptable control survival of >90%.

PO 24 THE EFFECT OF PARTICLE CONCENTRATION ON CLEARANCE RATE AND THE PRODUCTION OF PSEUDOFECES IN ELLIPTIO COMPLANATA.

Ariel Capili[1], Catherine M. Gatenby[2], Daniel A. Kreeger[2], Elizabeth A. Neal[2]. [1]University of Maryland, Baltimore, MD 21250, [2]Patrick Center for Environmental Research, Academy of Natural Sciences, Philadelphia, PA 19103, [3]Virginia Fish & Wildlife Cooperative Research Unit, Virginia Tech, Blacksburg, VA 24061.

The effect of particle concentration on clearance rate (CR) and the production of pseudofeces were examined in order to identify the concentration at which optimal feeding activity is presumed to occur in suspension-feeding freshwater mussels. Elliptio complanata were held in 2L buckets, with 7 mussels and 3 controls per treatment. The treatments were 2x103, 7x103, 2x104, 7x104, and 2x105 cells/mL. Ten mL samples were taken every 30 minutes for two hours, and the particle concentration measured using a Coulter Counter (Coulter Electronics). The particle count data were regressed and a time-integrated clearance rate was calculated for each individual mussel. The LNCR were compared within and between treatments. The time when pseudofeces were produced and the amount of pseudofeces was noted for each mussel. Clearance rate increased with particle concentration to 0.9L/h at 2x104 cells/mL, and then declined at the highest concentration to 0.5L/h. All mussels produced pseudofaeces, but more pseudofeces was produced by mussels exposed to higher concentrations. Following this 2h test, we again tested the effect of ration on clearance rate in mussels held 30d. We tested the concentration that first elicited pseudofeces, and double that concentration (2x104 cells/mL and 4x104 cells/mL). Thus far, clearance rate is not different between the two treatments. A greater amount of pseudofeces was produced by mussels in the higher ration. Feeding mussels over time at this higher ration, therefore, would waste culture space and labor, and potentially compromise water quality in captive environments.

PO25 JUVENILE DENSITY HAS DECREASED IN SELECT ST. CROIX RIVER MUSSEL COMMUNITIES OVER THE LAST 10 YEARS.

Mark Hove, Dan Allen, Katie Dietrich, Carlos Gonzalez, Kristin Swenson, and Daniel Hornbach, Dept. Biology, Macalester College, St. Paul, MN 55105

The diverse mussel community in the St. Croix River is an important national resource. We quantitatively assessed mussel communities during the summer of 2002 at: Interstate State Park, MN; Osceola, WI; Lakeland, MN; and Bayport, WI. These communities have been sampled at various

times during the last 10 years. During 2002 we observed 21 species at Interstate State Park, 19 at Lakeland, 13 at Osceola, and 9 at Bayport. During the last 10 years 5 mussel species have numerically dominated the mussel community at Lakeland, 2 species at Bayport and Osceola, and 1 species at Interstate State Park. Average mussel density during 2002 was highest at Interstate State Park (14.6 mussels/m2), followed by Lakeland (9.3 mussels/m2), Bayport (5.2 mussels/m2), and Osceola (2.6 mussels/m2). Since 1992 total mussel density has declined significantly at Interstate State Park. Also, declines in juvenile mussel density have occurred at many sites over the ten-year period. Shell-length frequency diagrams suggest there has been little recruitment or there is low juvenile survival among most dominant species at all four sites. The decline in juvenile density at these four sites is consistent with data from four other sites in the St. Croix River, which suggests that a lack of recruitment or low juvenile survivorship is a system-wide issue. The reasons for the apparent decline in recruitment are unknown but at Interstate State Park there has been sediment deposition over the past 10 years. Declines at Interstate State Park are of particular concern due to its valuable mussel assemblage including the federally endangered winged mapleleaf.

PO 26 FRESHWATER MUSSEL RESPONSE TO VARIOUS FLOW CONDITIONS.

Ashley S.McBride[1], Jerry L. Farris[2], Roger A. Kuhnle[3], and Daniel G. Wren[4]. [1]Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, AR 72467; [2]Environmental Sciences Program, Arkansas State University, P.O Box 847, State University, AR 72467; [3]USDA-ARS National Sedimentation Laboratory, P.O. Box 1157, Oxford, MS 38655; [4]National Center for Physical Acoustics, University of Mississippi, [1]Coliseum Drive, University, MS 38677.

The decline of freshwater mussel fauna has opened many questions pertaining to the optimum approach in the conservation of these organisms. It has been suggested that a greater understanding of the habitat requirements for freshwater mussels, as well as responses to habitat disturbance, can give more insight into their preservation. In this study, the main focus was on the ability of mussels to remain in the substrate when exposed to various ranges of flow. Shell size and morphology are also taken into account, and preliminary data is presented for two species: the pink papershell (Potamilus ohiensis), which has a large, thin, oval shell and a wing present near the umbo, and the pimpleback (Quadrula pustulosa), which has a small, thick, round shell that is covered in pustules. The mussels were placed in a laboratory flume filled with medium grain (0.55mm) sand and were exposed to flows between 0.2 and 0.7 m/s. When flow reached approximately 0.4 m/s, severe scour around the mussels' shells was observed. Once the flow reached 0.6 m/s, the pink papershell was completely dislodged from the sand and proceeded to tumble down the length of the flume. The pimpleback, although not completely dislodged, did experience movement due to the scour and increased water velocity. These preliminary results suggest that shell shape and size can have an effect on how different mussel species respond to disturbances such as flood events. Future studies will include these same methods using other species of mussels and various types of substrates such as sand-gravel and sand-gravel-cobble mixes.

PO 27 THE MUSSEL DATABASE PROJECT.

Daniel L. Graf[1] and Kevin S. Cummings[2]. [1]Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia PA 19103 and [2]Illinois Natural History Survey, 607 E. Peabody Dr., Champaign, IL 61820.

There are over 5200 nominal species and roughly 4700 available species-group names for the Unionoida worldwide. There are fewer than 900 valid species known from the same group. We regard the disparity in these two values to be a major impediment to thorough taxonomic treatments of unionoid clades: few workers have the energy to bring order to that kind of entropy. We apparently think that we do. Toward that end, we have developed a nomen/citation-based data model to manage nearly 250 years of species and generic descriptions, their associated type specimens and species (respectively), subsequent taxonomic opinions, current combinations, and distributional data. The data model has been developed to-date in FileMaker ProTM, which presents several advantages: (1) it operates seamlessly across the major computer operating systems (PC's and Macs), (2) it provides a user-friendly environment for development, experimentation, and operation, (3) The model is very flexible and easily adaptable for use with other taxa such as freshwater gastropods, and (4) it has exciting options for diverse deliverables. With regard to the latter, we have made subsets of our data available on the Internet (http://clade.acnatsci.org/mussel/) as well as through executables such as the Simpson-Haas Index. The Simpson-Haas Index is an on-line database where a user can type in the name of a taxon and the database will return those names thought to be valid by Simpson (1900. Synopsis of the naiades, or pearly fresh-water mussels. Proceedings of the United States National Museum 22(1205):501-1044) and Haas (1969. Superfamilia Unionacea. Das Tierreich (Berlin) 88:663 pp.) in their respective catalogues of worldwide unionoids.

PO 28 THE NATURESERVE EXPLORER DATA SET: APPLICATIONS TO FMCS.

Cordeiro, James R. and Lawrence M. Master, NatureServe, 11 Avenue de Lafayette, 5th Floor, Boston, MA 02111

NatureServe (http://www.natureserve.org/), a non-profit conservation organization, and its network of natural heritage programs work to provide the scientific information and tools needed to help guide effective conservation action. NatureServe Explorer (http://www.natureserve.org/explorer) is an acclaimed website providing authoritative conservation information in a searchable, database for more than 50,000 plants, animals (including 1200 freshwater mollusks), and ecological communities in the United States and Canada. NatureServe Explorer (NSE) represents a "snapshot" of dynamic data that is continually being refined through the input of hundreds of Natural Heritage scientists, support staff, collaborators, and contractors. NSE is updated from central databases three times each year to reflect new data from field surveys, the latest taxonomic treatments, and any updated conservation status assessments. Future enhancements to NSE include the addition of more detailed information on habitat requirements and ecology, guidelines for assessing relative viability of populations, interactive maps, images (freely downloadable for noncommercial use), and the ability to more readily download information. NatureServe hopes to partner with the Freshwater Mollusk Conservation Society (FMCS) in these and other endeavors of mutual interest that facilitate and promote the conservation of freshwater mollusks. For example, NatureServe could provide fundraising, databasing, and mapping assistance with ongoing mussel and snail Atlas projects and serve as a long-term repository for collected information in the Atlas projects (including taxonomy, status, distribution, habitat, and imaging). FMCS could provide specimen verification through museum visitation and collection of field locality data, periodic reviews of the information maintained in NatureServe's databases and web site, as well as images for use in promoting the conservation of freshwater mollusks.

Notes

PE 1 HUMAN POPULATION GROWTH IN THE U.S. DURING THE LAST HALF OF THE 20TH CENTURY.

Susan B. Hardy, U.S. Census Bureau, Charlotte Regional Office, 901 Center Park Drive—Suite 106, Charlotte, NC 28217.

During the 20th century, especially in the latter half of the century, the population growth in the South and the West dominated the nation's growth as the U.S. population shifted from the Northeast and the Midwest to the South and the West. By 2000, 58% of the population resided in either the South or the West. This trend is expected to continue well into the 21st century. While several states in the South and the West stood out as leaders in population growth trends, states in the Northeast consistently ranked among the most densely populated. "Metropolitanization" characterized the demographic change of the U.S. during the 20th century, especially after World War II, with the growth of the suburban population. By 2000, the majority of the population in 37 of the 50 states lived in a metropolitan area. However, although 4 out of every 5 people in the U.S. lived in a metropolitan area, the central city population in 2000 represented a smaller share of the U.S. population than it did in 1950.

PE 2 CHANNEL FORMING FLOWS AND BEDFORM DIVERSITY.

William A. Harman, P.G. Buck Engineering, 8000 Regency Parkway, Suite 200, Cary, NC 27511

The purpose of this presentation is to provide an overview of channel forming flows, including the dominant, effective, and bankfull discharges and their role in forming natural streambeds. These bed forms are the building blocks for unique and important aquatic habitats, such as riffles, runs, pools and glides. Human impacts on natural channel bedforms will also be discussed. Channel-forming flows maintain dimension, pattern, and profile and transport the bulk of bedload and suspended sediment over time. However, their definitions vary by degree of quantification. Dominant discharge is a qualitative term that simply means "channel forming flow" and is therefore rarely used in scientific investigations. Effective discharge is the most quantitative measure and is the product of a sediment transport rating curve and the flow duration curve. The difficulty is that the calculation requires field data of bedload and total suspended sediment along with discharge over a wide range of flows. The most common method for determining the channel forming flow is field identification of the bankfull stage. Numerous definitions exist of bankfull stage and methods for its identification in the field; however, it is generally accepted that bankfull stage corresponds with the discharge that fills a channel to the elevation of the active floodplain. Bankfull represents the break between erosion and depositional processes. Field indicators include the back of point bars, significant breaks in slope, changes in vegetation, the highest scour line, or the top of the bank. The bedload, which moves during bankfull events form the streambed and the corresponding aquatic habitats. Disturbances in sediment size, load, channel slope, or power can lead to dramatic shifts in channel stability and thereby bedform diversity and habitat.

PE 3 LOW IMPACT DEVELOPMENT: INNOVATIVE STORMWATER MANAGEMENT STRATEGIES FOR RESOURCE PROTECTION.

Neil A. Weinstein, The Low Impact Development Center, Inc., 5010 Sunnyside Avenue, Suite 200.Beltsville, Maryland 20705 (301) 982-5559

Low Impact Development (LID) is an innovative stormwater management strategy that utilizes a combination of planning strategies to reduce development impacts and decentralized stormwater management controls that are located at the source of pollution or runoff. These controls, called Integrated Management Practices (IMP's) are integrated into the infrastructure, landscape, site and building to maintain or recreate the pre-development hydrologic functions of the site. Many of the LID practices utilize or replicate natural biological, physical, and chemical processes to process and filter pollutants (e.g. metals, oils, grease, nutrients, temperature, suspended solids) from urban and agricultural non-point sources. The use of small-scale decentralized controls allow for the opportunity to develop "customized" watershed protection plans that can be used to meet specialized resource protection goals. This paper will discuss the state-of-the art research on the use of LID for resource protection and explore the potential of this technology to protect species of concern.

PE 4 UNIONID FOOD WEB DYNAMICS- WHERE DO WE GO FROM HERE?

S. J. Nichols, USGS-GLSC, 1451 Green Rd., Ann Arbor, MI, 48105

A review of the current research on unionid food web dynamics highlights the lack of knowledge about basic dietary requirements. The continued decline of many unionid communities throughout North America has been attributed to a host of factors ranging from pollution to exotic species. However, one main factor, food supplies, is rarely discussed. This raises a question: are populations declining or failing to reproduce because critical food types or quantities are no longer present? Until recent technological advances in tracking assimilation of specific molecules, determining the feeding habits of filter feeders has not been possible. Use of radio-labeled organic particles and stable isotope ratios can successfully delineate food web relationships. These studies show that unionids feed on a wide range of items including dissolved organic molecules and bacteria-mediated material. But these studies are limited, in that they do not address the importance, if any, of the functional guild structure of these microbial diet sources. Shifts in microbial guild assemblages have been well documented in aquatic watersheds. While some of these changes may reflect normal population cycling, others relate directly to alterations in use of the surrounding landscape or introduction of dreissenid mussels into the watershed. In-depth surveys of microbial communities in waters with healthy unionid populations are critically needed to understand their relationship, if any, to unionid survival. As homogenization of habitat and landscape continue, improving our understanding of unionid dietary resources and their relationship to the surrounding landscape may mean the difference between survival and extinction.

PE 5 EVERYTHING ADDS UP: MITIGATION OPTIONS FOR SECONDARY AND CUMULATIVE IMPACTS ON AQUATIC RESOURCES.

Danielle R. Pender, North Carolina Wildlife Resources Commission, 1142 I-85 Service Road, Creedmoor, NC 27522

Thousands of acres of land are developed each year in North Carolina, and this development consists of many seemingly small and often unrelated projects, that in aggregate may yield serious environmental impacts. Without proper safeguards, the cumulative effects of land development can transform the landscape and negatively impact the environmental character and natural functions of ecosystems. Some of the greatest impacts, both land-based and near-water development, alter water quality in our streams and rivers. Many native species of aquatic organisms, particularly freshwater mollusks, have become highly imperiled as a result. Representatives of multiple agencies within the North Carolina Department of Environment and Natural Resources were convened during 2001-2002 to identify, draft, and develop an approach and protocol for ensuring that cumulative and secondary impacts are adequately addressed during review of documents required under the North Carolina Environmental Policy Act. Identification of mitigation measures effective in reducing potential negative impacts associated with development projects was a major component of this endeavor, led by the North Carolina Wildlife Resources Commission. Mitigation measures include preservation of appropriately-sized forested stream buffers, impervious surface reduction, low impact design, and effective stormwater treatment. Recommendations are provided to government agencies and applicants to assist in the mitigation of direct, secondary, and cumulative impacts to aquatic and terrestrial wildlife and their habitats.

PE 6 THE MAKING OF TRADITIONAL NEIGHBORHOODS AND TRADITIONAL COMMUNITIES AS PLANNING TOOLS FOR SENSITIVE AQUATIC HABITATS: A STUDY OF TOWN PLANNING, SMART GROWTH AND WATER QUALITY.

Milt Rhodes, NC

Smart Growth Alliance. This study focuses on the traditional neighborhood and the principles associated with town making and where the goals of environmental stewardship and ecosystem integrity overlap. Specifically the study identifies, investigates and describes the features of traditional towns that are by their very design compatible with sensitive aquatic habitats in order to develop a methodology for implementation that can be applied to watersheds in North Carolina. A traditional neighborhood is defined as “a sector of development defined by walking distances, not by density, and contains a mix of uses, a mix of densities, a mix of incomes and a transportation pattern designed to support an alternative of modes of travel ranging from pedestrian to vehicular.” Traditional neighborhoods also maximize spatial distribution by having geographically restrained, definable centers of development and clearly established boundaries separating themselves from a rural or agrarian hinterland. The study looks at the patterns of development associated with traditional neighborhoods, their design history and historical antecedents utilizing a diverse set of resources. Using the communities of Mariemont, Ohio, Kentlands, Maryland, and other more recent places, the techniques that go into making them have also been cataloged. Precedents identified in the Bible and pre-Columbian codes were studied to help identify design and implementation practices common to traditional neighborhoods. A comparative taxonomy was developed to ally closely with established practices for sound aquatic ecosystem management. These practices include healthy riparian buffers, habitat areas, ability of a

stream system to respond to flooding conditions, ability of stream system to respond to pollutant and nutrient additions, and ability to transition in new features into a landscape. As the generation of storm water and associated impacts affect a stream system's ability to change, the treatment, nature and disposition of impervious surfaces is also being evaluated critically. A primary goal of the study is to develop a series of best practices that are common to the making of traditional communities and preserving areas with sensitive environmental habitats. This series of best practices can be used to develop guidelines, ordinances, and other codes communities and local governments might consider as growth comes to their areas. Upon identification of these commonalities, a watershed with known sensitive and/or endangered species will be chosen for testing. Testing will take place by developing a regional regulating plan utilizing the practices identified in the study on an analysis of existing developmental and environmental conditions. This land pattern analysis will lead to the identification of places where traditional neighborhoods and their agglomeration units (ie. the Hamlet, Village or Town) will be assembled to satisfy a projected demand for a 20-year duration. The regulating plan will rely on the existing comprehensive or zoning plan for the area as the comparative base. This study will identify economic costs and benefits associated with the traditional neighborhoods and compare opportunities and costs with the "status quo" as planned for the area. This research will show that development is not the enemy; rather it is the poorly placed, geographically expansive, poorly designed, and poorly managed development that is. Stopping development is an unlikely scenario; in fact, a stop would likely negatively affect many economic inputs to a community and could even facilitate more sprawl. It is hoped that this effort will provide a productive and constructive approach to the development of the future that will not only lead to successful communities, but also lead to environments with healthy aquatic habitats.

Notes

PLATFORM SESSION 1A

Status & Distribution I

Monday, March 17, 1:00 - 2:40 p.m.

Sheraton Imperial Hotel • Imperial I, II

PL 1 RANGE, DISTRIBUTION WITHIN RANGE, AND HABITAT CHARACTERISTICS OF THE CAROLINA HEELSPLITTER (LASMIGONA DECORATA).

John M. Alderman, NC Department of Transportation, 244 Red Gate Road, Pittsboro, NC 27312.

The Carolina heelsplitter was lost to science for more than 100 years until Dr. Eugene Keferl rediscovered 3 populations of the species in the Charlotte area of North and South Carolina in the late 1980s and early 1990s. Since then, 3 additional populations have been discovered, one in the Charlotte area and 2 in the Augusta/Aiken metropolitan area of South Carolina (probable type locality for the species). In an effort to help ensure survival of this federally listed endangered species, intensive surveys, habitat evaluations, and GIS data analysis have occurred during the past decade. Extant Carolina heelsplitter populations are restricted to Carolina slate belt streams. The best occupied habitats (based upon range, distribution within range, abundances, and signs of reproduction) appear to be entrenched F4 and G4 creeks with (1) significant bedrock outcropping having a strike perpendicular to stream flow and a nearly vertical dip, (2) landscapes dominated by relatively mature forestland, (3) specific STATSGO soils map unit associations, and (4) very stable banks maintained by tree roots and other vegetation.

PL 2 DISTRIBUTION SURVEY OF THE JAMES SPINYMUSSEL (PLEUROBEMA COLLINA) IN THE DAN RIVER DRAINAGE, VIRGINIA AND NORTH CAROLINA.

Tim Savidge[1], Melissa Petty[2], and Richard J. Neves[2]. [1]The Catena Group, 410-B Millstone Drive Hillsborough, NC 27278. [2]Freshwater Mollusk Conservation Center, Virginia Cooperative Fish & Wildlife Research Unit, Virginia Tech, Blacksburg, VA 24061.

Following discovery of the James spinymussel (Pleurobema collina) in the Dan River in Stokes County, North Carolina, the North Carolina Department of Transportation and Virginia Tech embarked on an intensive survey effort of Dan River subbasins in Stokes, Rockingham and Caswell counties, North Carolina; and Patrick, Henry, and Pittsylvania counties, Virginia. Representatives from various agencies, including the U.S. Fish and Wildlife Service, North Carolina Wildlife Resources Commission, North Carolina Natural Heritage Program, and North Carolina State University assisted at various times with river surveys. Over 500 person-hours were spent conducting surveys in the Dan River and its tributaries. In addition to the mainstem Dan River, the James spinymussel also was found in the Mayo River, a major tributary to the Dan River, North Carolina, and the South Fork Mayo River, Virginia. Distributional surveys will continue in Virginia in 2003 as one component of a thesis project at Virginia Tech. Although additional surveys are still needed, a workable range for this species in the Dan and Mayo rivers has been established. The species has been found in the following river reaches: 57 km of the Dan, 19 km of the Mayo, and 24 km of the South Fork Mayo rivers. Within these rivers, catch per unit effort (CPUE) varied from 0.08/hr to 11.67/hr, but was lowest at the upstream and downstream limits of the range. One stretch of river was surveyed three times before the species was detected. This survey effort not only established a minimum range of the James spinymussel, but it also emphasized the difficulty and effort needed to establish presence or absence of very rare species.

PL 3 THE STATUS OF FRESHWATER MUSSELS IN THE COOSA AND LOWER TALLAPOOSA RIVER DRAINAGES IN ALABAMA AND THE ROLE OF CHANNEL MORPHOLOGY, HYDROLOGY, AND LAND-USE.

Michael M. Gangloff and Jack W. Feminella, Department of Biological Sciences, Auburn University, Alabama 36849.

Freshwater mussel assemblages in the Upper Alabama River Drainage were historically among the most species-rich in North America. At least 52 species were known form this portion of the drainage. Over the last 4 years (1999-2002) we have conducted qualitative and quantitative surveys throughout this drainage and found live or fresh-dead material from 38 species including what appears to be a new species of Fusconaia. Medionidus acutissimus, M. parvulus, Epioblasma metastriata, E. othcaloogensis, E. penita, Pleurobema altum, P. hanleyanum, P. taitianum, and P. troschelianum appear to have been extirpated from the Coosa Drainage in Alabama. We measured site physical characteristics and channel morphology (bankfull width, depth, gradient) to construct models of channel flow and bed scour. Predicted shear stress at bankfull flows was significantly negatively correlated with mussel abundance throughout the Upper Alabama Drainage ($r = -0.434$, $p = 0.027$, $n = 28$) in 2001. When models were separated by drainages relationships were stronger for Coosa sites ($r = -0.592$, $p = 0.033$, $n = 13$) than for Tallapoosa sites (n/s). In the

Tallapoosa Drainage, mussel abundance appeared to be affected more by short-term hydrologic variability. Recent droughts and human-induced hydrologic disturbances appear to have a much greater role in Gulf Coastal Plain streams than in upland (Ridge and Valley, Piedmont) streams.

PL 4 RESULTS OF RECENT MUSSEL COLLECTIONS IN BEAR CREEK, ALABAMA AND MISSISSIPPI, WITH COMMENTS ON CHANGES IN ITS FAUNAL LIST.

Stuart W. McGregor[1] and Jeffry T. Garner[2], [1]Geological Survey of Alabama, P. O. Box 869999, Tuscaloosa, Alabama, 35486; [2]Alabama Division of Wildlife and Freshwater Fisheries, 350 Co. Rd. 275, Florence, Alabama, 35633

Drastic reductions in diversity and abundance of mussel populations are documented in many systems. Bear Creek, located in northwest Alabama and northeast Mississippi, has seen considerable changes to its fauna, possibly the result of impoundment, channelization, wastewater discharge, and sedimentation from such sources as strip mining, agriculture, and silviculture. The most obvious insults have been impoundment of the lowermost 17 miles of Bear Creek by Pickwick Reservoir of Tennessee River, construction of 4 dams within the system, construction of an 18-mile-long channel to limit flooding, and bank destabilization. Mussels are absent from much of the system and faunal composition has apparently been altered where mussels persist, based on comparison to limited previous studies. The most notable changes are the loss of Cumberlandian species and the apparent increase in Ohioan species. We sampled 40 stations in the Bear Creek system and report 32 unionid species live or fresh dead, including three Cumberlandian species, and two other species weathered dead. Fourteen of these species were not reported in two earlier studies. Ortmann (1925) reported 22 species (7 Cumberlandian) from two stations and Isom and Yokley (1968) reported 17 species (2 Cumberlandian) from three stations. During this study the most depauperate populations were upstream of Bear Creek km 41 and in tributaries. No mussels were collected immediately downstream of dams, and diversity gradually increased with downstream progression until 28 species occurred together in a free-flowing reach shortly before entering Pickwick Reservoir. One weathered dead zebra mussel, Dreisenna polymorpha, was also collected.

PL 5 A PARTIAL SURVEY OF MOLLUSK DISTRIBUTIONS WITHIN THE UPPER COOSA RIVER BASIN IN GEORGIA AND NORTHEAST ALABAMA.

Sabrina F. Novak[1], R. Ryan Evans[2], and Paul D. Johnson[1], [1]Tennessee Aquarium Research Institute, 5385 Red Clay Road, Cohutta, GA 30710; [2]Western Pennsylvania Conservancy, 209 Fourth Avenue, Pittsburgh, PA 15222.

With 76 mollusk species, including 13 endemics, the upper Coosa River Basin was historically one of the most species rich systems in the Southeast. In Georgia, 6 major sub-basins that compose the drainage were surveyed to determine species richness and distributions within each sub-basin. Work completed between 1998 and 2002 surveyed 419 sites above and including the Weiss Reservoir bypass in Northeast Alabama. Information on historic species richness and distributions was collected from major museums across the country and assembled into an electronic database. Mussel abundance within sub-basins, determined by Catch-Per-Unit-Effort (CPUE) estimates was highest in the Oostanaula (19.95), Conasauga (11.45), Coosawattee (3.59), and Chattooga (1.70) rivers respectively. Mussel abundance in the sub-basin tributaries, determined by CPUE estimates was highest in the Conasauga (7.44), Big Cedar Creek (4.04), Chattooga (3.07), Oostanaula (1.23), Etowah (0.92), and Coosawattee (0.63), rivers respectively. Gastropod species richness in each basin was highest in the Conasauga River (20 spp.), followed by the Etowah (18 spp.) and Oostanaula Rivers (17 spp.). Mussel species richness was highest in the Conasauga River (27 spp.), followed by the Coosa River bypass (21 spp.), and the Oostanaula (18 spp.) River. Mussels have been nearly extirpated from the Etowah River (6 spp.) and Big Cedar Creek (2 spp.) sub-basins. Results of this survey are supporting conservation and restoration efforts in the upper Coosa River Basin.

PLATFORM SESSION 1B

Evolution & Phylogenetics I

Monday, March 17, 1:00 - 2:40 p.m.

Sheraton Imperial Hotel • Imperial III

PL 6 THE PHYLOGENETIC SPECIES CONCEPT AND ITS APPLICATION IN THE CONSERVATION OF FRESHWATER MOLLUSKS.

Charles Lydeard. University of Alabama, Biodiversity & Systematics, Department of Biological Sciences, Box 870345, Tuscaloosa, AL 35487.

Species richness is often used as an indicator to locate biological hotspots for prioritizing conservation efforts. Species are the invertebrate focus for the United States Endangered Species Act. In short, species are the fundamental units in biodiversity studies. Despite the central role species play in conservation biology, biologists, especially systematists, still debate about species and how best to define and/or delineate one. The Phylogenetic Species Concept (PSC) is actually comprised of at

least two different concepts of species. The first one is the diagnosable version and the second one is based on monophyly. Here, I present data from freshwater mollusks illustrating the value of the Phylogenetic Species Concept (monophyly version) for delineating species boundaries and why this is important for conserving imperiled freshwater mollusks.

PL 7 SOMETHING'S FISHY WITH VILLOSA VANUXEMENSIS, V. LIENOSA, AND V. ORTMANNI (BIVALVIA: UNIONIDAE): FISH HOST USAGE AND PHYLOGEOGRAPHIC ANALYSIS OF MORPHOLOGICALLY SIMILAR SPECIES.

Jennifer E. Buhay[1], Wendell R. Haag[2], Charles Lydeard[3], Melvin L. Warren, Jr.[2]. [1]Department of Integrative Biology, Brigham Young University, Provo UT 84602, USA. crayfish@email.byu.edu [2]USDA Forest Service, Center for Bottomland Hardwoods Research, Oxford MS 38655, USA. whaag@fs.fed.us, mwarren01@fs.fed.us [3]Department of Biological Sciences, University of Alabama, Tuscaloosa AL 35487, USA. clydeard@bama.ua.edu

Villosa vanuxemensis and V. lienosa are two morphologically similar mussel species found primarily in the southeastern United States. As traditionally conceived, Villosa vanuxemensis was comprised of two subspecies: V. v. vanuxemensis (Lea 1838; mountain creekshell), endemic to the Tennessee and Cumberland drainages, and V. v. umbrans (Lea 1857; Coosa creekshell), restricted to the upper Coosa drainage. Villosa lienosa (Conrad 1834; little spectaclecase) ranges throughout the Mississippi and Mobile basins, and the eastern Gulf Coastal Plain and was thought to overlap with V. v. umbrans only in the Coosa drainage. Villosa ortmanni was considered endemic to the Green River drainage in Kentucky. Preliminary genetic data (ND1, 600 bp and 28S, 800 bp) suggest that V. v. umbrans is a distinct species and is sister to the lienosa/vanuxemensis/ortmanni clade. Within this clade, V. vanuxemensis from the Cumberland River drainage appears more closely related to V. ortmanni from the Green River than to V. vanuxemensis from the Tennessee River, which is sister to V. lienosa. Patterns of host usage are not concordant with phylogeny and suggest that host use has changed multiple times within these lineages. Villosa lienosa uses sunfish (Lepomis spp.) exclusively, but V. vanuxemensis from the Tennessee and Cumberland drainages use mostly sculpins (Cottus spp.). Although there appears to be little genetic differentiation among V. v. umbrans in the Coosa drainage, these populations show an unusual degree of heterogeneity in host use: some populations use sunfish, others use mostly sculpins, and still others use both groups of fishes. This group of mostly headwater species has a complex biogeographic and evolutionary history that is not reflected in perceived patterns of variation in shell morphology or host-fish use.

PL 8 MOLECULAR PHYLOGENY OF THE ENDANGERED SPINY MUSSELS OF THE SUBGENUS CANTHYRIA (UNIONIDAE).

Jeanne M. Serb[1], Arthur E. Bogan[2], and Charles Lydeard[1]. [1]University of Alabama, Biodiversity and Systematics, Department of Biological Sciences, Box 870345, Tuscaloosa, AL, 35487-0345; [2]North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Road, Raleigh, NC 27607

The Atlantic Slope mussel fauna includes the spiny mussel complex, whose members possess the unusual feature of elongate spines on their valves. Three species of spiny mussels are currently recognized, Pleurobema collina, Elliptio spinosa, and E. steinstansana, and have been placed within the subgenus Canthyria at various times. Two of the species (P. collina and E. steinstansana) are federally endangered and E. spinosa is a candidate for listing. DNA sequence from two mitochondrial gene regions, the first subunits of cytochrome oxidase c (CO1) and NADH dehydrogenase (ND1), were employed in phylogenetic analyses to address the following questions: 1) Is Canthyria a natural group, 2) Are spines convergent, and 3) What is the phylogenetic affinity of P. collina. Our molecular data does not support Canthyria as a natural group and follows the morphologically based conclusions of Boss and Clench (1967).

PL 9 PHYLOGENETIC SYSTEMATICS AND CONSERVATION STATUS OF THE PLEUROCERA OF THE MOBILE BASIN.

Jeffrey D. Sides, University of Alabama, Department of Biological Sciences, 313 Mary Harmon Bryant Hall, Tuscaloosa, AL 35487.

Over the last century, North America has seen the loss of 76 species of freshwater mollusks, all of which were endemic to the southeastern U.S. The Mobile River basin is distinguished by having the greatest freshwater snail diversity in North America, second only to river systems of Southeast Asia. Of the 76 species of freshwater mollusks lost in the U.S., 43 of these were endemic to the Coosa River basin portion of the Mobile basin. Mollusks face many threats in the southeastern U.S. today including stream siltation, impoundment, and pollution of streams by agriculture, industry, and mines. In order to effectively conserve and manage remaining imperiled molluscan biodiversity, one must first delineate phylogenetic species boundaries. Species of the gastropod genus Pleurocera have traditionally been based on a morpho-species concept, whereby each shell morph was described as a distinct species. Taxonomists later interpreted shell variation as largely intraspecific variation and reduced the number of species to the five currently recognized Pleurocera species in the Mobile drainage basin. I constructed a molecular phylogeny of Mobile basin Pleurocera based on a portion

of the mitochondrial cytochrome oxidase c subunit I gene to delimit phylogenetic species boundaries. Specimens for this analysis were found at 49 of 139 locales surveyed throughout the Mobile basin from September 1999 to September 2002. Specimens were sorted by shell morpho-type and DNA was extracted, amplified, and sequenced using an ABI 3100 Genetic Analyzer. The molecular phylogeny of Mobile basin Pleurocera revealed clades associated with drainage basin and not necessarily traditional morphological groupings. These findings will undoubtedly alter the conservation status of each species.

PL 10 TRACKING THE EVOLUTIONARY LEGACY OF THE BIOLOGICALLY INVASIVE, COSMOPOLITAN SPECIES- PHYSA ACUTA.

Wethington[1], A.R., R. T. Dillon[2], Jr., J. M. Rhett[2], and C. Lydeard[1]. [1]University of Alabama, Biodiversity & Systematics, Department of Biological Sciences, Box 870345, Tuscaloosa, AL 35497; [2]Department of Biology, College of Charleston, Charleston, SC, 29424.

Conventional wisdom maintains that Physa acuta has spread from its native homeland of Europe to South Africa, Hong Kong, New Zealand, and throughout much of the Old World and parts of the New World. Here we report the results of a detailed study examining allozyme and mitochondrial DNA sequence data to test the evolutionary validity of the species and test alternative hypotheses about the geographical origins of the species. Comparative allozyme frequency data and mitochondrial DNA sequence data from representative populations of putative P. acuta and nominal P. hetrostropha and P. integra from Indiana, Philadelphia, Charleston, Ireland and France revealed levels of genetic variation comparable to intraspecific values found within Physa populations from the Atlantic Piedmont of the southeastern United States. Furthermore, phylogenetic analysis revealed no support for the evolutionary distinction of P. acuta, P. integra and P. heterostropha. Collectively, these data support the recognition of the three nominal species as one valid entity, P. acuta. The genetic data is congruent with previously conducted mating studies, which revealed no reproductive isolation among the three nominal forms of Physa. We hypothesize that P. acuta is a native of North America and later colonized Europe and other regions of the world.

PLATFORM SESSION 2A

Habitat & Conservation

Monday, March 17, 3:20 - 5:00 p.m.

Sheraton Imperial Hotel • Imperial I, II

PL 11 IT'S THE HABITAT, STUPID! (Or, practicable methods to preserve and protect the integrity of surface waters in the face of the onslaught of humanity).

Kurt I. Welke, Wisconsin Department of Natural Resources, 3911 Fish Hatchery Road, Fitchburg, WI, 53711.

The pace of commercial and residential development is rampant over much of the United States. This development impacts surface waters by disrupting the hydrologic balance, thus affecting the fish and mussel communities that evolved initially under significantly different (e.g.: balanced) base conditions. Increased volumes and delivery rates of low quality runoff from impervious surfaces routinely overwhelm the capacity of traditionally engineered storm water systems. Conventional strategies to manage stormwater now accelerate habitat degradation and loss. New tools are emerging to decrease runoff volumes and delivery rates, reduce sediment delivery, mitigate thermal impacts, and eliminate nutrient and pollutant loading. Resource managers need to become aware of the options they may now employ in the design, permitting, construction, and maintenance of many development activities which affect their local resources.

PL 12 LIFE HISTORY AND HABITAT CHARACTERIZATION OF THE FEDERALLY ENDANGERED FRESHWATER MUSSEL ARKANSIA WHEELERI.

Josh H. Seagraves[1], J.L. Farris[2], and J.L. Harris[3]. [1] Arkansas State University, Dept. of Biological Sciences, [2]Arkansas State University, Environmental Sciences Program, [3]Arkansas Highway and Transportation Department.

The Ouachita rock-pocketbook (Arkansia wheeleri), listed as endangered, (USFWS 1991), is one of the most imperiled mussels in the United States. Prior to this study the only known viable population occurred within a 128 km stretch of the Kiamichi River in Pushmataha county, OK (Vaughn and Pyron 1995). The study objectives were to: 1) determine the fish host, 2) determine gravidity and glochidial release periods and 3) characterize the habitat where the Ouachita rock-pocketbook is found. During the current study a new population was discovered below Millwood Dam on the Little River, Arkansas. Repeated observations of the population were made to determine gravidity and glochidial release periods. On 10 October 2002, two females were observed gravid. Host fish determination was performed at the Mammoth Spring National Fish Hatchery, Mammoth Springs, Arkansas. Fish were chosen for propagation based on species accounts from the Kiamichi River and the Little River. Fish were collected using electrofishing and trawling techniques from a site near the known mussel bed. A habitat characterization of the bed was accomplished using varia-

tions of the US EPA's Rapid Bioassessment Protocol and the Basin Area Stream Survey. The Little River is a larger stream with a drainage area of 4,200 mi2 and did not fit the parameters of typical habitat assessment protocols (USDA 1999). A new habitat assessment was developed, based on the known habitat requirements of freshwater mussels, that could be used for higher order streams. Results from the study will be used by the USFWS to aide in the recovery of the species.

PL 13 RIPARIAN HABITAT AND FRESHWATER MUSSELS.

Mark H. Hughes[1], Craig W. Hedman[1], and Masato Miwa[1]. [1]Southlands Forest, International Paper, 719 Southlands Road, Bainbridge, GA 39819.

Anecdotal and scientific evidence suggest that freshwater mussels depend on riparian functions to sustain viable populations in adjacent conveyances. Some researchers have attempted to correlate riparian width with viable populations of mussels based on conventional knowledge. However, scientific evidence, supporting that theory, is scattered, and careful synthesis of pertinent data is crucial to understanding relationships between freshwater mussels and the contiguous terrestrial environment. Meanwhile, several watershed studies discuss land management history, legacy effects, and characterization of sediment inputs based on upland management, including clearcut timber harvesting, agriculture, and urban landuses. These studies suggest that upstream management has a significant effect on downstream conditions and that upstream, forested, riparian areas provide greater benefits to downstream habitats than adjacent riparian areas. The objectives of this talk is to review empirical and scientific evidence to date and identify gaps in our knowledge that need to be answered including; 1) How does forested, riparian width correlate with suitable aquatic habitat for freshwater mussels? 2) What features of forested, riparian corridors are known to provide necessary functions to support viable populations of mussels? 3) Are upstream terrestrial conditions more important to mussel survival than adjacent riparian conditions? and 4) How does disturbance history translate into legacy sedimentation and mussel decline? Answers to these questions, based on sound scientific information, would provide credible guidance to land managers. Even though there are information gaps in our knowledge about instream, sediment transport and the relationship between accumulated sediment and downstream habitat conditions, the importance of headwater management on bedload sediment transport and stream substrata (habitat) is emphasized.

PL 14 CONSERVATION OF FRESHWATER MUSSEL HABITAT IN OHIO.

Randall E. Sanders, Ohio Department of Natural Resources, Division of Wildlife, Fish Management and Research, Stream Conservation and Environmental Assessment Unit, 1840 Belcher Drive G-3, Columbus OH 43224.

Although water quality in many Ohio streams has significantly improved during the last 15 years, physical habitats in many historically good mussel streams remain impacted by poor riparian management, channel modifications, and excessive sedimentation. The Division of Wildlife is increasing its efforts towards the restoration and long-term protection of stream habitats within high quality streams. Project activities include dam removal, livestock exclusion, riparian and stream acquisition, floodplain restoration through levee setback and breaching, and the restoration of natural channels. Educational efforts include riparian corridor initiatives that promote the use of natural stream bank vegetation like the American sycamore (Platanus occidentalis) and the free distribution of A Guide to Ohio Streams. The physical and riparian attributes of "least impacted or reference" streams with high quality mussel assemblages are also being promoted. From a regulatory aspect, it is obvious that some water quality parameters may be over regulated while equally important factors such as naturally forested stream banks and connectivity to floodplains are not regulated at all. Sedimentation and habitat alterations have become leading causes on non attainment of Clean Water Act Goals in Ohio streams, yet water resource efforts remain focused on water quality. Freshwater mussel assemblages will not significantly improve until water resource managers, policy makers, and field staff change their focus from water quality to stream quality which incorporates both the chemical and physical integrity of flowing waters. The development of biological criteria to monitor and assess stream quality and CWA goals also needs to incorporate mussel data a long with fish and aquatic insect assemblages.

PL 15 CONSERVATION AND PROTECTION OF FRESHWATER MOLLUSCS IN CANADA.

Janice L. Metcalfe-Smith, Environment Canada, National Water Research Institute, P.O. Box 5050, 867 Lakeshore Road, Burlington, ON, Canada L7R 4A6.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 to develop a national list of wildlife species at risk. Mammals, birds, reptiles, amphibians, fish and terrestrial plants were considered for listing. COSEWIC's mandate was expanded in 1994 to include two groups of invertebrates, the Lepidoptera and Mollusca. Eleven mollusc species have been listed since 1996, including six freshwater mussels and two snails. Many freshwater species are under assessment or on the candidate list, including 21 of Canada's 53 freshwater mussel species. COSEWIC will have legal status for the first time under the proposed Species at Risk Act

(SARA), which was passed by the House of Commons in June 2002 and should be proclaimed in 2003. SARA will cover listings, prohibitions, recovery and habitat protection. RENEW, the Recovery of Nationally Endangered Wildlife committee, was established in 1988 to oversee recovery efforts for species listed as threatened, endangered or extirpated by COSEWIC. Under SARA, the development of recovery plans for endangered and threatened species, and management plans for species of special concern, will be mandatory. Recovery planning is underway for 64 wildlife species, including the Banff Springs Snail (Physella johnsoni) and Hotwater Physa (Physella wrighti). Multi-species and ecosystem-based approaches were introduced in 1997, and in 2002 RENEW approved the first aquatic ecosystem recovery strategy in Canada - for the Sydenham River, Ontario. Five species of mussels, including the Northern Riffleshell (Epioblasma torulosa rangiana) and Rayed Bean (Villosa fabalis) are included in this plan. Less than 10 years ago, freshwater molluscs were not even "on the radar screen" in Canada. Although considerable progress has been made, much work remains.

PLATFORM SESSION 2B

Contaminants I

Monday, March 17, 3:20 - 5:00 p.m.

Sheraton Imperial Hotel • Imperial III

PL 16 EFFECTS OF LOWHEAD DAMS ON BENTHIC INVERTEBRATE ASSEMBLAGES IN THE NEOSHO RIVER.

Jeremy Tiemann[1]*, David Gillette[1], Mark Wildhaber[2], and David Edds[1]. [1]Department of Biological Sciences, Emporia State University, Emporia, KS 66801, [2]Columbia Environmental Research Center, U.S. Geological Survey, Columbia, MO 65201, *Present address: Center for Biodiversity, Illinois Natural History Survey, Champaign, IL 61820.

Lowhead dams can cause severe disruptions to riverine ecosystems and negative impacts to the stream's overall biology. Direct effects of dams include converting lotic habitats to lentic habitats, increasing siltation upstream from and erosion downstream from the dam, and causing shifts in water chemistry. From November 2000 to October 2001, we investigated the effects of lowhead dams on benthic invertebrates in the Neosho River in Lyon County. We sampled macroinvertebrates, freshwater mussels, habitat, and water chemistry at eight gravel bar sites centered around two lowhead dams. We found a significant difference in macroinvertebrate abundance and evenness, but not species richness among sites, and a significant difference in freshwater mussel species richness and evenness, but not abundance among sites. We also found significantly lower %EPT immediately upstream and downstream from the dams compared to reference sites. Our findings suggest that these lowhead dams cause changes in habitat, including depth, velocity, and substrate composition, but not water chemistry variables, both upstream and downstream from the barriers, and that these changes cause alterations in benthic invertebrate assemblages.

PL 17 EFFECTS OF ROAD-CROSSINGS ON FRESHWATER MUSSELS IN NORTH CAROLINA PIEDMONT STREAMS.

Chris B. Eads[1], Periann P. Russell[1], Tim Savidge[2], Kenneth H. Pollock[3], Arthur E. Bogan[4], Jay F. Levine[1], [1]North Carolina State University, College of Veterinary Medicine, 4700 Hillsborough St., Raleigh, NC 27606, [2]The Catena Group, 410-B Millstone Drive, Hillsborough, NC 27278, [3]North Carolina State University, 614G Cox Hall, Raleigh, NC 27695, [4]North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Rd., Raleigh, NC 27607

The potential immediate effects of bridge and culvert construction on small stream ecosystems have been documented, but long-term implications of the presence of road crossings over streams is relatively unknown. Our objectives were to assess the potential impact of existing road crossings on relative abundance, diversity and spatial distribution of freshwater mussels and to identify key contributing factors. Small streams (3-27 meters wide) in two study areas in the North Carolina piedmont were chosen due to their rural nature and relatively unimpaired habitat and water quality. In these study areas, we surveyed the 300-meter reaches upstream and downstream of 80 road crossings. The reaches were divided into 25-meter cross-sections and were visually searched in three 1-meter-wide linear transects - one next to each bank and one in the center of the stream. Elliptio complanata comprised over 97% of all mussels encountered, and no differences in species diversity were found with respect to road-crossings. Collectively, no differences in relative abundance

were found between the upstream and downstream 300-meter reaches ($p = 0.623$). However, on average, there were fewer E. complanata directly under the crossing and in the first 50-meter reach downstream and 25-meter reach upstream of the structures. The specific reasons for these declines in abundance around crossing structures are unknown but may be due to channel constriction, loss of riparian shading, and lasting effects of construction.

PL 18 ASSESSMENT OF CONTAMINANTS IN HIGHWAY RUNOFF ON THE HEALTH OF FRESHWATER MUSSELS IN NORTH CAROLINA STREAMS.

Damian Shea[1], W. Gregory Cope[1], Peter R. Lazaro[1], Chris B. Eads[2], Jay F. Levine[2], Lori L. Gustafson[2] and Michael K. Stoskopf[2]. [1]North Carolina State University, Department of Environmental and Molecular Toxicology, Box 7633, Raleigh, NC 27695; [2]North Carolina State University, College of Veterinary Medicine, Box 8001, Raleigh, NC 27695.

In response to field observations regarding potential declines of freshwater mussel density and distribution around road crossings, we assessed the potential impact of road runoff at these structures. The primary objectives of this study were to identify contaminants in road runoff entering North Carolina streams at crossing structures, evaluate their accumulation by freshwater mussels, and assess the potential adverse impact of these contaminants on mussel health. We sampled mussels (Elliptio complanata) and sediment, and deployed passive sampling devices (PSDs—passive accumulators of organic contaminants) upstream and downstream of crossing structures from 26 sites in the upper Neuse River basin of North Carolina. The sites differed in landscape use and vehicular traffic patterns; 10 sites were in rural, forested areas, 10 were in agricultural areas, and 6 were within the Raleigh, North Carolina metropolitan area. The samples were analyzed for a suite of organic (polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine pesticides (OCs) and inorganic (metals) contaminants. We found that mussels, sediments, and PSDs had detectable levels of polycyclic aromatic hydrocarbons (PAHs) at all sites and were indicative of hydrocarbon (gasoline, diesel fuel, and oil) influx associated with vehicular traffic. The three matrices at all sites exhibited greater PAH concentrations downstream of bridge crossings relative to concentrations upstream. Concentrations of PAHs among all three matrices were strongly intercorrelated, indicating that sediments and PSDs may be good surrogates for evaluating PAH exposure in mussels. There were no apparent differences in PAH concentrations between forested and agricultural sites, but PAHs were significantly elevated at the urban sites in all matrices. Both PCBs and OC pesticides were found in low concentrations or were not detectable in samples from most of the sites. All contaminant concentrations measured in mussel tissues were below those known to cause acute toxicity.

PL 19 MONITORING PAH TRANSPORT AND ACCUMULATION IN AN URBAN WATERSHED WITH TRANSPLANTED UNIONID MUSSELS AND PASSIVE SAMPLING DEVICES.

Waverly A. Thorsen, W. Gregory Cope, Damian Shea, Peter R. Lazaro. College of Agriculture and Life Sciences, North Carolina State University, Raleigh, NC, 27606.

Polycyclic aromatic hydrocarbons (PAHs) are one of the most important classes of contaminants in urban aquatic environments. Assessing the ecological and human-health risks of PAH contamination requires an adequate measure of exposure. We conducted a 2-yr study to assess the fate and transport of PAHs in an urban and rural (reference control) stream in Gaston County, North Carolina. Unionid mussels (Elliptio spp.) were transplanted to three sites, with two replicates at each site and 25 mussels per replicate. Mussel samples were taken at 6-mo intervals after deployment and analyzed for survival, growth, and accumulation of a suite of 48 PAHs. Sediment samples were taken annually at each site and water samples and passive sampling devices, consisting of strips of polyethylene (PE), were analyzed monthly. Mussels survived (average 44 -94% over 2 yr) and grew significantly (as measured by increases in length and weight). Concentrations of total PAHs ranged from 437-3397 ng/g for mussels, 342-357 ng/g for sediment, 185-194 ng/L for water and 6835-14120 ng for PE strips. Mussels over-predicted the lower molecular weight (petroleum related) PAHs in water compared to sediment, whereas mussels under-predicted the higher molecular weight (combustion related) PAHs in water compared to sediment. This suggests that unionids are accumulating the various PAHs through differing routes of exposure (e.g., uptake of the lower molecular weight PAHs from the water via the gills and the higher molecular weight PAHs from the sediment via the gut) and/or that the higher molecular weight, combustion-related PAHs are less bioavailable to the mussels.

PL 20 CHARACTERIZATION AND MANIPULATION OF SEX STEROIDS AND VITELLOGNENIN IN FRESHWATER MUSSELS.

Kernaghan, Nicola J.,[1] Monck, Eileen K.,[1]* Borgert, Christopher J.,[1,2] and Gross, Timothy S.,[1,3]. [1]University of Florida, College of Veterinary Medicine, Gainesville, FL, [2]Applied Pharmacology and Toxicology Inc., Alachua, FL., [3]USGS/BRD/Florida Caribbean Science Center, Gainesville, FL.

Considerable evidence has accumulated over the past several years that a variety of chemical compounds present in the environment can disrupt

reproductive endocrine function in exposed wildlife populations. More recently, attention has been focused on a class of compounds known as Pharmaceutical and Personal Care Products (PCPPs), which include synthetic hormones used in birth control pills and on animal feedlots. The current study investigates the effects of a synthetic hormone, 17ß-estradiol and two organochlorine pesticides, DDE and Dieldrin on the reproductive cycle of the freshwater mussel, Elliptio buckleyi. Mussels were exposed to exogenous estradiol, DDE and Dieldrin and tissues were analyzed for androgens, and estrogens by standard RIA procedures. Vitellogenin, an egg yolk protein produced under the influence of sex steroids, was determined using an indirect method developed by Blaise et. al. (1999). Sex steroid concentrations were found to be closely correlated to reproductive activities and spawning. Tissue concentrations of both vitellogenin and estrogen were significantly elevated following exposure to exogenous estradiol. The development of these procedures for use with freshwater mussel species will be critical to the elucidation of potential habitat and contaminant effects on reproductive function.

PLATFORM SESSION 3A

Life History & Ecology I

Tuesday, March 18, 8:00 - 9:40 a.m.

Sheraton Imperial Hotel • Imperial I, II

PL 21 EFFECTS OF FRESHWATER MUSSELS ON SUBSTRATE STABILITY IN AN ARTIFICIAL STREAM.

Gregory F. Zimmerman[1] and Ferenc de Szalay[1]. Department of Biological Sciences, Kent State University, Kent, OH 44240.

Though it has been informally suggested that freshwater mussels stabilize the substrate, little published information exists on the subject. We investigated the effects of high mussel density at an artificial stream facility located in Hiram, Ohio. Eight 0.5 m2 plots of stream were tested with high and zero mussel density under both normal and high flow. High density plots were populated at 50 mussels per 0.5 m2 and used a 50:50 mix of average sized live mucket (Actinonaias ligamentina) and kidneyshell (Ptychobranchious fasciolaris) species. Sediment compression strength, shear, sediment transport, and transported sediment type were measured for plots with mussels and no mussels under normal and high flows. Both course sand (< 3 mm) and small gravel (4-16 mm) substrates were tested. Preliminary results indicate that high densities of mussels may increase sediment compression strength in sandy substrates. The complete results of the project will be presented and discussed.

PL 22 ASSOCIATIONS BETWEEN RIVERINE MUSSELS AND OTHER SEDIMENT-DWELLING INVERTEBRATES.

Caryn C. Vaughn, Daniel E. Spooner, Melissa Moore, and Ferrella March. Oklahoma Biological Survey and Department of Zoology, 111 E. Chesapeake St., University of Oklahoma, Norman, OK 73019.

Stream-dwelling mussels do not exist in isolation, but occur as part of a complex assemblage of animals, plants and microbes inhabiting the sediment, water column and their interface. We examined the association between mussels, benthic macroinvertebrates, and meiofauna in eight rivers of the Ouachita Uplands of Oklahoma and Arkansas. Mussels, macroinvertebrates and meiofauna were quantitatively sampled within 300, 0.25 m2 quadrats across 30 stream reaches. Environmental variables were measured at the quadrat and reach scale. Meiofauna samples are still being processed. Within quadrats, total macroinvertebrate density and taxa richness were both significantly and positively associated with total mussel density. We used canonical ordination to partition the variation in benthic macroinvertebrate assemblages explained by environmental factors, mussel distribution and abundance, and shared variation between mussel assemblages and environmental factors. Variation in mussel assemblages accounted for > 50% of the explained variation in macroinvertebrate assemblages. These data indicate that mussels influence the surrounding benthic community. Thus, current declines in mussel richness and abundance also may result in alterations in the rest of the benthic fauna. Species lists resulting from this project are available at www.biosurvey.ou.edu/Biodiversity_Web_Site/main.htm.

PL 23 A FIELD EXPERIMENT EXAMINING THE EFFECTS OF FRESHWATER MUSSELS (FAMILY: UNIONIDAE) ON SEDIMENT ECOSYSTEM FUNCTION.

Daniel E. Spooner and Caryn C. Vaughn. Oklahoma Biological Survey and Department of Zoology, University of Oklahoma Norman, OK 73019

We performed a field experiment examining the influence of two freshwater mussel species on the co-occurring invertebrate fauna. Using PVC and chicken wire enclosures, we followed the colonization of invertebrates in the sediment and on the shells of live mussels (Actinonaias ligamentaina, Amblema plicata) and empty shells weighted with sand for 1, 3 and 12 months. We measured chlorophyll a, organic matter, and algal and invertebrate communities in the sediment and on the shells at the end of each colonization interval. Live mussel treatments had significantly higher amounts of organic matter and chlorophyll a. In addition, live mussel treatments had higher densities of invertebrates in the sediment, yet despite trends, showed no statistical difference on the shells. Overall, differences between live mussel treatments and dummy shells appear to be largest during low flow conditions suggesting possible context dependency based on flow/seasonality. Our results suggest that freshwater mussels do affect local invertebrate assemblages, but that the strength of this effect is dependent on abiotic forces such as flow regime.

PL 24 POPULATION DYNAMICS AND REPRODUCTIVE BEHAVIORS OF LAMPSILIS STRECKERI (FRIERSON 1927), IN A GEOGRAPHICALLY ISOLATED STREAM IN ARKANSAS.

Rebecca Winterringer[1], Jerry L. Farris[2], and John L. Harris[1]. [1]Arkansas State University, Department of Biological Sciences, P.0. Box 599, Jonesboro, AR 72467; [2]Arkansas State University, Department of Environmental Sciences, P.O. Box 599, Jonesboro, AR 72467.

Population dynamics (abundance, species richness, density, sex ratio, age structure, associated fish and mussels), reproductive behaviors (brooding strategy, fish host), and associated stream habitat (riparian zone characteristics, canopy cover, fish cover, embeddedness, substrate characterization, water chemistry, stream morphology) are described for the federally endangered speckled pocketbook (Lampsilis streckeri). Though in relatively low densities, the speckled pocketbook population within the Middle Fork Little Red River appears to be stable and is documented in 83 of 124 total river km. Lampsilis streckeri was the dominant mussel species present at one of four sites quantitatively surveyed, and it was observed in abundance at three of 14 sites evaluated for stream habitat. The downstream-most site was documented with over 1,100 mussels, 24 species (including L. streckeri), but had the least amount of ecological habitat available (dominated by bedrock). Other species typically found in association with L. streckeri in the Middle Fork Little Red River were the rainbow (Villosa iris) and Ouachita kidneyshell (Ptychobranchus occidentalis). Twenty-two fish species representing five families were tested in two trials of host experiments. Glochidia tested on Centrarchidae successfully transformed into viable juvenile mussels, and over 2000 juvenile L. streckeri were released post propagation into the Middle Fork Little Red River. Baseline information collected for population dynamics, reproductive behaviors, and stream habitat characteristics provide resource managers with a framework for evaluating endangered species found in geographically isolated and highly variable stream systems.

PL 25 LEVELS OF RECRUITMENT NECESSARY TO PRODUCE VIABLE FRESHWATER MUSSEL POPULATIONS.

Wendell R. Haag and Melvin L. Warren, Jr. USDA Forest Service, Center for Bottomland Hardwoods Research, 1000 Front Street, Oxford, MS 38655.

We measured yearly recruitment of five mussel species (Elliptio arca, Fusconaia cerina, Pleurobema decisum, Quadrula asperata, and Q. pustulosa) in four stable populations in two rivers (Little Tallahatchie River, MS, and Sipsey River, AL) from 1999 to 2002. Survivorship from glochidia to the recruit stage (benthic individuals approximately 2-4 months of age) was low for all species (9.12 x 10-6 to 3.92 x 10-5). Nonetheless, recruitment was generally strong with recruits constituting an average of 11% of populations, but was variable among species, sites, and years (range = 0-56%). We used stochastic stage-based matrix population models based on observed demographic parameters for each species to evaluate the potential influence of varying levels of recruitment on long-term population viability. These models predicted that the minimum mean annual level of recruitment necessary to produce stable or increasing populations varies among species from approximately 5-12%. Our results show that strong recruitment is a regular feature of healthy freshwater mussel populations and recruits may sometimes constitute a large percentage of total individuals. Further, sporadic or low levels of recruitment seen in many populations are likely not sustainable conditions but rather, indications of declining populations. This approach may provide useful guidelines for assessment of mussel population viability.

PLATFORM SESSION 3B

Propagation & Reproduction I

Tuesday, March 18, 8:00 - 9:40 a.m.

Sheraton Imperial Hotel • Imperial III

PL 26 ACQUIRED RESISTANCE OF A HOST FISH TO GLOCHIDIA LARVAE AFTER MULTIPLE INFECTIONS.

Constance L. Rogers and Ronald V. Dimock, Jr. Department of Biology, Wake Forest University, Winston-Salem, NC 27109.

Although glochidia larvae of most freshwater mussels are obligate parasites on fish, not all fish species are suitable hosts for glochidia of a given species of mussel. However, if the glochidium attaches to a suitable host fish, the migration of host epithelial tissue forms a cyst surrounding the glochidium, in which the larva undergoes metamorphosis. There is evidence that a suitable host fish may become resistant to glochidia after multiple infections. In this study, bluegill sunfish (Lepomis macrochirus) were infected multiple times with glochidia of Utterbackia imbecillis and the number of glochidia attached, dynamics of daily shedding of glochidia and juveniles, and percent metamorphosis were observed over the course of the infections. After two infections, host fish began to exhibit resistance to glochidia. During the third and fourth infections, the percentage of glochidia that successfully metamorphosed into juveniles was significantly reduced and the number of glochidia that successfully attached to fish during the fourth infection was significantly reduced as compared to controls. Possible mechanisms of this acquired resistance were explored. Using SEM, the progress of cyst formation was found to be significantly delayed in resistant fish as compared to naïve fish. Additionally, protease activity in epithelial mucus of fish increased during the third and fourth infections as compared to naïve fish. Delayed cyst formation and increased protease activity may contribute to the increased mortality of larvae observed during the third and fourth infections and the decreased number of glochidia attached to fish during the fourth infection. This study demonstrated that host fishes become resistant to glochidia after multiple infections and has important implications in propagation and conservation.

PL 27 THE DISCOVERY OF THE PARASITIC GLOCHIDIUM: DEBATES, LOST CHANCES, AND SOUR GRAPES.

G. Thomas Watters and Ulrike Zika, Department of Evolution, Ecology, and Organismal Biology, Ohio State University, Columbus, OH 43212.

There is some confusion in the literature concerning the discovery of the parasitic nature of glochidia. The glochidium was first described by Leeuwenhoek in 1695 and illustrated by him in 1697. Although Leeuwenhoek believed that glochidia were larval mussels his opinion was challenged by Rathke a century later, who believed glochidia were parasites infesting mussels. A debate ensued over their true nature; eventually the Academie de Sciences Naturelles of Paris formed a distinguished committee to pass judgement. In 1828 the committee reported that glochidia were indeed parasites rather than larvae. But in 1832 Carus, carefully following the development of unionid eggs, demonstrated that glochidia were larval mussels. In 1866, Leydig noted (as a footnote to the dissertation of Noll, his student) that glochidia were found attached to fish. This seems to be the first report that glochidia might be parasites on fish. The same year Forel confirmed this observation. Braun and Schierholz in the winter of 1877/1878 independently attempted to artificially infest fish with glochidia, but Schierholz's experiment failed. However, Braun, apparently no friend of Schierholz, did succeed in infesting Anodonta. This was the first experimental evidence that glochidia were parasites on fish. Braun and his students moved on to developmental studies of glochidia, leaving their parasite studies for the time. In 1888 Schierholz experimentally infested Unio. But in 1889 Braun returned to the field complaining that he had already infested Unio in 1878 but simply had not published his results. In 1898 Schierholz turned the other cheek and clearly credited Braun with the first successful experimental infestation. Glochidia had come full-circle: from larvae to parasites to parasitic larvae.

PL 28 DETECTION OF HERMAPHRODITISM AND EVALUATION OF GAMETOGENESIS IN GONADS OF UTTERBACKIA IMBECILLIS AND VILLOSA IRIS.

William F. Henley and Richard J. Neves. Freshwater Mussel Conservation Group, Virginia Tech Aquaculture Center, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061.

To develop protocols for determination of gender and stage of gametogenesis, labeled quadrats within histological sections of gonadal tissues of Villosa iris and Utterbackia imbecillis were evaluated for frequencies of occurrence of oogenic, spermatogenic, hermaphroditic, intestinal, and stomach tissues. Sex was accurately determined in the central and dorsal portions of the viscera of male and female V. iris, and female regions of U. imbecillis. Spermatogenic tissue was consistently observed in the dorso-anterior areas of U. imbecillis. The tissues of these visceral positions also consistently provided accurate determination of gamete stage of development, with low associated probabilities of intestinal or stomach punc-

tures in individual specimens. Reproductive asynchrony was observed among males and females of these species ($p<0.02$). All examined male regions of U. imbecillis showed gamete development characterized by mature and developing spermatogenic tissue, while 2 groups of U. imbecillis showed oogenic development characterized by mature oocytes and resorption of gametes, respectively. Male V. iris showed early gamete development without mature spermatozoa, and 2 groups of female V. iris also showed different stages of oocyte development. One group was characterized by mature and developing gametes, and the other group of females showed resorption of gametes. Protocols for collection of non-lethal biopsy tissues from selected visceral areas are provided for specimens of U. imbecillis and V. iris for sex determination and staging of gametogenesis. The application of this biopsy protocol may be taxon-specific, and the suitability of these protocols for other mussel species should be tested.

PL 29 SEASONAL NUTRITIONAL DEMANDS OF MUSSELS AND A PROPOSED DIET FORMULATION FOR THEIR CAPTIVE CARE.

Catherine M. Gatenby[1], Daniel A. Kreeger[1], Deborah Raksany[1], and Richard J. Neves[2]. [1]Patrick Center for Environmental Research, Academy of Natural Sciences, Philadelphia, PA 19103, [2]Virginia Fish & Wildlife Cooperative Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061.

A necessary precursor to the goal of identifying suitable diets and feeding regimes for maintaining mussels in captivity is to define the bounds of the nutritional requirements of wild freshwater mussels. Three species from a large, reproducing bed of mussels in the Allegheny River were collected seasonally. We also collected seston from the Allegheny River in proximity to this bed of mussels. We constructed a seasonal profile of the mussel's nutritional demands, physiological condition, and the nutritional content of the available food source. There was a significant effect of season on the physiological condition and biochemistry of all three species of mussels. Condition peaked in July for all three species, with the May and November samples being similar. A diet high in protein and lipid appeared important from November through May for Elliptio dilatata and Lasmigona costata. We observed no increased seasonal demand for protein by A. ligamentina; however, tissue protein was high all year long, >30%, indicating protein was indeed important to this species' metabolic demands. A. ligamentina also required a diet high in lipid from November through May. There was no definable link between season and carbohydrate demand in these three species. The mean carbohydrate level (%DTW) of each species was similar; whereas, the relative protein and lipid levels differed between species. Until further information becomes available on absolute nutritional requirements, we recommend the following dietary composition for captive freshwater mussel diets: ~5-10%carbohydrate, ~20-40% protein, ~30% lipid, and ash ~ 20%.

PL 30 A FEEDING REGIME FOR MAINTAINING THE PHYSIOLOGICAL CONDITION OF MUSSELS IN CAPTIVITY.

Catherine M. Gatenby[1], Daniel A. Kreeger[1], Deborah Raksany[1] and Richard J. Neves[2]. [1]Patrick Center for Environmental Research, Academy of Natural Sciences, Philadelphia, PA 19103 , [2]Virginia Fish & Wildlife Cooperative Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061.

Our goal was to discern key feeding parameters and to identify a suitable diet for the captive care of a mixed assemblage of freshwater mussels. The effect of substrate, particle size, particle concentration, and diet on the feeding activity of a locally abundant mussel species (Elliptio complanata) were compared under laboratory conditions. We also tested a cultured algal diet instead of natural seston, and an artificial "lake water" medium (COMBO) instead of river water for maintaining mussels in captivity. Field information on food quality and quantity was used in setting our diet treatments. We compared diet absorption efficiencies between mussels fed natural seston and algae to determine whether a high quality diet enhanced absorption, and to verify the digestibility of the algal diet. Clearance rates of wild and laboratory held mussels were compared to examine whether feeding activity was compromised by our holding conditions. It doesn't appear that adult mussels require a burrowing substrate in captivity if their requirements for food quantity and quality are met. Indeed, clearance rate was similar between mussels fed seston, algae, or an algal/seston combination diet. Absorption efficiency (93%) was significantly greater in mussels fed the green alga, Bracteacoccus grandis than mussels fed seston or a combination of seston and algae (63-75%). Physiological condition of mussels held in COMBO media, out of substrate, and fed algae (B. grandis) at 20,000c/mL was similar to their wild counterparts indicating our feeding regime (and culture environment) adequately maintained fitness of mussels in captivity.

PLATFORM SESSION 4A

Life History & Ecology II

Tuesday, March 18, 10:00 a.m. - 11:40 a.m.

Sheraton Imperial Hotel • Imperial I, II

PL 31 FISH HOSTS AND POPULATION DEMOGRAPHICS OF LAMPSILIS CARIOSA AND LEPTODEA OCHRACEA (UNIONIDAE) IN MAINE.

Philip C. Wick, Alex D. Huryn. Department of Biological Sciences, University of Maine, Orono, ME 04469-5722

The yellow lampmussel (Lampsilis cariosa) and the tidewater mucket (Leptodea ochracea) are listed as threatened in Maine, and are declining in their southern range. The fish hosts of both species were unknown, and no density or demographic data existed for populations in Maine. These species are primarily coastal in distribution, suggesting that the fish hosts may be diadromous. We determined fish hosts for these species of mussels using laboratory infestations. We tested yellow perch (Perca flavescens), white perch (Morone americana) and pumpkinseed sunfish (Lepomis gibbosus) for suitability as a host for the yellow lampmussel. Transformed juvenile lampmussels were recovered from both P. flavescens and M. americana. For fish hosts of Leptodea ochracea, we infested P. flavescens, M. americana and Alewife (Alosa pseudoharengus). L. ochracea successfully transformed only on M. americana, with none of the A. pseudoharengus surviving long enough for transformation to take place. Density and size distribution were determined at five sites using excavated 0.25m2 quadrats. L. cariosa ranged from 0 to 2.8 animals per square meter, and from 21 to 104 mm in length. L. ochracea ranged from 0 to 1.2 animals per square meter, and from 19-112 mm in length. Length-at-age curves were constructed using thin sections of relict valves at each site in order to examine recruitment and demography of the populations. All populations were found to have recent recruitment of young mussels (2-3 years old).

PL 32 CLEARANCE RATE OF WILD ELLIPTIO DILATATA, LASMIGONA COSTATA, AND ACTINONAIAS LIGMENATINA.

Elizabeth A. Neal[1], Catherine M. Gatenby[2], Daniel A. Kreeger[2], Ariel Capili[2], and Richard J. Neves[3]. [1]Edinboro University of Pennsylvania, Edinboro, PA 16444, 2Patrick Center for Environmental Research, Academy of Natural Sciences, Philadelphia, PA 19103, [3]Virginia Fish & Wildlife Cooperative Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061.

Clearance rates (CR) of Elliptio dilatata, Lasmigona costata, and Actinonaias ligamentina were measured under field conditions from a large, reproducing bed of mussels in the Allegheny River. Ten mussels of each species were placed in individual 4L buckets containing a mixed sample of river water. Ten mL samples of water were taken from each bucket every thirty minutes for 2.5h during morning and afternoon trials. Particle concentrations and particle sizes of each sample were analyzed using a Multisizer Coulter Counter with a 100?m aperture (Coulter Electronics). The clearance rate data for each individual mussel were regressed and the slopes were compared between individuals within a species, between species, and between trials. No significant differences in mean CR (1.3 L/h) were found between the morning and afternoon trials ($p=0.23$). Clearance rates also were similar between species in the afternoon test ($p=0.5986$). However, there was a significant difference in mean among species in the morning trial ($p=0.0494$; CR was 1.76 L/h for A. ligamentina and 0.9 L/h for E. dilatata and L. costata. Freshwater mussel mean clearance rate on a daily basis may be similar across some taxa, but different species feed at different rates on a diurnal basis.

PL 33 WHAT'S FOR LUNCH? SEASONAL SESTON COMPOSITION OF TWO REGIONALLY DISTINCT FRESHWATER MUSSEL STREAMS.

Alan D. Christian[1], David J. Berg[2], Jason A. Porter[3], Robert H. Findlay[3], and Betty G. Crump[4]. [1]Department of Biological Sciences, Arkansas State University, State University, AR 72467, [2]Department of Zoology, Miami University, Hamilton, OH 45011, [3]Department of Microbiology, Miami University, Oxford, OH 45056. [4]Ouachita National Forest, Caddo Ranger District, 101 Smokey Bear Lane, Glenwood, AR 71943

Stream seston can be comprised of bacteria, fungi, algae, and detritus and is thought to be the major source of food for freshwater mussels. Seston can be quantified in a variety of ways such as total suspended solids (TSS), ash-free-dry mass (AFDM), nutrient and chlorophyll concentrations, microbial biomass and community structure, and stable isotopes. The two freshwater mussel streams presented here are the Little Darby Creek, OH, and the upper Ouachita River, AR, row crop dominated and forest dominated watersheds, respectively. Our objectives were to spatially and temporally describe and compare seston from these two streams across seasons using TSS, AFDM, C, N, P, and chlorophyll concentrations, microbial (heterotrophic and autotrophic) biomass and community structure, and stable C and N isotopes. TSS, AFDM, C, N, and chlorophyll concentrations were generally highest in the summer with higher concentrations in Little Darby Creek across seasons. Stable isotopes were spatially and temporally variable. Microbial biomass made up a large portion of the seston, with its contribution to seston

C and N lowest during the summer and was highest in Little Darby Creek across seasons. Our results show that land use influences seston quality and quantity and that microbial biomass dominates seston composition with seasonal shifts in dominance by either autotrophic or heterotrophic communities. Because microbial communities dominate the composition of seston, they represent the largest potential freshwater mussel food source.

PL 34 SUSPENSION FEEDING BIODYNAMICS OF FRESHWATER MUSSELS: 1. ENDOSCOPIC INVESTIGATIONS OF PARTICLE CAPTURE AND PROCESSING IN FIVE SPECIES OF FRESHWATER MUSSELS.

Richard A. Tankersley, Department of Biological Sciences, Florida Institute of Technology, 150 W. University Blvd., Melbourne, FL 32901.

To elucidate the role of the gills and other pallial structures in particle capture, transport, and selection, video endoscopy and scanning electron microscopy were used and compare the suspension feeding structures and mechanisms of five species of freshwater mussels, Amblema plicata, Ellipsaria lineolata, Ligumia recta, Megalonaias nervosa, and Potamilus alatus. In all species, particles were captured by the ctenidial filaments and transported, either individually or in mucous-bound clumps, along the frontal surface of the gills. In some species, particles were also observed moving dorsally along the fontal surface of the ctendia and were subsequently entrained in a slow-moving string of mucus-bound particles traveling anteriorly in ciliated tracts of the gill arch. Particles transported ventrally on both the lateral and medial gills were incorporated in a concentrated string of particles traveling toward the palps in the food groove of the medial gills. Although the food groove was the primary pathway by which particles reached the mouth for ingestion or rejection, its morphology differed among species and the method of transport varied with particle concentration. Upon reaching the gill-palp junction, particles were either transferred to the palps as an intact mucous string or shunted to the edge of the mantle margin and rejected as pseudofaeces. There was no evidence that the ctenidia are involved in particle sorting or selection. In gravid species, particle capture and processing was restricted to nonmarsupial regions of the ctenidia, suggesting that feeding rates may be reduced during brooding periods.

PL 35 SUSPENSION FEEDING BIODYNAMICS OF FRESHWATER MUSSELS: 2. EFFECT OF PARTICLE CONCENTRATION AND SILT LOAD ON PARTICLE SELECTION AND RETENTION.

Richard A. Tankersley, Department of Biological Sciences, Florida Institute of Technology, 150 W. University Blvd., Melbourne, FL 32901.

The effect of seston concentration and silt load on the retention of algal sized particles was measured in three species of freshwater mussels, Amblema plicata, Plectomerus dombeyanus, and Quadrula quadrula. When fed mixtures of quartz particles between 3 and 20 μm at low concentrations (1.5 x 104 particles ml-1), all three species preferentially retained particles > 6 μm and their retention spectra were nearly identical. However, at higher particle concentrations (7.5 and 15 x 104 particles ml-1), A. plicata and Q. quadrula were less efficient than P. dombeyanus at retaining particles < 12 μm. When exposed to increasing seston concentrations, mussels reduced their clearance rates and increased their production of pseudofaeces. Yet, the concentration at which pseudofecal production was initiated was significantly lower for Q. quadrula than for A. plicata and P. dombeyanus. To test the effect of fine silt on particle selection and retention, mussels were fed mixtures of 6, 10, and 22 μm microspheres and resuspended fine silt at concentrations spanning the range of values observed under natural conditions. For all three species, clearance rates of microspheres decreased when silt was added to the suspension. Similarly, Q. quadrula and A. plicata were less efficient at retaining small (6 and 10 μm) particles, even at low silt concentrations (5 mg L-1). For P. dombeyanus, retention of 10 and 16 μm particles was independent of silt concentration. Thus, responses of mussels to variations in particle concentration and silt load vary among species and may reflect their ability to cope with sudden changes in the quantity and quality of suspended particles.

PLATFORM SESSION 4B

Relocation & Recovery

Tuesday, March 18, 10:00 a.m. - 11:40 a.m.

Sheraton Imperial Hotel • Imperial III

PL 36 RELOCATION VERSUS TRANSLOCATION: WHAT'S IN A NAME.

W. Gregory Cope, North Carolina State University, Department of Environmental & Molecular Toxicology, Box 7633, Raleigh, NC 27695.

A recent assessment of the published literature dealing with the topic of moving freshwater mussels from one location to another revealed that two primary terms were being used to describe the process; these were relocation and translocation. According to guidelines and definitions established by the The World Conservation Union (IUCN), these terms differ in their meaning and thus, are not interchangeable. The specific objectives of this review were to assess the use patterns

of these and other similar terms in the freshwater mussel literature, provide distinctions for their proper use among resource managers, researchers and educators, and to propose terminology that could be used by all in the malacological field to harmonize the aquatic literature, similar to that proposed by the terrestrial wildlife conservation field in the year 2000. The IUCN definitions formally distinguish between four types of relocations, (1) introductions, (2) re-introductions, (3) translocations, and (4) supplementations. A translocation, which is commonly referred to in the freshwater mussel literature, is the deliberate and mediated movement of wild individuals or populations from one part of their range to another, whereas the term relocation is a neutral overarching term that describes all reasons for movement by humans of individuals or populations. In an effort to avoid confusion caused by all of the specific terms defining relocation, and to harmonize the freshwater mussel literature, the term relocation is proposed herein to refer to any intentional movement by humans of an individual or population from one location to another.

PL 37 RELOCATION SUCCESS AND SUBSEQUENT GROWTH RATE OF FRESHWATER MUSSELS IN THE MUSKINGUM RIVER NEAR DRESEDN, OHIO.

James B. Spence, Katherine Channell, Dr. Thomas G. Jones, and Dr. Ralph W. Taylor. Marshall University, [1]John Marshall Drive, Morrow Library Room G-31, Huntington, WV, 25755.

A relocation of approximately 2,300 mussels from a thousand-foot reach of the Muskingum River near Dresden, Ohio was accomplished in October of 2002. The authors identified all species, recorded weights, and digitally imaged all relocated mussels. Substrate composition of the impacted area and relocation sites was also recorded. The results demonstrate that the mussels were moved from an area of suboptimal habitat to an improved habitat based on the relocated substrate composition. Growth rates using shell dimensions and weights will be monitored both short-term and long-term to determine relocation success of all species. The method of planting the relocated mussels versus placing them on top of the substrate will also be evaluated to determine the most successful method. Historical inferred growth rate of the species Quadrula pustulosa was determined using shells from muskrat middens and the image analysis program ImageJ. The age (number of annuli) of the organism and the length of the shell parallel to the hinge line had the strongest correlation to determine growth rate. This growth rate will be compared with data gathered in previous studies at other sites in the Muskingum River.

PL 38 PROPAGATION AND CULTURE OF ENDANGERED JUVENILE FRESHWATER MUSSELS IN THE BIG SOUTH FORK NATIONAL RIVER AND RECREATION AREA OF THE CUMBERLAND RIVER, TENNESSEE.

Rachel Mair[1], Jess Jones[1], Richard J. Neves[1], Steve Ahlstedt[2], and Steve Bakaletz[3]. [1]Freshwater Mussel Conservation Center, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061. [2]U.S. Geological Survey, Knoxville, TN 37921. [3]National Park Service, Oneida, TN 37841.

Historically, the Big South Fork Cumberland River supported at least 50 mussel species; 26 species remain, to include five federally listed species. A cooperative effort between National Fish and Wildlife Foundation, Tennessee Wildlife Resource Agency, United States Fish and Wildlife Service, United States Geological Survey, National Park Service, and Virginia Tech was initiated to propagate endangered mussels in the Big South Fork Cumberland River National Recreation Area. The goal of this 2-year project is to assess the feasibility of restoring and augmenting existing populations of endangered mussels species in this national park. Because of high richness and endemism of mussel species, this watershed is of national significance to conservation of mussel resources in the United States. In 2002, juvenile mussels of 4 federally endangered species were produced and cultured at Virginia Tech for release in the river: tan riffleshell, Epioblasma florentina walkeri (4,654), Cumberland bean, Villosa trabalis (1,116), Cumberland combshell, Epioblasma brevidens (36,466), and little-wing pearlymussel, Pegias fabula (569). Juveniles were typically 2-3 wk old at the time of their release, although some were as old as 6 mo. The results of recent surveys in the river have documented viable populations of these endangered mussel species, which can now serve as broodstock to restore other rivers in the Cumberland River drainage system.

PL 39 PROGRESS IN THE REPRODUCTIVE BIOLOGY, PROPAGATION, AND STOCKING OF THE NEOSHO MUCKET, LAMPSILIS RAFINESQUEANA.

Christopher Barnhart and Melissa A. Shiver, Department of Biology, Southwest Missouri State University, 901 South National Avenue, Springfield, MO 65804.

The Neosho mucket mussel is a candidate for federal endangered status because of population declines and limited geographic range. Several aspects of reproduction were investigated to facilitate ongoing efforts to restore this species. Ten or more individuals were examined monthly throughout 2001 at each of two field sites in the Spring River system of SW Missouri. Neosho muckets were tachytictic, produced eggs in early May and brooded until the end of July. This result

contrasts with observations of many other lampsiline species, which generally produce eggs in the fall and release larvae in the following spring or summer. Approximately 5% of individuals harbored sterilizing trematode infestations and produced no gametes. Since 1999, we have propagated and released newly transformed Neosho mucket juveniles at several sites in Kansas and Missouri. Beginning in January 2002, and subsequently, we recovered midden shells and live individuals at two sites in the Fall and Verdigris Rivers in Kansas. All 28 individuals recovered thus far are attributed to releases made in August 2000. Judging from shell growth lines, these individuals grew to an average length of 11.2±2.6 mm in the first growing season (~5 months, Aug 2000-Jan 2001). They reached 49.1±4.6 mm at the Verdigris River site and 57.3±5.7 mm at the Fall River site by the end of the second growing season (~17 months, Aug 2000-Jan 2002). Growth rate in the second season was surprisingly rapid and provides a benchmark for comparison with growth in culture.

PL 40 AN UPDATE ON THE FRESHWATER MOLLUSK PROPAGATION AND RECOVERY PROGRAMS OF THE TENNESSEE AQUARIUM RESEARCH INSTITUTE.

Paul D. Johnson, Sabrina K. Novak, and Kathryn S. Klyce, Tennessee Aquarium Research Institute, 5385 Red Clay Road, Cohutta, GA 30710.

Freshwater mollusk recovery efforts of the Tennessee Aquarium Research Institute (TNARI) are focused primarily on species endemic to the Mobile River Basin. Freshwater mussel recovery programs have targeted the upper Coosa River basin. Since 2000, mussel recovery efforts have propagated and released over 11,000 mussels of 9 species, 4 listed as endangered or threatened by the U.S. Fish and Wildlife Service. Mussel releases have been completed in Tennessee, Georgia, and Alabama. The program has also identified host fish for 3 species of mussels including Pleurobema georgianum and Villosa nebulosa. Artificial propagation methods for freshwater gastropods (Pleuroceridae) have also been developed. To date gastropod restoration efforts have focused on Leptoxis spp. in the Mobile River Basin. The program has propagated and cultured over 6,000 rocksnails of 2 federally listed species (L. downiei and L. plicata). However gastropod propagation techniques have also been developed for the spiny riversnail, (Io fluvialis) from the Tennessee River basin, as a model for large river restoration efforts. To date TNARI has propagated, cultured, and released, over 2,700 spiny riversnails into the Tennessee River. Development of mollusk culture techniques and development of restoration plans will be discussed.

PLATFORM SESSION 5A

GIS

Tuesday, March 18, 1:00 - 3:00 p.m.

Sheraton Imperial Hotel • Imperial I, II

PL 41 DEMOGRAPHIC CHARACTERISTICS OF FISH HOSTS AND UNIONID COMMUNITIES AT MULTIPLE SPATIAL SCALES IN THE UPPER MISSISSIPPI RIVER.

Daelyn Woolnough[1], John Downing[1] and Teresa Newton[2]. 1Iowa State University, Ames, IA. [2]USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI.

The relation between unionid communities and fish hosts has been well documented in literature; however, it has yet to be explored in large river systems on multiple spatial scales. Because most unionids require a fish host to complete their life cycle, the distribution of unionids may overlap spatially and temporally with their fish hosts. Analysis of such overlap may be of importance to conservation, but presents complexities that include data collection techniques at multiple spatial and temporal scales. We compared two software applications, Biomapper (shareware developed by A.H. Hirzel) and ArcGIS(tm) extension Geostatistical Analyst(tm), to determine the spatial overlay of three unionid species and their fish hosts in three reaches of the Upper Mississippi River. Within these reaches (1:50,000), contiguous aquatic habitats were examined on a smaller spatial scale (1:10,000). Typical unionid data are locations where unionids are found (presence data) and lack sites where unionids are absent. Biomapper's strength is that it can analyze these presence only data. Geostatistical Analyst(tm) is a more robust program and can analyze data in numerous formats and can also process typical unionid data. Preliminary analysis suggests that unionid abundance has decreased since the 1970s in a similar fashion throughout the three reaches. This decline was similar at the 1:10,000 scale when we considered aquatic habitats within reaches (e.g. main channel border). This decline shows some spatial correlation with location of fish host abundance and is visualized using Kriging and Ecological Niche Factor Analysis. Geostatistical Analyst(tm) supports features to explore the data, and is a tool that would allow researchers to examine unionid communities at multiple spatial and temporal scales.

PL 42 GIS APPLICATIONS FOR CONSERVATION AND MANAGEMENT OF FRESHWATER MUSSELS.

Carol J. Myers and G. Thomas Watters, Department of Evolution, Ecology, and Organismal Biology, Ohio State University, Columbus, OH 43212.

Geographic information system (GIS) technology can be a useful tool for the conservation and management of freshwater mussels. Conventional databases are structured to examine data in one specific manner, and rearranging everything to look at it from a different viewpoint can be a tedious, cumbersome process. This information can be plotted on a map to help visualize data, but this results in a static map with limited practical use. Information such as survey data, IBI-like metrics, or water chemistry can be analyzed separately using ordinary methods, but it is very difficult to integrate many factors into one useful database. The emergence of GIS technology has changed that by allow us to examine data spatially, chronologically, or in a predictive fashion. It also lets us examine data from many sources at once, and to see how these data relate to one another. Creating a GIS of a watershed can help us to recognize trends and realize correlations that might not be readily obvious using traditional methods. For example, a GIS might help us to explain the decline of mussels in an area for which there is no obvious reason. Or, it might assist in locating problem areas and identifying possible reasons why these areas are in trouble. This technique would be most useful in systems with a wide variety of data, like the Big Darby Creek system, which has been sampled prolifically over the past several decades and contains detailed records for many kinds of data. Although we used the Big Darby Creek system as an example, this method has widespread applications in other systems as well.

PL 43 UNIONID COMMUNITY PATTERNS RELATED TO RIPARIAN LAND COVER PROPERTIES QUANTIFIED OVER MULTIPLE SPATIAL SCALES.

Reuben R. Goforth[1], David Stagliano[2], Peter J. Badra[1], and Stephanie M. Carman[1]. [1]Michigan Natural Features Inventory, Michigan State University Extension, Stevens T. Mason Bldg., PO Box 30444, Lansing, MI 48909; [2]EcoAnalysts, Inc. 105 E. 2nd St. Suite 1, Moscow, ID 83843.

Spatial scale is an important factor for modeling stream community responses to environmental degradation owing to the cumulative drainage influences of watersheds within diverse landscapes. To date, multi-scale evaluations of aquatic community response to landscape change have been largely based on fish and, to a lesser extent, benthic macroinvertebrate communities. The conservation and management of native unionids could also benefit from an improved understanding of spatial phenomena that influence mussel communities. However, little attention has been directed at developing an understanding of unionid community patterns within a multi-spatial context. We sampled 27 mussel communities in nine watersheds of southern Lower Michigan to observe mussel community responses to varied riparian land cover composition measured over multiple spatial scales, both adjacent to and upstream from sampled stream reaches. Mussel community parameters were not significantly different among local riparian width classes, although most community measures were significantly different among channel classes that were based on local evaluations of channel incision, substrate composition and flow characteristics. Correlation analysis of land cover data quantified over several spatial scales with mussel community parameters yielded few significant associations at a conservative alpha level of 0.005. However, patterns that were detected indicated the importance for larger scale, upstream riparian land cover properties as influencing factors in communities of downstream reaches. These results demonstrate the importance for remediation of upstream environmental disturbance in addition to local stressors when managing mussel taxa and communities.

PL 44 DEVELOPMENT OF LANDSCAPE MODELS FOR PROTECTION AND RESTORATION OF FRESHWATER MUSSELS IN LARGE RIVERS.

Teresa Newton[1], Michelle Bartsch[1], Carol Lowenberg[1], Ken Lubinski[1], Jennie Sauer[1], Jeff Steuer[2], and Steve Zigler[1]. [1]USGS, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603; [2]USGS, Wisconsin District Office, 8505 Research Way, Middleton, WI 53562.

Freshwater mussels are declining worldwide, but the factors contributing to their decline are generally unknown. Attempts to predict the distribution and abundance of unionids from habitat descriptors have largely failed when tested critically. We developed a GIS-based framework to determine if the spatial distribution of unionids can be predicted from a suite of physical, hydraulic, and biological features in the Upper Mississippi River and the surrounding landscape. This river has a wealth of physical and hydraulic data due to an extensive 15-yr monitoring program. We supplemented these data with data on unionids at 587 locations throughout a 38-km long reach of the river. Exploratory analyses were conducted by partitioning the locations into those with and without unionids, with and without juveniles, with low and high densities, and by grouping species into life history guilds. Each of these attributes was analyzed against a suite of physical and hydraulic measures such as depth, shear stress, aquatic area, and proximity to

wing dams. Initial analyses suggest that shear stress, aquatic area, and longitudinal position in the river reach may help explain the distribution of unionids in this large river. Additionally, shell thickness and shell sculpture varied in response to certain physical and hydraulic features. Variables that showed promise for predicting the spatial distribution of unionids will be used to build simple models of spatial occurrence. These models will ultimately be used to generate hypotheses for future research.

PL 45 A CASE STUDY IN THE NATURE CONSERVANCY'S APPROACH TO CONSERVATION PRIORITIZATION: A BALANCE BETWEEN THE SOUTHEAST'S DECLINING AQUATIC FAUNA AND "LAST GREAT PLACES".

Ryan Smith[1], Braven Beaty[2], Paul Freeman[3], and Rob Sutter[1]. [1]The Nature Conservancy, Southern Resource Office, 6114 Fayetteville Rd, Suite 109, Durham, NC 27713; [2]The Nature Conservancy, Clinch Valley Program, 146 East Main St, Abingdon, VA 24210; [3]The Nature Conservancy, Alabama Field Office, 2821-C Second Avenue South, Birmingham, AL 35233.

An important step in the work of any conservation organization or agency is prioritization of effort. One method of prioritization is a coarse-filter approach, where high quality ecosystems are targeted for protection, with the assumption that all the nested component species are protected before they decline. Such an approach, while proactive, has the possibility of missing important locations for imperiled mollusks and other organisms. On the other hand, only focussing on locations of rare species may result in the neglecting of more intact ecosystems and their associated representative regional biodiversity. A balanced approach must incorporate both factors. The Nature Conservancy has developed such a process that is based upon a GIS-based biophysical classification of aquatic ecosystems and a targeting of regional rare and declining species. This process results in the identification of priority freshwater conservation areas that, if protected, would conserve all the aquatic biodiversity of a region. We applied this methodology in four aquatic regions of the Southeastern United States, identified 400 conservation areas, and compiled an extensive dataset on targets, their status, and threats at each place. We discuss this approach and the implications of such a project for mollusk conservation.

PL 46 USE OF A COMPLETE HABITAT SURVEY AND A GEOGRAPHIC INFORMATION SYSTEM (GIS) TO IDENTIFY SUITABLE RELEASE SITES FOR CAPTIVELY PROPAGATED FRESHWATER MUSSELS IN THE CLINCH RIVER, VIRGINIA.

Lora L. Zimmerman and Richard J. Neves. U.S. Geological Survey, Department of Fisheries and Wildlife, Virginia Tech, Blacksburg, VA 24061

Recovery plans for endangered freshwater mussels include goals of propagation and release of juvenile mussels to augment or expand the range of existing populations to their historic levels. The Clinch River flows unimpounded through a remote region of Southwestern Virginia, with a sparse human population and generally low degree of anthropogenic impacts. These characteristics make the Clinch watershed a prime candidate for receiving captively propagated mussels as part of recovery attempts for the 18 endangered mussel species in residence. A habitat model was developed for the Clinch River, Virginia, for the purpose of identifying potential release locations. A complete survey of physical stream habitat was conducted between Clinch River Kilometer (CRK) 478 (Blackford, Russell County) and CRK 321 at the Tennessee/Virginia border. Physical habitat units (pools, riffles, and runs) identified in this survey provided a base for the model and were coupled with water quality and impact source data from various governmental agencies. Potential influences on water quality incorporated into the model included proximity to vehicular bridges, railroad bridges, cattle feedlots, permitted point source discharges, towns, and identified sources of acid mine drainage. All water and habitat quality data were compiled into a Geographical Information System (GIS), and an index of potentially suitable release habitats, ranked from Excellent to Poor, was calculated. The accuracy of the index was tested through comparison with river locations known to harbor reproducing populations of mussels.

PLATFORM SESSION 5B

Evolution & Phylogenetics II

Tuesday, March 18, 1:00 - 3:00 p.m.

Sheraton Imperial Hotel • Imperial III

PL 47 COMPARISON OF HOST COMPATIBILITY IN TWO POPULATIONS OF WESTERN FANSHELL, CYPROGENIA ABERTI.

Nathan Eckert and Christopher Barnhart, Department of Biology, Southwest Missouri State University, 901 South National, Springfield MO, 65804.

Cyprogenia aberti (Conrad, 1850) is sparsely distributed in rivers of the Interior Highlands, including the upper Arkansas, Ouachita, White, Black, and St. Francis River systems. Recent phylogenetic analysis of mtDNA sequences indicated that C. aberti might comprise several taxa. We studied aspects of the reproductive biology of

two genetically distinct populations of C. aberti, in order to test for phenotypic differences. Study sites were in the Verdigris River in eastern Kansas and the St. Francis River in eastern Missouri. A host test was conducted using four darter species, two from the Verdigris (slenderhead darter [Percina phoxocephala], orangethroat darter [Etheostoma spectabile]) and two from the St. Francis (logperch [P. caprodes] and rainbow darter [E. caeruleum]). Each of the four host species was infected with glochidia from both localities. Transformation success was significantly higher in sympatric pairings than in allopatric pairings on rainbow darters and slenderhead darters, but was similar between the two mussel populations on logperch and orangethroat darters. Glochidia from the Verdigris required more time to transform than those from the St. Francis. Differences were also seen in conglutinate color and morphology, and in glochidia shape. Verdigris conglutinates were white with a perforated dorsal end, while St. Francis conglutinates were either brown or red with no perforations in the dorsal end. These physiological and morphological differences are consistent with genetic evidence that these two C. aberti populations are distinct species.

PL 48 HIERARCHICAL ANALYSIS OF mtDNA VARIATION IN TWO WIDESPREAD MUSSEL SPECIES.

Curt L. Elderkin[1], David J. Berg[2], Janice L. Metcalfe-Smith[3], Caryn C. Vaughn[4], and Sheldon Guttman[1]; [1]Dept. of Zoology, Miami University, Oxford, OH 45056;, [2]Dept. of Zoology, Miami University, Hamilton, OH 45011, [3]National Water Research Institute, Burlington, ON, Canada L7R 4A6;, [4]Dept. of Zoology and Oklahoma Biological Survey, University of Oklahoma, Norman, OK 73019;

Knowledge of genetic structure of target species is essential for the development of effective conservation plans. Amblema plicata and Eliptio dilatata are common, widespread freshwater mussel species. However, A. plicata is a habitat generalist, whereas E. dilatata are generally restricted to headwater habitats. We sequenced mtDNA from ~10 individuals in two populations, from two rivers in each of three distinct drainages: Northern Lake Erie, Ohio River, and Ouachitau River (for at total of twelve populations). We used this herachical design to estimate percent variation at four levels: within populations, among populations within river, among rivers within drainage, and among drainages. These individuals were analyzed by sequencing fragments from a 652-base portion of the mitochondrial cytochrome oxidase I (COI) gene. Multiple haplotypes were identified for the COI gene at the population level, and unique sequences were found in southern populations for both species, indicating that these populations are much older. Also, for E. dilatata we found 4X the variation among rivers and among drainages than for A. plicata. These results indicate that genetic drift has historically had a more profound effect on E. dilatata than on A. plicata populations among these three drainages. Overall, this study indicates that management decisions for habitat specialists may involve conservation on a much larger geographic scale than for generalists, in order to preserve the genetic variation present in these species.

PL 49 PHYLOGEOGRAPHY OF LAMPSILIS HIGGINSII (HIGGINS' EYE PEARLY MUSSEL), AN ENDANGERED SPECIES IN THE UPPER MISSISSIPPI RIVER BASIN.

Bonnie S. Bowen, Dept. Natural Resource Ecology & Management, Iowa State University, Ames, IA 50011.

Lampsilis higginsii, a federally endangered mussel in the Upper Mississippi River basin, has suffered a 50% reduction in range since 1965. L. higginsii is currently threatened with extinction due to the alien zebra mussel (Dreissena polymorpha). Propagation and translocations to rivers that are free of zebra mussels are currently underway to help preserve this species. It is important to characterize the genetic structure and diversity of Lampsilis higginsii as a basis for conservation and management. We analyzed sequence variation for segments of three mitochondrial DNA (mtDNA) genes, cytochrome-b, cytochrome oxidase I, and 16S rRNA 128, in 130 individuals from seven populations. We found little genetic differentiation among the populations, but a high level of genetic variation within the populations. These data suggest that L. higginsii may have occurred in isolated refugia during times of glacial advance, and that current populations in the Mississippi River represent a mixing of those historical groups. We suggest that when plans are made for propagation and translocations, a large number of individuals should be collected to preserve this genetic variation.

PL 50 PATTERNS OF GENETIC DIVERSITY AMONG POPULATIONS OF FRESHWATER MUSSELS IN THE BONNEVILLE BASIN, UTAH.

K. E. Mock[1], J. Brim Box[2], M. E. Gordon[3], M. P. Miller[1], and W. R. Hoeh[4]. [1]Department of Forest, Range, and Wildlife Sciences, Utah State University, Logan, UT 84322-5310; [2]National Aquatic Monitoring Center, Utah State University, Logan, UT 84322; [3]New Mexico Museum of Natural History and Science, 1801 Mountain Road NW, Albuquerque, NM 87104; [4]Department of Biological Sciences, Cunningham Hall, Kent State University, Kent, OH 44242.

Freshwater mussels are an integral component of aquatic ecosystems and are indicator species for assessing the health of freshwater systems. The richest mussel fauna (Bivalvia:Unionidae) in the

world is found in North America. However, freshwater mussels are considered the most endangered faunal group in the U.S. In the western U.S., there is an alarming lack of basic information on the distribution, abundance, and taxonomic status of freshwater mussels. Nine of the 11 western freshwater mussel species currently recognized are in the genus Anodonta. Historically at least six species of Anodonta occurred in the Great Basin. Of these six species, A. californiensis is tentatively considered to be the only extant species the Basin. Given the high level of endemism of other Great Basin taxa (e.g. fishes), however, it is probable that other described or previously unrecognized mussel species persist in the Basin. We conducted an intensive genetic survey of Anodonta populations in the Bonneville Basin (a sub-basin of the Great Basin) to describe patterns of phylogeny and gene flow. We found these populations to be remarkably homogeneous, although there were interesting differences between Bonneville Basin populations and adjacent populations. These patterns raise intriguing questions about taxonomy, reproduction, gene flow, and host fish requirements in western Anodonta.

PL 51 AN OVERVIEW OF THE FRESHWATER MOLLUSK COLLECTIONS CURATED AT THE DELAWARE MUSEUM OF NATURAL HISTORY.

Kevin J. Roe, Delaware Museum of Natural History, 4840 Kennett Pike, P. O. Box 3937, Wilmington, DE 19807-0937.

The Delaware Museum of Natural History's mollusk collection consists of more than 2 million mollusk specimens making it eleventh largest the United States. The 210,000+ cataloged lots represent more than 17,000 species, are worldwide in scope, and cover all seven living classes of mollusks. Although marine species dominate the collection, holdings also include significant numbers of land and freshwater gastropods (25%) and freshwater bivalves (5%). The library in the Collections & Research Division includes more than 10,000 volumes with an emphasis on mollusks. The Malacology division also offers an annual $500.00 scholarship to cover travel expenses of graduate students who wish to use the collections. An overview of the history of the collection and a detailed breakdown of freshwater holdings will be presented.

PL 52 A PRELIMINARY EXAMINATION OF SYSTEMATIC RELATIONSHIPS WITHIN THE LAND SNAIL GENUS PRATICOLELLA (GASTROPODA: POLYGYRIDAE).

Kathryn E. Perez. Department of Biological Sciences, University of Alabama, Tuscaloosa, AL, 35487.

The shrub snail, Praticolella Von Martens is comprised of 13 currently recognized species, several of which are of proposed hybrid origin and uncertain taxonomic status. Descriptions of most Praticolella species were published pre-1900 and did not give comparative diagnostic information. The genus is found throughout the Southeastern US and Mexico. Habitat of terrestrial snails throughout the range of Praticolella is rapidly being modified, and a phylogenetic hypothesis of relationships within this taxonomically problematic genus is necessary to determine the conservation status of these organisms. This study is a comparative examination of all members of this genus using both morphological and molecular methods and attempts to resolve taxonomic issues which can impede conservation efforts. The morphometric analysis and preliminary sequence results provide new insights into relationships in this group of land snails.

PLATFORM SESSION 6A

Status & Distribution II

Tuesday, March 18, 3:20 - 5:00 p.m.

Sheraton Imperial Hotel • Imperial I, II

PL 53 FRESHWATER MOLLUSK INVENTORY OF THE DUCK RIVER BASIN TENNESSEE - A PRELIMINARY REPORT.

Steven A. Ahlstedt[1], Paul D. Johnson[2], Jeff Powell[3], and Robert S. Butler[4], Mark Fagg[5], Don Hubbs[6], Katherine Klyce[2], Sabrina F. Novak[2] and Sally R. Palmer[7]. [1]USGS, 1820 Midpark Drive, Suite A, Knoxville, TN 37921; [2]Tennessee Aquarium Research Institute, 5385 Red Clay Road, Cohutta, GA 30710; [3]USGS, 640 Grassmere Park, Suite 100, Nashville, TN 37211; [4]USFWS 160 Zillicoa Street, Asheville, NC 28801; [5]TWRA 3030 Wildlife Way, Morristown, TN 37814; [6]TWRA, PO Box 70, Camden, TN 32801; [7]TNC, Duck River Alliance, 715 N. Main Street, Columbia, TN 38401.

The Duck River basin located in south-central Tennessee has long been established as an area of freshwater mollusk diversity. This inventory effort examined 112 sites throughout the basin for freshwater mollusks. Historical species distributions were assembled from a database of museum records to examine changes in species richness and distribution. For freshwater mussels, 73 species historically occurred in the basin, and 55 of these are extant, including 3 federally listed species (Epioblasma capsaeformis, Lemiox rimosus, and Quadrula intermedia). Mussel densities examined either as Catch Per Unit Effort (CPUE) or direct quadrate sampling indicates a significant increase in 1979 versus 2002. Mean mussel densities at

Lillard's Mill increased from 17.8 m2 in 1979 to 36.6 m2 (n = 20) in 2002. Mussel species richness increased down-river (maximum 33 species), with a mean diversity of 17.6 species per site in the lower drainage. Mussel richness was not significantly different ($p = 0.76$) across 12 sites sampled in 1922, 1965, and 2002. In contrast to the main-stem river, mussel species richness has declined dramatically in tributary systems. Twenty-five species of freshwater gastropods were located during this study, and 2 were new species records for the drainage. Gastropod species richness was highest in the middle reach of the drainage with a mean of 6.84 species sampled per site. Habitat utilization patterns and density data for freshwater gastropods in the main-stem river are under evaluation. The apparent long-term stability for mollusk species richness and abundance in the Duck River basin make it an outstanding national resource.

PL 54 SPATIO-TEMPORAL PATTERNS OF DIVERSITY AND EXTIRPATION OF FRESHWATER MUSSELS IN THE CUMBERLAND RIVER BASI.

Melvin L. Warren, Jr. and Wendell R. Haag, Center for Bottomland Hardwoods Research, Southern Research Station, USDA Forest Service, 1000 Front Street, Oxford, MS 38655.

We synthesized survey information (early 1900s to present) for freshwater mussels in the Cumberland River Basin, Kentucky and Tennessee. We examined spatio-temporal patterns in species richness, persistence, and range extent and used species-area relationships to assess whether assemblages in tributary streams are biogeographic isolates. We subdivided the basin into 8 mainstem and 14 tributary units and assigned species to each as historically (early 1900s to 1985) or currently (post 1985) present or absent. Current species richness showed steep declines relative to historical richness throughout the basin (23 of 86 species extirpated), but mainstem units experienced larger declines (40 of 79 species extirpated) than tributary units (30 of 76 species extirpated). Current-day species persistence was associated strongly with the extent of historical distribution (Spearman's $r = 0.78$, $p < 0.0001$, $n = 86$). Mean range extent of species decreased from 10.2 ± 5.88 (mean ± 95% CI) units per species historically to 3.3 ± 0.73 units currently. Of the extant fauna (63 species), about one fourth now persist only in a single unit. Analysis of historical species richness in tributaries using species-area models indicated tributary faunas were functioning as biogeographical isolates. Our results have three implications. First, extensive range shrinkage and species isolation in the basin portend a continued, steep extinction trajectory. Second, most tributaries probably were capable of maintaining their mussel assemblages even if isolated from the mainstem. Finally, a large portion of the once great Cumberland River mussel fauna might persist if habitat and water quality conditions are maintained or improved in some major tributaries.

PL 55 A SURVEY OF THE FRESHWATER MOLLUSKS OF FORT STEWART, GEORGIA.

Kathryn E. Sukkestad[1], Thomas D. Bryce[2], Directorate of Public Works, Fish and Wildlife Branch Fort Stewart, Georgia 31314-4928, and Eugene P. Keferl[2], Coastal Georgia Community College, Brunswick, Georgia 31520-3644; 1-912-262-3089 (telephone), keferl@cgcc.edu

Fort Stewart is an 113,089-hectare U.S. Army Installation located on the Lower Coastal Plain of Georgia. The Canoochee and Ogeechee Rivers (Ogeechee River Basin) flow through the installation, and thousands of hectares of wetlands within their watersheds dominate Fort Stewart's landscape. The waters of the installation have never been systematically surveyed for freshwater mollusks. During the summers of 2001 and 2002, 79 sites across the installation were surveyed revealing eleven species of native freshwater Unionids. Two additional Unionid species were observed immediately adjacent to Fort Stewart waters. In addition, the exotic Asiatic clam, Corbicula fluminea, and five species of freshwater gastropods were also observed. Timed searches were conducted to assess relative abundance of mussel populations. Preliminary survey results reveal a sparsely populated mussel community with limited distribution and low diversity. High Unionid abundance was limited to three locations: a low order stream reach below the Hinesville/Fort Stewart Regional Water Pollution Control Plant, a series of old abandoned borrow pits within the floodplain of the Canoochee River, and an oxbow slough on the Ogeechee River. Mussel abundance and diversity were positively influenced by alkalinity and pH. Increasing levels of total phosphorus appeared to favor mussel abundance up to 6 mg/l, beyond which mussel counts declined. The Asiatic clam was observed at all sample sites, except those occurring in a first order stream segment within the Altamaha River basin, located in the southwestern end of the installation. Results of this survey will provide environmental managers with the necessary data to better coordinate military mission activities to protect the aquatic resources of Fort Stewart.

PL 56 STATUS REVIEW OF FRESHWATER MUSSELS (UNIONIDAE) OF THE RIO GRANDE, INCLUDING RECENT DISCOVERIES IN 2002.

Robert G. Howells[1], Tom Miller[2], and Jose-Luis Egremy-Hernandez.[3] [1]Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, HC07, Box 62, Ingram, TX 78025; rhowells@ktc.com; [2]Laredo Community College, [1]W. Washington Street, Laredo, TX 78040; [3]Northwest Vista College, 3535 N. Ellison Drive, San Antonio, TX 78251.

The Rio Grande drainage of Texas, New Mexico, and Mexico historically supported at least 16 species of freshwater mussels (Unionidae), but all have declined dramatically in recent decades. Field surveys 1992-2001 found living or recently-dead specimens of only six native and two apparently introduced taxa. In 2002, additional collections by Laredo Community College and Texas Parks and Wildlife Department personnel found two additional species alive and recently dead shells of another. Among the endemic taxa, recently-dead shells Salina mucket (Potamilus metnecktayi) and Mexican fawnsfoot (Truncilla cognata) have been collected, but Rio Grande monkeyface (Quadrula couchiana) is likely extinct. False spike (Quincuncina mitchelli) has probably been extirpated. Texas hornshell (Popenaias popeii) survives in New Mexico, near Laredo, and probably downstream of Big Bend. Tampico pearlymussel (Cyrtonaias tampicoensis) and paper pondshell (Utterbackia imbecillis) persist, as does yellow sandshell (Lampsilis teres). Introduced bleufer (Potamilus purpuratus) and southern mapleleaf (Quadrula apiculata) are also present; and giant floater (Pyganodon grandis) had apparently been lost, but then reintroduced. Among the other taxa, even unionids that are often abundant else where, appear to have disappeared from the Rio Grande within the past 10-100 years. Numerous ongoing factors have contributed to this decline including natural and anthropogenic desertification, poor water and land management practices, habitat modification, pollution, siltation, and increased salinity. However, the continued survival of species like washboard, yellow sandshell, Texas hornshell, and Mexican fawnsfoot is encouraging.

PL 57 THE CONSERVATION STATUS OF NORTH AMERICAN FRESHWATER GASTROPODS.

Kenneth M. Brown[1] and Paul D. Johnson[2]. [1]Department of Biological Sciences, Louisiana State University, Baton Rouge, LA 70803. Tennessee Aquarium Research Institute, 5385 Red Clay Road, Cohutta, GA 30710.

With 592 described species as of 1998, North America has the greatest species richness of freshwater snails on the planet. However this natural resource appears to be the most threatened of all major taxa. Fully 61% of the species have a Global Conservation Rank (G Rank) < 3, which is a higher rate of imperilment than any other major taxal group (amphibians, fishes, crayfishes, or mussels). To date 44 species are extinct, 21 are listed under the U.S. Fish and Wildlife Service Endangered Species Act, and the recent extinction rate is estimated at 0.8% species loss per decade. We will present updated distributional and conservation status information originally assembled by The Nature Conservancy. These data indicate our gastropod resources are highly endemic and increasingly rare, especially in the Mobile, Tennessee, and the Great Basin drainages. To date the majority of species listings, highest imperilment rates, and species extinctions have occurred in the Mobile River Basin. Historically species losses were attributable to dam construction, navigation projects, and point source discharge, but current challenges are presented by habitat destruction, sedimentation, population fragmentation, and non-point source water quality problems. Recent artificial Lack of specific status information, some remaining systematic problems, and the limited number of specialists, impede conservation efforts with these animals.

PLATFORM SESSION 6B

Contaminants II

Tuesday, March 18, 3:20 - 5:00 p.m.

Sheraton Imperial Hotel • Imperial III

PL 58 EFFECTS OF SEDIMENTARY AMMONIA ON JUVENILE UNIONIDS IN LABORATORY AND FIELD STUDIES.

Teresa Newton[1], Michelle Bartsch[1], John Allran[2], and Jon O'Donnell[2]. [1]USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI 54603; [2]University of Wisconsin-La Crosse, La Crosse, WI 54602.

Ammonia is a common pollutant that enters rivers through industrial and sewage discharges, fertilizers, and natural processes, and is toxic at low concentrations. The St. Croix River contains an abundant and diverse unionid fauna, but as the metropolitan area of Minneapolis-St. Paul expands, there is a threat of deteriorating water and sediment quality in the basin. Ammonia and other contaminants preferentially accumulate in sediments and pore water; these may be important routes of exposure for benthic, filter-feeding unionids. In the laboratory, juvenile Lampsilis cardium were exposed to un-ionized ammonia (NH3-N) in pore water in 96-h and 10-d sediment toxicity tests. Concentrations of NH3-N that were lethal to 50% of the mussels ranged from 93 to 165 μg/L. Growth rate was substantially reduced at concentrations as low as 31 μg NH3-N/L. The

lethality results (expressed as total ammonia) are about one-half the acute national water quality criterion, suggesting that existing criteria may not be protecting juvenile unionids. In the field, we deployed six chambers (each containing 20 juveniles) into sediments at eight sites in the St. Croix River and removed two chambers at 4, 10, and 28 days to assess survival and growth. Survival (mean, 45% at 4 d, 28% at 10 d, and 41% at 28 d) and growth (range, 3 to 45 μm/d) of juveniles were highly variable and were generally unrelated to NH3-N concentrations. Although unionids are frequently used as indicators of contaminant exposure, the large variance associated with survival and growth suggests that more sensitive endpoints need to be found in this imperiled faunal group.

PL 59 EVALUATION OF WATER QUALITY CRITERIA FOR PROTECTION OF FRESHWATER MUSSELS (UNIONIDAE) FROM AMMONIA EXPOSURE.

Tom Augspurger[1], Anne E. Keller[2], Marsha C. Black[3], W. Gregory Cope[4], and F. James Dwyer[5]. [1]U.S. Fish and Wildlife Service, P.O. Box 33726, Raleigh, NC 27636; [2]U.S. Environmental Protection Agency, Science and Ecosystem Support Division, 980 College Station Road, Athens, GA 30605; [3]Department of Environmental Health Science, University of Georgia, Athens, GA 30602; [4]North Carolina State University, Department of Environmental and Molecular Toxicology, Raleigh, NC 27695-7633; [5]U.S. Fish and Wildlife Service, 608 East Cherry Street, Columbia, MO 65201.

Ammonia toxicity data for freshwater mussels (Unionidae), were used to derive estimates of concentrations that would not be harmful in acute and chronic exposures and to assess the protectiveness of existing water quality criteria. Twenty-two 24 to 96 h LC50s, covering nine species in eight unionid genera were used to calculate genus mean acute values (GMAVs) from 3.57 to 8.88 mg/l total ammonia as N, normalized to pH 8. Freshwater mussels were uniformly at the sensitive end of the range when added to the GMAVs from the national data-base used to derive the criteria maximum concentration (CMC). We derived freshwater mussel criteria maximum concentration guidelines (CMCFM) using acute data for all freshwater mussel lifestages (2.21 mg/l total ammonia as N, normalized to pH 8) and using only data for adult and juvenile mussel lifestages (2.81 mg/l total ammonia as N, normalized to pH 8). These were about 60% and 50% less, respectively, than the CMC of 5.62 mg/l used for the national acute water quality criteria. There were no chronic ammonia exposure data for unionids and no assessments that incorporated sublethal endpoints. Thus, two acute-chronic ratios were used that yielded freshwater mussel criteria continuous concentrations guidelines (CCCFM) from 0.28 to 0.48 mg/l total ammonia as N, normalized to pH 8 and 25 oC. The average CCC for mussels (0.38 mg/l total ammonia as N, normalized to pH 8 and 25oC) is about 70% less than the CCC of 1.24 mg/l for pH 8 and 25oC in the national criteria. The current numerical criteria for ammonia may not be protective of mussels.

PL 60 EFFECTS OF DRILLING AGENTS ON THE GROWTH AND SURVIVAL OF JUVENILE MUSSELS.

Robert G. Hudson,[1]David A. McKinney,[2] James T. Wetzel,[1] Jason Griner,[1] Amanda Brinson,[1] and Jay Hinesley.[1] [1]Department of Biology, Presbyterian College, Clinton, SC 29325; [2]Tennessee Wildlife Resources Agency, Ellington Agricultural Center, Nashville, TN 37204.

Two common drilling agents used for directional boring (bentonite clay and EZ Mud(r)) were tested for chronic and acute effects on juvenile mussels, Utterbackia imbecillis. Juveniles placed in increasing proportions of bentonite clay in sediment (3.125%, 6.25%, 12.5%, 25%, 50% and 100%) did not demonstrate a lethal effect when compared to control mussels in a 90-day chronic test; however, SEM and light microscopy revealed permanent shell deformities and growth retardation with increasing levels of bentonite in sediment (r= -0.78). Because the second agent, EZ Mud(r), was water soluble, it could be used in 9-day acute tests with varying concentrations in water. The initial acute test had a wide range of 1.56%, 3.12%, 6.25%, 12.5%, 25% and 50% EZ Mud(r), whereas subsequent acute tests were narrowed to a range between 0.312% and 5%. These acute tests demonstrated that EZ Mud(r) in solution was toxic at concentrations of 0.5 - 1.6%. These tests were run using fish-transformed and artificially transformed juveniles. Data produced from these comparisons indicate that the size of the mussels rather than their mode of transformation was responsible for observed mortality variations. Unlike bentonite which could be part of the sediment itself, the EZ Mud(r) chronic test contained control sediment which had been soaked in solutions containing 3.125%, 6.25%, 12.5%, 25%, 50% and 100% EZ Mud(r). Chronic lethal effects could be seen above 18% EZ Mud(r) for days 27 - 41 and growth gain was inversely proportional to the concentration of EZ Mud(r) in sediment (r = -0.93).

PL 61 TOXICOLOGICAL ASSESSMENT OF CONASAUGA RIVER SEDIMENTS.

Elizabeth Guthrie Nichols[1], Chris Hofelt[1], Paul Johnson[2]. [1]North Carolina State University, Raleigh, NC 27695, [2]Tennessee Aquarium Research Institute, 5385 Red Clay Road, Cohutta, GA 30710.

The Conasauga River, located in northwest Georgia, is impacted by various land uses that include row crop, livestock operations, urban inputs, recreational human use, and transportation corridors. Initial toxicity screening data from July 2000 to April

2002 suggests that sediments may be acutely toxic, particularly at low flow events, due to external input factors. Initial screening data is sufficient to warrant more intensive investigation of sediment quality. One time sampling may not always capture the full impact of external inputs due to various meteorological and land use patterns that change over time. Based on toxicity screening data, we will deploy passive sampling devices to monitor contaminants in the river during spring, summer, and fall/winter. Composite sediments and river water will be collected separately and screened for organic and inorganic contaminants. Sediments will also undergo geochemical analyses such as percent organic carbon and CPMAS 13C NMR to evaluate sediment organic structure. Aliquots of collected freeze-dried sediments will be screened again for acute toxicity using the Vibrio fischeri Flash Test. Chemical speciation data, toxicity data, and geochemical data will be correlated with available water quality, biological inventory data, and land use patterns. Based on this assessment data, research efforts will be directed to determine specific mechanisms that may impact mussel reproduction, abundance, diversity, and survival.

PL 62 IMPACTS ON EARLY LIFESTAGES OF FRESHWATER MUSSELS FROM SEDIMENTS AND CONTRIBUTED METALS ASSOCIATED WITH SURFACE MINING IN SOUTHWEST VIRGINIA.

Mary T. McCann[1], Jerry L. Farris[2], and Richard J. Neves[3]. [1]Framatome ANP DE&S, 500 Washington Ave., Portland, ME 04103; [2]Environmental Sciences Program, Arkansas State University, State University, AR 72401; [3]Virginia Polytechnic Institute, Fisheries & Wildlife Sciences, 106B Cheatham Hall, Blacksburg, VA 24061.

Ongoing loss of mussel fauna in the Powell River has been attributed to extensive mining activities in headwater streams of Wise and Lee Counties, Virginia. Surface mining contributes sedimentation from erosion and associated particulate fines from coal washing and waste pile runoff. Historic water quality has been shown to contain toxic concentrations of metals in temporal occurrence. Glochidia and juvenile mussels of Medionidus conradicus, Actinonaias pectorosa, and Villosa iris were used in testing water with Zn & Cu, mixtures of Zn & Cu, and sediment from the Powell River to establish possible metal thresholds or site effects. Acute LC50 values for glochidia were species specific and ranged from 274 to 4,123 ug Zn/L and 52 to 156 ug Cu/L. Acute EC50 values ranged from 25 to 115 ug Cu/L for juveniles of A. pectorosa. LC50 tests indicated at certain concentrations, Zn had an antagonistic effect when mixed with Cu. Impairment sensitivity to metal exposures was species specific and differed with higher temperature, softer water and increased exposure times. The temporal nature of site sediment toxicity was apparent in test comparisons between river and dechlorinated laboratory tap water. Measured episodic excursions of metal ions above water quality criteria coupled with the toxicity assessments from this study suggests the need for more extensive monitoring of water quality to identify specific sources of pollution and to provide adequate conservation for mussel environmental requirements in the Powell River.

PLATFORM SESSION 7A

Status & Distribution II

Wednesday, March 19, 8:00 - 9:40 a.m.

Sheraton Imperial Hotel • Imperial I, II

PL 63 STATUS, RANGE, AND HABITAT USE OF UNIONIDS IN SEVERAL LOWER MICHIGAN RIVERS.

Peter J. Badra and Stephanie M. Carman. Michigan Natural Features Inventory, Michigan State University Extension, Mason Building, PO Box 30444, Lansing, MI 48909.

More complete and up-to-date information on the status, range, and habitat use of unionids occurring in Michigan is needed to guide management decisions related to these species and their associated ecosystems. The lower reaches of large rivers in particular have not been adequately surveyed in recent times. This is in part due to the difficulty in accessing and surveying these habitats with greater depth, current, and turbidity. In 2001 and 2002 unionid communities were surveyed at a total of 81 sites on 11 rivers in Michigan's lower peninsula. We report our findings to date on this ongoing effort to document and assess unionid communities statewide. Tactile and visual searches of transects were performed with SCUBA and glass-bottomed buckets depending on water depth and clarity. The relation of substrate composition to unionid community composition across several watersheds is investigated. Associations between substrate type and occurrence of special concern, threatened, and endangered unionids are investigated to better understand the habitat requirements of these species. Intensity of Dreissena polymorpha colonization of unionids was determined to estimate the impact of this exotic on associated unionid communities. Potential impacts

to sites with particularly high unionid diversity are identified. Occurrence data is being used to help assess the statewide status of listed and non-listed unionids, as well as contribute to the range-wide status assessment of these species.

PL 64 WHY IS THE UNIONID FAUNA DIFFERENT AROUND THE CORNER FROM THE ST. CROIX? UNIONID RECOVERY IN MISSISSIPPI RIVER.

MARGINAL HABITAT, POOL[2], MINNESOTA. Marian E. Havlik, Malacological Consultants, La Crosse, WI 54601-4969

Mississippi River unionids, upstream of the St. Croix River mouth, have been impacted by pollution from the Twin Cities. In 2002, 19,680 unionids (23 species) were recovered from 52,250 m2 of marginal habitat in lower Pool 2 prior to construction of an outfall pipe. Seven species were on Minnesota's T & E list. Endangered Quadrula nodulata was 7.37 % (1451) of the total, and 3rd most abundant. Endangered Arcidens confragosus was 0.99% (194) of the fauna, and 10th most abundant. Other T & E species (1-7 specimens) included Megalonaias nervosa, Tritogonia verrucosa, Actinonaias ligamentina, Obovaria olivaria, and Ligumia recta. The most common species were Obliquaria reflexa (46.8%) and Quadrula quadrula (23.9%); Amblema plicata was 3.2%. Nearly 600 of 1657 widely distributed T & E unionids, from all habitat types, were measured and numbered. Although densities were low (mean 0.38/m2), there was good reproduction by most species. The substrata was marginal quality (mud) in <1 m - 6m depths. Most of the area was shallow since site was in the impounded area upstream of Lock & Dam 2, Hastings, MN. The large old (main) Ninninger channel, adjacent to N shoreline, was 125-300 m wide and 6 m deep with little to moderate current. The only areas of unionid concentrations were near the navigation channel where the substratum was coarser and thus better habitat. Damage to unionids near the navigation channel is apparently from commercial traffic. A 1980's lawsuit improved the Twin Cities water quality, which improved the Pool 2 unionid fauna. But for unknown reasons Q. nodulata and A. confragosus are almost nonexistent in the nearby, protected St. Croix.

PL 65 SURVEY OF UNIONOIDS IN REGULATED RIVERS IN SOUTHWESTERN MISSOURI.

Christian A.Hutson and Christopher Barnhart. Department of Biology, Southwest Missouri State University, 901 South National Avenue, Springfield, MO 65804.

The Sac and Pomme de Terre Rivers are major tributaries of the Osage River (Missouri River system). The Sac was impounded in 1970 and Pomme de Terre in 1961. We sought to determine the distribution and abundance of native freshwater mussels and to document the downstream effects of dams on these faunas. Fifty sites were surveyed (35 in the Sac system and 15 in the Pomme de Terre) between August 2001 and September 2002. Timed searches by snorkeling and diving averaged 2.7 man-h per site and totaled 139 man-h. We collected 12,393 individual mussels, representing 35 living species, with up to 21 species per site. Catch per unit effort ranged from 1 to 286 individuals per man-h with an average of 89.1 individuals per man-h. The most abundant species in the Sac (as percent of the total) were the purple wartyback (25%), Wabash pigtoe, pimpleback (~9% each), threeridge, washboard, butterfly (~8% each), mucket, monkeyface, plain pocketbook, pistolgrip, and threehorn wartyback (~4% each). The most abundant species in the Pomme de Terre were the threeridge (43%), plain pocketbook (10.4%), purple wartyback (6.9%), ellipse and pimpleback (5.9% each) and deertoe (4%). The Sac fauna includes the federally endangered pink mucket as well as several other species of concern. The salamander mussel was found in a Sac tributary, constituting the first record of this species in any part of the Missouri River system. Operation of the Stockton hydropower dam on the Sac has severe erosive effects downstream, and unionid diversity and abundance are lowered for over 15 miles below the dam. A non-hydropower dam on the Pomme de Terre apparently has much less downstream impact.

PL 66 CONSERVATION INITIATIVE: ATTEMPTS TO IDENTIFY CAUSAL FACTORS OF DECLINE IN A MISSOURI MUSSEL ASSEMBLAGE.

Sue A. Bruenderman[1], Joseph R. Bidwell[2] and Alan C. Buchanan.[1] [1]Missouri Department of Conservation, Conservation Research Center, 1110 S. College Avenue, Columbia, Missouri 65201; Department of Zoology, 430 Life Sciences West, Oklahoma State University, Stillwater, OK 74078.

Surveys of the mussel fauna in Little Black River, Ripley Co., Missouri between 1979 and 1998 revealed a severe decline in mussel diversity, including the apparent extirpation of the federally endangered Curtis pearlymussel, Epioblasma florentina curtisi. During subsequent visits to Little Black River, we observed that living mussels exhibited shell erosion, reduced body weight and slow valve closure when handled. Cause(s) of mussel decline and the loss of the Curtis pearlymussel are unclear, but known problems in the watershed include elevated fecal coliform bacteria, floodplain scour and accelerated soil erosion In addition, high densities of the Asian clam (Corbicula fluminea) may also be contributing to the problem since ammonia levels produced from decomposing dead clams during periodic die-offs can negatively affect native mussels. In 2002, we initiated a study to further investigate this issue Our objectives were to: 1) characterize ammonia and dissolve oxygen levels in sediments (porewater) from Little Black River during an artificially-induced die-off of Asian clams, and 2) field validate the laboratory study. Results of this and other planned research will be presented.

PL 67 CURRENT AND HISTORICAL DISTRIBUTIONS OF MUSSELS IN THE MUSKEGON RIVER WATERSHED, MICHIGAN.

Stephanie M. Carman and Peter J. Badra. Michigan Natural Features Inventory, Michigan State University Extension, Mason Bldg., P.O. Box 30444, Lansing, MI 48909-7944.

The Muskegon River is one of the largest rivers in Michigan, draining over 2,723 square miles of mainly agricultural and forested land in north-central Michigan. The Muskegon River watershed has experienced numerous human-induced changes, including the impoundment of nearly 25% of the main stem and the dredging and straightening of many of the tributaries. Unfortunately, little data exists about the state of the aquatic communities present prior to these impacts. Here we seek to understand changes in the native unionid populations over the past 70 years, using van der Schalie's 1934 survey as baseline data. In the summer of 2002, we surveyed mussel populations at 61 sites in the watershed. At each site, we searched 130 square-meters using either glass-bottomed buckets or SCUBA equipment. Significant differences were found between the historic and current mussel communities, particularly in terms of species richness and relative abundance of mussels. While nineteen unionid species had previously been reported from the watershed, only fourteen unionid species were found live in 2002. Unionid species diversity tended to be more similar to historical data in upper watershed tributaries than in the lower reaches of the main channel. Of the twelve sites on the main stem where van der Schalie reported mussels, only four had live mussel communities in 2002. This may be due in part to the impacts of several large dams on the system and increased sedimentation lower in the watershed.

PLATFORM SESSION 7B

Monitoring

Wednesday, March 19, 8:00 - 9:40 a.m.

Sheraton Imperial Hotel • Imperial III

PL 68 REFERENCE RANGES FOR HEMOLYMPH CHEMISTRIES FROM ELLIPTIO COMPLANATA OF NORTH CAROLINA.

Lori L. Gustafson[1], Jay F. Levine[1], William Showers[2], W, Gregory Cope[3], Christopher Eads[1], Rick Linnehan[4], Thomas Kwak[5], Beth Anderson[6] and Michael K. Stoskopf[1] [1]College of Veterinary Medicine, North Carolina State University (NCSU), Raleigh, NC 27606. [2]College of Physical and Mathematical Sciences, NCSU, Raleigh, NC 27695,[3]College of Agriculture and Life Sciences, NCSU, Raleigh, NC. 27695, [4]National Aeronautic and Space Administration, Houston, TX 77058, [5]College of Agriculture and Life Sciences, NCSU, Raleigh NC27695, [6]Center for Earth Observation, NCSU, Raleigh, NC. 27695.

Hemolymph chemistries are potentially useful nonlethal measures of bivalve health. The prognostic value of hemolymph, however, depends on comparison of populations' chemistry results with reference ranges developed from healthy individuals. Currently, knowledge of expected hemolymph values in healthy and unhealthy freshwater mussels is extremely limited. We present reference ranges from a total of 200 Elliptio complanata collected from 10 apparently healthy populations. The mussels were obtained from forested waterways northwest of Raleigh, North Carolina during May through July 2001. We compare these results to populations of animals from agricultural sub-basins in the same temporal and geographic regions. We also present associations noted between hemolymph chemistries and physical or physiologic parameters. A statistically significant difference was observed in hemolymph calcium and glucose values of animals obtained in agricultural and forested areas. There was also a statistically significant difference in the hemolymph protein concentrations observed in gravid and nongravid animals. The results from this study will aid the interpretation of health measures from populations of Elliptio complanata of similar geographic and seasonal origin.

PL 69 DEVELOPMENT OF EXPECTED, NORMAL BACTERIAL FLORA DATABASES (FROM SELECTED UNIONIDS) AND THEIR USE TO IDENTIFY DISEASE CAUSING AGENTS.

Clifford Starliper[1], Richard Neves[2], William F. Henley[2] and Shane D. Hanlon3. [1]USGS National Fish Health Research Laboratory, Leetown, WV 25430; [2]Virginia Coop Fish and Wildlife Research Unit, Blacksburg, VA 24061; [3]USFWS Southwestern Virginia Field Office, Abdingdon, VA 24210.

Mussel mortality events i.e. dieoffs are being noted and often a cause is not identified. With some dieoffs, several associated criteria, such as, gravidity, seasonality and host specificity have been noted and in other animals (e.g. fishes) these criteria can be predisposing factors to diseases. To date, etiology-caused diseases and mortality in mussels has been minimally addressed. Dieoffs have been observed in the Holston and Clinch Rivers. Clinical signs include weakened abductor muscles resulting in impaired valve closure. Mortality has occurred to species (some gravid) including Lexingtonia dolabelloides, Pleurobema oviforme and Fusconaia ebena. With this study, we want to position ourselves to identify bacterial agents as a cause of dieoffs. Normal bacterial flora databases

will be developed through periodic sampling at sites on the aforementioned rivers. This will allow for comparison to the bacteria from diseased mussels. Mussels are being collected quarterly; 20 per species per site. Pallial fluids and tissue homogenates are used to inoculate microbiological media for primary isolation of bacteria. Resulting bacteria are enumerated and characterized. Bacterial counts range from 3×104 to 4×106 cfu total. Most frequently, motile Aeromonads, nonfermenters and Enterics are isolated. During this study, a dieoff in the Holston occurred; two bacteria are suspected as causes; challenges are being done in an attempt to fulfill Koch's Postulates. As pathogens are identified, they can be screened during health inspections and strategies can be implemented to prevent transmission to populations of captive mussels.

PL 70 COOPERATIVE MITIGATION DESIGN: A CASE STUDY, MULLET RIVER, GREENBUSH, WI.

Heidi L. Dunn[1] and Helen Kitchel[2].
[1]Ecological Specialists, Inc., O'Fallon, MO; [2]Wisconsin Department of Natural Resources, Madison, WI.

The State Historical Society of Wisconsin (SHSW) proposed reconstructing a water-powered sawmill at Wade House Historic Site in Greenbush, Wisconsin, which required damming the Mullet River to maintain historical accuracy. The Mullet River currently contains one of the few populations of Venustaconcha ellipsiformis and Alasmidonta viridis (both threatened in Wisconsin) in Wisconsin. Although a difficult process, SHSW and WDNR along with consultants worked to design the project such that the mill could be restored with minimal harm to the unionid community in the river. Issues that were considered in design included minimizing the impounded area by creating a side pond, maintaining adequate flow in the original river channel to support the existing aquatic community through modified sawmill operation during low flows, fish passage around the dam through a fish tunnel, and damping of temperature and flow fluctuations downstream of the dam through construction of a re-regulation pool. Only 50m of the river were impounded, yet the public can view an operating water-powered sawmill. Water temperature, dissolved oxygen, flow, fish assemblages, and unionids have been monitored upstream, within, and downstream of the project for three years. Preliminary results indicate that unionid and fish assemblages are coexisting with historical sawmill operation.

PL 71 A COOPERATIVE EFFORT TO REDUCE CONSTRUCTION AND OPERATION EFFECTS OF A BARGE LOADING FACILITY ON UNIONIDS IN THE OHIO RIVER.

Charles S. Howard and Heidi L. Dunn. Ecological Specialists, Inc., 1417 Hoff Industrial Drive, O'Fallon, MO 63366.

Cooperation between Ecological Specialists, USFWS, USACE, and LeTart Corporation facilitated changes in location and operation of a barge loading/fleeting facility to reduce effects on unionids near Ohio RM 205. Facility changes included construction in an area with lower unionid density, elimination of dredging, reduced scour and turbidity, and alleviated flow restriction near the bank. Species richness, density, mortality, and age structure near the facility in 1999-2001 were compared to baseline conditions (1994-1998) and an upstream reference area. Mean live species decreased between baseline and operation phases (20 to 17 species), but they also decreased within the reference area (17 to 14 species). Mean density decreased significantly (5.1 to 1.3/m2) between phases, but also decreased significantly (3.4 to 0.7/m2) within the reference area. Mortality increased dramatically in both the facility area (5 to 47%) and reference area (0 to 52%) between the baseline and operation phases. Mean age of unionids within the facility area (6-11y) varied significantly amongst years (1994-2001), but did not vary significantly between any years in the reference area (5-10y). However, juveniles (=3y) within both areas may be declining since operation began. Although deleterious changes to the unionid community within the facility area are indicated by all parameters measured, these changes are occurring similarly within the reference area. Effects from fluctuating zebra mussel densities and the Belleville Dam hydropower facility (RM 204), which began operation in 1999, may be masking differential changes in unionids of the facility and reference areas that are associated specifically with the barge loading/fleeting facility.

PL 72 REVIEW OF CHANNELED APPLESNAIL (POMACEA CANALICULATA) INTRODUCTIONS IN THE UNITED STATES.

Robert G. Howells[1] and James W. Smith.[2]
[1]Texas Parks and Wildlife Department, Heart of the Hills Fisheries Science Center, HC07, Box 62, Ingram, TX 78025; rhowells@ktc.com; [2]United States Department of Agriculture, Animal and Plant Health Inspection Service, 1017 Main Campus Drive, Suite 2500, Raleigh, NC 27606; james.w.smith@aphis.usda.gov.

The South American channeled applesnail Pomacea canaliculata (Family Ampullariidae) has been introduced and established within the United States in central Florida, three sites in southern California, and over 12 locations in southeastern and northern Texas. In Florida, populations are not generally in agricultural areas; however, some ecological impact has been observed there. One California introduction discovered in 2001 may be near cultivated lands, but at present not agricultural plant species subject to Pomacea depredation. In Texas, however, most populations found in 2000 and 2001 were centrally-located in the rice-producing region (Harris, Galveston, and Brazoria

counties). In late 2002, snails were also reported in fields in Fort Bend County, Texas, upstream and west of the introduction sites. The species is now present in Texas rice irrigation canals, natural streams and bayous adjacent to fields, and rice fields themselves. Although egg masses, vast numbers of juveniles, and some adults were found in rice fields in 2002, no crop damage has been reported to date (October 2002). It is hoped that draining irrigation canals over winter, dewatering fields when not in production, and perhaps use of selected pesticides may be able to restrict population size to tolerable levels. Present P. canaliculata populations, except possibly in Florida, also are not currently in locations where extensive ecological damage would be expected. Texas, Mississippi, and U.S. Department of Agriculture have recently pass regulations to restrict trade, transport, and distribution of exotic applesnails.

PLATFORM SESSION 8A

Propagation & Reproduction II

Wednesday, March 19, 10:00 - 11:40 a.m.

Sheraton Imperial Hotel • Imperial I, II

PL 73 FRESHWATER MUSSEL PROPAGATION: THE HARVEST IS GREAT BUT THE WORKERS ARE FEW.

Richard J. Neves, Jess W. Jones, William F. Henley, and Rachel A. Mair. Virginia Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, Virginia Tech, Blacksburg, VA 24061.

The Freshwater Mollusk Conservation Center at Virginia Tech required nearly 10 years of research and aquaculture experimentation to develop effective techniques for the propagation, production, and release of endangered juvenile mussels into the upper Tennessee River system. Initial releases of cultured juveniles began in 1997, and annual releases of a suite of endangered species have continued through funding support by the U.S. Fish and Wildlife Service, Tennessee, and Virginia. A grant from the National Fish and Wildlife Foundation in 2000 allowed construction of a propagation facility dedicated to mollusk conservation. Involvement in mollusk propagation by other states, and federal hatcheries, is now expanding to address the conservation needs of the 70 federally protected species, as well as endemic or regionally rare species. As this nucleus of facilities begins to demonstrate success, the expectation and hope is that now-timid hatchery personnel will embrace this conservation tool to diversify their mission and responsibility for restoration of shellfish as well as finfish in state and national waters.

PL 74 FACTORS AFFECTING SURVIVAL AND GROWTH OF JUVENILE FRESHWATER MUSSELS (BIVALVIA: UNIONIDAE) CULTURED IN RECIRCULATING AQUACULTURE SYSTEMS.

Jess W. Jones, Rachel A. Mair and Richard J. Neves. Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061. email: vtaquaculture@hotmail.com

Seasonal differences in glochidial maturity, substrate, and diet were studied to determine how these factors affect survival and growth of juvenile freshwater mussels. Comparisons were made between juveniles produced in the fall vs spring of the year; cultured in sediment, sand or without substrate; and fed either of 2 small (5-10 (m) species of green algae. Survival and growth of endangered juveniles of Epioblasma capsaeformis also were compared to those of a common, seemingly more robust species, Villosa iris. Survival and growth of juvenile V. iris was significantly ($p<0.001$) greater than that of juvenile E. capsaeformis. Survival and growth of juveniles of both species was significantly greater when propagated in the spring vs fall ($p<0.001$), when glochidia were more mature. Survival and growth of juveniles of both species was significantly greater when cultured in a sediment substratum vs sand or no substratum ($p<0.001$). No differences ($p>0.05$) were observed in survival and growth of juveniles fed either algal species Neochloris oleoabundans or Nannochloropsis oculata. In fall culture experiments, mean survival of juvenile E. capsaeformis was 1.6% at 60 days of age, and mean length was 410 (m. In contrast, mean survival of juvenile V. iris was 29.0% at 60 days of age, and mean length was 1193 (m. In spring culture experiments, mean survival of juvenile E. capsaeformis improved to 47.6% at 60 days of age, and mean length was 664 (m; whereas mean survival of juvenile V. iris was 42.3% at 60 days of age, and mean length was 1447 (m.

PL 75 PROPAGATION OF FRESHWATER MUSSELS IN KENTUCKY: APPLIED MANAGEMENT TO AN IMPERILED RESOURCE.

Monte A. McGregor and Adam Shepard. Kentucky Department of Fish and Wildlife Resources. #1 Game Farm Road, Frankfort, KY 40601.

The state of Kentucky has one of the most diverse mussel populations in North America with 41 genera and 104 recognized species. Twelve mussels are presumed extinct, and another 22 are listed by the U.S. Fish and Wildlife Service as endangered. Due to recent advances in technology and interests in proactive recovery of freshwater mussels, the Kentucky Department of Fish and Wildlife Resources started an Aquatic Restoration

Initiative to restore and recover the highly imperiled freshwater habitats and its native mussel fauna. We renovated an existing hatchery building in the summer 2002 to hold adult mussels in captivity, culture juveniles in a closed recirculating system, and rear juveniles in an open (partial flow-through) recirculating system. Adult holding tanks (raceways) were created using natural substrates and fast and slow flow conditions with high exchange rates (0.5 to 1 exchanges per minute). Thirty-four species of mussels were held in captivity throughout the summer with high survival (100% for most species). Juveniles of the wavyrayed lampmussel, Lampsilis fasciola, were cultured at the hatchery using largemouth and smallmouth bass. Infested fish were held in a 62 tank (one to nine liters) closed recirculating system (Aquatic Habitats (). Metamorphosed juveniles were placed in a 24 tank open recirculating system with mechanical filtration (bag filters) and temperature control. We evaluated growth and survival of juveniles after 100 days. Juveniles increased from ~ 220 microns to an average of 1,100 microns with a survival of 43%.

PL 76 THE USE OF FLOW-THROUTH AND RECIRCULATING SYSTEMS TO HOLD, PROPAGATE, AND GROW FRESHWATER MUSSELS.

Michael J. Pinder[1], Joe J. Ferraro[2], and Monte A. McGregor.[3] Virginia Department of Game and Inland Fisheries, 12206 South Main Street, Suite C, Blacksburg, Virginia, 24060, [2]Rt. 3, Box 391, Marion, Virginia 24354, [3]Kentucky Department of Fish and Wildlife Resources, #1 Game Farm Rd., Frankfort, KY 40601.

To cultivate freshwater mussels, we have found that a multi-system approach is the best method to optimize production at each life stage. The Virginia Department of Game and Inland Fisheries' Aquatic Wildlife Conservation Center near Marion, Virginia implements a flow-through system to hold adult mussels, a recirculating system to produce juveniles, and a filtered flow-through system to raise juveniles. Before entering the facility, river-water is diverted to a 1,000 m3 pond that increases algae and temperature. Adult mussels are maintained in the flow-through system of a hatchery raceway. Of the 25 species held since 1998, most have shown high survival and reproductive condition. To produce newly metamorphosed juveniles from infected host fishes, we use a multi-tank recirculating system that incorporates multiple filtration devices to sterilize water. A constant water temperature of 21°C produces mussels in 14 days post-infestation. We have produced Villosa iris and Potamilis alatus and tested host fishes for Cumberlandia monodonta with this method. The filtered flow-through system passes river-water through a cartridge filter into several circular tanks containing juveniles of various species. The filter functions to reduce the number of large mussel predators and excessive silt loading while still allowing small particulates to juveniles. We have demonstrated >70% survival from 60 to 90 days and a 3-10 fold increase in shell length for several species. Using the appropriate system for each specific life history stage is critical in the successful production of freshwater mussels.

PLATFORM SESSION 8B

Evolution & Phylogenetics III

Wednesday, March 19, 10:00 - 11:40 a.m.

Sheraton Imperial Hotel • Imperial III

PL 77 HIGH LEVELS OF MITOCHONDRIAL DNA SEQUENCE DIVERGENCE IN ISOLATED POPULATIONS OF THE FRESHWATER SNAIL, GONIOBASIS.

Robert T. Dillon, Jr., Robert C. Frankis, Jr.. Department of Biology, College of Charleston, Charleston, SC 29424.

In addition to their utility for phylogenetic reconstruction, mitochondrial sequence data have increasingly found application in studies of species-level systematics. We have amplified and sequenced a 709 bp fragment of the mitochondrial gene encoding cytochrome oxidase 1, and an approximately 530 bp fragment of the ribosomal large subunit (16S) gene for three individuals from each of three populations representing geographic races of the well studied freshwater prosobranch snail, Goniobasis proxima. By comparing intraspecific divergence to divergence in these same genes among G. proxima and the related Goniobasis semicarinata and Goniobasis catenaria, our purpose was to calibrate mitochondrial sequence data for application in future systematic studies of isolated, poorly-mobile mollusk populations where genetic relationships may be less well understood. We identified four distinct haplotypes in the nine G. proxima genomes we amplified for each gene fragment, with a maximum likelihood sequence difference of 8.6% - 16.9% for CO1 and 5.7% - 18.7% for 16S. These levels of intraspecific divergence overlapped extensively with interspecific maximum likelihood differences, which ranged from

11.4% - 17.7% for CO1 and 9.5% - 16.5% for 16S. The extreme fragmentation which often characterizes freshwater gastropod population structure, together with the ability of such populations to reach large size and great age, must be taken into consideration before systematic inference can be made on the basis of sequence divergence for these genes.

PL 78 PHYLOGEOGRAPHY OF THE DWARF WEDGE MUSSEL, ALASMIDONTA HETERODON (UNIONIDAE).

Cheryl L. Morrison, Michael S. Eackles, and Tim L. King. US Geological Survey, Biological Resources Division, Leetown Science Center, Aquatic Ecology Branch, 11700 Leetown Rd., Kearneysville, WV, 25430.

We have collected mitochondrial DNA sequence data for the cytochrome oxidase I gene from individuals of the federally endangered dwarf wedge mussel, Alasmidonta heterodon (Superfamily Anodontinae), from five geographical populations from the Eastern US (New Hampshire, New York, New Jersey, Maryland, and North Carolina). The relatedness of these disjunct populations is unknown and must be ascertained before appropriate management actions can be implemented. The extent of genetic variation between these populations will be discussed, and a parsimony-based haplotype network representing the extent of haplotype differentiation within and between populations will be presented. Mitochondrail DNA divergence between geographical A. heterodon populations will be put into a phylogenetic context with several other at-risk congeners (A. undulata, A. marginata, A viridis), several closely related taxa in the genus Lasmigona, plus several other genera belonging to the Superfamily Anodontinae (e.g. Anodonta, Strophitus). Evolutionary and management implications based upon these results will be discussed.

PL 79 SEARCH FOR CRYPTIC SPECIES IN THE PARAPHYLETIC GENUS LASMIGONA RAFINESQUE, 1831 (MOLLUSCA, BIVALVIA, UNIONIDAE.

Morgan E. Raley[1,2], Arthur E. Bogan[2], John L. Harris[3], and Jay Levine[1], [1]North Carolina State University, College of Veterinary Medicine, 4700 Hillsborough Street, Raleigh, NC 27606; [2]North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Road, Raleigh, NC 27607; [3]Arkansas Highway & Transportation Department, Environmental Division, P.O. Box 2261, Little Rock, AR 72203.

Clarke (1985) monographed the genus Lasmigona, split it into three subgenera, and recognized six species and one subspecies. However, recent genetic work on Lasmigona subviridis using sequences of the Cytochrome c oxidase subunit 1 (COI) pointed out the large variation between populations, and more importantly, indicated that Lasmigona, as defined by Clarke and used historically, is paraphyletic. King et al. (1999) reported that L. costata and L. complanata clustered together while L. compressa and L. subviridis clustered together. We analyzed Arkansas populations of L. costata because of the degree of shell variation and the initial observation that anal structure differed between specimens of L. costata of the upper Tennessee River basin in east Tennessee and specimens from Arkansas. Some Arkansas populations either lacked or had greatly reduced fluting along the posterior slope that is consideredcharacteristic of L. costata. We sequenced representatives from throughout the range of L. costata as well as 11 populations, identified historically as L. costata throughout Arkansas. Preliminary evidence points to very low genetic divergence in the examined populations of L. costata.

PL 80 A NEW LOOK AT THE GENUS ELLIPTIO OF THE SOUTH ATLANTIC SLOPE REGION (BIVALVIA: UNIONIDAE).

Arthur E. Bogan[1], Jeanne M. Serb[2], and Charles Lydeard[2] 1North Carolina State Museum of Natural Sciences, Research Laboratory, 4301 Reedy Creek Road, Raleigh, NC 27607; [2]Department of Zoology, University of Alabama, Tuscaloosa, AL

The rivers of the Atlantic Slope Region of Eastern North America are home to many of the taxa placed in the genus Elliptio. Isaac Lea and a few others described 213 taxa from the area extending from Canada to Florida. Johnson (1970) synonymized these taxa under 12 species. We have begun to assess the monophyly and phylogeny of the genus using topotypic specimens of some of the 70 taxa described from North and South Carolina currently assigned to the genus Elliptio. We have used DNA sequences of Cytochrome C Oxidase subunit 1 (COI) and NDI to develop a phylogeny. The genus is not monophyletic.

PL 81 TAXONOMIC COMPOSITION AND GEOGRAPHIC DISTRIBUTION OF VIRGINIA'S FRESHWATER GASTROPOD FAUNA: A REVIEW USING HISTORICAL RECORDS.

Timothy W. Stewart[1] and Robert T. Dillon, Jr.[2]. [1]Department of Natural Sciences, Longwood University, Farmville, VA 23909; [2]Department of Biology, College of Charleston, Charleston, SC 29424.

Survey information from electronic databases and the literature was used to summarize knowledge of the composition and geographic distribution of Virginia's freshwater gastropod fauna. After excluding records likely based on misidentified species, we compiled a list of 53 species of freshwater gastropods that have been reported from

Virginia. Maps and/or narrative descriptions of statewide distributions were produced for each taxon. Several species appear to be restricted to a few Virginia sites and are highly endangered, including the hydrobiids Fontigens bottimeri (Walker, 1925), Fontigens morrisoni (Hershler, Holsinger and Hubricht 1990), Holsingeria unthankensis (Hershler, 1989), and Holsingeria sp. 1 (Hershler, 1989). Absence of recent records for the hydrobiid Somatogyrus virginicus (Walker, 1904), the pomatiopsid Pomatiopsis cincinnatiensis (Lea, 1840), the pleurocerids Goniobasis arachnoidea (Anthony, 1854) and Pleurocera gradata (Anthony, 1854), and the lymnaeid Stagnicola neopalustris (Baker, 1911) indicate these species are also imperiled if not already extirpated from Virginia. Our study reveals substantial gaps in knowledge of Virginia's freshwater gastropod fauna. We have a reasonable understanding of distributions of species in the genus Fontigens (Hydrobiidae) and of several pleurocerids inhabiting the southwestern region of the state. However, awareness of the status and distribution of other taxa, and of fauna inhabiting geographic regions outside southwestern Virginia, is inadequate. This review provides baseline information needed to design surveys to fill knowledge gaps, and to monitor temporal changes in freshwater gastropod distributions and abundance. Comparisons of historic and modern survey data will benefit endangered species by providing quantitative evidence of restricted geographic ranges or declining populations.

Notes

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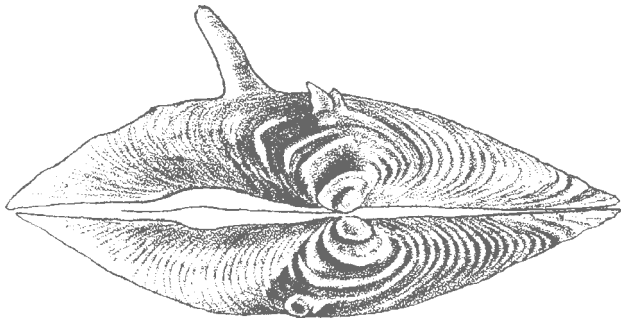

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Local Arrangements

John Alderman
Judith Ratcliffe

Plenary Session

John Alderman
Judith Ratcliffe

Technical Program - Platform

Greg Cope
Jay Levine

Technical Program - Poster

Chris Eads
Greg Cope
Jay Levine

Student Awards

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Please take a few minutes to answer the following questions and provide the officers with information to improve future symposia.

ACTIVITY	*YOUR REACTION*			
	POOR	*GOOD*	*GREAT*	*DID NOT ATTEND*
Poster session (Sunday night)				
Plenary Session (Monday)				
Museum Social (Monday night)				
Monday Contributed Sessions				
Status & Distribution I				
Evolution & Phylogenetics I				
Habitat & Conservation				
Contaminants I				
Tuesday Contributed Sessions				
Life History & Ecology I				
Propagation & Reproduction I				
Life History & Ecology II				
Relocation & Recovery				
GIS				
Evolution & Phylogenetics II				
Status & Distribution II				
Contaminants II				
Wednesday Contributed Sessions				
Status & Distribution III				
Monitoring				
Propagation & Reproduction II				
Evolution & Phylogenetics III				
FACILITIES				
FOOD				

(over)

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Your opinion is appreciated!

How would you improve the contributed paper sessions?

How would you improve the poster sessions?

How would you improve the meals during our next meeting?

What did you like most about this meeting? Why?

What needs to be improved most before the next meeting? What would make it better?

Thanks