2011

Maryland Streams Symposium
and
Mid-Atlantic Volunteer Monitoring Conference

Carroll County Community College

Westminster Maryland

August 10-13

This project was funded in part by the
US EPA Chesapeake Bay Implementation Grant

Third Maryland Streams Symposium and Mid-Atlantic Volunteer Monitoring Conference
August 10-13, 2011; Carroll Community College

Wednesday Morning August 10

7:30-9:00 **Registration/Poster Set-up/Coffee**

Morning Plenary Session I – Auditorium

9:00 – 9:10 **Welcome, Symposium Goals, Charge to Participants**
Paul Kazyak, Monitoring and Non-Tidal Assessment Division
Maryland DNR

9:10 – 9:15 **Greetings**
Faye Pappalardo, President
Carroll Community College

9:15 – 9:35 **Maryland's Commitment to Healthy Streams**
Frank Dawson, Assistant Secretary for Aquatic Resources
Maryland DNR

9:35 – 10:05 **Science and Politics Don't Have to be Like Oil and Water**
Chris Trumbauer, Anne Arundel County Councilman and West/Rhode Riverkeeper

10:05 – 10:45 **Break – Great Hall**

10:45 – 11:15 **Pollution Limits Under Attack in Congress and Court: Why We Must Fight Back**
Tom Pelton, Senior Writer for the Chesapeake Bay Foundation, host of "The Environment in Focus" on WYPR public radio in Baltimore

11:15 – 11:30 *Congressman John Sarbanes*

11:30 – 12:00 **Evolution of the Maryland Biological Stream Survey: Three Rounds and 15 Years Later**
Ron Klauda, Director, Monitoring and Non-Tidal Assessment Division
Maryland DNR

12:00 – 1:00 **Lunch – Great Hall**

Wednesday Afternoon August 10

Session	***Status and Trends: How are Maryland's Streams Doing?***	***Dam(n) Lessons Learned***	***Freshwater Mussels***	***Aquatic Invaders***	
Room	**Auditorium**	**K100A**	**K100B**	**L287**	
Moderator	**Mark Southerland (Versar, Inc.)**	**Jim Thompson (MD DNR)**	**Matt Ashton (MD DNR)**	**William Harbold (MD DNR)**	
1:00 pm	Maryland Stream, River and Lake Sampling as Part of the National Aquatic Resource Surveys: Current Status and Future Assessments *Ellen Tarquinio [1]*	Chesapeake Bay Fish Passage Prioritization *Julie Devers [6]*	Human Activities and the Capacity for Native Freshwater Mussels (*Unionidae*) to Mitigate Cultural Eutrophication in the Chesapeake Bay *Daniel E. Spooner [12]*	Invasive Species and Maryland DNR *Sarah Widman [18]*	
1:20 pm	Status and Trends of Non-tidal Chesapeake Streams and Rivers *Adam Griggs [2]*	Video Overview *Jim Thompson [7]*	Using Predictive Distribution Models to Find the Dwarf Wedge Mussel in Maryland *Cara A. Campbell [13]*	Blue Catfish, The Potomac's Largest Unwelcome Invasive or an Increasingly Popular Sportfish *Mary Groves [19]*	
1:40 pm	Status and Trends in the Ecological Condition of Maryland Streams and Rivers: Results of Maryland DNR's Maryland Biological Stream Survey and Long-term Monitoring Programs *Mark Southerland [3]*	Designing and Implementing Dam Removal Projects in the Context of the Regulatory Climate: The Simkins Dam Removal Case Study *Mary Andrews [8]*	Freshwater Mussel Survey of the Potomac River Mainstem *James D. Cummins [14]*	Ongoing Efforts to Control the Invasive Northern Snakehead *Josh Newhard [20]*	
2:00 pm	Streams in Maryland's National Parks: How Are They Doing? *Marian Norris [3]*	Flow and Suspended-Sediment Monitoring at Three Stream gages on the Patapsco River, Maryland, October 2010 to March 2011 *William Banks [9]*	Freshwater Mussel Conservation in Virginia—Using Propagation as a Recovery Tool *Brian T. Watson [15]*	Hood College Student-Faculty Research: Ecology, Physiology and Genetics of Native and Invasive Maryland Orconectes Species *Susan Carney [21]*	
2:20 pm	Just What Is the Condition of Baltimore County Streams? *Dennis Genito[4]*	Geomorphic Monitoring of the Patapsco River Following the Removal of the Simkins Dam, Patapsco River, Maryland *Graham Boardman [10]*	Experimental Stocking of American Eels n the Susquehanna River Watershed *Julie Devers [16]*	Management Strategies for Water Chestnut (*Trapa natans*): A Historical Perspective *Mark Lewandowski [22]*	
2:40 pm	Montgomery County Streams – Change and Recovery *Jennifer St. John [5]*	Patapsco River Dam Removal Study: Assessing Changes in American Eel Distribution and Aquatic Communities *William Harbold [11]*	How a State-Wide Stream Survey Can Aid in Understanding Freshwater Mussel (Bivalvia: *Unionidae*) Ecology: Examples of Utility and Limitations from Maryland *Matthew J. Ashton [17]*		
3:00-3:30 pm	**Poster Break (authors in attendance)**				

Session	***Stream Biodiversity***	***High Quality Streams***	***Urban Streams I***	***Sustainability and Healthy Watersheds***	***Film Forum***
Room	**Auditorium**	**K100A**	**K100B**	**L287**	**M157**
Moderator	**Scott Stranko (MD DNR)**	**Andy Becker (MD DNR)**	**Ken Belt (USFS) and Ed Doheny (USGS)**	**Paul Kazyak (MD DNR)**	**Jenny Mulhern (MD DNR)**
3:30 pm	Biodiversity Conservation in Maryland: What makes the Free State Naturally Great! *Dave Brinker [23]*	EPA's Healthy Watersheds Initiative: A Systems-based Construct for Protecting Aquatic Ecosystems *Laura Gabanski [29]*	Pilot Testing of Real-Time Nitrate and Conductivity Sensors in an Urban Watershed *Jason Ver Hoef [34]*	Maryland Forests and Streams – Key Challenges for Sustainability in a Rapidly Changing World *Dan Fiscus [40]*	
3:50 pm	Physiological Tolerance and Behavioral Preferences of Freshwater Mussels: Consequences for Mussel Biodiversity in a Changing Environment *Heather S. Galbraith [24]*	Balancing Our Investment in the Chesapeake: The Importance of Maintaining Healthy Watersheds *Mark Bryer [30]*	Applications of Real-time Water Quality to Identify Episodic Pollution Events in Urban Streams in the Washington, D.C. Metropolitan Area *Joe Bell [35]*	Urbanization and the Future of Aquatic Biodiversity in Maryland *Bob Hilderbrand [41]*	
4:10 pm	First Probabilistic Survey of Stream Salamanders in Maryland *Mark Southerland [25]*	Incorporation of Maryland's Current Antidegradation Implementation Procedures into the Approval or Permitting Framework *Angel Valdez [31]*	Introducing the Baltimore City Stewardship Mapping and Assessment Project *Michele Romolini [36]*	Beyond Urbanization: Seeing into the Future of Maryland Streams *Paul Kazyak [42]*	
4:30 pm	Maryland's Crawdads – their Status, Distribution, and Conservation *Jay Kilian [26]*	Virginia Healthy Waters Initiative *Todd Janeski [32]*	Understanding the Implications of Using Indices to Detect Biological Responses in Streams *Matt Baker [37]*	Forest Buffers: How Fast do their Functions Develop? *Anne Hariston-Strang [43]*	
4:50 pm	From Ablabesmyia to Zygoptera : the Incredible Diversity of Maryland's Freshwater Macroinvertebrates *Dan Boward [27]*	Frederick County Stream Protection Program *Shannon Moore [33]*	Nutrient and Sediment Sources, Transport, Retention, and Effects of Best Management Practices in the Urban Difficult Run Watershed, Virginia *Greg Noe [38]*	Updating Maryland's GreenPrint Map *Kevin J. Coyne [44]*	
5:10 pm	Biodiversity of Maryland's Freshwater Fishes *Rich Raesly [28]*		Tracking Nonpoint Source Nitrogen Pollution in Human-impacted Watersheds *Sujay Kaushal [39]*		
5:30 pm	**Adjourn**				

Thursday Morning August 11

8:00-11:00 Registration and Coffee/Pastries

Session	***Brook Trout Status, Ecology and Management***	***Climate Change in Maryland: It's More Than Sea Level Rise***	***The Chesapeake Phase II Watershed Implementation Plan***	***Contributed Papers -Stream Critters and Beyond!***	
Room	**Auditorium**	**K100A**	**K100B**	**L287**	**M157**
Moderator	**Bob Hilderbrand (University of Maryland)**	**Ron Klauda (MD DNR)**	**Claudia Donegan (MD DNR)**	**Beth Franks (Versar, Inc.)**	
8:30 am	Brook Trout in Maryland, Five Years Down the Road Since Implementation of the Fisheries Management Plan *Alan Heft [45]*	Climate Change Adaptation in Maryland Watersheds: A Strategy for Resilience *Markus Griswold [51]*	The Chesapeake Bay TMDL and the Maryland Watershed Implementation Plan - an Overview and Panel Discussion *Richard Eskin [56]*	Culvert Designs for Fish Passage in Pennsylvania *Dave Spotts [57]*	
8:50 am	A Revisitation of Maryland Brook Trout Genetics *Ray Morgan [46]*	It's Hard to Make Predictions, Especially about the Future: Possible Climate Change Impacts on Maryland Streams *Andrew Miller [52]*		The Growing Scientific, Education, and Conservation Impact of FrogWatch USA *Rachel Gauza [58]*	
9:10 am	Brook Trout Declines with Land Cover and Temperature Changes in Maryland *Scott Stranko [47]*	The USGS Streamflow-Monitoring Network in Maryland – What Can It Tell Us about Climate Change? *Jonathan Dillow [53]*		Year One (2010) of the Maryland Amphibian and Reptile Atlas *Heather Cunningham [59]*	
9:30 am	Life History of Brook Trout in Western Maryland *David Kazyak [48]*	What Are Some Management Steps for Addressing the Impacts of Climate Change on Fish Species? *Nancy Butowski [54]*	Panel Discussion with: *Julie Pippel – Wash. County;* *Kim Burgess – Balto. City;* *Rupert Rossetti – Cecil County;* *Bill Wolinski – Talbot County*	Adult and Larval Caddisfly (Trichoptera) Taxa Richness Indicate Regional Processes Limit In-stream Larval Richness and Colonization Potential of Urban Headwater Streams *Robert Smith [60]*	
9:50 am	Brook Trout Population Responses to Restrictive Fishing Regulations in the Savage River Watershed *Bob Hilderbrand [49]*	Stream Fish Colonization and Extinction in Shenandoah National Park *Nathaniel (Than) P. Hitt [55]*		Benthic Invertebrates as Vectors of Fish Pathogens in Aquatic Ecosystems *Heather L. Walsh [61]*	
10:10 am	Conservation Genetics and Genomics of Brook Trout (*Salvelinus fontinalis*) Populations: Identification of the Functional Unit of Management in the Chesapeake Bay System *Tim King [50]*			Taxonomic Data Quality Control for the Maryland Biological Stream Survey, 1995-2009 *Erik W. Leppo [62]*	
10:30-11:00 am	**Poster Break (authors in attendance)**				
11:00-11:30 am	**Welcome to Volunteers and Morning Plenary Session - Peter Bergstrom – NOAA - Promoting Stewardship with Volunteer Monitoring**				
11:30-12:30	**Lunch (pre-made sandwiches)** **Presentation – Riparian Buffer Plantings: Trials and Successes** *Brandon Green, Kelly Habicht and Reed Portney, Venturing Crew 202 Members* This talk will be a lighthearted look at the riparian buffer plantings of Boy Scout Venturing Crew 202 over the last dozen years. Key lessons learned will be summarized and implications for other volunteer groups discussed. [NOTE: Crew 202 has arguably planted more trees than any other all-volunteer group in the entire Chesapeake Bay watershed, and has won numerous state and national awards for its environmental efforts. Crew members are also volunteering at this symposium, feel free to chat with them as they perform various support roles]				

Thursday Afternoon August 11

Session	*Marcellus Shale I: Science and Policy*	*Say Hello to my TMDL! A Look at Freshwater Regulations in Maryland*	*Volunteer Monitoring Success Stories*	*Contributed Papers – Nutrients*	*Film Forum*
Room	**Auditorium**	**K100A**	**K100B**	**L287**	**M157**
Moderator	**Jennifer Fulton (US EPA)**	**Greg Sandi (MDE)**	**Ginger North (Delaware Nature Society)**	**Beth Franks (Versar, Inc.)**	**Jenny Mulhern (MD DNR)**
12:30 pm	*TBA* *David Kargbo [63]*	Maryland's Ion Monitoring Plan: Supporting Water Quality Criteria Development for Chloride Concentrations *Adam Rettig [67]*	Oyster Gardening: A Volunteer Success Story *EJ Chalabala [72]*	Major Sources and Transport Pathways for Nitrogen and Phosphorus to Chesapeake Bay and its Tributaries *Scott W. Ator [77]*	
12:50 pm	Geology of the Marcellus Shale in Maryland *David K. Brezinski [64]*	Watershed-Based Monitoring Network Design for Chlorides and Sulfates *Allison O'Hanlon [68]*	The Delaware Nature Society's Riparian Habitat Assessment *Kristen Travers [73]*	Nodal Point Pollution: Changing the Paradigm for Chesapeake Bay Restoration *Andrew Muller [78]*	
1:10 pm	An In-Depth Look at Water Chemistry in the Upper Monongahela River Basin *Paul Ziemkiewicz [65]*	The Integrated Report (aka 303d/305b List) of Surface Water Quality Calling It as We See It. *Matt Stover [69]*	*RiverTrends: Using Volunteer Data for Outreach on Water Quality Issues and Solutions* *Anna Mathis [74]*	Coastal Bays Non-tidal Nutrient Indicators & Thresholds for Use in an Annual Report Card *Carol Cain [79]*	
1:30 pm	The Maryland Marcellus Shale Executive Order *Brigid Kenney [66]*	Incorporation of Maryland's Current Antidegradation Implementation Procedures into the Approval or Permitting Framework *Angel Valdez [70]*	Maryland Stream Waders: Eleven Years of Success! *Dan Boward [75]*	Combination of a Stressor-Response Model with a Conditional Probability Analysis Approach for Developing Candidate Criteria from MBSS Data *John F. Paul [80]*	
1:50 pm		Maryland's Synoptic Survey *Quentin Forrest [71]*	Stream Research and Community Outreach Using Volunteers *Lindsay Hollister [76]*		
2:10 pm					
2:30-3:00 pm					

Session	*Marcellus Shale II: Assessing our Waters*	*Contributed Papers – Urban Streams II*	*Contributed Papers – Contaminants and Human Health*		
Room	**Auditorium**	**K100A**	**K100B**	**L287**	**M157**
Moderator	**Bill Richardson (US EPA)**	**Ginny Rogers (Versar, Inc.)**	**Patrick Graves (MD DNR)**		
3:00 pm	Water Quality Monitoring in Pennsylvania's Marcellus Shale Field – Trying to Stay "Ahead of the Curve" *Tony Shaw [81]*	Assessing the Ecological and Human Health Status of Baltimore's Inner Harbor *Caroline Wicks [86]*	Clean Water, Healthy Families Campaign Terry Cummings *[91]*		
3:20 pm	Maryland Assesses Baseline Water Quality Conditions in Streams near Potential Marcellus Shale Drilling Locations *Tony Prochaska [82]*	An Approach for Monitoring Biological Response to an Urban Stream Restoration Including an Evaluation of the Relationship between Geomorphology and Biological Communities *Sean Sipple and Kate Estler [87]*	Illicit Discharges – Hidden Polluters in Maryland Waters *Lori Lilly [92]*		
3:40 pm	Marcellus Monitoring *Julie Vastine [83]*	Mitigating the Effects of Urbanization on a Naturalized Population of Brown Trout (*Salmo trutta*) in a Tributary of the Anacostia River in the Washington, D.C. Metropolitan Area *Mitch Keiler [88]*	Contaminants of Emerging Concern: Chemical and Biological Effects Monitoring *Vicki Blazer [93]*		
4:00 pm	Monongahela River QUEST: A Collaborative Approach to Monitoring Water Quality in the Mon River Basin *Melissa O'Neal [84]*	An Altered State: Mitigating the Effects of Urbanization on Aquatic Ecosystems *Mitch Keiler [89]*	The Use of Scent Trained Canines for Illicit Discharge Detection in Storm Water *Scott Reynolds [94]*		
4:20 pm	Susquehanna River Basin Commission Marcellus Monitoring *Matthew Shank [85]*	Comparing the Fish and Benthic Macroinvertebrate Diversity of Restored Urban Streams to Reference Streams *Scott Stranko [90]*			
4:40 pm					
5:10 pm	**Adjourn**				
6:00-9:00 pm	**Social/Cookout at Carroll County Farm Museum - BYOB**				

Friday Morning August 12

8:00 – 8:30 Registration and Coffee/Pastries

8:30 – 9:00 Morning Plenary Session – **Creating Change in your Watershed: One Person at a Time**
Ned Tillman, Author of "The Chesapeake Watershed: A Sense of Place and a Call to Action", President - Sustainable Growth, LLC; Chair of the Sustainability Board of Howard County, MD

9:00 – 9:30 Poster Break (authors in attendance)

Session	***Stream and Watershed Education I***	***Hands On in the Bay***	***Money Behind Water Quality Initiatives***	***Stream Geomorphology***	***Mattawoman Creek: A Fragile Gem***	***Film Forum***
Room	**Auditorium**	**K100A**	**K100B**	**L287**	**M157**	**K116**
Moderator	**Sonja Schmitz (Community College of Baltimore County)**	**Larry Merrill (US EPA)**	**Jen Raulin (MD DNR)**	**Mike Pieper (KCI, Inc.)**	**Jim Uphoff (MD DNR)**	**Jenny Mulhern (MD DNR)**
9:30 am	Using the Mapping-Our-Streams-with-FieldScope unit to Expand Your Stream Investigations in the Chesapeake Bay Watershed *Cassie Doty [95]*	The Spirit of Growing Our Chesapeake Bay Partnership: The Continued Evolution of the Chesapeake Bay Program Partnership's Long term Water Quality Monitoring Program *Peter Tango [100]*	Advancing Watershed Restoration at the Local Level *Jennifer Raulin [104]*	Applying Fluvial Geomorphic Monitoring Techniques to Evaluate Stream Restoration Project Success in the Red Hill Branch Subwatershed *Colin Hill [107]*	Evaluating Anadromous Spawning Habitat Changes in a Changing Landscape *Margaret McGinty [110]*	
9:50 am	Chesapeake Exploration: Investigate the Bay Watershed in Real-time with NOAA's Online Curriculum *Kevin Schabow [96]*	Citizen Involvement and the Chesapeake Bay Executive Order *Michelle Ryan [101]*	Water-related Funding Opportunities Provided by the National Fish and Wildlife Foundation's Chesapeake Bay Stewardship Fund *Mandy Chesnutt [105]*	The Stream Functions Pyramid: A Conceptual Model for Setting Goals and Evaluating the Functional Improvement of Stream Restoration Projects *Rich Starr [108]*	Migrating to Mattawoman Creek—Or Not: Icthyoplankton Surveys of Anadromous Fish Spawning in the Nontidal River *Jim Long [111]*	
10:10 am	Students in the Community as Environmental Stewards and Citizen Scientists: CCBC Bay Watershed Educational Training Project. *Sonja Schmitz [97]*	Choose Clean Water - Engaging Local Organizations *Ryan Ewing [102]*	Water-related Funding Opportunities Provided by the Chesapeake Bay Trust *Kacey Wetzel [106]*	Fish Passage Barriers and Mitigation Options *Kathy Hoverman [109]*	Interpretation of a Ten-Year Record of Discrete and Continuous Water-Quality Data for a Rapidly-Urbanizing Coastal Plain Watershed *Jeffrey G. Chanat [112]*	
10:30 am	TBA *Karen Anderson [98]*	Chesapeake Commons Database *John Dawes [103]*			Development, Stressors, Habitat and Fish Community Changes in Mattawoman Creek *Jim Uphoff [113]*	
10:50 am	A Virtual Stream Sampler *Neil Gilles [99]*				The Role of Mattawoman Creek in the Largemouth Bass Fishery of the Potomac River *Joe Love [114]*	
11:10 am						

11:30 – 12:30 Lunch *(Hot pasta dish)*
Cafeteria

Presentation – Visualizing Fluvial Geomorphology: A Multimedia Phenomenon- Speaker TBA
Great Hall

Friday Afternoon August 12

Session	**Stream and Watershed Education II**	**Making Your Voice Heard**	**Volunteer and Professional Monitors Unite!**	**Stream Water Temperature**	
Room	**Auditorium**	**K100A**	**K100B**	**L287**	
Moderator	**Sonja Schmitz (Community College of Baltimore County)**	**Sara Weglein (MD DNR)**	**James Beckley (VA DEQ)**	**Tony Prochaska (MD DNR)**	
12:30 pm	RiverWebs: A Documentary film about Life, Death, Science, and Streams *Keith Williams [115]*	Maryland Stream Waders- Providing the Mega-phone *Sara Weglein [120]*	TBA *James Beckley [124]*	Maryland's Temperature Criteria *Adam Rettig [129]*	
12:50 pm	The View Below: Using Creek Snorkeling to Connect People with Rivers *Keith Williams [116]*	Mattawoman Matters *Bonnie Bick [121]*	TMDLs, Pollution Trading and the Need for Volunteer Monitoring *Michael R Helfrich [125]*	Thermal Regimes of Maryland's Non-Tidal Streams *Bob Hilderbrand [130]*	
1:10 pm	Volunteering: What you can do Beyond Monitoring - Join TEAM DNR! *Amy Henry [117]*	How to Create Change: Strategies and Very Cool Tips for Making a Difference *Paul Kazyak [122]*	Partnering with Watershed Organizations to Produce Tributary-Specific Report Cards *Sara Powell [126]*	Improving the Thermal Protection for Maryland Streams: Getting the Most Out of Designated Uses *Michael Kashiwagi [131]*	
1:30 pm	Discovery, Fun and Watershed Education – Right in Your Own Backyard! *Betsy McMillion [118]*	How The MBSS Uses the Internet to Spread the Word *Luke Roberson [123]*	Partnership in Stream Monitoring – Loudon County, Virginia *David Ward [127]*	Tailwater trout Management in Maryland. Where did all the cold water go? *Charlie Gougeon [132]*	
1:50 pm	Observations in Action: An Elementary School Teacher's Experience with the Maryland Biological Stream Survey *Lauren Catts [119]*		Meeting Community Needs: Developing Partnerships Between Local Governments and Volunteer Water Monitors *Chris French [128]*	Thermal Regime and Stream Characteristics in the Prettyboy Reservoir Watershed *Dennis Genito [133]*	
2:30 – 3:00 pm	**Break**				
Session	**Moving Forward Together – Panel Discussion on Effectively Using Volunteers' Contributions in the Mid-Atlantic**				**Film Forum**
Room	**Auditorium**	**K100A**	**K100B**	**L287**	**M157**
Moderator	**Chris French (Alliance for the Chesapeake Bay)**				**Jenny Mulhern (MD DNR)**
3:00 pm	James Beckley (VA), (TBA; MD), Chesapeake Bay Program, NGO representative				
4:30 pm	Adjourn				

Workshops and Field Trips

Wednesday August 10

1:00 – 3:30 pm

	Session Number *see descriptions	Topic	Instructor	Room
Field Trip	1	Agricultural Best Management Practices to Protect Streams	Eric Hynes (Carroll County SCD/NRCS)	Parking Lot
	2	Fish PIT Tagging	Dave Kazyak (University of Maryland)	Parking Lot
	3	Fish Sampling	Rebecca Bourquin (MD DNR)	Parking Lot
	4	Tour de Forest (AKA Riparian Buffer Tour)	Ron Graunke	Parking Lot

3:30 – 5:10 pm

	Session Number	Topic	Instructor	Room
Workshops	1	Basic Fish ID	Rich Raesly (Frostburg State University)	M 150
	2	Basic Benthic Macroinvertebrate ID	Neal Dziepak (MD DNR)	C 170
	3	Crayfish ID	Casey Swecker (Environmental Solutions & Innovations, Inc.)	C 174

Thursday, August 11

8:30 – 10:30 am

	Session Number	Topic	Instructor	Room
Workshops	4	Advanced Fish ID	Rich Raesly (Frostburg State University)	M 150
	5	Mayfly, Caddisfly, Stonefly ID	Ellen Friedman (MD DNR)	C 170
	6	Basic Mussel ID	Matt Ashton (MD DNR)	C 174

12:30 – 2:30 pm

	Session Number	Topic	Instructor	Room
Workshops	7	Advanced Mussel ID	Matt Ashton (MD DNR)	C 174
	8	How to Build a Rain Barrel (CANCELLED)	Organizer TBA	TBA
	9	Herpetofauna	Rachel Gauza (AZA)	A 215

3:00 – 5:00 pm

	Session Number	Topic	Instructor	Room
Workshops	10	Herpetofauna	Rachel Gauza (AZA)	A 215
	11	Basic Benthic Macroinvertebrate ID	Ginger North (Delaware Nature Society)	C 170
	12	Basic Fish ID	Jay Kilian (MD DNR)	M 150
	13	Coliscan Easygel – How to Use it Like a Pro	James Beckley (VA DEQ)	K 306

2:30 – 5:00 pm

	Session Number *see descriptions	Topic	Instructor	Room
Field Trips	5	Herpetofauna Search	William Harbold (MD DNR)	Parking Lot
	6	Benthic Macroinvertebrate Sampling	Dan Boward (MD DNR)	Parking Lot
	7	Naturalist Hike	Eric Creter (Maryland Conservation Corps)	Parking Lot
	8	Creek Snorkeling Adventures	Keith Williams (North Bay)	Parking Lot

Friday, August 12

9:30 – 11:30

	Session Number	Topic	Instructor	Room
Workshops	14	Basic Benthic Macroinvertebrate ID	Dennis Genito (Baltimore County)	C 170
	15	Field Equipment Basics	James Beckley (VA DEQ)	K 308
	16	Invasive Plant ID and Native Plant Propagation	Matt Lustig (Hashawa)	C 174
	17	Wetland Plants	Erin Mclaughin (MD DNR)	A215

12:30 – 2:30

	Session Number	Topic	Instructor	Room
Workshops	18	Fish Taxonomy Test	Rich Raesly (Frostburg State University)	M 150
	19	Ordonate Taxonomy	Richard Orr (Mid-Atl. Invert. Field Studies)	C 174
	20	Basic Benthic Macroinvertebrate ID	Neal Dziepak/Ellen Friedman (MD DNR)	C 170
	21	Marcellus Monitoring	Julie Vastine (PA ALLARM)	K306

2:30 – 5:00

	Session Number *see descriptions	Topic	Instructor	Room
Field Trips	9	Wetland Plants	Jeff Thompson (MDE)	Parking Lot
	10	Stream Geomorphology	Mike Piper (KCI, Inc.)	Parking Lot
	11	Invasive Plants	Kathryn Laycock (MD DNR)	Parking Lot
	12	Hands-on Water Quality and Habitat Assessment	Michael Kashiwagi (MD DNR)	Parking Lot

Saturday, August 13

9:00 – 11:00

	Session Number *see descriptions	Topic	Instructor	Room
Field Trips	13	Fish Sampling	Rebecca Bourquin (MD DNR)	Parking Lot
	14	Benthic Macroinvertebrate Sampling	Dan Boward (MD DNR)	Parking Lot
	15	Tour de Volunteer Forest (AKA Riparian Buffer Tour)	Paul Kazyak (MD DNR)	Parking Lot
	16	Agricultural Best Management Practice to Protect Streams	Eric Hynes (Carroll County SCD/NRCS)	Parking Lot
Workshops	22	Basic Benthic Macroinvertebrate ID	Patrick Graves (MD DNR)	C 170
	23	Basic Fish ID	Andy Becker (MD DNR)	M 150
	24	Herpetofauna ID	William Harbold (MD DNR)	A 215

9:00 – 12:00

	Session Number *see descriptions	Topic	Instructor	Room
Field Trips	17	Identifying Legacy Sediments in the Field, Historic Records, and Remote Imagery	Deborah Slawson (Hedgerow Land Ecology Services)	TBA

Field Trip Descriptions

Field Trip 1 and 16 – **Agricultural Best Management Practices to Protect Streams** – Get your boots muddy while learning about the best agricultural BMPs in Carroll County.

Field Trip 2 – **PIT Tagging** – Have you ever asked yourself, "hey….where's my fish?" Learn how to keep track of your finny friends using Passive Integrated Transponder (PIT) tagging – a widely-used technique in contemporary fisheries research. Lecture and workshop components will include case studies and hands-on experiences.

Field Trip 3 and 13 – **Fish Sampling** – What scary creature lurks beneath that submerged boulder? Experience first-hand the techniques used to sample fish in freshwater streams as well as basic identification of some of Maryland's 100 freshwater fish species. Hip waders are required.

Field Trip 4 – **Tour de Forest (AKA Riparian Buffer Tour)** – Tour several local stream sites with riparian buffer plantings. Learn why some succeeded and some didn't.

Field Trip 5 – **Invasive Plants** – As if snakeheads and zebra mussels aren't enough, our streams must deal with a host of invasive plants. Join a MD DNR biologist on a streamside trek to find and identify many Maryland's invasive plants.

Field Trip 6 and 14 – **Benthic Macroinvertebrate Sampling** – Ever wonder what all those stream fish eat? Find out by turning over a rock and observing benthic macroinvertebrates in their natural habitat. You WILL get wet on this ride. Old sneakers are suitable.

Field Trip 7 - **Naturalist Hike** – Enjoy a 5-mile trek over land and through water with naturalists to observe and learn about the flora and fauna of Morgan Run (old sneakers are suitable).

Field Trip 8 – **Creek Snorkeling Adventures** - Don snorkeling gear (provided) and crawl in! Discover the wonders of freshwater streams up close and personal through the lens of a snorkeling mask. Proper attire required.

Field Trip 9 – **Wetland Plants** – From *Acer rubrum* to *Zizania aquatica*, Maryland's wetlands support an incredible variety of plant life. Join us as you soak up lots of information on Maryland's amazing wetland plants!

Field Trip 10 – **Stream Geomorphology** – Thalwegs, meanders, and bankfull....oh my! Join local stream geomorphology experts as you learn the basic techniques used to characterize stream geomorphology.

Field Trip 11 – **Herpetofauna Search** – Snakes and lizards and frogs…oh my! Hop into a local stream to discover the slimy herpetofauna that are so essential for healthy stream ecosystems.

Field Trip 12 – **Hands-on Water Quality and Habitat Assessment** – Does your thalweg need assessed? Have you counted your pebbles today? Join water quality and habitat experts as we explore ways of assessing the stream water quality and the physical habitat that's so important to the critters therein.

Field Trip 15 – **Tour de Volunteer Forest (AKA Riparian Buffer Tour)** – Tour several local stream sites with riparian buffer plantings completed by VOLUNTEERS! Learn why some succeeded and some didn't.

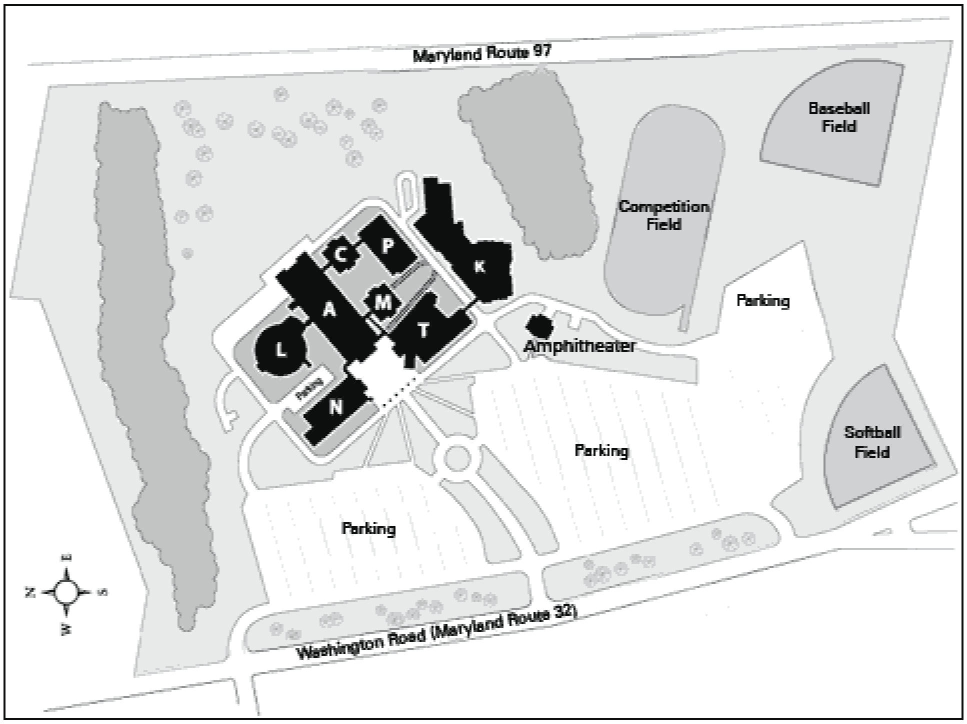
Field Trip 17 - **Identifying Legacy Sediments in the Field, Historic Records, and Remote Imagery** - Legacy sediments from old mill dams are everywhere in mid-Atlantic streams and their identification is essential for understanding stream and riparian physical and biological impairments and for designing stream restorations. Their presence is very frequently missed. This is a "how-to" workshop on the Gunpowder Falls River near Hoffmanville in northern Baltimore County. Please wear long pants and boots (you may get wet).

Notes:

Concurrent session, workshop and field trip organizers/instructors names and affiliations are shows after titles.
All concurrent session, workshop and field trip times are subject to change pending availability of organizers/instructors.
Room capacities: Auditorium – 400; M157 – 70; K100B – 100; K100A – 100; L287 – 84; K116 - 50

Campus Layout and Selected Building Maps

Carroll Community College



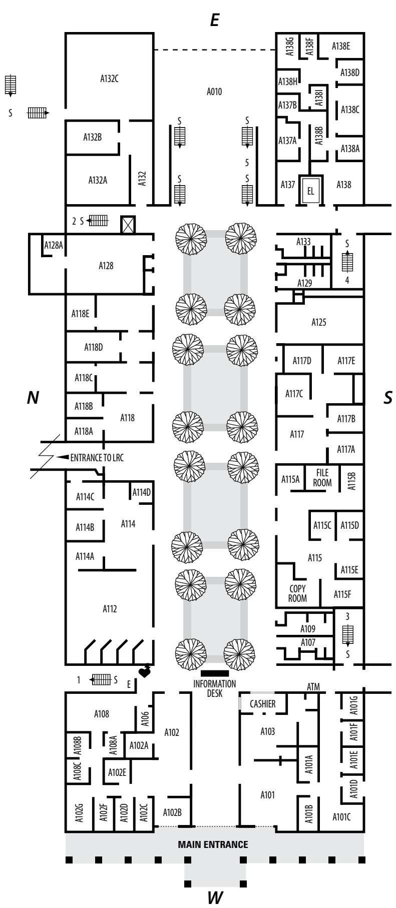
A Building Main Level

Carroll Community College

Academic/Administration Building

A010 Seating Below
A101 A–G Admissions, Articulation & ADA Support Services
A102 A–G Advising and Transfer Services
A103 Business Office
A106 Electrical
A107 Men's Room
A108 Career and Transfer Services
A109 Women's Room
A112 Records and Registration
A114 Financial Aid
A115 Continuing Education & Training
A117 A–E Learning Outcomes Assessment
Integrity & Judicial Affairs Advocate
Office of the Deans
A118 A–E Offices of Student Life, Service Learning, Student Government & Career Development
A125 Classroom
A128 Computer Center
A128 A Electrical
A129 Women's Room
A132 A–C Testing Center
A133 Men's Room
A137 A–B Office of Public Safety & Security
A138 A–I Human Resources

Automated External Defibrillator
EL **Elevator**
S **Stairs**
E **Evac+Chair**



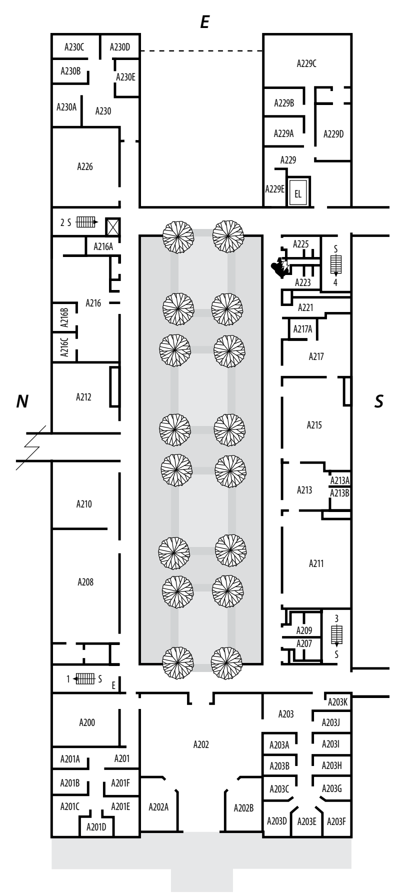
A Building Upper Level

Carroll Community College

Academic/Administration Building

A200 Classroom
A201 A–F Faculty Offices
A202 Student Center
A202 A Meeting Room
A202 B Meeting Room
A203 A–K Faculty Offices
A207 Men's Room
A208 Computer Classroom
A209 Women's Room
A210 Computer Classroom
A211 Science Laboratory
A212 Computer Classroom
A213 Science Prep Room
A213 A–B Science Prep Storage
A215 Science Laboratory
A216 Learning Technology Support Office
A216 A Staff Office
A216 B Staff Office
A216 C Staff Office
A217 Science Staff Offices
A217 A Staff Office
A221 Campus Safety & Security
A223 Women's Room
A225 Men's Room
A226 Office Technology Lab
A229 President's Office
Instruction & Student Development
A230 Administration Office

Automated External Defibrillator
EL **Elevator**
S **Stairs**
E **Evac+Chair**



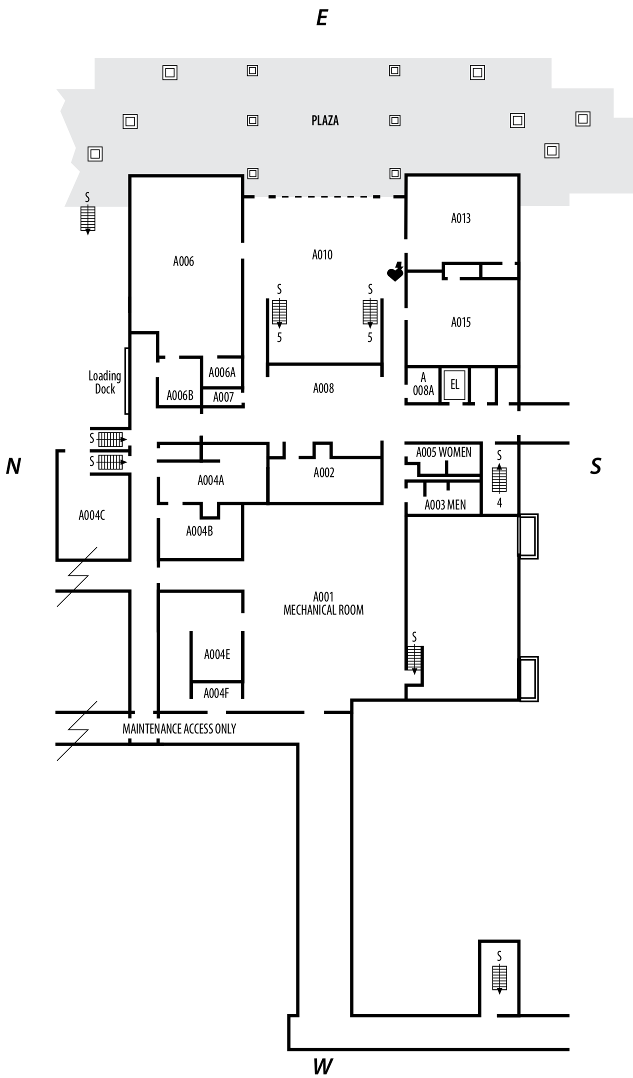
A Building
Lower Level

Carroll Community College

Academic/Administration Building

A001	Mechanical Room
A002	Conference Room
A003	Men's Room
A004 A–C	Bookstore Storage
A004 C	Lawn Shop
A005	Women's Room
A006	Bookstore
A006 A	Bookstore Office
A006 B	Bookstore Receiving
A007	Storage
A008	Vending Area
A010	Cafe Seating
A013	Art Studio
A015	Art Studio

Automated External Defibrillator
EL **Elevator**
S **Stairs**



C and M Buildings
Main Level

Carroll Community College

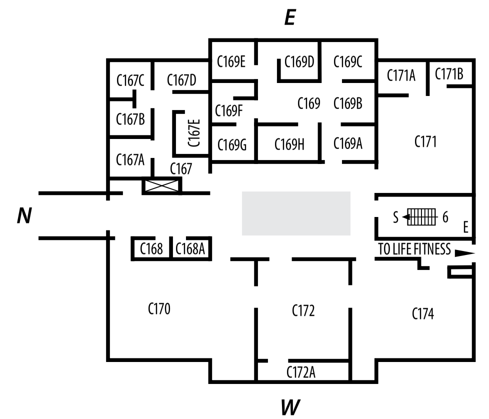
Classroom Building C

C167 A–E	IT Offices
C168	Closet
C168 A	Closet
C169 A–H	Information Technology Offices
C170	Science Lab
C171	Information Technology
C171 A & B	Staff Offices
C172	Science Prep Room
C172 A	Staff Office
C174	Science Lab

Classroom Building M

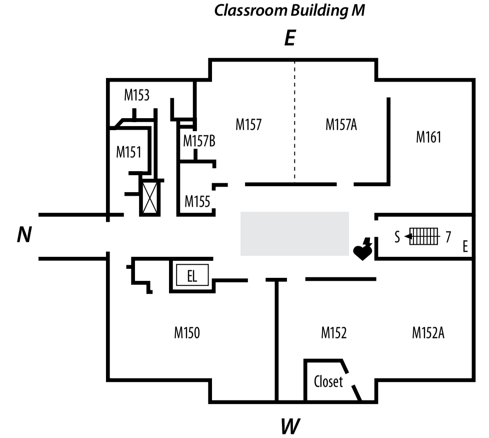
M150	Dry Science Lab
M151	Women's Room
M152	Engineering/Physics Lab
M152 A	Engineering/Physics Lab
M153	Men's Room
M155	Kitchenette
M157	Conference Suite
M157 A	Conference Suite
M157 B	Storage
M161	Dental Labs

Automated External Defibrillator
EL **Elevator**
S **Stairs**
E **Evac+Chair**



Classroom Building C

Classroom Building M



C and M Buildings Upper Level

Carroll Community College

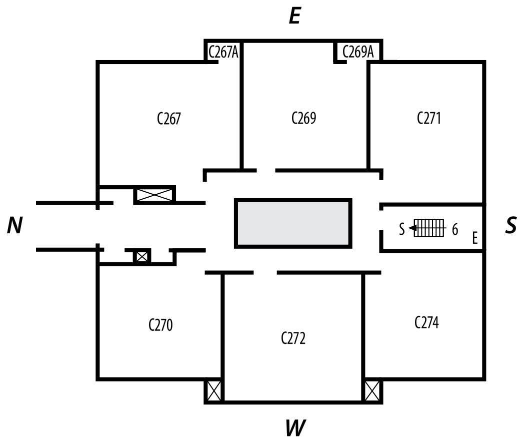
Classroom Building C

C267	Classroom
C267 A	Closet
C269	Classroom
C269 A	Closet
C270	Classroom
C271	Classroom
C272	Classroom
C274	Classroom

Classroom Building M

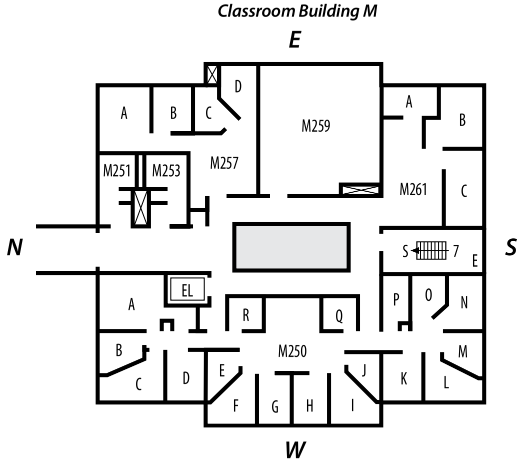
M250 A	Conference Room
M250 B–R	Faculty Offices
M251	Women's Room
M253	Men's Room
M257 A–D	Vacant
M259	Classroom
M261	Institutional Development & College Foundation
M261 A–B	Staff Offices
M261 C	Storage

(AED symbol)	**Automated External Defibrillator**
EL	**Elevator**
S	**Stairs**
E	**Evac+Chair**



Classroom Building C

Classroom Building M



C and M Buildings Lower Level

Carroll Community College

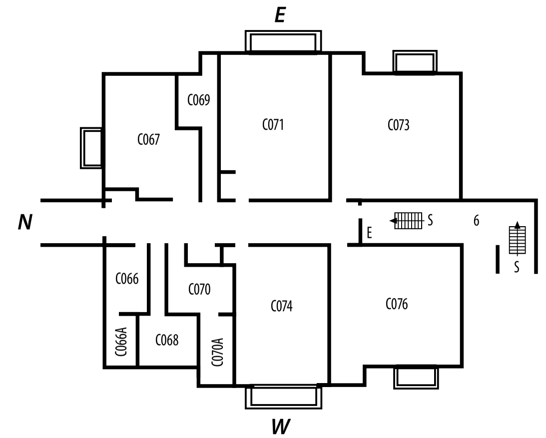
Classroom Building C

C066	Housekeeping
C066 A	Housekeeping Office
C067	Mechanical
C068	Housekeeping
C069	Housekeeping
C070	Carroll Chronicle
C070 A	Storage
C071	Classroom
C073	Classroom
C074	Classroom
C076	Classroom

Classroom Building M

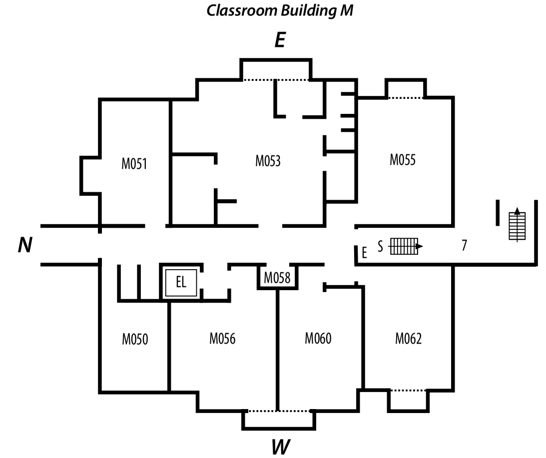
M050	Adjunct Faculty Office
M051	Mechanical Room
M053	County Maintenance
M055	Classroom
M056	Classroom
M058	Electrical Closet
M060	Classroom
M062	Classroom

(AED symbol)	**Automated External Defibrillator**
EL	**Elevator**
S	**Stairs**
E	**Evac+Chair**



Classroom Building C

Classroom Building M



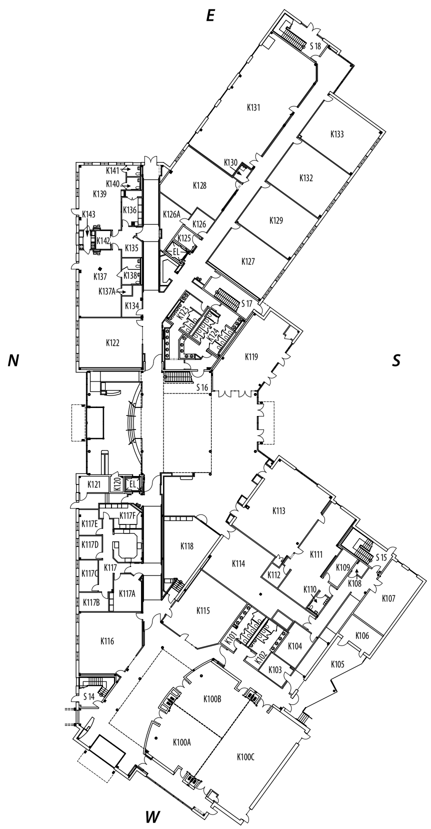
K Building
Main Level

Carroll Community College

Classroom Building K

K100 A	Meeting Room 1
K100 B	Meeting Room 2
K100 C	Meeting Room 3
K101	Women's Room
K102	Men's Room
K103	Catering
K104	Telephone/Data
K105	Loading Dock
K106	Electrical
K107	Mechanical
K108	Soap Storage
K109	Dry Storage
K110	Kitchen Bathroom
K111	Kitchen
K112	Kitchen Office
K113	Servery
K114	Facilities Storage
K115	Classroom
K116	Classroom
K117 A	CET Conference Room
K117 B–F	Continuing Education
K118	Private Dining
K119	Student Life Lounge
K120	Elevator Machine Room
K121	Water/Sprinkler
K122	Classroom
K123	Men's Room
K124	Women's Room
K125	Elevator Machine Room
K126	Electrical
K126 A	Telephone/Data
K127	Classroom
K128	Classroom
K129	Classroom
K130	Environmental Services
K131	Mechanical
K132	Classroom
K133	Classroom
K134	Technical Support
K135	Child Development Center & Lab School
K136	Child Development Office
K137	Early Childhood 1
K137 A	Storage
K138	Bathroom/Diaper Station
K139	Early Childhood 2
K140	Bathroom
K141	Bathroom
K142	Child Development Observation
K143	Child Development Kitchen

EL	**Elevator**
S	**Stairs**



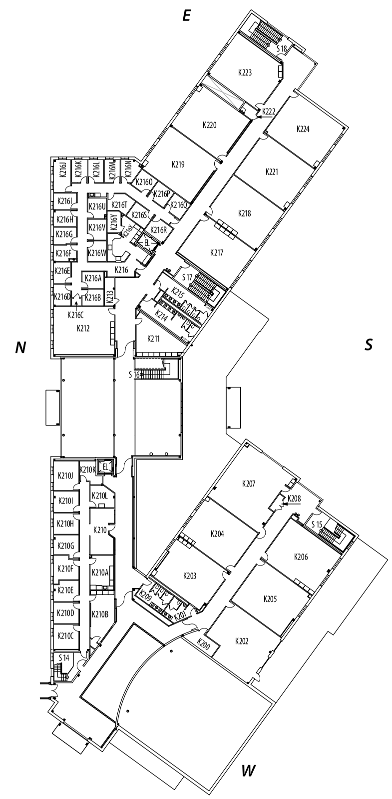
K Building
Second Level

Carroll Community College

Classroom Building K

K200	Telephone/Data
K201	Men's Room
K202	Mechanical
K203	Multi-Media Lab
K204	Multi-Media Lab
K205	Classroom
K206	Graphics Lab
K207	Multi-Media Lab
K208	Electrical
K209	Women's Room
K210 A–L	Planning, Marketing & Assessment
K211	Conference Room
K212	English Writing Lab
K213	Electrical
K214	Men's Room
K215	Women's Room
K216 A–Y	Faculty Offices
K217	Math Development Lab
K218	Math Development Lab
K219	English Classroom
K220	English Classroom
K221	English Classroom
K222	Environmental Services
K223	Language Classroom
K224	English Classroom

EL	**Elevator**
S	**Stairs**



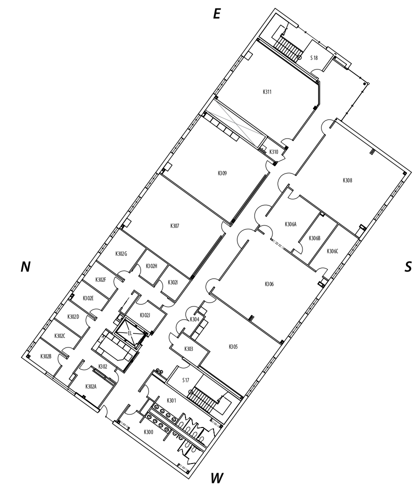
K Building
Third Level

Carroll Community College

Classroom Building K

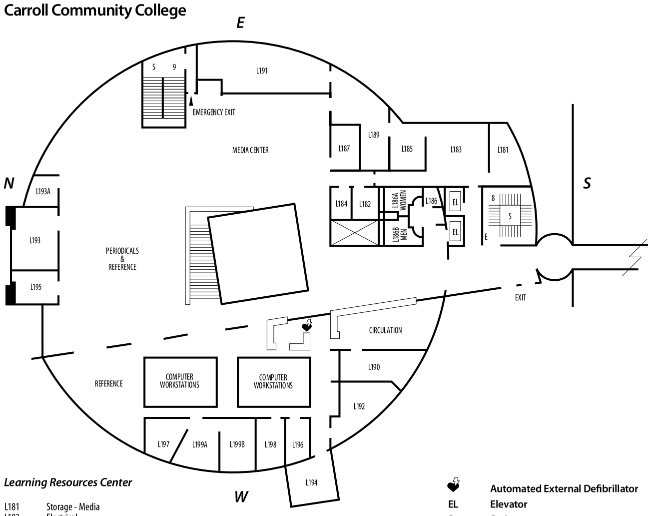
K300	Men's Room
K301	Women's Room
K302 A–J	Faculty Offices
K303	Telephone/Data
K304	Electrical
K305	Math Lab
K306	Organic Chemistry
K306 A	Chemistry/Forensic Prep.
K306 B	Chemical Storage
K306 C	Instrument Storage
K307	Math Classroom
K308	Chemistry/Forensic Lab
K309	Math Classroom
K310	Environmental Services
K311	Classroom

EL	**Elevator**
S	**Stairs**



L Building Main Level

Carroll Community College



Learning Resources Center

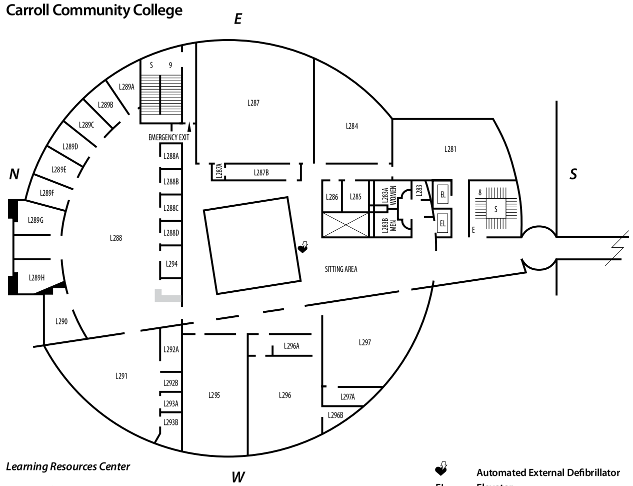
L181 Storage - Media
L182 Electrical
L183 Storage - Media
L184 Tele/Data/AV
L185 Storage - Media
L186 Housekeeping
L186 A Women's Room
L186 B Men's Room
L187 Media Group Study
L189 Media Offices
L190 Circulation Department
L191 Media Center Broadcast
L192 Blackboard/Distance Learning Office
L193 Conference Room
L193 A Group Study Room

L194 Center for Teaching and Learning
L195 Group Study Room
L196 Inter-Library Loan Office
L197–199 B Library Offices

Automated External Defibrillator
EL **Elevator**
S **Stairs**
E **Evac+Chair**

L Building Upper Level

Carroll Community College



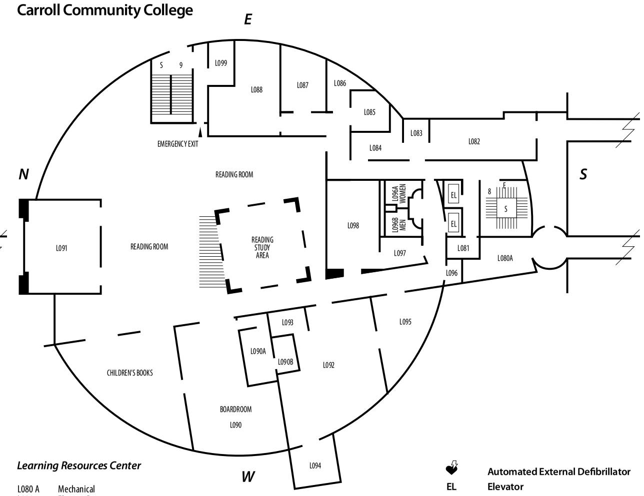
Learning Resources Center

L281 Classroom
L283 Housekeeping Closet
L283 A Women's Room
L283 B Men's Room
L284 Classroom
L285 Electrical
L286 Tele/Data/AV
L287 Distance Learning Lab
L287 A Storage
L287 B Control Booth
L288 Academic Services Center
L288 A–D Faculty Offices
L289 A–E Faculty Offices
L289 G–H Faculty Offices
L289 F Student Support Services
L290 Conference Room
L291 The Write Way Lab
L292 A Faculty Office
L292 B Faculty Office
L293 A Kitchenette
L293 B Faculty Office
L294 Faculty Office
L295 Classroom
L296 Distance Learning Lab
L296 B Storage
L297 Computer Lab
L297 A Storage

Automated External Defibrillator
EL **Elevator**
S **Stairs**
E **Evac+Chair**

L Building Lower Level

Carroll Community College



Learning Resources Center

L080 A Mechanical
L081 Elevator Room
L082 Central Warehouse
L083 Receiving
L084 Mail Center
L085 Electrical
L086 Tele/Data/AV
L087 Copy Center
L088 College Maintenance
L090 Board Room
L090 A Storage
L090 B Kitchenette
L091 Classroom
L092 Processing/Technical Services
L093 Lounge
L094 Library Office
L095 Continuing Education Learning Technologies
L096 Housekeeping
L096 A Women's Room
L096 B Men's Room
L097 Speech Department Coordinator & Speech Team
L098 Classroom
L099 Fire Closet

Automated External Defibrillator
EL **Elevator**
S **Stairs**
E **Evac+Chair**

Status and Trends: How are Maryland's Streams Doing?

[1] Maryland Stream, River and Lake Sampling as Part of the National Aquatic Resource Surveys: Current Status and Future Assessments

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US EPA Office of Water
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Tarquinio.ellen@epa.gov

Co-Authors: Ellen Tarquinio (US EPA Office of Water), Marsha Johnson (US EPA Office of Water), Richard Mitchell (US EPA Office of Water), Treda Grayson (US EPA Office of Water) and Sarah Lehmann (US EPA Office of Water)

A key goal of the National Aquatic Resource Assessments is to establish baseline water quality and biological condition estimates for the Nation's surface waters using standardized field, lab, and analytical methods. This presentation will focus on Maryland's participation in that effort, across streams, rivers and lakes, presenting data in the context of the broader ecoregion. In addition to current status, any preliminary data for the National Rivers and Streams Assessment will be presented as well as the plans for future analysis and sampling to establish trends.

Ms. Tarquinio has been working at the U.S. EPA Office of Water since 2004. She is the lead for the National Rivers and Streams Assessment, OW Technical Lead for the National Lakes Survey, and co-lead of the Landscape Ecology and Predictive Tools Guidance Document. Previously, she worked at the University of Maine and The New York State Department of Environmental Protection.

[2] Status and Trends of Non-tidal Chesapeake Streams and Rivers

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Aquatic Ecologist
Interstate Commission on the Potomac River Basin
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301.274.8103
www.potomacriver.org

Have 20 years of restoration, conservation practices, and point-source reductions improved overall conditions in the watershed, or are increasing development, legacy effects, and a changing climate slowing our progress to restore the bay? The multi-jurisdictional "Chessie" non-tidal benthic database was used to explore trends in the status of macroinvertebrate community condition and select stressors for non-tidal streams and rivers of the Chesapeake Bay Watershed. Family-level macroinvertebrate metrics and regional benthic IBIs were used to measure benthic community condition and to test for trends over several scales of time and space. Data were classified by physiographic region, relative stream size, and sampling season, in order to quantify and separate inherent natural variability and to better identify meaningful changes in the condition of Chesapeake streams and rivers. Analyses focused on repeat observations at unique stations across the Chesapeake Basin from 1993 through 2009. A total of 5,932 repeat benthic samples were identified at 1,369 stations, with trend events that ranged from 2 to 29 repeat observations for a single station.

Adam Griggs is an Aquatic Ecologist with the Interstate Commission on the Potomac River Basin, where he specializes in the development and use of biological indicators to identify causes of degradation in the non-tidal rivers and streams of the Chesapeake Basin. He is a native of the Monocacy River Watershed and holds an M.S. in Environmental Biology from Hood College and a genus-level taxonomic certification from the North American Benthological Society. Additionally, Adam serves on the board of the Catoctin Land Trust and is an avid paddler, fly-fisherman, gardener and naturalist.

[3] Status and Trends in the Ecological Condition of Maryland Streams and Rivers: Results of the Maryland Biological Stream Survey and Long-term Monitoring Programs

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Co-authors: Beth Franks (Versar, Inc.), Tony Prochaska and Ellen Friedman, (Maryland DNR)

The probability-based survey design of the Maryland Biological Stream Survey (MBSS) provides robust estimates of stream conditions at varying geographic scales. MBSS Round 1 (1995-1997) and Round 3 (2007-2009) provide statistically valid condition estimates both statewide and by 12 major tributary basins while Round 2 (2000-2004) provides estimates at the scale of individual or combined Maryland 12-digit watersheds. Biological integrity (fish and benthic macroinvertebrate) scores integrate perturbations (natural and anthropogenic) over time and are useful indicators of the overall condition of streams, while physical and chemical integrity provide evidence of specific stressors. One of the most important questions for managing water resources is, how is the condition of streams changing over time? The MBSS is designed to detect trends in stream condition in three ways: (1) changes across multiple-year rounds of statewide sampling, (2) annual changes in statewide assessments with partial coverage of watersheds, and (3) annual changes at sentinel sites. Statewide, the percentage of stream miles in good condition increased by 5-7% from Round 1 to Round 3, while the percentage of stream miles in very poor condition decreased by a comparable amount. Maryland DNR also maintains a long-term monitoring program (referred to as the Core/Trend Program) that was initiated in the mid-1970s. Monitoring stations on major freshwater rivers (e.g., Choptank, Gunpowder, Patapsco, Patuxent, Susquehanna, Potomac, and Youghiogheny River basins) throughout the state are sampled regularly to provide information on water quality and benthic macroinvertebrate community health. Water quality samples have been collected monthly at 54 monitoring stations since 1986, while benthic macroinvertebrate communities have been sampled regularly at 116 monitoring stations starting as early as 1976. We present long-term trends in water quality (1986-2010) and benthic community health (1976-2006) for major rivers in Maryland, including demonstrable improvements. The observed improvements suggest that aggressive management actions (e.g., upgrades in wastewater treatment plants and acid mine drainage mitigation) can be effective in improving conditions for Maryland's aquatic resources.

Mark Southerland, Ph.D., PMP, CSE, has been supporting federal, state, and local water quality programs since 1988. He was the lead author of the EPA national program guidance on biological criteria and has been the lead consultant on the Maryland Biological Stream Survey for the Maryland Department of Natural Resources (DNR) since 1993. He also supports the impaired waters, stressor identification, and TMDL programs for the Maryland Department of the Environment (MDE). Mark currently serves as chair of the Maryland Water Monitoring Board and is an original member of the Howard County Environmental Sustainability Board.

[4] Streams in Maryland's National Parks, How are They Doing?

Marian Norris
Water Resources Specialist
Inventory and Monitoring Program
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marian_norris@nps.gov
http://www1.nature.nps.gov/im/units/ncrn/index.cfm

The Inventory and Monitoring Program is a major component of the National Park Service's strategy to improve park management through greater reliance on scientific information.
Nationwide, 270 national parks have been grouped into 32 Vital Signs Networks linked by geographic similarities, common natural resources, and resource protection challenges. The network approach facilitates collaboration, information sharing, and economies of scale in natural resource monitoring. The National Capital Region Inventory and Monitoring Network (NCRN) encompasses 11 park units in Virginia, West Virginia, Maryland and the District of Columbia. In Maryland NCRN includes Antietam National Battlefield, Catoctin Mountain Park, Monocacy National Battlefield, and National Capital Parks – East. NCRN has collected stream water chemistry and quantity data in these parks since 2005. This presentation will discuss trends in stream water quality and quantity across the National Capital Region with a focus on these 4 parks. Data collected by staff from Catoctin since 1978, and Monocacy since 2004 will also be included.

Marian is in charge of the water monitoring program for the National Capital Region Inventory and Monitoring Network of the National Park Service. She began monitoring as a volunteer in high school. Since then she has worked in systems ranging from agricultural headwater streams to urban estuaries, and from freshwater riparian zones to tidal saltmarshes. Before joining the National Park Service, she developed several Hydrogeomorphic Functional Assessment models for urban wetlands in New Jersey, and researched and developed environmental education curricula.

[5] Just What is the Condition of Baltimore County Streams?

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Baltimore County Department of Environmental Protection and Sustainability
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Towson, MD 21204
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Baltimore County has collected probabilistic stream benthic and physical habitat data since 2003. Streams in the northern part of the county are sampled in even-numbered years, while streams in the southern part of the county are sampled in odd-numbered years. This sampling regime is roughly aligned with the Urban-Rural Demarcation Line, which allows for some examination of water quality in relation to urban and rural development patterns and forest cover. Stream condition was generally better in the northern part of the county, as measured by biological and physical habitat indices. Within each region, streams with more forest cover were consistently higher in biological and physical quality. Some trends in stream quality related to annual precipitation patterns were noted.

Dennis has managed the biological and geomorphological sampling programs at the Baltimore County Department of Environmental Protection and Sustainability since 2007. He is responsible for benthic and fish field data collection and analysis, and is the primary macroinvertebrate taxonomist. He also collects and analyzes cross-sectional and longitudinal profile data for stream restoration projects in Baltimore County.

[6] Montgomery County Streams – Change and Recovery

Jennifer St. John
Montgomery County DEP
Jennifer.St.John@montgomerycountymd.gov

Co-Authors: Keith Van Ness (Montgomery County DEP)

Montgomery County's stream monitoring program began in the 1970's with an emphasis on water quality sampling. The first county-wide biologically based stream monitoring program began in 1994. This program produced the County-wide Stream Protection Strategy (CSPS) establishing watershed conditions, management categories and stream restoration priorities. Special Protection Area (SPA) stream monitoring also began in 1994. Through an interagency partnership, SPA stream monitoring in the Clarksburg SPA has recorded changes in stream conditions before, during and, in some areas, after development. Monitoring links changes in the landscape to changes in hydrology, morphology and biology. Stream restoration project monitoring documents the cumulative benefits an urban watershed has received from over 20 years of restoration efforts. Monitoring results from these programs are used to help answer how are these streams doing.

Jennifer St. John is a watershed planner with Montgomery County's Department of Environmental Protection, Watershed Management Division. She oversees the County's restoration monitoring program and works with County engineers to implement restoration projects throughout the County. Before becoming a planner, Jennifer was a water quality specialist for the County, responsible for assessing baseline watershed health, effects of development on water quality in Special Protection Areas (SPAs), and effectiveness of stream restoration.

[7] Chesapeake Bay Fish Passage Prioritization

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Co-Authors: Jim Thompson (Maryland DNR), Mary Andrews (National Oceanic and Atmospheric Administration) and Steve Minkkinen (U.S. Fish and Wildlife Service)

American shad (*shad*) and river herring were historically a major fishery resource in the Chesapeake Bay and a common food for Native American tribes. However, landings of American shad in Maryland declined from 7 million pounds in 1890 to 18,000 pounds in 1979. Harvest and habitat loss due to manmade barriers are two contributors to the declines. Over the past century many manmade barriers have fallen out of use and into disrepair. While many fish passageways over barriers were built in the latter part of the 20th century, biologist and engineers agree that barrier removal is the best option for providing fish passage. Because barrier removals are often expensive and funding is limited, the Fish Passage Taskgroup of the Chesapeake Bay Program has been working to develop a tool that will support decisions about where fish passage dollars should be spent to provide the most benefit to migratory and resident fish species. This effort started with a pilot fish passage prioritization in Maryland. However, metrics for ranking fish passage projects have been developed in collaboration with the States of MD, VA and PA, Federal agencies (NOAA, NRCS, and USFWS) and American Rivers. NOAA and the USFWS have provided funding to The Nature Conservancy to advance the efforts of the Chesapeake Bay Fish Passage Taskgroup in developing a watershed-wide prioritization procedure. Specifically, TNC will develop updated databases in Maryland, Virginia, and Pennsylvania that can be used to calculate comparable Ecological Value Criteria and related metrics for the Chesapeake Bay watershed. The metrics will be used to produce a relative prioritization of dams, largely following the model used in TNC's NEAFWA work with amendments by the Chesapeake Bay Fish Passage Taskgroup. In addition, the project will create a Chesapeake Connectivity Assessment Tool that will be easy to use, can be updated over time with new data or criteria, and can be used at relevant scales of analysis.

Julie Devers is a Fishery Biologist at the U.S. Fish and Wildlife Service's Maryland Fishery Resources Office in Annapolis, MD. She previously worked at the U.S. Fish and Wildlife Service's White Sulphur Springs National Fish Hatchery and Southwest Virginia Field Office. Julie has a B.S. in biology from Millersville University and an M.S. in fisheries science from Virginia Tech.

[8] Designing and Implementing Dam Removal Projects in the Context of the Regulatory Climate: The Simkins Dam Removal Case Study

Mary Pittek Andrews
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Dam removal is an evolving field where, as removals continue to gain traction as a respected river restoration technique, hot button topics and complicated engineering questions are emerging that bifurcate the restoration, engineering and regulatory community. The Simkins Dam Removal project will be used to examine key issues impacting dam removal projects in the context of the latest in scientific research, engineering practices and political climate. The practical applicability of these issues, such as sediment management, will be discussed in light of their real-life constraints. The Simkins Dam was a 10-ft high concrete dam on the Patapsco River within the Patapsco Valley State Park area two miles east of Ellicott City, Maryland. The dam was located just upstream of the 34 foot high Bloede Dam. NOAA, American Rivers, and other partners contracted with Interfluve to design the removal of the Simkins Dam. Together with the Bloede Dam removal and the recent removal of the Union Dam, the Simkins removal will result in passage for diadramous fish (alewife, blueback herring, American eel), free flowing river conditions, restored sediment transport processes and reduce safety concerns related to an aging dam structure in a waterway heavily used for water-based recreational activities. This presentation will focus on the regulatory requirements and design information required to permit the passive sediment management approach, including the DREAM sediment transport model, soil analysis for grain size and contaminants, adaptive management plan, and monitoring approach. We will also investigate the real life implications of permit requirements during construction, modifications made to sediment and erosion control features and compare and contrast alternative approaches for a dam removal completed just upstream of the Simkins site.

Mary P.Andrews, P.E. is an environmental engineer with the NOAA Restoration Center in Annapolis, MD. She has been working in the restoration field for more than 10 years on wetlands restoration and dam removal projects.

[9] Flow and Suspended-Sediment Monitoring at Three Stream gages on the Patapsco River, Maryland, October 2010 to March 2011

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The United States Geological Survey (USGS), in cooperation with NOAA and American Rivers is determining flow and monitoring sediment transport in order to calculate daily, monthly, and annual sediment loads at three stream gages on the Patapsco River, Maryland. The stream gages were established prior to the removal of Simkins Dam, a nineteenth century, low-head mill dam. The dam no longer provided industrial benefit, posed a safety hazard, and obstructed anadramous and catadramous fish migration. Computation of sediment loads and discharge will be used to monitor the impact of the dam removal on the aquatic and riparian-zone habitat of the river, and to support the planning process for the removal of another dam further downstream on the Patapsco River. Prior to dam removal, estimates of the volume of impounded sediment ranged from between 90,000 to 100,000 cubic yards of predominately sand-sized material. Three USGS stream gages on the river are being used to continuously monitor river stage and turbidity. In addition, suspended-sediment samples are collected periodically at base flow and during storm events. The two downstream stream gages were established for this study and data collection began in October 2010. Stream flow and stage data from all three sites can be accessed on the web at http://waterdata.usgs.gov/md/nwis/rt. All suspended-sediment samples, as well as continuously collected turbidity data, provide information that is used to calculate instantaneous suspended-sediment concentration, as wells as suspended-sediment loads. Initial analysis of the data collected over the first nine months of monitoring suggest a positive correlation between suspended-sediment concentration, discharge and stage, and turbidity at all three stream gages. Select sample analysis for particle size indicates a positive correlation between grain size and discharge or stage.

Mr. Banks is a hydrologist with the U.S. Geological Survey in Baltimore, Maryland. For the past 8 years Mr. Banks has been studying sediment sourcing and transport in the Piedmont and Coastal Plane streams in Maryland and Pennsylvania. Currently, Mr. Banks is part of a study team looking at the effects of the removal of Simkins Dam on the Patapsco River.

[10] Geomorphic Monitoring of the Patapsco River Following the Removal of the Simkins Dam, Patapsco River, Maryland

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The Simkins Dam was removed in late 2010 as part of the Patapsco River Restoration Project aimed at restoring critical spawning and rearing habitat for American eel, alewife, blueback herring, yellow and white perch, and American shad. The project team and regulators elected for passive sediment management whereby the deposit was neither dredged nor protected from natural fluvial erosion and thus much of it was transported and deposited in the downstream reaches. This approach warranted an extensive monitoring program including pre- and post-removal evaluation of suspended sediment and river stage at two downstream USGS stream gages, fish and macroinvertebrates, and stream channel geomorphology. The geomorphology study includes 31 permanently benchmarked cross sections, over 100 benchmarked photo monitoring points, five Digital Elevation Models (DEMs) including impoundment bathymetry over nearly 2.5 linear miles, and detailed facies mapping at each of the cross sections. This diachronous study included survey efforts undertaken in 2010 before dam removal, again in early Spring 2011 post-dam removal, and following a storm event in Spring 2011. Survey efforts will be repeated in the Fall of 2011 and in the Spring and Fall of 2012. One survey effort is reserved to record geomorphic changes immediately following a significant storm event during the monitoring period. The primary goal of the stream channel geomorphology study is to understand the upstream and downstream geomorphic response of the river to the dam removal by documenting morphologic changes, the movement and transient storage of sediment, and bed sediment grain size changes. Changes in channel morphology and the rates at which they occur have important implications for the project's ecologic, engineering, aesthetic, and recreation objectives. Preliminary conclusions are also provided based on the predictions made in the DREAM-1 Model prepared prior to dam removal and the observed results. Here we describe the establishment of the survey as well as present preliminary results observed in the months preceding and following dam removal.

Mr. Graham C. Boardman is a Fluvial Geomorphologist at McCormick Taylor. Mr. Boardman focuses on stream restoration design, dam removal, river assessment and monitoring.

[11] Patapsco River Dam Removal Study: Assessing Changes in American Eel Distribution and Aquatic Communities

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The Maryland Biological Stream Survey (MBSS) in collaboration with American Rivers, NOAA, and the DNR Fisheries Service, is performing biological monitoring in the Lower North Branch Patapsco River as part of the removal of Simkins, Union and Bloede dams. The goals of this project are to determine the potential impacts of dam removal on the distribution of American eels (Anguilla rostrata) and other diadromous fish species, as well as on other fish and benthic macroinvertebrate communities in the Patapsco River. Sampling was conducted at 26 sites in spring and summer of 2009-2011 and will continue through 2012 to more fully assess the changes to the river after the dams are removed. Removal of Union Dam was completed in September of 2010 and the removal of Simkins Dam was completed in January 2011. The feasibility of removing Bloede Dam is currently under investigation. American eels were present at all sites except a small tributary just upstream of Simkins Dam, but eels decreased in abundance with increasing distance upstream. What caused this distribution pattern or how the pattern might change once the dams are gone is not known. Seven species of diadromous fish were collected in the river in spring 2011, but only two of those species were collected above Bloede Dam- and indication that the structure may create a migration barrier in spite of its fish ladder. Benthic macroinvertebrate indices of biotic integrity were drastically different between 2009 and 2010, and 2011 benthic sampling protocols were adjusted in an attempt to determine the cause of those differences. The two years of data collected thus far (analysis of the third year is underway) are not sufficient to draw conclusions on the dam removals impacts on water quality and benthic macroinvertebrates. Continued monitoring should be helpful in determining dam removal effects on water chemistry as well as fish and benthic macroinvertebrate communities in the Patapsco River.

William Harbold graduated from the State University of New York College of Environmental Science and Forestry in Syracuse, NY with a B.S. in conservation biology in May 2010. He has been working as a biologist for the Maryland Biological Stream Survey since June 2010.

Freshwater Mussels

[12] Human Activities and the Capacity for Native Freshwater Mussels (Unionidae) to Mitigate Cultural Eutrophication in the Chesapeake Bay

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The Chesapeake Bay watershed currently faces an unprecedented challenge of balancing the needs of a growing population with those of an ecologically fragile freshwater-marine ecotone. As such, urbanization and agricultural land-cover modifications have led to increased headwater nutrient export rates with cascading eutrophic impacts on the Chesapeake Bay ecosystem. To mitigate these impacts, many have suggested using oyster bed aquaculture and harvesting as a mechanism to sequester nutrients from the Bay. Unfortunately, the potential for native freshwater mussels to mitigate nutrient pollution has been largely neglected, which is especially unfortunate since native mussels are often found in regions of higher nutrient TMDL. Here I outline the ecological mechanisms for which native freshwater mussels provide important ecosystem services, compare these services on a dollar per dollar basis to other nutrient removal strategies, and discuss the context for which these services may be important when combined with other nutrient reduction strategies.

Daniel Spooner is a Research Associate at the USGS Northern Appalachian Laboratory. He received his PhD from the University of Oklahoma, "Linking physiology, species traits and environmental context to biodiversity and ecosystem function". Daniel is interested in the link between abiotic and biotic components within ecosystems. Currently, he studies how freshwater mussel communities provide ecological services and how these services change under varying climate and land-use regimes. This involves understanding species interactions among individuals within a community; physiological responses to disturbances (climate change and land-use); and an understanding of biogeochemical interactions among consumers and producers along gradients of disturbance.

[13] Using Predictive Distribution Models to Find the Dwarf Wedgemussel in Maryland

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One mussel species of particular importance to states along the Atlantic slope is the federally endangered dwarf wedgemussel, *Alasmidonta heterodon*. Maintaining and restoring viable populations is central to recovery efforts, yet the sparse and fragmented nature of the species makes locating populations difficult. We are using landscape and biological community data for distribution models to discover unknown populations. Model development began in Maryland using hierarchical stream segment attributes and potential mussel and fish surrogate species identified through community analyses. Five variables predicted *A. heterodon* occurrence with an error rate below 6%: position in the stream network, woody wetlands, Miocene geology (may be a geographic artifact), precipitation, and the presence of redbreast sunfish. In the habitat only model, redbreast sunfish was replaced with intensity of development in the drainage basin. Application of the predictive model in a GIS identified stream segments with the potential to contain *A. heterodon*. These predictions can direct future snorkel surveys and potentially uncover unknown populations.

Cara holds a Masters Degree in Wildlife and Fisheries Conservation from the University of Massachusetts and is currently pursuing a Ph.D. at the University of Maryland. She has been working in research with the federal government for 20 years, and is currently a research fishery biologist at the US Geological Survey's Northern Appalachian Research Laboratory in Wellsboro, Pennsylvania.

[14] Freshwater Mussel Survey of the Potomac River Mainstem

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A multi-year, two-phase freshwater mussel survey of the Potomac River mainstem was initiated by the Interstate Commission on the Potomac River Basin in 2009. The primary objectives of this survey are; 1) augment biological information collected at study reaches established in the Potomac River's mainstem through a nationwide survey of large river conducted by the US EPA, 2) improve our understanding of the status of Potomac River mussel species, their temporal variation and trends, relationship to the river's general health, and 3) help evaluate how mussel communities in typical sections of the Potomac river compare with sections potentially impacted by pollution or altered flows, especially where low-flows are exacerbated by consumptive water uses. Survey parameters include species richness, relative abundance, density, recruitment, and presence of any state or federally rare, threatened or endangered mussels. Phase 1 was conducted in 2009 when freshwater mussel habitat was qualitatively evaluated and mapped for four mainstem river segments. This work was performed with assistance from the Maryland DNR and the USGS Leetown Science Center, Aquatic Ecology Branch. Estimates of search efficiencies were calculated through timed visual snorkel surveys conducted at 11 random locations within river segments. Phase 2 began in 2010 with an intensive quantitative survey conducted at a 4 kilometer river segment just downstream of Dam #5 near Williamsport, Maryland. Six mussel's species represented by sixty-one individual mussels were collected, including two Maryland endangered species; the Brook Floater (*Alasmidonta varicosa*) and the Green Floater (*Lasmigona subviridis*), two species formerly considered extirpated in this portion of the Potomac River mainstem. One-hundred and fifty-six 0.25 m^2 quadrats were examined by visual examination of the surface (detection rate 2.5 min/individual) and one-hundred and four by excavation to approximately 10 cm depth (detection rate 11.9 min/individual). Based upon density estimates over 200,000 mussels are present in the 4 kilometer river reach. Mussels provide significant ecological benefits including; filtering and improved water quality, food-chain enhancement, habitat creation, and carbonate (CO_2) sequestration. The presence of the state endangered mussels is important for considerations of proposed construction or disturbance activities, water withdrawal, and discharge permits. Phase 2 will continue, funding permitting, into 2012 with additional river reach assessments.

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Major duties and responsibilities include interstate coordination, stimulation and implementation of projects relating to fisheries biology, natural resource development and management, aquatic ecology, and habitat restoration and enhancement.

[15] Freshwater Mussel Conservation in Virginia—Using Propagation as a Recovery Tool

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The Commonwealth of Virginia ranks 6th in the U.S. for freshwater mussel diversity with 81 species. However, much like the national trend, many of these species are imperiled with 38 species (47%) listed as federally and/or state endangered or threatened. Likewise, 62 species (77%) are listed on the Commonwealth's Wildlife Action Plan as Species of Greatest Conservation Need. In an effort to restore this highly imperiled taxa, the Virginia Department of Game & Inland Fisheries (DGIF) has been a leader in using propagation as a recovery tool. In 1998, DGIF started the Aquatic Wildlife Conservation Center (AWCC) in Marion primarily as a facility to hold adult mussels from the Upper TN River Basin in cases of environmental calamities but also as a propagation facility. With advances in propagation, the facility has transitioned to a propagation facility. Since 2003, AWCC has propagated over 4.4 million juvenile mussels representing 26 species and released nearly 700,000 mussels of various sizes representing 20 species. Prior to 2008, the main goal was to release propagated mussels one to two months after transformation. Because individuals released using these methods were rarely recovered at augmentation sites, our strategy changed to culturing individuals to larger sizes before their release. While this change has resulted in producing fewer mussels, the ones produced are large enough to be tagged and recovered. Following on the success of the AWCC, DGIF started a

cooperative mussel propagation facility in 2007 with the U.S. Fish & Wildlife Service at their Harrison Lake National Fish Hatchery in Charles City. The Virginia Fisheries and Aquatic Wildlife Center (VFAWC) works solely with Atlantic Slope mussel species filling a critical need in freshwater mussel recovery. Since 2008, VFAWC has propagated over 1.2 million mussels representing nine species and released over 5,000 2-3 year old mussels representing three species.

Brian Watson currently works for the Virginia Department of Game & Inland Fisheries and serves as their Aquatic Invertebrate Biologist specializing in freshwater mollusks. Prior to joining DGIF in 2002 Brian worked for the North Carolina Wildlife Resources Commission as a Nongame Aquatics Biologist. Brian received his B.S. degree in Marine Science/Biology from the University of Tampa in 1994 and his M.S. degree in Fisheries Science from Virginia Tech in 1998.

[16] Experimental Stocking of American Eels in the Susquehanna River Watershed

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American eel populations have been declining along the Atlantic coast. Conowingo Dam, at mile 10 of the Susquehanna River, blocks American eels from accessing 43% of previously available habitat in the Chesapeake Bay watershed. Following the construction of large mainstem dams in the Susquehanna River, eels were stocked sporadically until 1980. However, no eels have been captured in Pennsylvania Fish and Boat Commission surveys in the Susquehanna River since 1980. In addition to very low abundance of eels found in the river, *Elliptio complanata*, a common freshwater mussel species in most mid-Atlantic streams and rivers, is relatively low in abundance in the Susquehanna River watershed. Laboratory tests conducted by U.S. Geological Survey and U.S. Fish and Wildlife Service suggest that American eels play an important role in the *E. complanata* life cycle by hosting the mussel's larvae on their gills. The U.S. Fish and Wildlife Service has been working since 2006 to assess the best methods for capturing eels below Conowingo Dam. The successful capture of eels below the dam provides an opportunity for experimental stocking of eels near freshwater mussel beds in the Susquehanna River Basin to determine if the reintroduction of eels significantly increases recruitment in *E. complanata* populations. Following baseline fish and mussel surveys, experimental eel stockings in two tributaries began in 2010 and will continue through 2012. Fish and mussel populations will be monitored until 2019. If eels are the missing link to abundant *E. complanata* populations in the Susquehanna River, restoring eels could also restore this fauna and result in improved water quality.

Julie Devers is a Fishery Biologist at the U.S. Fish and Wildlife Service's Maryland Fishery Resources Office in Annapolis, MD. She previously worked at the U.S. Fish and Wildlife Service's White Sulphur Springs National Fish Hatchery and Southwest Virginia Field Office. Julie has a B.S. in biology from Millersville University and an M.S. in fisheries science from Virginia Tech.

[17] How a State-Wide Stream Survey Can Aid in Understanding Freshwater Mussel (Bivalvia: Unionidae) Ecology: Examples of Utility and Limitations from Maryland

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Gaps in our knowledge of freshwater mussel life history, distribution and ecology remain even though their study has increased considerably over the past few decades. These types of studies have traditionally taken place within a population, river, or larger drainage unit, but rarely across a broad landscape, such as a state. Given the imperiled status of a majority of freshwater mussel species alternative opportunities to collect potentially valuable data cannot be overlooked. We present results from a statewide biological monitoring program, the Maryland Biological Stream Survey, offer examples of analyses that can be conducted with such data, and discuss the utility and limitations of incorporating freshwater mussels into stream assessments. Since 2007, we have encountered 11 of the 16 unionid species extant in Maryland during assessments of wadeable streams by using an informal visual survey and recording incidental observations. On several occasions, we have discovered new populations of imperiled mussels or extended a species distribution. The biological and physiochemical

data collected at sites coincident with freshwater mussel presence has allowed us to investigate factors potentially limiting species distribution, such as fish-host dynamics, habitat quality, nutrient concentration, and land use. We feel that by adding minimal effort into a biological monitoring program, invaluable data can be collected that can help resource managers, malacologists, and researchers answer a variety of questions. Further work is needed to investigate the cost-benefits of additional sampling effort as this could vary markedly among molluscan faunal regions and project specific objectives.

Matt is a Natural Resource Biologist with Maryland DNR's Monitoring and Non-Tidal Assessment division and serves as the freshwater mussel expert for the Maryland Biological Stream Survey. Masters of Science (2005) earned from Tennessee Technological University where he researched the status, distribution and habitat use of an endangered darter and various aspects rare fish ecology and freshwater mussel life history and conservation.

Invasive Species

[18] Invasive Species and Maryland DNR

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The Maryland Department of Natural Resources (MDNR) has in the past decade gathered the support of the Maryland General Assembly and the public in combating invasive species. In 2007, MDNR formally recognized a group of biologists and experts within MDNR who work jointly between units to respond to invasive species issues. This group, the MDNR Invasive Species Matrix Team, has worked on a number of issues including rusty crayfish, didymo, snakehead, catfish, wavyleaf basketgrass, and many others. The presentation will discuss some of the legal structure which MDNR operates under, some of the success stories it has had, some of the challenges it faces, and what issues it is anticipating in the future.

Sarah Widman is a regulatory administrator for the Maryland Department of Natural Resources Fisheries Service, where she writes fisheries regulations and legislation. She received her J.D. from the University of Baltimore School of Law in 2004. Prior to law school, Sarah worked for the Geothermal Energy Association. She holds a M.A. in Media and Public Affairs from the George Washington University and a B.A. in Political Science from American University. In 2007, Sarah presented a paper titled, "Fishing for Law: How Changes in Maryland Fisheries Management Have Impacted Judicial Review of Maryland Fisheries Law," at the American Fisheries Society Annual Meeting San Francisco. She also authored the Maryland Environmental Legislative Update for 2004 for the University of Baltimore Journal of Environmental Law, Vol. 11:2, Spring 2004. Sarah serves as a member of the Maryland Invasive Species Council and Maryland Department of Natural Resources Invasive Species Matrix Team. She also staffs the Maryland Sport and Tidal Fisheries Advisory Commissions' Penalty Workgroup and has previously staffed Maryland's Working Waterfront Commission.

[19] Blue Catfish, The Potomac's Largest Unwelcome Invasive or an Increasingly Popular Sportfish

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Catfish have long been an important species in America. Whether for recreation or for a means of supplying food for the dinner table, millions of pounds of catfish find their way from local waterways to the shore each year. In the tidal Potomac, White Catfish (*Ameiurus catus*) and Channel Catfish (*Ictalurus*) are most commonly harvested for food. Less popular, but still harvested, are members of the Bullhead family (*Ameiurus ssp.*). In recent years, however, blue catfish (*Ictalurus furcatus*) have been found in increasing numbers. Wildly popular as a sportfish in some other states, Blue Catfish are known for reaching weights over 100 lbs. and are highly prized because of their size. But introduced populations of Blue Catfish are also known to displace native catfish, grow quickly, reproduce efficiently, and feed heavily on mollusks, crustaceans and other fish. By 600 mm in length, they are almost totally piscivorous. The Virginia Department of Game and Inland Fish has been collecting data on Blue Catfish in tidal rivers since 2002 and has compiled growth and mortality information for the James, York and Rappahannock. Maryland DNR biologists are currently conducting a diet study and compiling growth data on Blue Catfish found in the tidal Potomac River. Emphasis also centers on predation of Blue Catfish on protected Shad populations and the possible competition on available forage needed for other gamefish and aquatic species. The tidal Potomac Blue Catfish population has quickly become popular among catfish anglers and commercial watermen who remain involved in talks concerning the management of the species. As a result, biologists and researchers from Maryland, Virginia and Washington DC have been working together to formulate a region-wide policy for Blue Catfish; one that will address the important environmental concerns that they pose while remaining sensitive to the economical and recreational value that they may bring to local communities.

Mary Groves has been working for the Maryland DNR, Inland Fisheries Division for 22 years. Mary is currently the Southern Region Manager for Inland Fisheries and is based out of Cedarville Fish Hatchery in Brandywine, Maryland.

[20] Ongoing Efforts to Control the Invasive Northern Snakehead

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Controlling populations of invasive fish species is an ongoing problem throughout fisheries management. Sometimes little to no information of the invading species is known or available, therefore hampering control efforts. The northern snakehead (*Channa argus*), a species native to Asia, has been established in the Potomac River since 2004. Efforts to control northern snakehead populations have had varied success since its introduction. Our goals were to better understand northern snakehead behavior to enhance control efforts. From spring 2009 to present, we have monitored northern snakehead movement and behavior within the Potomac River by external and radio tagging. External tagging has shown that an overwhelming majority of individuals (approximately 90%) tend to remain in the same creeks where they were initially captured. However, those individuals that do move can cover relatively large distances (up to 47 river km). Seasonal and climatic events appear to drive northern snakehead behavior. Northern snakehead activity tended to peak within two to five days after periods of high rainfall. Furthermore, as temperatures dropped during fall and winter, so too did snakehead activity. This suggests that removal efforts should be focused during times when snakehead activity is low, to increase capture efficiency. While no obvious negative impacts of the presence of northern snakehead have yet been observed, there should be continued vigilance to deter the spread and growth of this invasive species population.

Josh received his Bachelor's degree at the University of Delaware and received his Master's degree from the University of Maryland Eastern Shore, where he studied growth of juvenile white perch. Josh is currently a fish biologist with the U.S. Fish and Wildlife Service working with the Maryland Fishery Resources Office in Annapolis, MD. He typically works with Northern snakehead, American eel, and American shad.

[21] Hood College Student-Faculty Research: Ecology, Physiology and Genetics of Native and Invasive Maryland Orconectes Species

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Faculty and students at Hood College, in collaboration with the Maryland Department of Natural Resources (DNR), use a multidisciplinary approach to study invasive and native crayfish in Maryland's waterways. Using ecological, physiological, and genetic methods, we are attempting to characterize the effects of invasive *Orconectes spp*. on native flora and fauna and to understand the mechanisms by which they exert their impact. The rusty crayfish, *Orconectes rusticus*, has recently joined the longer-established virile crayfish, *Orconectes virilis*, as a problematic invasive species in the Monocacy River and its tributaries. From multi-year surveys, it appears that *O. rusticus* is gradually displacing *O. virilis*. We hypothesize that the competitive exclusion of *O. virilis* takes place in the early life stages. Our research group is presently examining potential mechanisms of displacement including competition for optimal habitat, adult and juvenile behavior, fecundity, and juvenile mortality. We are also studying the salinity tolerance of adults and juvenile *O. rusticus* in an effort to predict the potential expansion of this species into higher salinity waters. Through mesocosm experiments, we have seen that *O. rusticus* has a considerable impact on selected species of submerged aquatic vegetation (SAV) and the resulting turbidity of surrounding waters. The genetic variation of *O. rusticus,* as assessed by microsatellite DNA markers, appears to be high, further suggesting a robust population established by multiple individuals. We are currently comparing levels of genetic variation between rusty crayfish in the Monocacy and in Antietam Creek to determine if the introductions stem from related source populations. Finally, virile crayfish have impacted the native Allegheny crayfish, *O. obscurus*. The DNR has noted that in some areas of the Monocacy, *O. obscurus* presents a severely skewed sex ratio, with many more females than males. We are testing three genetic hypotheses to identify the potential basis for this sex ratio distortion.

Sue Carney is an Assistant Professor of Biology at Hood College. She is a molecular ecologist interested in the genetic basis of how organisms and populations adapt to different environments. She began her training while studying deep sea hydrothermal vent tubeworms and mussels. In addition to crayfish genetics research at Hood, she advises undergraduate and graduate students who are working on research projects involving *genetics of stingrays, sea anemones, hydra, and the Florida manatee.*

[22] Management Strategies for Water Chestnut (Trapa natans): A Historical Perspective

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Water chestnut (*Trapa natans*) is an aquatic plant native to Asia. Introduced to North America near Concord, Massachusetts in 1859, water chestnut became established in locations throughout the northeast and by the early 20th century was moving southward. Water chestnut first appeared in Maryland in the Potomac River near Washington, D.C. as a two-acre patch in 1923. The plant spread rapidly, covering 40 river miles within a few years. By 1933, 10,000 acres of dense beds extended from Washington, D.C. to just south of Quantico, VA. Water chestnut was recorded in the Bird River in Chesapeake Bay for the first time in 1955. The Maryland Departments of Natural Resources (MD-DNR) used mechanical removal and an herbicide (2,4-D) to control the population. This effort was believed to have been successful, and no plants had been detected in vegetation surveys until summer 1997. Water chestnut was discovered on the Bird and the Sassafras Rivers during the summer of 1997. A massive mechanical and volunteer harvesting effort began on both rivers in 1999. Working from small vessels, canoes, and kayaks, approximately 100 volunteers worked for two weeks to remove 400,000 pounds of plants from the two rivers. Less than 1000 pounds of plants were removed from both rivers in 2000 with a much smaller work force, indicating that the 1999 removal efforts were successful in controlling the outbreak. Since 2001, the harvest effort decreased as the plant abundance declined. In 2010, after a record low harvest in 2009, biologists discovered large concentrations of plants interspersed with American Lotus (*Nelumbo lutea*) on the Sassafras River. Large numbers of plants were discovered in remote areas, and given that the water chestnut seeds remain viable for years, it is likely to return for the next few years in these locations. The 2011 harvest efforts will focus mainly on harvesting from canoes and kayaks to remove the water chestnut among the lotus.

Mark Lewandowski has a B.S. in Marine Science from University of MD, College Park. He has been a Natural Resources Biologist at DNR for the last 10 years, and has been coordinating the removal efforts for DNR for the last 5 years. He is a member of the Invasive Species Matrix Team at DNR, and has worked extensively on research and restoration of submerged aquatic vegetation in Chesapeake Bay.

Stream Biodiversity

[23] Biodiversity Conservation in Maryland: What makes the Free State Naturally Great!

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From sunrise over the Atlantic Ocean, to sunset on the Appalachian Plateau, for a relatively small state Maryland harbors an amazing wealth of Biodiversity. The geographic diversity of the Free State and our location midway between the "North" and the "South" have blessed us with a great array of plants animals and other living organisms. The patterns of diversity across Maryland are the result of the present interaction of geography and cultural changes to our landscape. The Maryland Department of Natural Resources is committed to protecting and conserving Biodiversity across Maryland. This presentation will provide a quick overview of biodiversity in the Free State and set the stage for detailed presentations on aquatic biodiversity that follow.

[24] Physiological Tolerance and Behavioral Preferences of Freshwater Mussels: Consequences for Mussel Biodiversity in a Changing Environment

Heather S. Galbraith

NO ABSTRACT SUBMITTED

[25] First Probabilistic Survey of Stream Salamanders in Maryland

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In 2007, the Maryland Biological Stream Survey (MBSS) added quantitative sampling of stream salamanders to their probability-based survey of biota, physical habitat, water chemistry, and riparian features in the 9,000 miles of wadeable, perennial streams in Maryland. The sampling method was developed to support (1) estimates of salamander distribution and abundance and (2) calculation of a stream salamander index of biotic integrity (SS-IBI), while minimizing sampling effort. Qualitative sampling of reptiles and amphibians within the stream corridor has been conducted since the initiation of the MBSS in 1995. The qualitative sampling provided dramatic evidence of the loss of stream salamanders in the urban area between Washington, DC, and Baltimore, MD, since the 1960s. The quantitative sampling provides the first estimates of stream salamanders statewide and by major watersheds. It also provides a mechanism for identifying the stressors affecting salamanders and headwaters streams in general. Preliminary results are provided. Attempts to validate the SS-IBI were unsuccessful as the MBSS method (modified from the SS-IBI developmental method for efficiency) did not capture as many individuals. Therefore, modifications to the method or the index are planned so that validation of the SS-IBI can be completed for use in the next round of the MBSS. Factors affecting this validation included (1) a greater range of stream types and sizes assessed, (2) sampling of random stream banks versus banks with best available habitat, and (3) assigning condition class thresholds to reference sites sampled with a different method.

Mark Southerland, Ph.D., PMP, CSE, has been supporting federal, state, and local water quality programs since 1988. He was the lead author of the EPA national program guidance on biological criteria and has been the lead consultant on the Maryland Biological Stream Survey for the Maryland Department of Natural Resources (DNR) since 1993. He also supports the impaired waters, stressor identification, and TMDL programs for the Maryland Department of the Environment (MDE). He has provided watershed and NPDES MS4 support to Anne Arundel, Baltimore, Carroll, Fairfax, Frederick, Harford, Howard, Loudoun, and Montgomery Counties. Mark currently serves as chair of the Maryland Water Monitoring Board and is an original member of the Howard County Environmental Sustainability Board.

[26] Maryland's Crawdads – Their status, distribution, and conservation

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Abstract:
The Maryland Department of Natural Resources' Maryland Biological Stream Survey (MBSS) has conducted an inventory and status assessment of Maryland crayfishes since 2006. To date, crayfish data have been collected from over 1,225 sites and we have compiled an additional 237 records from regional crayfish experts, university researchers, and environmental consultants. These data have greatly improved our understanding of the status, distribution, and habitat associations of Maryland's nine native species. Our monitoring efforts have identified non-native, invasive crayfishes as the most important threat to Maryland's native crayfishes. There are currently five non-native crayfishes established in the state. Three of these, *Orconectes rusticus*, *O. virilis*, and *Procambarus clarkii*, are invasive and pose the greatest risk to native species. Distribution and abundance data collected as part of this project provide an invaluable baseline to track changes in native species in response to the spread of non-native, invasive species over time.

Jay Kilian is a biologist with the Maryland Department of Natural Resources' Maryland Biological Stream Survey. He enjoys crayfishes.

[27] From Ablabesmyia to Zygoptera : the Incredible Diversity of Maryland's Freshwater Macroinvertebrates

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In Maryland, agencies, consultants, and NGOs have been using benthic macroinvertebrate collections to assess stream and river health for many years. Maryland Biological Stream Survey (MBSS) benthic data are used by the Maryland Department of the Environment for a variety of regulatory purposes, by the Chesapeake Bay Program to assess stream health throughout the Bay watershed and by local governments, consultants and NGOs to guide protection and restoration efforts. Maryland DNR's benthic trend data (CORE/Trend Program) are also used to track changes in stream health since the mid 1970s. The diversity of Maryland's physiography, vegetation, and geology is reflected in it's diversity of freshwater macroinvertebrate fauna. Benthic macroinvertebrate data collected between 1995 and 2010 by the MBSS (3,452 sites; randomly-selected, primarily sampled only once) and CORE/Trend program (115 sites sampled repeatedly) forms the core of this presentation. A total of 470 benthic macroinvertebrate genera in 141 families were represented in the MBSS dataset. One hundred fifteen genera (24%) occurred at less than 5% of all sites and 52 genera (11%) were even rarer, occurring at less than 1% of all sites. Two hundred twenty-three genera occurred at more than 25% of all sites. The CORE/Trend dataset contains 346 species contained within 350 genera. Three hundred forty-five of these taxa (mix of genus and species) occurred fewer than five times among all sites across years. Gear types and sampling index period likely result in differences between taxa collected by both programs. Other highlights from each program will be presented as well as relationships of select taxa to anthropogenic stressors.

Dan is a biologist with the Maryland Department of Natural Resources' Maryland Biological Stream Survey. He has a BS in Zoology from the University of Maryland and a MS in Environmental Science and Policy from Johns Hopkins University.

[28] Biodiversity of Maryland's Freshwater Fishes

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Biological diversity exists at three levels: 1) genetic diversity within species, 2) the number of different species in an area (species richness), and 3) diversity among ecological systems. Genetic data exist for relatively few populations of Maryland fishes and are biased towards species of economic importance (e.g., *Salvelinus fontinalis*) and those with localized or disjunct distributions (e.g., *Percina bimaculata*). Species richness is the most thoroughly understood component of biological diversity in the state, largely as a result of data generated by the Maryland Biological Stream Survey. Nearly all species taxa in Maryland have been formally described and geographic distributions are well defined, but questions still remain regarding status (native vs. introduced) of several species (e.g., *Etheostoma blennioides*). Diagnosing fish assemblages and the habitat templates that influence them is complex, and although progress has been made, primarily by analysis of MBSS site data, much work remains in this area.

Rich Raesly began working with Maryland fishes in 1986 while he was a graduate student at Penn State. His introduction to that state's fish fauna began by snorkeling for Maryland darters in Deer Creek. He joined the faculty at Frostburg State University in 1989 and is currently the Chair of the Department of Biology. He has been working with the Maryland Biological Stream Survey since 1994.

High Quality Streams

[29] EPA's Healthy Watersheds Initiative: A Systems-based Construct for Protecting Aquatic Ecosystems

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EPA is charged with restoring and maintaining the chemical, physical, and biological integrity of the nation's waters under the Clean Water Act (CWA). When the CWA was passed, the House Public Works Committee's report clarified that the intended use of the term, "integrity," was to recognize the importance of preserving natural ecosystems rather than simply improving water quality in a narrow sense. EPA's Healthy Watersheds Initiative takes a systems-approach to managing the ecological integrity of our nation's waters that acknowledges both the spatial and temporal context including the dynamics and interconnectivity of aquatic ecosystems in the landscape. The focus of the HWI is to develop state programs and capacity to assess and identify healthy watersheds and implement priorities for protection at the state and local levels. Partnerships, both across state agencies and with other Federal agencies, NGO's, etc., will be critical in implementing these programs

[30] Balancing our Investment in the Chesapeake: The Importance of Maintaining Healthy Watersheds

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We all know that restoring water quality is an essential part of the solution to improve the health of the Chesapeake Bay. But it will be increasingly difficult, more expensive, and ultimately impossible to restore the Bay if we continue to see healthy streams succumb to degradation. In response to this reality, the Chesapeake Bay Program established a committee to focus directly on advancing the protection of healthy watersheds as part of the restoration program. This presentation will discuss the activities of this committee, including the development of interstate metrics of stream health, critical communication strategies, and opportunities to integrate protective actions into the Chesapeake TMDL and other regulatory and voluntary mechanisms.

[31] Incorporation of Maryland's Current Antidegradation Implementation Procedures into the Approval or Permitting Framework

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Currently the only characteristic utilized to designate high quality or Tier II waters in the State of Maryland is biology. All of the data utilized in the designation effort is provided by the MD DNR Maryland Biological Stream Survey (MBSS) program. Through a well established working relationship with the MD DNR, MDE has utilized the MBSS program in recent years to identify additional high quality waters throughout the state, and this has resulted in an increase in the number of high quality waters in the State, growing from 83 in 2004 when the Antidegradation Implementation Procedures were originally promulgated into the Code of Maryland Regulations (COMAR) 26.08.02.04-1, to 238 in 2011. As mandated by the regulation, the Department must ensure that applicants minimize the use of each high quality waters' assimilative capacity, which is the difference between the water quality at the time the water body was designated as Tier II (baseline) and the water quality criterion, taking into account potential changes due to natural variability. As the MBSS dataset is supplemented annually, it not only provides the initial baseline data, it also provides a mechanism to assess the current status, or assimilative capacity of those waters moving forward. To further that end, the State also leverages applicable permitting and regulatory approval authorities to not only address assimilative capacity and anthropogenic degradation issues identified by current biological data, but also to gather additional biological data during the course of the permitted activity.

Angel Valdez is a graduate of Loyola University Maryland, where she received her Bachelor of Science in Biology. Upon graduation Ms. Valdez worked extensively in the field of environmental education before joining the Maryland Department of the Environment's Science Services Administration where she helps coordinate the Antidegradation Policy Implementation effort and assists with technical over site and management of dredging and other natural resource activities throughout the state.

[32] Virginia Healthy Waters Initiative

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The Virginia's Healthy Waters initiative designed to raise awareness about the need to protect stream resources before they become impaired and to work with communities to implement opportunities for conservation. Water quality programs have been focused on rehabilitating degraded waters. The Healthy Waters initiative broadens the scope of conservation efforts to include protecting the ecological integrity and diversity of living resources in our healthy waters. Virginia Healthy Waters data is being used for prioritization and protection efforts, the integration into land-use decision making and steps toward voluntary conservation efforts. This program may reduce the number of streams that will become degraded and have an overall positive, long-term impact on the interconnected health of Virginia's waters from the mountains to the ocean.

To date, biologists in Virginia have assessed more than 2,000 creeks and streams to collect fish, shellfish and aquatic insect data; documented in-stream habitat; and scrutinized the stability of banks and bed material. Surprisingly, at a time when there is so much bad news about the environment, they've found nearly 200 ecologically healthy streams, creeks and rivers throughout the state, and there are more yet to be identified.

Virginia is working collaboratively between state, federal, regional and local bodies to identify opportunities to implement the healthy waters initiative on the ground and integrate into existing planning and programmatic efforts. Recent projects have been completed in the Rivanna River Basin (tributary Virginia's James River) and Richmond County, Virginia (natural resource planning integrated into County Comprehensive planning). The Healthy Waters initiative has been integrated into programmatic efforts in the Virginia Agricultural Cost Share guidance and the Virginia Scenic Rivers evaluation criteria. Virginia is working with North Carolina and the Albemarle-Pamlico National Estuary Program to develop a pilot Healthy Waters planning effort to standardize healthy waters planning and integrate with current impaired waters restoration planning guidance.

Mr. Janeski, of the Virginia Commonwealth University, is managing the VA Healthy Waters Initiative and the VA Coastal Nonpoint Source Pollution Program at the Virginia Department of Conservation and Recreation. He is also co-managing the development of a Low Impact Development stormwater technology research and education facility in Richmond, VA. He is actively involved community engagement and has recently published the Forging the Link: Linking the Economic Benefits of LID with Community Decisions, Manual and Curriculum through a partnership with the University of New Hampshire Stormwater Center and Antioch University, New England.

[33] Frederick County Stream Protection Program

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Brook trout in Frederick County are in danger of local extirpation from the same types of threats that are affecting high-quality streams all over the region. Frederick County Government and its partners are working to protect the Green Infrastructure that supports these high value fisheries, as well as meet the Chesapeake Bay Executive Order priority to restore brook trout habitat. This work is being accomplished through partnerships with groups like the US Fish and Wildlife Service, DNR Inland Fisheries, Trout Unlimited, Potomac Conservancy, and local landowners.

Shannon Moore is the Acting Manager of the Office of Sustainability and Environmental Resources for Frederick County, Maryland. She previously managed the Watershed Management Section and has worked for Frederick County for nine years. She has a Masters Degree in Environmental Science and Management from the Bren School at UC Santa Barbara. She has an avid interest in brook trout restoration and works with partners in the Monocacy and Catoctin Watershed Alliance to implement restoration goals.

Urban Streams I

[34] Pilot Testing of Real-Time Nitrate and Conductivity Sensors in an Urban Watershed

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We have deployed Satlantic SUNA nitrate optical sensors and YSI 660 LS temperature/ conductivity sensors in a nested design within Dead Run, a highly urbanized watershed in Baltimore County, MD. The sensors are collocated with 6 USGS stream gaging stations. Deployment began in October 2010 and has continued through summer of 2011. The sensors are secured in utility boxes on stream banks and water is pumped to the sensors by means of submersible pumps placed in the streams. Data are recorded every half hour and transmitted by cellular modem to a central location. Data are available for viewing in near-real time via web services, allowing project personnel to continually check on site functionality. Important considerations for system design include hydraulics, power, data logging, telemetry, and maintenance issues such as potential for biofouling and pump intake clogging. Observations from the deployed sensors show strong nitrate and conductivity signals present at base flow, with data exhibiting a clear diurnal pattern. The chemical diurnal patterns are observed under conditions of constant stream discharge. The mean concentration of nitrate ranges from 1 to 2 mg/L, with higher values in first order streams. Diurnal nitrate variability around the mean is about +/- 0.05 mg/L. Specific conductance ranges from about 1 to 1.5 mS/cm, and exhibits a temporal pattern that mimics the nitrate data, indicating the diurnal influence of the biotic portion of specific conductance on the recorded signal. Under storm conditions, both nitrate and conductivity base-flow signals show a sharp drop in concentration with the onset of storm flow, with minimum values at peak storm flows, and gradual recovery to pre-storm conditions as storm flow recedes. The data can be evaluated using any of several mixing models to interpret the contribution of groundwater to storm flow. Preliminary analysis using a simple binary mixing model shows that groundwater comprises 20 – 50 percent of storm flow and is most strongly dependent on antecedent moisture conditions, compared to storm size or duration. In comparing calculations across nested watershed scales for a single storm, the percent groundwater contribution to storm flow varies with scale and is greatest in first-order watersheds. In addition to use in characterizing natural patterns, sensor data can aid in identifying random anthropogenic inputs affecting stream water quality such as fertilizer application, sewer overflows, and swimming pool clean-outs.

Jason VerHoef is a Graduate Research Assistant in the Center for Urban Environmental Research and Education at UMBC. He is pursuing a MS degree in the Department of Chemical, Biochemical and Environmental Engineering. Jason holds a BS in Mechanical Engineering from UMBC where he was a Student Research Assistant at the National Institute of Standards and Technology for one year. His current research focuses on using high frequency sensors to infer groundwater/surface water interactions.

[35] Applications of Real-time Water Quality to Identify Episodic Pollution Events in Urban Streams in the Washington, D.C. Metropolitan Area

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Continuous real-time water-quality data collection may function as part of an early warning system in urban streams by identifying episodic changes in water chemistry and physical conditions. Multi-parameter water quality datasondes, along with stage-monitoring equipment and automatic samplers, have been used to capture rapidly changing stream conditions and water chemistry in several small urban streams within the Capital Beltway, and surrounding Washington, D.C. Metro area, and to identify pollution events that may degrade water quality

and disrupt biological productivity. Water-quality data were collected at North East Branch Anacostia at Riverdale, MD (U.S. Geological Survey Station 01649500), North West Branch Anacostia near Hyattsville, MD (01651000), and Paint Branch near College Park, MD (01649190) from as early as 2003 through 2010. Data from Mattawoman Creek near Pomonkey, MD (01658000), a stream in a less-developed watershed in Charles County, MD, is presented for comparison to the urban streams. Some examples of dynamic stream water-quality events include disruption of normal diurnal pH and primary productivity patterns due to point-source discharges of petroleum-based substances, episodic daily and annual interference with natural patterns of surface-water conductivity due to road salt applications, anthropogenic spikes on normal baseflow turbidity levels, and shifts in multiple parameters from broken sewer lines. Such events can be observed on the U.S. Geological Survey Water Alert service (http://water.usgs.gov/wateralert), which is a useful tool for automated early warning of rapidly changing or unusual water conditions. Continuous real-time water-quality data collection aids communities, agencies and partnerships, such as the Urban Waters Federal Partnership, in attaining urban watershed and waterway revitalization goals.

Joe Bell has been a hydrologic technician with the USGS in the MD/DE/DC Water Science Center since February 2010. He has a master's degree in geological sciences from the University of South Carolina and a bachelors of science in geology from James Madison University. He honorably served in the U.S. Marine Corps from 1997 to 2002. Joe has extensive experience with collecting and interpreting continuous water-quality data.

[36] Introducing the Baltimore City Stewardship Mapping and Assessment Project

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Building a more sustainable Baltimore will require participation from all individuals and groups in the city. While a single organization can help improve natural resources and build stronger communities, it is only one part of a larger picture. Given the relationships and overlap among those working on the environment, it is important to understand the networks that tie them together, how those networks are formed, and what impacts networks can have on the environment and communities where they work. In recognition of this need, our new project looks at the network of groups and organizations doing environmental stewardship work in Baltimore City. Through this citywide effort, we seek to better understand the who, what, where, and how of stewardship in the city. First, we will compile a comprehensive inventory of stewardship organizations. We define stewardship as caring for the land, water, and people of Baltimore. This can cover a range of activities—from planting trees to advocating for clean streets to educating about the Chesapeake Bay—performed by many different types of groups from the public, private, and non-profit sectors. Second, we will send out a survey to these organizations to find out what types of stewardship activities they do, where they conduct these activities, and what other groups they work with. Third, we will use the survey results to produce different types of analyses about the stewardship networks in Baltimore. We will use statistics to understand the composition of groups in the city, apply GIS and spatial mapping techniques to assess the geographic extent of stewardship, and conduct social network analysis to understand how funding and information resources are exchanged between stewardship organizations in Baltimore. The results of this work will be published on a publicly available, interactive map so that Baltimore residents, public agencies, and stewardship groups can search and view the types and locations of stewardship work being done in their city. This helps support organizations as they seek new projects, funding, and opportunities to grow and build capacity, working towards a sustainable Baltimore.

Michele Romolini is a PhD candidate at the University of Vermont's Rubenstein School for the Environment and Natural Resources. She is studying urban sustainability organizations in Seattle and Baltimore, working with the USDA Forest Service, the University of Washington, and the Baltimore Ecosystem Study.

[37] Understanding the Implications of Using Indices to Detect Biological Responses in Streams

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Use of biotic indices and other metrics that summarize aggregate community structure (e.g., taxon richness) are ubiquitous in aquatic research and management. While indices summarizing complex data sets are useful for communicating science to nontechnical audiences, as an analytical tool they are highly vulnerable to misinterpretation and should not be used in isolation to detect response to environmental gradients. Indices ignore the fundamental reality that we care about which taxa respond to environmental degradation and why, both from a conservation and mechanistic standpoint. To illustrate, we examine macroinvertebrate community response to urban land use using MBSS data to show how representative biotic indices are relatively insensitive to threshold declines of numerous individual taxa. We then reproduce these responses using simulated data with similar properties to demonstrate how indices mask real changes (both positive and negative) in biotic assemblage composition and structure. Our findings do not mean indices should be abandoned entirely, but they do challenge assumptions that such metrics are capable of accurately reflecting important forms of community change. We recommend an alternative analysis framework that begins with the characterization of responses of individual taxa, and uses aggregation only after distinguishing the magnitude, direction, and uncertainty in the responses of individual members of the community.

Dr. Baker is an Associate Professor in the Department of Geography and Environmental Systems and Faculty Fellow at the Center for Urban and Environmental Research and Education at UMBC. He holds adjunct appointments in the Department of Watershed Sciences, Ecology Center, and Western Water Monitoring Center at Utah State University. Prior to his faculty appointments, Dr. Baker was a research associate at the Smithsonian Environmental Research Center in Edgewater, Maryland. He received both MS and PhD degrees from the University of Michigan.

[38] Nutrient and Sediment Sources, Transport, Retention, and Effects of Best Management Practices in the Urban Difficult Run Watershed, Virginia

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Urban watersheds are a large source of sediment, phosphorus (P), and nitrogen (N) to sensitive water bodies, including the Chesapeake Bay. However, little is known about the sources, transport processes, and retention of pollutants in urban stream systems – information critical to successful implementation of best management practices (BMP's) to reduce pollutant loading. The U.S. Geological Survey is conducting ongoing studies of these issues in a small (5th order, 151 km^2), urban, Piedmont watershed in Virginia: Difficult Run. Geochemical and isotopic fingerprinting is identifying the sources of stream suspended sediment load in a headwater catchment, distinguishing among bank erosion and developed and natural upland soils. Isotopic fingerprinting will be used to identify the sources of nitrate throughout the watershed. The transport of sediment, P, and N through the coupled stream-riparian ecosystem corridor is being evaluated by comparing rates of bank erosion, floodplain sedimentation, and internal floodplain nutrient cycling. Bank erosion is being measured with 192 bank erosion pins along with 102 feldspar marker horizons to quantify floodplain deposition at 6 mainstem reaches, in addition to 546 bank pins at 26 headwater stream reaches. We are currently identifying the controls of stream-riparian geomorphology and vegetation on bank erosion rates in order to target potential hotspots of bank erosion throughout the watershed. Finally, the effect of the implementation of BMP's on suspended sediment and nutrient loads is being compared across four headwater catchments in the watershed, as well as across numerous other monitoring stations throughout Fairfax County. Results to date have found that overall rates of floodplain sedimentation exceed rates of bank erosion along the mainstem (on average net retention of 64 Mg- sediment reach-1 yr-1), but that the riparian corridor is a net source of sediment in the steeper portions of the stream nearer the headwaters. High rates of floodplain sedimentation translate into high retention of stream particulate nutrient loads. After about one year of measurement at the headwater sites, 221 bank pins were eroding (averaging 4.6 cm) and 273 pins were depositional (averaging 5.8 cm). The floodplain tightly cycles P and N internally, with rates of plant nutrient uptake exceeding rates of soil nutrient mineralization, indicating that the riparian zone nearly permanently stores nutrients. Initial annual yield computations (2 years) across the four County-wide load stations range from 1.25 to 4.81 tons of total N, 0.18 to 0.57 tons of total P, and 250 to 1749 tons of suspended sediment per square mile. Investigations of relations between these yields and landscape factors, such as land use and BMP implementation, will be conducted in future years of the study. Our synergistic methods for understanding nutrient and sediment loads in this urban watershed is a robust approach for guiding management efforts to improve water quality and is generating synthesis that should be general to other urban Piedmont watersheds.

Greg Noe is a research ecologist with the National Research Program of the USGS in Reston, VA. Dr. Noe's research centers on wetland ecosystem ecology, focusing on the interactive influences of hydrology, geomorphology, climate, and biology on nitrogen and phosphorus biogeochemistry in fluvial ecosystems. He earned his B.S. at Virginia Tech and Ph.D. at San Diego State University and UC Davis.

[39] Tracking Nonpoint Source Nitrogen Pollution in Human-Impacted Watersheds

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Nonpoint source nitrogen (N) pollution is a leading contributor to U.S. water quality impairments. We combined watershed N mass balances and stable isotopes to investigate fate and transport of nonpoint N in forest, agricultural, and urbanized watersheds at the Baltimore Long-Term Ecological Research site. Annual N retention was 55%, 68%, and 82% for agricultural, suburban, and forest watersheds respectively. Analysis of 15N-NO_3-, and 18O-NO_3- indicated wastewater was an important nitrate source in urbanized streams during baseflow. Negative correlations between 15N-NO_3- and 18O-NO_3- in urban watersheds indicated mixing between atmospheric deposition/wastewater, and N source contributions changed with storm magnitude (atmospheric sources contributed ~50% at peak storm N loads). Positive correlations between 15N-NO_3- and 18O-NO_3- in watersheds suggested denitrification was removing septic system and agriculturally-derived N, but N from belowground leaking sewers was less susceptible to denitrification. N transformations were also observed in a storm drain (no natural drainage network) potentially due to carbon inputs. Overall, nonpoint sources such as atmospheric deposition, wastewater, and fertilizer showed different susceptibility to watershed N export. There were large changes in nitrate sources as a function of runoff, and anticipating source changes in response to climate and storms will be critical for managing nonpoint N pollution.

Dr. Sujay Kaushal is an assistant professor in the Department of Geology & Earth System Science Interdisciplinary Center at University of Maryland, College Park. His area of expertise is in ecosystem ecology and biogeochemistry. He obtained a B.A. from Cornell University, a PhD from University of Colorado, and conducted postdoctoral work at the Cary Institute of Ecosystem Studies.

Sustainability and Healthy Watersheds

[40] Maryland Forests and Streams – Key Challenges for Sustainability in a Rapidly Changing World

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Healthy, diverse and extensive forests are widely known to be essential for water quality and for aquatic biodiversity and ecosystem health. But forests are also valued for many other human needs and ecosystem services, and some of these other roles may be pushed to increase to help solve major environment problems. For example, management of forests is also considered an essential practice that must assist with decreasing atmospheric carbon dioxide to reduce global climate disruption. Intensive management can lead to increased carbon sequestration in growing trees and long-lived wood products. Wood also requires less energy input than concrete and steel as a building material, and its increased use and substitution can prevent some CO_2 emissions. Beyond forest management scenarios, forests also now are threatened by fragmentation (both of ownership and in spatial extent), loss due to development, invasive species and diseases, climate change, acid rain and fog, atmospheric nutrient deposition and additional challenges. These changes to forests have potential to reduce their ability to protect and enhance water quality and aquatic ecosystems. This presentation will address potential effects that changing forests and forest management may have on streams and how to envision and realize a sustainable path forward.

[41] Urbanization and the Future of Aquatic Biodiversity in Maryland

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Urbanization causes major declines in native aquatic biodiversity in Maryland's streams. Among benthic macroinvertebrates, approximately one-half of taxa are negatively affected by increasing impervious surfaces. Many of these taxa are effectively absent from streams whose upstream area contains more than 5% impervious surfaces. Similarly 45-75% of fishes are negatively affected by increasing impervious surfaces. Across regions, taxa found in the Piedmont show greater vulnerability to similar levels of urbanization than they do in the Coastal Plain. Unchecked development could result in the disappearance of as many as 60% of the benthic macroinvertebrate taxa by the time impervious surfaces reach 15% of the watershed. Application of our results to buildout scenarios in the Middle Patuxent River watershed forecast the disappearance of up to 50% each of fish and invertebrate taxa. The data strongly suggest that maintaining aquatic biodiversity in Maryland's streams will require better planning in the face of expanding human populations.

Robert Hilderbrand is an associate professor at the Appalachian Laboratory, University of Maryland Center for Environmental Science in Frostburg, MD. His main research interests revolve around the conservation and management of fish and benthic macroinvetrebrates in headwater streams.

[42] Beyond Urbanization: Seeing into the Future of Maryland Streams

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From acid deposition to climate change to species loss, this talk will present ideas about what the future of Maryland streams may look like. Using the current state of knowledge about conditions, stressors, projected trends and even economics, a picture of the future will be developed and management implications discussed.

[43] Forest Buffers: How Fast do their Functions Develop?

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Restored forest buffers have multiple ecological functions that develop at different rates over time depending in part on tree survival and growth. Thirty-four buffers, newly planted with trees, were monitored between 2000 and 2008 in the Monocacy, Catoctin, and Antietam watersheds to assess rates of development of desired functions. Although first year survival averaged more than 80%, survival after five years ended up around 50%, just over 200 trees per acre. Vegetation richness increased from 165 to 276 species, but some invasive exotic weeds also increased, including some new to the ally entering the watershed during the study period. Instream nitrate and phosphate generally showed improving trends, but variability among sites and years resulted in differences that were not considered significant at five to seven years of age. For macroinvertebrate studies, an average of two additional taxa per site were found in 2006, a significant increase only five years after buffer establishment. The Pfankuch Streambank Stability rating significantly improved between 2003 and 2008, although the more urbanized watershed with 66% impervious surfaces upstream was consistently less stable. Based on these results and other longer-term studies, faster growth, denser tree stocking, and greater biomass appear to be associated with earlier production of expected benefits.

The project also assessed estimated financial benefits for marketable products and ecosystem functions. Harvest values were based on what would be allowed under current State rules, which require leaving a certain proportion of trees beside streams. To compare the different time frames and compare to other investments, net present value (NPV) of harvestable timber in the buffers was calculated using a 4% alternative rate of return. NPV averaged $51 for hardwoods harvested at 80 years, and $541 for pines at 30 years with thinning. Values for water quality and air quality were estimated at $419/year and $60/year, respectively. Adding some hunting lease income for $10/year and annualizing timber income ($15/year for hardwoods) gives $504/acre/year for these values alone.

Riparian forest buffers are important and cost-effective components in long-term nutrient reduction strategies because of 1) the pattern of increasing functions over decades without annual investments and 2) the potential to self-regenerate with minimal future investment if designed with sufficient width and managed correctly. Benefits from riparian forest buffers can be expected to build over time, usually becoming significant within 15 years of establishment. The increase in buffer function over time and likely survival beyond the minimum practice life can help provide reasonable assurance that nutrient reduction benefits will be maintained over time.

Dr. Hairston-Strang has been the forest hydrologist at MD DNR Forest Service since 1997, working on riparian forest buffer restoration, watershed partnership, forest management for water quality protection, and BMP assessment. Her education is in forestry, forest soils, and forest hydrology (B.S., Virginia Tech., M.S., Univ. Minnesota, Ph.D., Oregon State University).

[44] Updating Maryland's GreenPrint Map

Kevin J. Coyne

NO ABSTRACT SUBMITTED

Brook Trout Status, Ecology, and Management

[45] Brook Trout in Maryland, Five Years Down the Road Since Implementation of the Fisheries Management Plan

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Concern for the status of the Brook trout resource inspired the Maryland DNR Inland Fisheries Division to implement a Brook trout Fisheries Management Plan (FMP) in 2006. Partners in this effort included MD DNR Fisheries Service, MD DNR MBSS, and the University of Maryland's UMCES Appalachian Laboratory. Two vital components of the plan were the Management and Research Recommendations sections, a blueprint for future management efforts and direction. This presentation will discuss and provide updates on the progress that has been made in meeting these recommendations, prioritization of future efforts based on the FMP review process, and provide an update on the status of the Eastern Brook Trout Joint Venture. Highlights of several successful restoration projects involving municipal, state, federal, and non-governmental agencies will also be described, and spotlighting the formation and success of the non-profit Savage River Watershed Association.

Alan Heft is a statewide fishery biologist with the Inland Fisheries Management Division. He has been working on freshwater fisheries management with the Department for the past 23 years, after graduating from Frostburg State University with a B.S. in Wildlife and Fisheries Management. He is a certified Fisheries Scientist by the American Fisheries Society.

[46] A Revisitation of Maryland Brook Trout Genetics

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Since the early 80's, there was considerable interest in the genetics of Maryland brook trout, *Salvelinus fontinalis* populations, as evidenced by the number of papers and reports produced on this native species. Historically, Maryland contained significant precolonial native brook trout, *Salvelinus fontinalis* populations, but now contains only remnant, highly-fragmented and disjoint populations throughout the state. Using microsatellite data, collected from 26 brook trout populations in Maryland drainages, we describe the genetic and population relationships of this species in Maryland, with a discussion on zoogeographical mechanisms. These relic brook trout populations are highly vulnerable to anthropogenic stresses, and many extant populations may be extinct in the near future. Native brook trout populations, in many Maryland watersheds, are increasingly becoming more restricted to headwaters, with resulting detrimental effects on population connectivity and potentially genetic structure.

Dr. Ray Morgan is a Full Professor with the Appalachian Laboratory, University of Maryland Center for Environmental Science. He received his BS degree (1966) from Frostburg State University with a biology major and minors in chemistry and secondary education, and earned his PhD (1971) from the Department of Zoology, University of Maryland at College Park with an animal ecology major and physiology minor. During his career at Chesapeake Biological Laboratory, Battelle Columbus Laboratories, and the Appalachian Laboratory, his research efforts centered on aquatic ecology and fisheries genetics, with special research emphasis currently on urbanization effects, nutrients, remediation of acid mine drainage, and genetics of brook trout and other Appalachian fishes.

[47] Brook Trout Declines with Land Cover and Temperature Changes in Maryland

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We examined the influence of landscape alteration and in situ stream habitat variables on brook trout by using a landscape-scale, space-for-time substitution analysis and a smaller data set that tracked long-term changes in land use over time. Forested land cover within a catchment was the overall best landscape-scale predictor of brook trout occurrence at a given site; measures of impervious land cover and urbanization were also important predictors. Brook trout were almost never found in watersheds where impervious land cover exceeded 4%, as assessed from the 2001 National Land Cover Dataset (2001 NLCD); the single exception was in a stream that displayed consistently low water temperatures. Landscape scale analyses indicated that increases in water temperature and erosion were associated with increasing percentages of urbanization and imperviousness and decreasing percentage of forested land cover. Three of six brook trout populations that were followed over time were extirpated within the last 15 years (between 1990 and 2005), coinciding with increases in urbanization and impervious land cover. At these sites, water temperatures were substantially greater than at the three sites with extant brook trout. Land use amounts derived from high-resolution aerial photography showed substantially greater amounts of urbanization and particularly impervious land cover than did amounts derived from the 2001 NLCD. The differences in measured land cover between imagery types warrant caution when stating upper threshold limits of land cover, because use of imagery methods interchangeably may produce inconsistent results. Our findings suggest that brook trout are very sensitive to landscape alterations in Maryland and disappear at low levels of impervious land cover regardless of the specific mechanism involved.

Scott has worked on the MBSS since 1994. He has worked on nearly every aspect of the MBSS from data collection and management to quality control and report writing. He has an intense desire to realize stream biodiversity protection in Maryland.

[48] Life History of Brook Trout in Western Maryland

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Widespread declines have been documented in the distribution, abundance, and size structure of brook trout over the last several centuries. In recent years, brook trout have garnered increasing conservation attention and in 2006 Maryland adopted a brook trout management plan. This plan identified further study of brook trout life history and movement as research priorities to inform future management decisions. We are using a large-scale passive integrated transponder (PIT) tagging study to follow individual brook trout through space and time to generate field-based estimates of movement, growth, and survival. To date, we've tagged over 2,000 individuals and have stationary PIT antennas at two locations. We are also using portable PIT antennas linked to high-performance GPS units to follow the fine-scale movements of brook trout throughout the year. Ultimately, the results of our field study will parameterize a population model which will be used to evaluate management alternatives and population responses to stochastic events.

Dave Kazyak grew up in central Maryland and spent many years working on the Maryland Biological Stream Survey. He recently completed a master's degree in Wildlife Ecology at the University of Maine where he studied the life history of coastal brook trout populations. He is currently a PhD student in Fisheries at the University of Maryland Center for Environmental Science Appalachian Lab.

[49] Brook Trout Population Responses to Restrictive Fishing Regulations in the Savage River Watershed

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Recent brook trout declines in Garrett County's upper Savage River watershed prompted a fishing regulations change to artificial lures only and no harvest. The year prior to regulation changes, brook trout numbers were inversely related to ease of angler access with substantially fewer trout in the most easily accessible sections. Even four years after the regulation changes, total numbers of adults, numbers of large (> 203 mm) fish, and biomass remain significantly lower in the most easily accessible sections to fishing. Although the results suggest that fishing pressure may limit recovery even with strict regulations, the data also suggest that the regulations may be limiting losses: populations have been tending downward since 2008 in low- and medium access sections, but remain stable in high access sections.

Biography. Robert Hilderbrand is an associate professor at the Appalachian Laboratory, University of Maryland Center for Environmental Science in Frostburg, MD. His main research interests revolve around the conservation and management of fish and benthic macroinvetrebrates in headwater streams.

[50] Conservation Genetics and Genomics of Brook Trout (*Salvelinus fontinalis*) Populations: Identification of the Functional Unit of Management in the Chesapeake Bay System

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While the current paradigm for conservation of species and associated habitats places emphasis on recognition and protection of irreplaceable evolutionarily distinct lineages, the identification of adaptive features must become a priority and may best be protected by maintaining evolutionary potential in the form of heterogeneous landscapes, migratory corridors, and viable populations rather than protecting specific phenotypes. However, habitat restoration in the form of migratory corridors is frequently an unrealistic conservation goal for many range/habitat compressed brook trout populations. Therefore, resource managers must plan for an evolutionary future for populations of this trust species, as such, ecological and evolutionary processes—those that maintain genetic diversity and provide the raw material for evolution and adaptation of populations—must be explicitly identified and represented in conservation and restoration efforts. LSC is employing a research framework that involves quantifying neutral (e.g., genetic drift) and adaptive (i.e., natural selection) genetic variation among ecologically and evolutionarily distinct brook trout populations. Phase I of this research has witnessed an extensive survey of genetic variation at 13 microsatellite DNA loci in over 13,000 brook trout sampled from 325 collections comprising the species' native range. This survey includes over 4,300 brook trout from 106 collections representing the major river systems (including the Gunpowder (2 collection sites), Patapsco, Susquehanna (6), Potomac/Shenandoah (63), Rappahannock (30), and James (4) rivers) feeding the Chesapeake Bay. Analyses have identified prodigous levels of genetic differentiation at all spatial scales with nearly all geographic populations existing as discrete populations (i.e., a punctuated distribution) often isolated by unacceptable habitat (e.g., natural and man-made barriers, unacceptable water temperature). In addition to traditional population genetics analyses, retrospective monitoring (i.e., coalescent simulations) of brook trout populations has illuminated previously undetected demographic histories and evolutionary relationships among populations and shed light on past and future evolutionary trajectories of populations at previously intractable scales. Phase II is designed to identify a suite of physiologically and immunologically relevant genes and consists of de novo transcriptome assembly and annotation for brook trout (currently underway). This will be followed by the quantification of whole-genome comparative gene expression profiles generated from deep sequencing (e.g., RNA-seq) to identify genes exhibiting differential expression in fish representing a broad latitudinal and elevational distribution. Populations exhibiting superior capabilities (e.g., genes contributing to adaptive variation) will be identified and this information can be used to assist in prioritizing restoration and conservation efforts. We will discuss how our research objectives link to the Chesapeake Bay Executive Order strategy and how our findings will reduce the probability of stochastic extinction for brook trout populations under scenarios of habitat and population fragmentation.

Dr. Tim King is a Research Fishery Biologist with the aquatic Ecology Branch of the U.S. Geological Survey's Leetown Science Center in Kearneysville, WV. Dr. King conducts molecular genetics research to develop markers for informative regions of DNA that allow assessment of population genetic structure, phylogeography, phylogenetics, and genomics of threatened and endangered wildlife species. He strives to assist natural resource managers with guidance in identifying appropriate units of conservation.

Climate Change in Maryland: It's More Than Sea Level Rise

[51] Climate Change Adaptation in Maryland Watersheds: A Strategy for Resilience

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Climate change is a far reaching process that will affect the way we manage our natural resources. Broadly, the impacts of climate change reach beyond those related to sea level rise, though these may be the most obvious and well documented. A report released by the Maryland Climate Commission suggests that broad-reaching impacts unrelated to sea level rise may be just as important and will clearly be the dominant impacts in non-coastal counties. Generally, Marylanders should expect to see stronger winter storms, drier summers, a higher frequency and intensity of storms, and hotter days. All of this will make competition for clean water greater, potentially placing aquatic species at odds with other water users. Because of these threats, Maryland has established a series of climate change adaptation strategies that will reduce potential competition and make communities more resilient to changes in water quantity and quality. As a result, the Department of Natural Resources has been working with other state and local agencies to incorporate climate change adaptation into planning processes and policies. These strategies and progress towards achieving them will be discussed.

Marcus currently serves as the Program Coordinator for Climate Change Adaptation in partnership with UMCES and DNR. He works to develop new outreach programs and enact new laws and policies aimed at increasing state and local capacity to adapt to a changing climate. Marcus' background is broad, with a strong focus on watershed management and ecosystem functioning, including research, on the ground practices, and federal and local policies that will enhance the resilience of watersheds in the face of disturbance.

[52] It's Hard to Make Predictions, Especially about the Future: Possible Climate Change Impacts on Maryland Streams

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In its 2008 report, "Global Warming in the Free State," the Scientific and Technical Working Group of the Maryland Commission on Climate Change cited the results of IPCC ensemble modeling scenarios for future changes in temperature and precipitation in Maryland, and summarized a broad range of literature sources to identify likely consequences of climate change. This was followed by a 2011 report on adaptation and response strategies.

We don't know which IPCC scenario is most likely, nor can we remove the inherent uncertainty associated with the modeling scenarios themselves or with the difference in scale between global climate models and the local dynamics of atmospheric processes and interaction with the surface. However despite these uncertainties there is a fair degree of consensus on the direction of change that can be anticipated. We expect that by 2090, seasonal average temperature will increase by 4 to 9 degrees Fahrenheit, with slightly larger increases in summer than in winter and the magnitude of increase depending on which emissions scenario is used. It is likely that stream temperatures will show comparable trends. Summer heat waves will increase in frequency, intensity and duration. Urban areas will experience hotter temperatures in summer owing to the heat island effect, and stream temperatures will continue to experience rapid spikes from water striking hot pavement in summer thunderstorms. Predictions about precipitation are less reliable, but on balance the climate will be wetter and more of our annual precipitation will arrive as rain and less in the form of snow and ice. It is likely there will be increased precipitation and runoff in winter and an earlier annual runoff maximum in spring. Average summer precipitation should increase slightly, but with increased evapotranspiration we may not see an increase in average summer runoff. Regardless of the direction of change the summer trend is not likely to show a large change in average runoff. However the variability in runoff may increase. The likelihood and intensity of heavy rainfall probably will increase, with commensurate changes in flood magnitude and frequency; and the likelihood of drought probably will also increase. Thus, even with a wetter climate overall, uncertainties associated with extremes of both wet and dry are likely to increase, and we will not be able to rely on past history to predict future hazards. These changes will have implications for fluxes of nutrients and sediments, biogeochemical processing, stream geomorphology and aquatic habitat, and stream biota.

In considering impacts on streams, we should consider the frequency distributions of streamflow and temperature rather than focusing on changes in the mean. We also need to consider the combined effects of global climate change and urban development, given that urban streams are already experiencing much greater impacts on temperature and runoff as a result of development than we are likely to see elsewhere on the landscape for at least the next few decades. The world will look, and feel, very different by the end of this century compared to what we experience today. But it is still reasonable to expect that, given the considerable year to year variability that we already are seeing, there are analogues for the conditions of 50 or 100 years from now that are currently part of our experience. One way to think about future conditions is in terms of shifts in the relative likelihood of what we now think of as either normal or extreme.

Andy Miller is Associate Professor in the Department of Geography & Environmental Systems at UMBC. In 2000 he founded UMBC's Center for Urban Environmental Research and Education. He is a co-PI on the Baltimore Ecosystem Study and on several multidisciplinary NSF-funded projects investigating linkages between urban development, climate, and watershed hydrology. He served as lead author of the Water Resources and Aquatic Environments chapter in the report of the Scientific and Technical Working Group of the Maryland Commission on Climate Change ("Global Warming in the Free State," 2008), and of the Water Resources chapter in the Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change (2011).

[53] The USGS Streamflow-Monitoring Network in Maryland—What Can It Tell Us About Climate Change?

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The USGS Maryland-Delaware-District of Columbia Water Science Center works in cooperation with a variety of agencies to provide hydrologic data and hydrologic investigations needed to describe and understand water resources on local and regional scales. In 2011, the streamflow-monitoring network maintained by USGS, and supported by a large group of Federal, State, and local agencies provides streamflow data from 135 locations in Maryland. Data provided include near-real time, instantaneous streamflow data recorded at intervals ranging from 5 to 15 minutes, and updated for public access every one to four hours. These data provide current information useful in protecting public safety and minimizing property damage (in the case of flooding), and can be used to manage available water resources to accommodate multiple natural and anthropogenic functions during times of low flow or drought. The statistics derived from long-term data sets at numerous monitoring locations can be used to assess intermediate- and long-term trends and fluctuations in streamflow in Maryland to help predict magnitudes of future floods, droughts, and average annual streamflow available for water supply. These statistics have traditionally been produced using an assumption of long-term climate stability. Recent discussions asserting that the global climate is nonstationary can, and should, be examined and tested at the local and regional scales using available temperature, precipitation, land use, and other data along with historic and current streamflow-monitoring data to determine if there are more accurate methods of producing long-term streamflow statistics. Such analyses may also offer insights into the future characteristics of local and regional streamflow.

Jon Dillow, M.S.C.E. 1995 (Drexel University)—The next speaker has worked for the past 19 years in the USGS MD-DE-DC Water Science Center. Over the course of his career he has been involved in studies of flood magnitude and frequency, drought prediction, and ground-water/surface-water interaction. He is currently responsible for the maintenance and operation of the USGS streamflow-monitoring network, and technical oversight of surface-water analysis projects, in Maryland, Delaware, and the District of Columbia.

[54] What are Some Management Steps for Addressing the Impacts of Climate Change on Fish Species?

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Developing and implementing effective fishery management strategies requires an understanding of the potential impacts of climate change. The effects of climate change on fishery resources are complex and will vary depending on the fish species. Climate change is expected to shift the geographic distribution and productivity of species; increase variability in stock production; increase the vulnerability of critical habitat; increase the probability of invasive species; create economic hardships in commercial fisheries; and change ecosystem function and capacity resulting in altered fish community structure and dynamics. Maryland Department of Natural Resources has developed a policy to guide the building of natural resource resilience to climate change. One aspect of the policy is to develop and integrate both adaption and mitigation reduction strategies into natural resource management plans and programs. Steps for improving fishery management include:

establishing harvest practices that preserve the natural buffering characteristics of individual fish stocks; developing harvest predictors that account for both short-term and long-term shifts in productive capacity; incorporating uncertainty into management frameworks; and adjusting management actions to maintain or more carefully regulate human activity. A key tool for informing adaptation planning and decision-making will be conducting vulnerability assessments.

Nancy received her BA in biology from St. Louis University and her MS from the University of West Florida. She has worked for the Maryland Department of Natural Resources, Fisheries Division for over 20 years. She is the Program Manager for Fishery Management Planning & Fish Passage. She was part of the technical workgroup for the Bay and Aquatics section of the Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase II document.

[55] Stream Fish Colonization and Extinction in Shenandoah National Park

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Stream fish colonization and extinction dynamics may indicate broad-scale patterns of environmental change. We investigated temporal changes in stream fish communities within Shenandoah National Park (SNP) from 1996-2010. Our objectives were to (1) assess temporal trends in community homogenization and differentiation, (2) identify species with the greatest temporal changes in occurrence and abundance, and (3) evaluate predictors of temporal changes in brook trout abundance. We used 3-pass backpack electrofishing data collected by National Park Service personnel for 20 stream sites (with > 7 data-years and > 4 species) and applied Monte Carlo simulations and multivariate techniques to evaluate temporal changes in fish communities and species. Fish communities exhibited significant changes over time, but generally retained distinctive community structure among sites. The communities exhibiting the greatest temporal changes were subject to massive flooding in 1995, and ordination results suggested a 5-year recovery period for fish communities. Species-level changes were characterized by colonization and increases in abundance, not extinction events. The greatest increases in abundance were observed in American eel (*Anguilla rostrata*), bluehead chub (*Nocomis leptocephalus*), margined madtom (*Noturus insignis*), and mountain redbelly dace (*Phoxinus oreas*). Temporal patterns of young-of-the-year brook trout (*Salvelinus fontinalis*) abundance were positively correlated to discharge in nearby rivers, suggesting important effects of flow and stream drying on brook trout population dynamics. These findings indicate that fish communities and associated long-term datasets within SNP can serve as useful tools to study broad-scale patterns of climate change in Appalachia.

Dr. Nathaniel (Than) P. Hitt is a Research Fish Biologist in the Aquatic Ecology Branch of the U.S. Geological Survey's Leetown Science Center in Kearneysville, West Virginia. Dr. Hitt's research investigates freshwater fish ecology and community ecotoxicology from a landscape perspective, focusing on stream ecosystems in the mid-Atlantic highlands.

The Chesapeake Phase II Watershed Implementation Plan

[56] The Chesapeake Bay TMDL and the Maryland Watershed Implementation Plan - an Overview and Panel Discussion

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In order to increase the pace of Bay States efforts to restore the Chesapeake Bay, in 2010 the U.S. Environmental Protection Agency (EPA) set limits on the amount of nutrients and sediment that can enter the Chesapeake Bay. In addition to setting these limits, known as a Total Maximum Daily Load (TMDL), EPA required the Bay states to develop statewide Watershed Implementation Plans (WIPs), to provide assurance that these jurisdictions (NY, PA, MD, DE, VA, WV and the District of Columbia), were hitting the mark for meeting nutrient reduction goals. The Phase I WIPs were developed in 2010 at the State level. They allocated the allowable load among different pollution sources and identified statewide strategies for reducing nutrients and sediments that impair the Chesapeake Bay. In 2011, the State is working with county scale teams to develop their portion of Maryland's Phase II WIP. The local teams include broad representation from those entities with responsibility and authority to control nutrient and sediment loads such as county and municipal governments, soil conservation districts, federal and State agencies, as well as stakeholders such as environmental NGOs.

The presentation will cover the key elements of the Bay TMDL and Phase II WIP process including establishing the target loads, current capacity analysis, strategies to achieve interim targets, contingency strategies, tracking and reporting, and 2-year milestone commitments. The panel discussion will include local WIP Team representatives who will share their perspectives on the TMDL and WIP process.

Rich has served as the Director, Science Services Administration at the Maryland Dept. of the Environment (MDE) since 2003. His responsibilities include leadership and oversight of a major unit of MDE with approximately 100 staff and $12 million budget; multi-media, water quality standards, environmental health, emergency chemical and oil response and nuclear disaster planning (until 2006), and environmental assessment assignments. He received a Ph.D. in 1985 from the University of South Carolina, an MS in 1980 from Hofstra University, and a BS in 1973 from State University of New York at Stony Brook.

Contributed Papers - Stream Critters and Beyond!

[57] Culvert Designs for Fish Passage in Pennsylvania

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Pennsylvania contains approximately 86,000 miles of streams and 119,000 miles of public roadways. Fish movement can be impeded by highway culvert designs that create sheet flow or increased current velocity within the culvert barrel, and/or perched outlet conditions. The Pennsylvania Fish and Boat Commission and the Pennsylvania Department of Transportation reviewed performance measures of existing box culverts and pipe culverts to develop designs that enhance fish passage. Single and twin cell box culverts are depressed twelve inches below streambed elevation. Box culverts installed in waterways with stream slope less than four percent are constructed with a different baffle design than those installed with stream slopes greater than four percent. Stream flows are directed to the primary cell of the twin cell box culvert structure while the secondary cell is designed only to accept storm flows. Pipe culverts can be depressed at varying depths below streambed elevation depending upon the upstream drainage area. All culvert structures are installed parallel to the stream gradient and riprap used to protect the inlet and outlet is placed to match the invert elevation of the structure. The Pennsylvania Department of Transportation and other public road stakeholders have adopted these designs as statewide standards. Field observations of recently installed box culverts have concluded that for the most part, the designs are effective for fish passage and prohibits scour around the structure.

Dave has been employed with the Pennsylvania Fish and Boat Commission since 1979. He is currently the Chief of the Division of Environmental Services and oversees the agency's waterway permit review, water quality, and non-game species programs. Dave has been an active member of both the National and Pennsylvania Chapter of the American Fisheries Society. During his career, Dave has received several awards including the Outstanding Service Award from the Pennsylvania Chapter of the American Fisheries Society and Vice President Al Gore's Hammer Award.

[58] The Growing Scientific, Education, and Conservation Impact of FrogWatch USA

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FrogWatch USA, established in 1998, is a citizen science program that was acquired by the Association of Zoos and Aquariums (AZA) in 2009. FrogWatch USA utilizes volunteers to conduct long-term monitoring of frog and toad calls in wetland sites that are registered, characterized, and surveyed several times per year. AZA is a nonprofit organization dedicated to the advancement of zoos and aquariums in the areas of conservation, education, science, and recreation. Accredited zoos and aquariums serve over 175 million visitors annually and strive to connect people with nature.

AZA is committed to expanding the national scope of the FrogWatch USA program and has developed a chapter model to capitalize upon the impressive regional reach of its member institutions. FrogWatch USA chapters are branded, managed, and hosted by AZA-accredited institutions or other like-minded organizations. Chapter coordinators receive either in-person or online training and are responsible for recruiting, training, and supporting local FrogWatch USA volunteers. Volunteers use standardized procedures to record a variety of data which provides valuable information about frog and toad presence and relative abundance. In addition, AZA is partnering with the National Geographic Society (NGS) on a National Science Foundation funded project that will allow volunteers to use the online FieldScope software platform to enter, map, visualize, and analyze their data in real time.

FrogWatch USA promotes environmental stewardship and increases public awareness of local fauna and supporting habitats. Data collected from the program contribute to the scientific understanding of local and national amphibian population declines and the global amphibian extinction crisis by providing valuable information on species distribution, phenology, and population trends at individual wetland sites across the United States. It is expected that AZA's commitment to increase the number of FrogWatch USA chapters and trained volunteers and its partnership with NGS to develop a rich online platform will substantially increase the impact and value of FrogWatch USA in the next few years.

Rachel Gauza is a Citizen Scientist Program Specialist at the Association of Zoos and Aquariums and is the new National Coordinator for FrogWatch USA. Before joining AZA, Rachel was a biologist specializing in monitoring and assessment of freshwater streams systems, herpetofauna, and sediment and stormwater best management practices. Rachel is also the Montgomery County Coordinator for the Maryland Amphibian and Reptile Atlas (MARA) and serves on the steering committee and review panel. Rachel holds bachelor's degrees in biology and music performance from Hood College in Frederick, Maryland. Her professional interests include the monitoring, conservation, ecology, and behavior of amphibians and small mammals, as well as promoting environmental stewardship through public outreach and education.

[59] Year One (2010) of the Maryland Amphibian and Reptile Atlas

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The Maryland Amphibian and Reptile Atlas is a joint project of the Natural History Society of Maryland and Maryland Department of Natural Resources. The aim of the project is to document the distribution of all amphibian and reptile species in Maryland using a systematic and repeatable approach. This is a citizen science project. Volunteers conduct the necessary fieldwork to document the presence of the 93 species of amphibians and reptiles within Maryland. Data collection began in 2010 and will continue through 2014. The Atlas is conducted on a grid-based geographic scale using U.S. Geological Survey 7.5 minute quadrangle (quad) maps. Each quad is further divided into six blocks, 10 square miles each. A total of 260 quads and 1,441 blocks are covered in the Atlas. Minimum coverage goals are 25 species or 25 active search hours per quad and 10 species per block. In 2010, approximately 5,000 amphibian and reptile reports and 2,383 search hours were submitted from over 100 volunteers. Seventy-four of Maryland's amphibian and reptile species were encountered including a number of state rare and endangered species. However, the contribution of the different taxonomic groups varied. Roughly half of 2010 records were Anuran (49%). Overall, data were received from 75% of Atlas quads and 51% of blocks. Understanding distribution patterns of amphibians and reptiles is needed to create effective conservation strategies. The Maryland Amphibian and Reptile Atlas will establish a baseline for future efforts to determine changes in the distribution of amphibians and reptiles in Maryland.

Heather Cunningham works with the Natural History Society of Maryland as the Statewide Coordinator of the Maryland Amphibian and Reptile Atlas. She received her Ph.D in biology from the University of Alabama in 2010. Her background is in ecology and behavioral ecology with a research focus on the role of abiotic and biotic factors in shaping amphibian distributions.

[60] Adult and Larval Caddisfly (Trichoptera) Taxa Richness Indicate Regional Processes Limit In-Stream Larval Richness and Colonization Potential of Urban Headwater Streams

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Research in urban watersheds has focused on how human activities in and around streams lead to lower in-stream habitat and water quality and decrease fitness and survivorship of in-stream stages of aquatic insects. Human activities can also decrease survival and reproduction of adults, and these impacts may contribute to species loss as well. We compared assemblage richness and composition of adult and larval caddisfly (Trichoptera) assemblages between four urban and four rural Maryland headwater streams. This indicated the importance of regional (dispersal driven) versus local (habitat driven) processes for the observed low diversity of larval assemblages in urban headwaters. Richness was higher at the rural headwaters for both larvae and adults. Several taxa of adult caddisflies were found at urban streams where their larvae were absent. This suggests that poor local habitat and water quality prevented colonization. However, both larvae and adults of other taxa of caddisflies typical of rural headwaters were absent from some urban headwaters. Regional constraints on dispersal likely prevent these species from migrating to these urban sites, and the lack of potential colonizers may work in conjunction with poor water and habitat quality to cause low larval diversity. These results indicate that only some caddisly taxa from the regional species pool are available to colonize urban streams following restoration of habitat and water quality.

Robert is a graduate student from the Entomology department at the University of Maryland. He is interested in the effects of watershed urbanization on stream insect diversity. Robert's dissertation work specifically addresses the impacts of watershed urbanization on the movement of adult caddisflies through urban landscapes and how these impacts contribute to species loss from urban headwater streams.

[61] Benthic Invertebrates as Vectors of Fish Pathogens in Aquatic Ecosystems

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Benthic invertebrates such as shellfish, oligochaetes, snails and leeches have been identified as potential vectors of fish pathogens. In the Potomac River Basin spring skin lesions and die-offs of adult smallmouth bass (Micropterus dolomieu) occurred in 2002 and subsequent years. Young-of-the-year smallmouth bass mortalities have occurred for a number of years in the Susquehanna drainage. Dead and moribund bass exhibit varying intensities of parasites in their tissues and internal and external bacterial infections. Parasites such as white grubs (Posthodiplostomum minimum) and myxozoans are found in multiple tissues of the bass. Snails of the Physa genus are a host of the white grub and release cercariae which infect the fish. Aquatic oligochaetes, polychaetes and bryozoans have been identified as hosts of myxozoan parasites of fish. High nutrient loads, periphyton, aquatic vegetation or other factors may contribute to increased benthic invertebrates. Additionally, various contaminants (metals, atrazine, estrogenic compounds) may reduce the resistance of fish to pathogens and parasites. High parasite infections are known to increase stress in fish and interfere with normal tissue function. When they enter the fish microwounds are produced which may be sites of entry for bacterial pathogens. Bacterial pathogens may also be directly transmitted to fish by parasites such as leeches and parasitic crustaceans. Shellfish may also serve as reservoirs of bacterial pathogens to fish. In a laboratory study, transmission of Aeromonas salmonicida between fish and mussels was demonstrated to readily occur through simple cohabitation. Flavobacterium columnare, the cause of columnaris disease to many fishes, has been recovered from two mussel species Amblema plicata from the Ohio River and Villosa iris from the Clinch River, Virginia. The role of invasive species in parasite introduction and/or pathogen transmission is currently unknown in the Potomac and Susquehanna drainages, hence recognizing and understanding the role of benthic invertebrates (native and invasive) as vectors of fish disease is important.

Heather will graduate with her master's degree in August. Her thesis is on the effects of land use and season on trematode infection in smallmouth bass and describing two new gill myxozoans of smallmouth bass. Heather works at the National Fish Health Research Lab as a technician and spends most of her time working on histopathology and some molecular biology projects.

[62] Taxonomic Data Quality Control for the Maryland Biological Stream Survey, 1995-2009

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Benthic macroinvertebrate samples used by the Maryland Biological Stream Survey (MBSS) for stream and watershed assessments are processed by taxonomists of the Department of Natural Resources (MDNR). Since the 1995 inaugural year, the MBSS has done in excess of 2,500 stream assessments through 2009; they began an intermittent (sometimes annual) quality control (QC) analysis of taxonomic consistency/precision in 1998. The technique used for this analysis relies on having two independent taxonomists or laboratories identify organisms in a sample, direct comparison of the results by a third party, and documenting the occurrence and causes of differences in the results. Detailed, taxon by taxon evaluation of the comparisons provides information on problematic taxa, areas for improvement, and documented data quality. Differences are summarized for a sample as an error rate (percent taxonomic disagreement [PTD]), thus, lower values are desirable; the unofficial standard used by many programs is a measurement quality objective (MQO) of 15%. Sample QC is typically done roughly at a rate of 10% of the total number of samples in a lot, where, following identification by the primary taxonomist, that proportion is randomly-selected from the entire set, and, they are transferred to the QC taxonomist. The first comparisons done were based on 55 samples, which were randomly selected from approximately 1,000 samples collected from 1995-97, and represented between 5-6% of the sample lot. Routine and external QC was not done for several years, until, beginning in 2005, comparisons have been done annually for 4 out of 5 years, through 2009 averaging about 10 samples per year. The procedure has become more efficient in that timeframe due to its use in the USEPA National Aquatic Resource Surveys (NARS), as well as for a number of other individual state and county programs. The mean error rate (PTD) for the 95 samples is 15.3% (sd = 9.7), with approximately 40% of the samples exceeding

the MQO of 15%. The 38 samples in exceedence exhibit error rates ranging from 15.1 – 52.5%, with those lower than the MQO ranging from 1.1 – 15.0% (n = 57). Changes in error rate from the 1995-1997 testing (mean PTD = 16.6%; range 1.1 – 52 .5; 47% of samples in exceedence) to 2005-2009 (mean PTD = 13.9%; range 1.7 – 29.8; 38% exceedence) reflects a better understanding of the process having been developed by the MDNR taxonomists, as well as greater attention to problematic issues (consistency of hierarchical effort, count/no-count specimens). We recommend that routine annual monitoring of taxonomic data quality for the MBSS continue, while instituting a goal of having <20% of samples in exceedence of the MQO.

Mr. Erik Leppo has worked at Tetra Tech for over 17 years, performing benthic macroinvertebrate-based biological assessments for numerous agencies/entities across the U.S. Currently, he participates in index development and landscape classification projects, and manages databases for several national, regional, and state monitoring and assessment programs. Along with Dr. Stribling, he helped develop a taxonomic quality control procedure, and has been integral in its use in multiple USEPA National Aquatic Resource Surveys (NARS), even making initial efforts to apply it to periphyton, phytoplankton, zooplankton, and fish samples. This included the National Wadable Streams Assessment, National Lakes Assessment, and the National Rivers and Streams Assessment. Cumulatively evaluating around 300 samples as representative 10% of >3,000 samples collected as part of those efforts.

Marcellus Shale I: Science and Policy

[63] NO TITLE

David Kargbo

NO ABSTRACT SUBMITTED

[64] Geology of the Marcellus Shale in Maryland

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Over the past 70 years, the 400 million-year-old Oriskany Sandstone has been the primary target of Appalachian gas exploration. Tens of thousands of conventional wells have been drilled to this rock formation. Geologists have presumed that the gas contained within this porous sandstone unit was likely generated in the overlying organic-rich Marcellus Shale. Recent developments in well drilling and stimulation technologies have made it possible to exploit these organic rich layers directly and allow the capture of gas contained within the less permeable shale. The Marcellus Shale is the oldest and deepest of several Devonian Appalachian organic-rich shale units. The Marcellus was deposited 390 million years ago when western Maryland was located at about 30 degrees south of the equator. This rock unit was formed in a geographically restricted, deep sea setting that formed as the result of tectonic plate collision in areas now buried beneath Maryland's Coastal Plain. This collision produced a seaway that was thousands of feet deep. Below the warm, well-lit surface waters where animals and plants could survive, the waters were stagnant and devoid of circulation. As a result, at depths greater than about 100 to 200 meters the water column was oxygen deficient. Thus, when the animal and plants that lived in the shallow waters died, their remains sunk into the anoxic waters and were preserved in the oxygen-free depths. Through millions of years organic material sank to the sea floor and accumulated as a black organic shale. This black carbon-rich shale was buried subsequently by as much as 15,000 feet of rock. During the ensuing millions of years the elevated temperatures and pressures from the overlying blanket of rocks, as well as added pressures from mountain building episodes, served to heat the organic matter. This prolonged heating causing the break-up of long organic kerogen molecules into shorter and shorter hydrocarbon molecules that make up natural gas.

David K. Brezinski is the Appalachian stratigrapher and paleontologist for the Maryland Geological Survey. His main research interest is the study of the limestone rocks of Maryland and how sinkholes form within them. He has worked at the Survey since 1985.

[64] An In-Depth Look at Water Chemistry in the Upper Monongahela River Basin

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The Mon River QUEST is a collaborative water quality monitoring and reporting project for the Monongahela River Basin (MRB), led by the West Virginia Water Research Institute (WVWRI). The program serves to display and manage data collected internally by the WVWRI and through QUEST volunteers. The WVWRI has been collecting bi-weekly samples in the MRB since 2009. Those samples are analyzed for a variety of chemical parameters. To complement this sampling program, the WVWRI is currently embarking on a collaborative approach to display conductivity data provided by various watershed networks and individuals. A strategic monitoring program for the Monongahela River watershed was developed and implemented in July, 2009. The program includes water quality monitoring and sampling on a bi-weekly basis. Monitoring locations have been established at 16 locations in the watershed including 4 sites on the Monongahela River and at 12 locations at the mouths of its major tributaries. Soon after the monitoring program was implemented, a fish kill in September 2009 on Dunkard Creek, a tributary of the Mon River, gained much media attention. The WV DEP and PA DEP determined that the fish kill was caused by a toxic bloom of golden algae, P. parvum, which flourishes in saline water. Not typically found in the freshwater streams of the Appalachians, it has not been determined how the algae were introduced into Dunkard Creek. Controlling

salinity in the tributaries as well as the Monongahela mainstem gained urgency as coal mining continues and shale gas well development is on the upswing. This presentation focuses on the trends in water chemistry, pollutant loadings and sources in the Upper Monongahela River and its major tributaries. In addition, the application of this type of monitoring data to better manage pollutants on large river systems will be discussed. For example, using the flow model generated through this program the WVWRI established a Coal Industry Working group in January 2010 to coordinate mine pumping with the assimilative capacity of the receiving streams. Since then TDS and sulfate have been below the secondary drinking water standards on the Monongahela River mainstem and the Dunkard Creek fishery has rebounded.
Paul Ziemkiewicz is the Director of the West Virginia Water Research Institute (WVWRI). The WVWRI has a staff of thirteen and works with the faculty of WVU and other universities to manage programs that range from local, regional, national, to international in scope. Major programs include mine drainage, watershed management, biofuels, industrial site restoration and treatment of drilling brines.

Dr. Ziemkiewicz's responsibilities focus on addressing high priority environmental issues by developing research opportunities, assembling and managing research teams and responding to the needs of sponsors. In addition to his research roles, Dr. Ziemkiewicz serves on both state and federal policy advisory committees focusing on energy and water. Dr. Ziemkiewicz is a member of the West Virginia Acid Mine Drainage Task Force, the Eastern Mine Drainage Federal Consortium, the West Virginia Special Reclamation Trust Fund Advisory Council and the Ohio River Basin Water Availability and Management Work Group. Dr. Ziemkiewicz received the E.M. Watkin Award in 1985 for Outstanding Contribution to the Betterment of Land Reclamation in Canada, presented by the Canadian Reclamation Association. In 2005 he received the Environmental Conservation Distinguished Service Award, presented by the Society for Mining, Metallurgy and Exploration. He holds a Bachelor's degree in Biology and a Master's degree in Range Ecology from Utah State University, and Doctorate in Forest Ecology from the University of British Columbia.

[65] The Maryland Marcellus Shale Executive Order

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On June 6, 2011, Governor O'Malley signed an Executive Order establishing the Marcellus Shale Safe Drilling Initiative to ensure that, if drilling for natural gas from the Marcellus Shale proceeds in Maryland, it is done in a way that protects public health, safety, natural resources, and the environment. While there are many potential benefits that could come from exploring and exploiting Maryland's Marcellus shale gas reserves, there are also many legitimate public health, safety, environmental, and natural resource issues. The Governor directed the Department of Natural Resources and the Department of the Environment, in consultation with an Advisory Commission, to perform a study and report on its conclusions and recommendations. The Marcellus Shale Safe Drilling Initiative is intended to provide critically needed information about the risks inherent in deep drilling and fracking and consensus about what policies and permit conditions would adequately protect against those risks. The Marcellus Shale Safe Drilling Initiative is not a moratorium on drilling in the Marcellus Shale and does not restrict the Department's ability to issue permits under existing law and regulation. The Maryland Department of the Environment currently has the authority in state law and regulation to place all reasonable conditions in permits necessary to provide for public safety and to protect public health, the environment and natural resources. If information becomes available during the course of the study that is sufficient to demonstrate that the natural gas can be extracted from shale formations in Maryland without adverse impact to human health, natural resources, or the environment, MDE could issue permits with all appropriate safeguards in place.

The Executive Order instructs the Maryland Departments of the Environment and Natural Resources and the Advisory Commission to take advantage of other ongoing research. By December 31, 2011, the Departments shall present findings and related recommendations regarding the desirability of legislation to establish revenue sources, such as a State-level severance tax, and the desirability of legislation to establish standards of liability for damages caused by gas exploration and production. By August 1, 2012, it must make recommendations for best practices for all aspects of natural gas exploration and production in the Marcellus Shale in Maryland. No later than August 1, 2014, it must issue a final report with findings and recommendations relating to the remaining issues.

The Commission was named on July 19. It includes a broad range of stakeholders and representatives from western Maryland, including representatives from the scientific community, the gas industry, business, agriculture, environmental organizations, citizens, and government. Information about the study will be publicly available and the Advisory Commission's meetings will be open to the public.

Brigid Kenney joined the Maryland Department of the Environment as Planning Director four years ago. Secretary Summers has tasked her with coordinating MDE's work on the Marcellus Shale Safe Drilling Initiative. Before joining MDE, Ms. Kenney practiced law for 28 years at a large Baltimore firm, concentrating on Environmental Law.

Say Hello to my TMDL!
A Look at Freshwater Regulations in Maryland

[67] Maryland's Ion Monitoring Plan: Supporting Water Quality Criteria Development for Chloride Concentrations

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MDE Sciences Services Administration

Based on the Maryland Stressor ID methodology, The Maryland Department of The Environment (MDE) has placed several streams on the 303d list for being impaired by elevated chloride (Cl^-) concentrations. As a result, the MDE – Science Services Administration (SSA) has started the process of developing Cl- TMDLs for these watersheds. In support of this effort, the Water Quality Standards Section of SSA has developed a monitoring plan that will help identify an appropriate water quality criteria for Cl- to protect the aquatic life Designated Use. Elevated concentrations of Cl- negatively impact aquatic organisms by imposing added osmoregulatory stress. The osmoregulatory effects of elevated Cl- can vary drastically at given concentrations, due to the presence or absence of other ions (and trace metals) in solution (Mount et al., 1997). This collective mixture of ions (and trace metals) in surface waters is known as the "ion matrix". Because of the ion matrix's ability to ameliorate or compound the toxicity of Cl-, it is imperative that the concentration of Cl- is examined in concert with the composition and concentration of the ion matrix. The monitoring plan will examine Cl- concentrations and the ion matrix associated with the two dominant mechanisms of delivery of Cl- to surface water: the runoff of contaminated snowmelt and stormwater, and the inflow of contaminated ground water. These 2 delivery mechanisms vary temporally and geographically in MD, which influences the concentrations of ions in surface waters in a similar fashion. Extremely high, and presumably acutely toxic, levels of Cl- are present during the late winter and spring in MD streams that are close to urban centers and transportation corridors, when stream discharge is runoff dominated, post road de-icing activities. Elevated Cl- concentrations in surface waters as a result of contaminated ground waters are most evident during the drier times of the year, when a stream's flow is composed primarily of the ground water contribution. This portion of the overall Cl- contribution to surface waters is expected to have more of a chronic effect on ecosystem function. Consequently, the Cl- monitoring plan has a two pronged approach: a storm-flow approach and a base-flow approach. An automated storm sampler will be established along the bank of a stream that is documented to posses biologically impairing Cl- concentrations. The sampler will take timed water chemistry samples to capture the maximum Cl- (and other ions) concentrations that exist during late winter and spring flows. The intent is to determine the concentration of Cl- that presents acutely toxic conditions to aquatic organisms, and to identify the ion matrix associated with that Cl- concentration. To identify Cl- concentrations in surface waters during base flow dominated discharges, grab samples will be taken from streams, by ecoregion, that meet the biological criteria for non-impairment status (fish and benthic invertebrate IBI score ≥ 3), and from streams that meet the biological criteria for high quality status (fish and benthic invertebrate IBI score ≥ 4). This baseflow approach will attempt to characterize the background ion matrix in high quality systems (IBI ≥ 4), representing the natural conditions, and in streams that meet non-impairment status (IBI ≥ 3). Approximately 860 samples will be collected as a result of the stormflow and baseflow monitoring approaches. Samples will be analyzed for conductivity, total dissolved solids, calcium, magnesium, sodium, potassium, chloride, sulfate, bicarbonate / alkalinity, nitrate/nitrite, phosphate, hardness, bromide, iron, manganese, selenium, aluminum, strontium, barium, zinc, lead, and copper. Baseflow sampling will be completed by then fall of 2011, and automated/storm flow sampling will be completed by summer 2012.

Adam received his BS at Frostburg State University in Fisheries and Wildlife Management and an MS at the University of Missouri-Columbia in fisheries ecology, with a focus on watershed impacts on stream function. He has been working for the state of MD for 5 years. He started as the "Corsica Guy" for MDE, and then moved to Water Quality Standards Development. Prior to MDE, Adam worked for 2 years as biologist for Tetra Tech's Ecological Services Division in Owings Mills. Adam is interested in restoring and conserving aquatic and terrestrial ecosystems and researching, monitoring, and managing the effects of land use activities on structure and function of aquatic and terrestrial ecosystems; and encouraging connectivity between natural resources and the public through recreation and sensible use. Adam grew up in Waynesboro, PA (3 miles north of the Mason-Dixon Line), along the banks of the East Branch of the Antietam. So with the exception of his time in Missouri, he has spent his entire life boating, biking, hunting, hiking, fishing, and working in ecosystems familiar to Maryland.

[68] Watershed-Based Monitoring Network Design for Chlorides and Sulfates

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In 2002, the State of Maryland began listing biological impairments on the Integrated Report of Surface Water Quality (IR). These Category 5 listings for biological impairments represent degraded biological conditions for which the stressors, or causes, are unknown. In 2009 the Maryland Department of the Environment (MDE) developed a biological stressor identification (BSID) process, to determine the predominant cause(s) of degraded biological conditions, thus enabling MDE to most effectively direct corrective management action(s). For each 8-digit watershed with a biological impairment listing, the BSID process will identify specific stressor(s), or Category 5 impairments, which are causing failure of the watershed to attain its designated use.

The BSID process is currently, and will continue to add many new pollutant specific Category 5 impairment listings to the IR. Recently, the BSID process has identified elevated concentrations of chlorides (CL) and sulfates (SO4) as potential cause(s) of biological impairment in watersheds throughout the State of Maryland. These watersheds are typically associated with urban areas and/or major transportation routes. In total, the BSID process has identified approximately twenty six CL and twenty SO4 impairment listings at the 8-digit watershed scale. CL and SO4 were first listed in the 2010 IR; the IR included 11 new Category 5 listings for these biological stressors. Currently, MDE has never submitted a chloride or sulfate Total Maximum Daily Load (TMDL) to the Environmental Protection Agency (EPA), therefore; the Department must invest resources into developing these types of TMDLs. Addressing these new CL and SO4 category 5 listings will be a critical focus of the TMDL program over the next several years. A key component to addressing these new listings is to have sufficient water quality data for TMDL and/or Water Quality Analysis (WQA) development.

Allison graduated from St. Mary's College of Maryland in 1987 and started her career as a Biologist with the Academy of Natural Sciences of Philadelphia. In1989 Allison started as a Natural Resource Biologist for the Maryland Department of the Environment. In 2009 she became Section Head of the Biological Stressor Identification Section.

[69] The Integrated Report (aka 303d/305b List) of Surface Water Quality: Calling It as We See It

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The Integrated Report (IR) is a biennial report submitted to the Environmental Protection Agency (EPA) on the quality of Maryland's surface waters. The IR was formerly submitted as two separate reports commonly known as the 303(d) List (the impaired waters list) and the 305(b) Report, both required by the federal Clean Water Act. The IR provides assessment information for Maryland's streams, rivers, impoundments, estuaries, and ocean waters. Assessments for the IR are conducted by compiling and analyzing high quality data from a multitude of sources including state and local government agencies, academia, and watershed organizations. Waters are placed into five different categories according to their water quality status, including: Category 1 - waters attaining all standards; Category 2 - waters attaining some standards; Category 3 - waters with insufficient information to determine if water quality standards are attained; Category 4 – impaired or threatened waters that do not need or have already completed a Total Maximum Daily Load (TMDL); and Category 5 [the historical 303(d) List] - impaired waters for which a TMDL is required. The Maryland Department of the Environment (MDE) currently provides an online searchable database and clickable map application for finding water quality assessment information specific to a watershed of interest (http://www.mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/303d.aspx). In the near future, MDE will be providing a more interactive and higher resolution map that will offer assessment information at the stream segment level. This water quality information is used extensively for setting state monitoring priorities, driving TMDL development, informing National Pollutant Discharge Elimination System (NPDES) permit conditions, and influencing water quality restoration and protection efforts. It is MDE's goal to have this information increasingly used at all levels of planning in order to make progress in restoring and protecting Maryland's waters. How can your organization use this information to improve resource planning efforts?

Matthew Stover graduated from Washington College in Chestertown, MD with a B.A. in Environmental Studies. He currently works in MDE's Science Services Administration performing duties including: assessing water quality for the 303(d) List, reviewing projects so as to protect Tier II high quality waters, and providing guidance in the management of dredge material containment facilities. He has been at MDE for 6 years and before that worked at Maryland DNR and later with a private consulting firm.

[70] Incorporation of Maryland's Current Antidegradation Implementation Procedures into the Approval or Permitting Framework

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Currently the only characteristic utilized to designate high quality or Tier II waters in the State of Maryland is biology. All of the data utilized in the designation effort is provided by the MD DNR Maryland Biological Stream Survey (MBSS) program. Through a well established working relationship with the MD DNR, MDE has utilized the MBSS program in recent years to identify additional high quality waters throughout the state, and this has resulted in an increase in the number of high quality waters in the State, growing from 83 in 2004 when the Antidegradation Implementation Procedures were originally promulgated into the Code of Maryland Regulations (COMAR) 26.08.02.04-1, to 238 in 2011. As mandated by the regulation, the Department must ensure that applicants minimize the use of each high quality waters' assimilative capacity, which is the difference between the water quality at the time the water body was designated as Tier II (baseline) and the water quality criterion, taking into account potential changes due to natural variability. As the MBSS dataset is supplemented annually, it not only provides the initial baseline data, it also provides a mechanism to assess the current status, or assimilative capacity of those waters moving forward. To further that end, the State also leverages applicable permitting and regulatory approval authorities to not only address assimilative capacity and anthropogenic degradation issues identified by current biological data, but also to gather additional biological data during the course of the permitted activity.

Angel Valdez is a graduate of Loyola University Maryland, where she received her Bachelor of Science in Biology. Upon graduation Ms. Valdez worked extensively in the field of environmental education before joining the Maryland Department of the Environment's Science Services Administration where she helps coordinate the Antidegradation Policy Implementation effort and assists with technical over site and management of dredging and other natural resource activities throughout the state.

[71] Maryland's Synoptic Survey

Quentin Forrest

In Maryland, the Synoptic Survey is a state-wide, inexpensive, rapid water quality assessment tool that focuses on non-tidal streams. The Synoptic Survey uses the technique of collecting numerous water quality samples over a short period of time for a defined geographic area. Using GIS software to map the Synoptic Survey results enables managers to paint a snapshot of a watershed that highlights potential problem areas for the constituent of concern. Maryland has used the Synoptic Survey technique to locate "hotspots" for nutrients, bacteria, road salt, low pH, high conductivity, dissolved oxygen, and some toxins. State, county and municipal agencies have found Synoptic Survey data to be very useful as a building block for watershed plans and as a good starting point for targeting implementation activities with regards to TMDLs. Repetitive surveys, both seasonally and annually, can provide additional information about the impact of land use changes, agricultural crop changes, groundwater lag time, and progress towards TMDL goals.

Quentin Forrest presently serves as the Division Chief of the Chemical and Biological Monitoring Division with the Maryland Department of the Environment (MDE), Science Services Administration, Field Services Program. He has worked for MDE since 1999. He earned a Bachelor of Science (BS) in Biology from St. Mary's College of Maryland and a Master of Science (MS) in Environmental Science from the University of Houston.

Volunteer Monitoring Success Stories

[72] Oyster Gardening: A Volunteer Success Story

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Oyster gardening is the nursery culture of small, hatchery-produced oysters, called "seed" or "spat" to a larger "juvenile" size by volunteers in floating cages off of the volunteer's dock. We started in 2003 with 20 volunteers and now we have over 200. Numerous thesis' have been written and published on the information attained and hundreds of bushels of oysters have been planted for restoration purposes in the Delaware Inland Bays. It's the Delaware Center for the Inland Bays most popular volunteer program, with lots of interest every year.

E.J. Chalabala who has been the Restoration Coordinator for the Delaware Center for the Inland Bays since 2003. He attained his Bachelor's Degree in Aquaculture and Fisheries from Clemson University. He now spends much of his time with volunteers helping to raise shellfish for restoration purposes in the Delaware Inland Bays.

[73] The Delaware Nature Society's Riparian Habitat Assessment

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Learn about how the Delaware Nature Society, Streamwatch volunteers and the Delaware Department of Natural Resources and Environmental Control teamed-up to develop and pilot a riparian habitat assessment program to evaluate the health of local streams and prioritize stream sites for future work. The presentation will cover the assessment tools developed, initial volunteer training design and quality control, and future directions for the project.

Kristen Travers is the Water Quality Monitoring Coordinator for the Delaware Nature Society, bringing over 15 years of experience communicating watershed science to diverse audiences. She has worked extensively with watershed organizations to provide mentoring and technical training and has developed nationally available watershed-based curriculum materials for educators. She has presented on watershed education and science at numerous conference including the National Science Teachers Association, North American Association for Environmental Education, and the National Water Quality Monitoring Conference. Kristen holds a B.S. in Environmental Science and M.Ed in Instructional Design and Training.

[74] RiverTrends: Using Volunteer Data for Outreach on Water Quality Issues and Solutions

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RiverTrends, the Alliance for the Chesapeake Bay's volunteer water monitoring program, has been collecting high-quality data for over 25 years. Most recently, we have worked with the volunteer watershed organizations to analyze data which is then published in a report card type newsletter or on a website. The goal is to provide easy-to-understand information to communities regarding local water quality conditions and solutions to problems. We will highlight the Hazel Run Bacteria Report and provide an overview of current projects.

Anna Mathis is the Program Coordinator for the Alliance's Virginia office. She coordinates the RiverTrends water quality monitoring program, BayScapes projects, and other projects in partnership with watershed groups in Virginia's portion of the Chesapeake Bay watershed. Anna graduated from the Nicholas School for the Environment and Earth Sciences at Duke University with a Masters in Environmental Management.

[75] Maryland Stream Waders: Eleven Years of Success!

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Quiz – What has cold toes, loves creeks, and gives time and energy generously to help Maryland's environment? A Maryland Stream Wader Volunteer, of course! Since 2000, the Maryland the Maryland Department of Natural Resources has trained and recruited volunteers to sample benthic macroinvertebrates in freshwater streams as part of the Maryland Stream Waders Program. Many aspects of Stream Waders are seamless with those of the Maryland Biological Stream Survey (MBSS), including field and laboratory methods, data analysis, and determination of stream quality using a Benthic Index of Biotic Integrity (BIBI). About 1,240 volunteers have sampled 5,590 sites statewide to help fill in the gaps in areas not sampled by DNR professionals. This talk will provide an overview of the first 11 years of Stream Waders highlighting the Program's successes, challenges and future.

Dan is a biologist with the Maryland Department of Natural Resources' Maryland Biological Stream Survey. He has a BS in Zoology from the University of Maryland and a MS in Environmental Science and Policy from Johns Hopkins University.

[76] Stream Research and Community Outreach Using Volunteers

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In 2009 the Jug Bay Wetlands Sanctuary began a Stream Watershed Study, comparing three small Patuxent River tributaries that flow through our property. These freshwater, coastal plain streams have varying watershed sizes and land use. Working with volunteers, we conduct biological and chemical monitoring. In addition, we have an outreach component to encourage upstream homeowners within the watersheds to help us improve the health of the streams over time. Research is ongoing, and to date, our outreach efforts have included a Stream Summit, presenting data and best management practices, and a Stream Blitz research event. Successes and setbacks will be discussed, with data and resources for planning research projects and outreach events with volunteers.

Lindsay Hollister has served as Volunteer Coordinator and Naturalist for the Jug Bay Wetlands Sanctuary since 2004. In 2009 she went through the first class of the Anne Arundel County Watershed Stewards Academy. She leads outdoor education programs and coordinates education, ecological research, and stewardship projects on the Patuxent River as a county government employee and a community Master Watershed Steward.

Contributed Papers - Nutrients

[77] Major Sources and Transport Pathways for Nitrogen and Phosphorus to Chesapeake Bay and its Tributaries

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Efficient nutrient management in support of Chesapeake Bay restoration requires a regionally-consistent and comprehensive understanding of nitrogen and phosphorus sources, fate, and transport in the Bay watershed that is available only through numerical models. The U.S. Geological Survey (USGS) supports Chesapeake Bay restoration through research and modeling of the upland sources of nutrients and the factors that affect nutrient transport from the watershed to the Bay. As part of this effort, spatially-referenced regression on watershed attributes (SPARROW) models were calibrated to estimates of long-term mean annual total nitrogen (TN) and total phosphorus (TP) loads in selected Chesapeake tributaries. The models provide empirical estimates of sources, fate, and transport of TN and TP in the watershed and of the mean annual TN and TP loads to the bay and in each of 80,579 tributary-stream and shoreline reaches. Chesapeake Bay receives an estimated 1.32 x 108 kilograms (132,000 metric tons) of nitrogen and 9.74 x106 kilograms (9,740 metric tons) of phosphorus, annually, from its watershed, largely through its two largest tributaries, the Susquehanna and Potomac Rivers. Sources of nutrients to bay tributaries include fertilizer and manure applications in agricultural areas, urban activities, point sources, atmospheric deposition and direct fixation by crops (for nitrogen), and mineral sources (for phosphorus). Agriculture (primarily fertilizer applications and crop fixation) contributes more than half of the nitrogen from the watershed to the bay; phosphorus contributions are more evenly distributed among agricultural (fertilizer and manure applications) and urban (including point) sources. Natural mineral dissolution in siliciclastic or crystalline rocks contributes approximately 15 percent of the phosphorus loads from the watershed to Chesapeake Bay. Groundwater is an important pathway for nitrogen transport (as nitrate), and TN loads are greatest in areas with greater groundwater flow and in areas of the Piedmont underlain by carbonate rocks. TN loads are generally lower in areas with greater vegetative growth (likely indicative of plant uptake) and soil available water capacity (likely indicative of reducing conditions). Phosphorus transport to streams, conversely, is greatest in areas most likely to generate overland runoff and related erosion, and in the Coastal Plain, possibly due to saturation of soils with historical agricultural phosphorus applications. Both nitrogen and phosphorus are lost within watershed impoundments (lakes, ponds, or reservoirs), and nitrogen is also lost significantly along selected flowing reaches. The comprehensive accounting of nutrient sources and the empirical estimates of TN and TP loads specific to each tributary provided by the models can be used to target limited resources in support of local and regional surface-water restoration.

Scott Ator is a hydrologist with the U.S. Geological Survey, located in Baltimore. His major research interests include the occurrence, distribution, sources, fate, and transport of contaminants (primarily nutrients and pesticides) in groundwater and nontidal streams, and improvements in methods to evaluate spatial and temporal trends in water quality at large regional scales. He holds a BS degree in Geology from the University of Maryland and a MS degree in Environmental Science and Policy from Johns Hopkins University.

[78] Nodal Point Pollution: Changing the Paradigm for Chesapeake Bay Restoration

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The South River is an estuarine tributary of the Chesapeake Bay on the western shore in Anne Arundel County, Maryland in the United States. The South River watershed covers approximately 66 square miles, including approximately 500 miles of non-tidal streams, and 15 square miles of open water with approximately 66,00 residents living in the watershed.
Recent intensive data collected by the South River Federation's South Riverkeeper from the South River indicate that the tidal tributaries are the root cause of hypoxia and anoxia in the main stem of the South River. These tributaries act as confluences of stormwater from the

non-tidal streams which create nodal points of nutrients, sediments, and organic matter loading. Therefore, they can and should be treated as point sources of pollution. Identifying the nodal points allows prioritization for restoration, reducing pollutant loading and eventually reducing the hypoxia and anoxic events in the main stem of the South River. This model suggests that working locally to fix these targeted areas rather than the traditional regional approach may be more effective in restoring the Chesapeake Bay and its tidal tributaries.

Andrew Muller received his undergraduate degree in Geology then went on the receive a Master's and Ph.D. in Oceanography from Old Dominion University. His studies include sediment transport, hydrology, estuarine physical and chemical dynamics, modeling and wavelet modeling.

[79] Coastal Bays Non-tidal Nutrient Indicators & Thresholds for Use in an Annual Report Card

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An annual 'state of the Coastal Bays' report card has been produced since 2008 by the Maryland Coastal Bays Program in partnership with MD-DNR and other organizations, similar to the Chesapeake Bay report card. A standard set of indicators is used to provide an annual snapshot of the health of the Bays focusing on water quality, plus several living resources indicators of importance in the Coastal Bays. Multiple thresholds for each indicator are used to provide a goal attainment continuum and a means to construct a grading scheme. During 2010, we recognized that that non-tidal data were inappropriately combined with tidal data to determine attainment of water quality goals, and that separate non-tidal indicators and thresholds should be identified. Because several partners collect water quality data that is contributed to the report card, these indicators must be common to all. Total nitrogen and total phosphorus were chosen, and various methods to identify multiple threshold values for determining goal attainment have been explored. Here we present the results of these trials and request feedback from the streams community.

Carol Cain is a biologist with the Maryland Coastal Bays Program and Carol McCollough is biologist with MD-DNR.

[80] Combination of a Stressor-Response Model with a Conditional Probability Analysis Approach for Developing Candidate Criteria from MBSS Data

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I show that a conditional probability analysis using a stressor-response model based on a logistic regression provides a useful approach for developing candidate water quality criteria from empirical data, such as the Maryland Biological Streams Survey (MBSS) data. The critical step in this approach is transforming the response data into a binary variable using a threshold that is a desirable management goal for the intended water bodies. A logistic regression analysis on the stressor and binary response data is conducted and the result can be viewed as transferring uncertainty in empirical data to an estimate of the probability of missing the management goal. Results from analyses with multiple data sets, including MBSS, demonstrate the robustness of this approach. This approach is also able to incorporate multiple stressors into the analysis, allowing examination of the interaction among stressors that can be observed from the data. The issue of nutrient (N and P) co-limitation in Maryland streams will be used to demonstrate this capability.

John F. Paul is a Research Environmental Scientist at the National Health and Environmental Effects Research Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. Dr. Paul was involved in the development and implementation of USEPA's Environmental Monitoring and Assessment Program (EMAP). He received the EPA's highest awards (gold medal for exceptional service and silver medal for superior service) for his work in EMAP. He has been involved in writing the Framework for Developing Suspended and Bedded Sediments Water Quality Criteria and Using Stressor-response Relationships to Derive Numeric Nutrient Criteria. His current research interests include the interactions between human and ecological systems. Dr. Paul received a Ph.D. in Engineering from Case Western Reserve University.

Marcellus Shale II - Assessing our Waters

[81] Water Quality Monitoring in Pennsylvania's Marcellus Shale Field—Trying to Stay "Ahead of the Curve"

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Pennsylvania's Department of Environmental Protection's (PADEP) water quality (WQ) monitoring program has strong, long-term elements in place that assess and monitor the surface water quality of Pennsylvania rivers, streams, and lakes. For many years, these monitoring programs were 'static', in that most of them had well established, consistent, and routine sampling schedules that targeted point source (PS) discharges and impacts associated with urbanized areas. However, emerging environmental monitoring issues have increased in recent years, and as a result, PADEP's WQ monitoring efforts have evolved to respond and adapt to specific emerging issues, such as Marcellus deep shale gas exploration. PADEP's monitoring response to Marcellus exploration and extraction ranges from tweaking existing, traditional long-term water quality monitoring designs to implementing new 'mobile' monitoring designs incorporating data-logger technology and expanded analytical testing.

Tony Shaw has been a field biologist with Pennsylvania's Department of Environmental Protection for over 25 years and currently is a Biologist Supervisor in that agency's Water Quality Monitoring Section. He has training and experience in benthic macroinvertebrate biology and has conducted many aquatic life use surveys and biological stream assessments for Pennsylvania's water quality monitoring and Antidegradation Programs. He is directly involved in the development and implementation of PA's Water Quality Monitoring programs and protocols.

[82] Maryland Assesses Baseline Water Quality Conditions in Streams near Potential Marcellus Shale Drilling Locations

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In June 2011, Maryland Department of Natural Resources (MDNR) Monitoring and Non-Tidal Assessment, Tidewater Ecosystem Assessment and Fisheries Service staff began collaborating to collect baseline data (presence of Prymnesium parvum (a golden algae) and continuous conductivity values) from 11 western Maryland streams in the Potomac and Youghiogheny River basins near potential Marcellus Shale gas well sites. Water samples were collected and filtered. The filters were shipped to a laboratory specializing in DNA fingerprinting of Prymnesium parvum to determine presence/absence. Golden algae are believed to produce a number of toxins, collectively known as prymnesins, which include an ichthyotoxin, a cytotoxin and a hemolysin. MDNR also deployed Onset HOBO conductivity loggers (model U24-001) in all 11 streams. Conductivity values are currently being measured on an hourly basis and will be recorded for at least 12 months. Conductivity is a useful surrogate water quality parameter for detecting discharges of salts and some chemical by-products that may be introduced into surface waters during gas well drilling activities, runoff or through wastewater discharges. This effort will define baseline conditions and variability in stream conductivity prior to any gas well drilling activities in Garrett County. In 2012, MDNR will also sample these 11 streams during spring and summer using Maryland Biological Stream Survey methods to describe the biota, physical habitat, other water chemistry parameters, riparian zone, and catchment land use.

Tony Prochaska is a biologist with the Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division.

[83] Marcellus Monitoring

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Concerned residents and landowners living within the Marcellus shale play are asking how they can best determine if streams are being affected by drilling activities. For many, the goals are early detection and prevention of serious environmental impact. Community groups involved in volunteer monitoring and regional and state-wide service providers have responded to this need by collaboratively developing protocols and database management strategies to achieve these goals. In 2010 the Alliance for Aquatic Resource Monitoring spent seven months researching and testing a volunteer-based Marcellus Monitoring protocol for the early detection of flowback contamination in small Pennsylvania streams. The presentation will cover the steps in and the science behind the protocol as well as information on Marcellus Monitoring resources throughout the state.

Julie Vastine is the director of the Alliance for Aquatic Resource Monitoring (ALLARM) at Dickinson College. She is responsible for leadership of the ALLARM program, as well as providing monitoring technical assistance to watershed organizations. Julie has worked with volunteer monitors for nine years.

[84] Monongahela River QUEST: A Collaborative Approach to Monitoring Water Quality in the Mon River Basin

Melissa O'Neal

NO ABSTRACT SUBMITTED

[85] Susquehanna River Basin Commission Marcellus Monitoring

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The Susquehanna River Basin Commission (Commission) is a federal-interstate commission tasked with coordinating water resources efforts within the Susquehanna watershed, which makes up part of New York, Pennsylvania, and Maryland. The natural gas industry has recently begun extracting natural gas from the Marcellus shale layer that underlies 72% of the watershed. The gas industry requires quantities of water used in an extraction technique called hydraulic fracturing. Water withdrawals from the Susquehanna watershed are regulated by the Commission, and the impacts of withdrawals of surface waters are being investigated by targeted monitoring. Additional monitoring that targets potential impacts of the industry is investigating chemical parameters on streams located within the Marcellus area. A network of multi-parameter water quality sondes are maintained by the Commission. The real-time data gathered from these sondes can be used as an early detection technique or a way to compare changes in water quality over periods of time.

Matt Shank is an aquatic biologist that has been with the Commission since 2008. Matt manages the Aquatic Resource Survey project, which will be discussed in detail today.

Contributed Papers - Urban Streams II

[86] Assessing the Ecological and Human Health Status of Baltimore's Inner Harbor

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Baltimore's Inner Harbor and its watershed is a highly urbanized area in the mid-Atlantic region of the United States. The city of Baltimore was founded in the 1700s, with the population spreading out into adjacent lands over the last three centuries and continuing to expand into suburban and exurban areas today. The Gwynns Falls drains to the Middle Branch and the Jones Falls drains to the Inner Harbor. Both streams originate in the outer suburbs and in the urban parts of these watersheds, the majority of the streams have been channelized or enclosed in storm drains. This study assessed water quality and biotic parameters as ecological health indicators of Baltimore's Inner Harbor and its watershed. Bacteria and trash were assessed as human health indicators. Assessment of each indicator is based on methodologies validated through peer-reviewed scientific articles and years-long development of indicators for assessing the health of Chesapeake Bay via the Chesapeake Bay Program. Each indicator is compared against a threshold value and scored on a 0-100% scale, which is a gradient from Very Poor to Good health. The study found most water quality indicators to be either poor or very poor in the Inner Harbor. Additionally, the bacteria and trash levels in the Inner Harbor were rated as poor. The watershed health was better than the Inner Harbor receiving waters, with water quality indicators and bacteria scoring from good to poor. Lack of spatial and temporal coverage of basic water quality data in the Inner Harbor was a major hindrance to accurately assessing its ecological health. Future plans to remedy these problems, such as expansion of citizen science monitoring, will be discussed.

Caroline received her Master of Science degree from the University of Maryland in 2005 and started working for EcoCheck (a NOAA UMCES Partnership) in early 2006. Her work focuses on health assessments of Chesapeake Bay, ecological forecasting, and science communication. One of her bigger projects was helping to write and edit a book titled 'Integrating and applying science: A practical handbook for effective coastal ecosystem assessment.'

[87] An Approach for Monitoring Biological Response to an Urban Stream Restoration Including an Evaluation of the Relationship between Geomorphology and Biological Communities

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To mitigate for stream impacts resulting from the construction of the Intercounty Connector (ICC), the Maryland State Highway Administration (SHA) is currently restoring a 19,000 linear foot section of the Northwest Branch of the Anacostia River. The restoration strategy focused on using large woody debris structures to increase roughness to induce aggradation and increase flooding; increase zones of flow separation; increase riffle lengths and increase depth and frequency of pools; and to improve habitat diversity through addition of woody debris in low flow areas. A primary goal of the project was to provide ecological uplift to stream and floodplain biotic communities. As this project provided most of the stream mitigation for the ICC project, SHA has expended tremendous resources to evaluate the success of this project and its goal of providing ecological uplift. The effect of stream restoration projects on biotic communities is not clearly understood. Many monitoring programs use multimetric index scores and have a limited number of sample sites within a restoration area and predictably, show little or no change in the biological communities due to the limitations of the monitoring approach. The project team felt that more subtle or unexpected shifts or changes in the biotic communities may not be detected by these broad assessment tools, especially in urban stream systems with degraded water quality. In order to address the limitations of the traditional monitoring approach,

the Northwest Branch monitoring plan uses a data-driven, iterative process. To address the need for greater monitoring sensitivity, we used a modified MBSS method for collecting benthic macroinvertebrate samples that segregated riffle samples from rootwads/woody debris habitat samples and modified lab methods that included a full sample rather than the standard 100-organism subsample. In addition, we used a relatively large number of biotic samples and a very large (93) suite of metrics to evaluate the biotic communities, as well as indices of biotic integrity. In addition to the community metrics, we conducted multivariate analyses of the pre-construction biological communities using cluster analysis to group sites based on natural heterogeneity and ordination techniques in order to determine existing correlations between biota and geomorphic conditions within each site. These methods will be used during post-construction monitoring and we anticipate, based on the greater resolution of biological sampling and the wide range of analysis techniques, to be better able to identify any biological responses to this restoration project. This presentation will describe this multi-faceted approach to stream restoration monitoring and present the preliminary results of the pre-construction biological assessments including linkages to geomorphic variables.

[88] Mitigating the Effects of Urbanization on a Naturalized Population of Brown Trout (Salmo trutta) in a Tributary of the Anacostia River in the Washington, D.C. Metropolitan Area

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The Paint Branch stream, a tributary of the Anacostia River in Washington, D.C., supports brown trout (Salmo trutta) that were introduced to the stream in 1929. There has been no restocking of brown trout in this system, since 1938, when it became a self-sustaining population. During the last 50 years, development pressures have increased the amount of impervious cover in the Paint Branch watershed above thresholds normally associated with sustainable trout fisheries. As impervious cover has increased, the brown trout population has steadily declined. Additionally, Maryland's largest highway construction project will be crossing over Good Hope Tributary, which is the most productive spawning habitat area for brown trout in the Paint Branch watershed. There has been considerable effort expended by local government, non-profits, and state resource agencies to protect the Paint Branch watershed through zoning restrictions, land preservation, and stormwater retrofits. As part of the compensatory mitigation and environmental stewardship projects required for impacts associated with the Maryland State Highway Administration's, Intercounty Connector (ICC) project, numerous urban Best Management Practices (BMPs), stormwater management, and stream restoration projects are being implemented. The Service analyzed the Good Hope Tributary, the proposed BMPs, and impervious surfaces, for effectiveness in preserving or enhancing the conditions to sustain the brown trout populations. The BMPs are broken into three categories: urban water quality, stormwater management, and stream channel restoration. This study benefits from long term, pre-disturbance data related to stream morphology, water quality, and benthic communities gathered by the ICC study team. The study looked specifically at spawning habitat for brown trout in this system. Analysis shows that, while water quality parameters may be improved, the long term adjustments to the stream's morphology and sediment transport are de minimus. These relationships have an immediate effect upon the future of consistent and successful brown trout spawning in the Paint Branch watershed.

Mitch Keiler is a graduate of Ohio University, Athens, Ohio with a double major in Environmental Geography / minor in surface geology 84' and Cartography 86'. He is currently enrolled in the Graduate program at the University of Maryland. Mitch worked for the Maryland Department of Natural Resources for 13 years in various capacities with the Nontidal Wetlands Program, the Coastal Program and as a restoration project manager with the Ecosystem Restoration Program. In 2006 he received the National Conservation award from the Federation of Fly Fisherman in Bozeman, Montana for his stream restoration work on Carroll Creek (a Use III stream) in Frederick, Maryland. Currently he is an employee of the U.S. Fish and Wildlife Service were he serves as the Transportation Liaison to the Maryland State Highway Administration. With 27 years of resource management experience, Mitch has specialized in stream and wetland restoration, construction management, monitoring and assessment.

[89] An Altered State: Mitigating the Effects of Urbanization on Aquatic Ecosystems

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Urbanization in Maryland has altered the stability of streams and affected aquatic resources. The primary culprit has been impervious surface without adequate stormwater control. The Service has taken an active approach in recommending corrective actions in two watersheds: Dorsey Run a tributary to the Little Patuxent and Good Hope Tributary in the Upper Paint Branch. These two watersheds in Maryland's Piedmont Plateau Province present and excellent opportunity to examine resource management decisions applied at a landscape level. The Dorsey Run watershed approaches 40% impervious cover with poor IBI-B and F scores. Good Hope Tributary is part of Montgomery County's Special Protection Area zoning overlay which has capped imperious cover at 10% and currently has the capacity to support brown trout (*Salmo trutta*). The implications of land use planning and how it relates to resource management decisions are examined in these two case studies. The Service will provide for workshop attendees a copy of the Montgomery County – Special Protection Area ordinance with discussion on how this can be modified for other cold water watersheds. We will also provide a work sheet that can serve as guidance on how to calculate measureable reductions in peak discharge for subcatchments in urbanized watersheds.

Mitch Keiler is a graduate of Ohio University, Athens, Ohio with a double major in Environmental Geography / minor in surface geology 84' and Cartography 86'. He is currently enrolled in the Graduate program at the University of Maryland. Mitch worked for the Maryland Department of Natural Resources for 13 years in various capacities with the Nontidal Wetlands Program, the Coastal Program and as a restoration project manager with the Ecosystem Restoration Program. In 2006 he received the National Conservation award from the Federation of Fly Fisherman in Bozeman, Montana for his stream restoration work on Carroll Creek (a Use III stream) in Frederick, Maryland. Currently he is an employee of the U.S. Fish and Wildlife Service were he serves as the Transportation Liaison to the Maryland State Highway Administration. With 27 years of resource management experience, Mitch has specialized in stream and wetland restoration, construction management, monitoring and assessment.

[90] Comparing the Fish and Benthic Macroinvertebrate Diversity of Restored Urban Streams to Reference Streams

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Substantial losses to stream biological diversity have been documented throughout the mid-Atlantic region of the United States due to urban-related impacts. Stream restoration has been used to improve stream conditions and, in part, to ameliorate these losses. However, it is not yet clear if biological diversity is recovering in streams within this region as a result of restoration activities. Our objective was to critically examine the efficacy of urban stream restorations with regard to biological diversity. To do this, we compared restored urban stream sites to urban non-restored, non-urban (streams without substantial urbanization, but with evidence of other sources of degradation such as agricultural, water quality, or physical habitat impacts), and reference (minimally degraded by any potential perturbation) stream sites using five measures of fish and five measures of benthic macroinvertebrate diversity. Using both multivariate and univariate statistical analyses, we show that biological diversity of restored urban streams was not different from non-restored urban streams and was lower than non-urban and reference streams. Over time, restored urban sites also showed no apparent increase in biological diversity, while it decreased at two of the reference streams coincident with an increase in urban development within the site catchments. The results of this study indicate that the restoration approaches used in the urban streams we studied, which are commonly deployed in the mid-Atlantic, are not leading to recovery of native stream biodiversity. This along with recent findings from other studies indicates a need for dramatic changes in restoration approach, and we argue for a large-scale, watershed focus that includes protection of the least impacted streams and the implementation of other land-based actions such as increased stormwater management, riparian replanting, and reforestation within the watershed where possible.

Scott has worked on the MBSS since 1994. He has worked on nearly every aspect of the MBSS from data collection and management to quality control and report writing. He has an intense desire to realize stream biodiversity protection in Maryland.

Contributed Papers - Contaminants and Human Health

[91] Clean Water, Healthy Families Campaign

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To address the continuing water pollution issues from stormwater runoff, sprawl and sewage treatment plants, Maryland's environmental community is launching an ambitious campaign to put Maryland's waterways and the Chesapeake Bay itself onto a path of steady improvements in water quality and the health and quality of life of our communities.

Focused on three legislative initiatives to be undertaken during the Special Legislative Session during Fall 2011 and the regular General Assembly Session of 2012, successful outcomes would ensure new policies, regulations, and revenues for implementing critical pollution reductions well into the future and dramatically improve water quality for years to come.

In Maryland, environmental groups have identified four specific goals that they will collectively pursue during the special and regular General Assembly sessions occurring in the fall 2011 and spring 2012. By the end of the 2012 General Assembly Session, Maryland will:

- Provide sufficient funding to ensure major wastewater treatment plants are upgraded on schedule;
- Ensure ongoing dedicated funding source for local governments to address stormwater treatment needs and other clean water initiatives;
- Protect water quality by reducing sprawling development; and
- Require a treatment standard for all waste water treatment systems to meet Maryland's water quality goals (including the WIP and TMDL).

These community goals have formed the foundation for the CLEAN WATER - HEALTHY FAMILIES Campaign, and planning efforts have already commenced to put a plan into action that will:

- Articulate specific policy vehicles for achieving each stated goal;
- Develop a focused grassroots plan that raises citizen awareness, conveys the urgency of the needed actions, and gives individuals and organizations the tools to lobby their elected officials;
- Educate elected officials on the circumstances surrounding the TMDL and the need for statewide "reasonable assurances" to avoid consequences;
- Place pressure on elected officials (Governor and General Assembly members) to prioritize adoption of specified policy vehicles;
- Engage "nontraditional" partners to expand the perception that only environmental advocates fight for clean water during the Assembly sessions.

Campaign coordinators would like to present a poster session at the 2011 Stream Symposium in August to include a short lecture on the campaign, hand-outs and a petition participants could sign should they desire to support the campaign. The display will consist of one poster and the hand-outs. It will be set-up on Wednesday and taken down Friday. A speaker will be available on Thursday morning to discuss the campaign.

[92] Illicit Discharges – Hidden Polluters in Maryland Waters

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Co-Authors: Greg Hoffmann (Center for Watershed Protection)

The Center for Watershed Protection (CWP) collaborated with Montgomery County, the City of Salisbury and City of Cambridge to train staff and volunteers on the methods of illicit discharge detection & elimination and ways to build an effective local government program. Field assessments were conducted that documented illicit discharge frequency and dry weather pollutant loading for nutrients and bacteria. Results from the field assessments indicate that illicit discharges are a significant yet unaccounted for source of pollution to the Chesapeake Bay. In Sligo Creek, over 95% of E. coli from outfalls came from those that were suspect for illicit discharges based on water quality screening. In addition, nearly 100% of the total dry weather nitrogen load and total dry weather phosphorus load in the watershed came from outfalls suspect of illicit discharges. Data and experience indicate that illicit discharge detection & elimination is an under-utilized tool in the Best Management Practice Toolbox. Likewise, the methods promoted by CWP can be easily integrated into volunteer-based water quality monitoring programs thereby increasing the breadth and scope of local governments' efforts.

Lori is a Watershed Planner and Ecologist at the Center. Her responsibilities include watershed planning and implementation, GIS mapping and analysis, field assessments, and capacity building for local watershed organizations. Prior to joining the Center, Lori served as Director for a watershed association in northwest Oregon where, in addition to organization development and volunteer coordination, she managed multiple salmon habitat restoration projects. Lori has a B.S. in Natural Resource Management from Rutgers University and a Master's degree in Marine, Estuarine and Environmental Science from the University of Maryland Eastern Shore.

[93] Contaminants of Emerging Concern: Chemical and Biological Effects Monitoring

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Contaminants of emerging concern include a wide variety of chemicals, including pharmaceuticals, natural and synthetic human and animal hormones, current-use pesticides and substances in personal care products and plastics. Most of these chemicals are not routinely monitored in the aquatic environment, but there is increasing evidence for biological effects in a wide range of species. Many of the substances are endocrine-modulating chemicals and so can have significant effects at very low concentrations. In addition, we have sparse information on the complex mixtures wild populations are exposed to and potential additive or synergistic interactions. Various methods are used for chemical analyses of water samples including grab water samples and time-integrated samplers. The advantages, disadvantages and caveats of various methods will be discussed. Due to the recognized limitations of monitoring water concentrations, the importance of biological effects monitoring of wild populations is increasingly recognized. Hence, observations such as intersex (testicular oocytes), plasma vitellogenin in male fishes, reduced vitellogenin concentrations in female fishes, abnormal thyroid or reproductive hormone plasma concentrations, neoplastic lesions, increased parasite loads, increased susceptibility to infectious agents (immunosuppression) and other biomarkers are important endpoints. Findings in the Potomac and Susquehanna drainages indicate associations of certain biological endpoints with point sources such as waste water effluent as well as nonpoint agricultural landuse. In addition, species differences in sensitivity and expression of the various endpoints were noted and are important to understand.

Vicki Blazer is a research fishery biologist/pathologist with the National Fish Health Research Laboratory, U.S. Geological Survey, Kearneysville, WV. In recent years her research emphasis has been in fish health assessments of wild populations, development of techniques/methods for assessing overall health of populations and evaluating the interactive effects of contaminants and infectious disease and parasites. She is involved in studies in the Chesapeake and Great Lakes watersheds and at National Wildlife refuges throughout the Northeast.

[94] The Use of Scent Trained Canines for Illicit Discharge Detection in Storm Water

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The use of scent trained canines as a rapid screening method for the detection of human sewage and/or detergents in stormwater drains is an accurate and cost effective practice. The canine handlers received instant feedback regarding the presence or absence of target scents in storm drain structures allowing them to make an immediate plan for source tracking. The ability to make these quick decisions in the field reduces and in some cases eliminates the need for traditional water sampling; reducing waiting periods for laboratory results as well as reducing the time discharges negatively impact water quality and human health. The method was developed by Scott Reynolds with canine Sable in 2007. Building on that foundation Mr. Reynolds and canine Sable along his wife Karen Reynolds and canine Logan started Environmental Canine Services LLC (ECS) in 2009. Since that time the ECS team has added one additional handler and two additional canines to the team. ECS continues to assist municipalities and non-profit watershed groups track illicit discharges to the source and enhance water quality across the nation.

Scott Reynolds is the Director of Canine Training for Environmental Canine Services. He has over 15 years of experience in canine scent training having trained and certified canines in multiple scent disciplines. Scott holds a bachelors degree in Environmental Studies from Michigan State University and has worked in the water resources field for 6 years.

Stream and Watershed Education I

[95] Using the Mapping-Our-Streams-with-FieldScope unit to Expand Your Stream Investigations in the Chesapeake Bay Watershed

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Abstract: Our presentation will demonstrate how the Mapping-Our-Streams-With-FieldScope curricular unit can dramatically expand stream investigations. The unit examines human impacts on a local stream site and promotes deeper understanding of watersheds and upstream land use impacts. It targets middle and high school students but can be adapted for volunteer monitoring programs. We will provide an overview of the unit and an introduction to FieldScope—an online user-friendly mapping program developed by National Geographic. We will review ways to get started including attending a special follow-up online workshop for symposium attendees.

Cassie Doty is a faculty research assistant at the University of Maryland Center for Environmental Science Appalachian Laboratory in Frostburg, Maryland. She is the education coordinator for several teacher professional development projects and regularly leads workshops on watersheds, local schoolyard investigations and geospatial technology for Chesapeake Watershed teachers, and helps develop related curricular materials. She holds a M.S. in Environmental Biology and B.S. in Biology.

[96] Chesapeake Exploration: Investigate the Bay Watershed in Real-time with NOAA's Online Curriculum

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The NOAA Chesapeake Bay Office has developed an online curriculum -"Chesapeake Exploration"- that brings the science of the Bay to life through the use of data from the NOAA Chesapeake Bay Interpretive Buoy System (CBIBS) and other partners, including the NOAA National Estuarine Research Reserve System (NERRS). This high school curriculum, developed in partnership with National Geographic and the Chesapeake Bay Foundation, will give teachers unprecedented access to lessons designed around real-time data while allowing students to explore. Teachers will have the ability to create a unique online environment for their classrooms, including locking parameters such as date/time so all students are using the same data sets and storing student answers online for easy grading. Presenters will provide a detailed overview of the curriculum and take participants on a live tour of the site to demonstrate its function and capabilities. We will be using the National Geographic's Fieldscope application to investigate the watershed's landscape and various environmental monitoring platforms to learn about the relationships between the land, the water and the organisms that live in the Bay.

Bart Merrick is the Education Coordinator for the NOAA Environmental Science Training Center (ESTC). The ESTC provides training and in-depth experiences for environmental education professionals to advance their abilities to effectively convey accurate and timely science to teachers and students. Trainings focus on integrating science into field and classroom curriculum, drawing on NOAA and partner expertise and capabilities. Prior to his work with NOAA, Bart was the Education Coordinator for the Chesapeake National Estuarine Research Reserve, and an educator with the Chesapeake Bay Foundation and Living Classrooms Foundation.

Kevin Schabow has been working on the Environmental Literacy team at NOAA's Chesapeake Bay Office since 2007. He coordinates the Chesapeake Bay-Watershed Education and Training grant program and supports the development other education resources and partnerships. Prior to his work in the Chesapeake region, Kevin was the director of Pathfinder Ranch Outdoor Education School in Mountain Center California.

[97] Students in the Community as Environmental Stewards and Citizen Scientists: CCBC Bay Watershed Educational Training Project.

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The CCBC Bay Watershed Educational Training (B-WET) is an interdisciplinary education program that uses the urban streams as a living classroom to explore environmental issues facing the Chesapeake Bay watershed. One of the goals of this NOAA funded grant is to develop sustainable relationships between public schools, non-profit environmental groups and community colleges to create a continuous, seamless pipeline of teachers and students at the middle, high school and college levels who are able to collect field data and integrate it with geospatial technology. The CCBC-BWET program has reached 8 schools and over 600 students who participated in meaningful watershed educational experiences (MWEEs) over the course of two years. Students collected stream macro invertebrates, identified them in lab and calculated an index of biological integrity (IBI) using metrics and protocols from MBSS and Virginia Save Our Streams. In order to explore the relationship between riparian buffers and stream quality, vegetation data were collected at permanent transects from which stem density, basal area, canopy closure and species diversity were assessed. The data are uploaded to National Geographic's FieldScope website so that students can interpret the implications for the health of the Chesapeake Bay watershed. Students share their data with County and State agencies.

Sonja Schmitz is an Associate Professor at CCBC where she teaches biology and botany. She is a board member of the MWMC, and a steering committee member of the Lower Patapsco Small Watershed Action Plan (LPSWAP).

[98] NO TITLE

Karen Anderson

NO ABSTRACT SUBMITTED

[99] A Virtual Stream Sampler

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A Virtual Stream Sampler is the latest in a suite of watershed lessons at the online Potomac Highlands Watershed eSchool, serving the k-12 and broader environmental education community in the Chesapeake Bay Watershed. A Virtual Stream Sampler offers a realistic simulation of a volunteer stream assessment that includes water quality measurements, habitat assessments, and benthic macroinvertebrate collections. Water quality measurements are collected with virtual testers for pH, temperature, dissolved oxygen, nitrogen, conductivity, and alkalinity. Students read the results off the measurement device, and then "enter" that data by selecting the range in which the answer falls. The habitat assessment section (embeddedness, algae, stream bed composition) involves selecting the right answers by interpreting visual clues. The benthic macroinvertebrate (BMI) collection begins by dipping a virtual kick net into the stream, sorting the debris out of the net, and then dragging organisms over to an ice cube tray. As each organism is dropped in the tray students are challenged to correctly identify it off a list or using an animated dichotomous key. When they identify an organism, a screen pops up that tells them how many were in the net and a data sheet automatically records this answer. After students have completed the chemical, physical and biological assessments, they are given a score page showing how well they did in each of the three sections and a total score. They will also see tables where the streams are scored using the Virginia and the West Virginia Save Our Streams methods. A link is available to explain more about the stream and how each state's stream scoring method works; this provides an opportunity for teachers to discuss key ecological concepts like diversity, pollution tolerance, and dominance. This activity is based on real data collected in real streams by Cacapon Institute and agency partners. More streams will be profiled, including one from the Shenandoah Valley, one in Maryland from below the fall line near DC, and a

restored acid mine drainage impaired stream. While Virtual Stream Sampler works well as a stand-alone activity, this and the other eSchool activities are designed to enhance the academic value of school field trips. Students who have been exposed to stream sampling concepts and images in the classroom prior to a field trip will be better prepared to learn when they get into the field. The Virtual Stream Sampler was programmed by Jennifer Gillies and funded by NOAA Bay Watershed Education & Training, The MARPAT Foundation, and Cacapon Institute's members. The eSchool is available 365/24/7, free of charge, at http://www.cacaponinstitute.org/e_classroom.htm.

W. Neil Gillies (Executive Director, Cacapon Institute, High View, WV) began his career as an environmental scientist in South Florida in the 70's and early 80s, with diverse studies ranging from estuarine invertebrate communities to studies on the endangered American Crocodile at a nuclear power plant. In 1996, Neil joined Cacapon Institute, a WV non-profit environmental organization where, among other things, he does water quality and quantity research, developed an innovative web-based e-school, participated in an economic experiment on agricultural incentives, is an active partner in WV's Tributary Team, and is studying how to keep deer out of riparian plantings. He has a B.S. from the University of Miami, Florida, and a M.S. from Florida International University.

[100] The Spirit of Growing Our Chesapeake Bay Partnership: The Continued Evolution of the Chesapeake Bay Program Partnership's Long term Water Quality Monitoring Program

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The spirit of a community partnership has supported the maintenance of the long-term Chesapeake Bay Program (CBP) tidal water quality monitoring program was initiated in August 1984. The network consists of over 150 monitoring stations distributed throughout the Bay, sampled 12-20 times throughout the year. Integrated into the program are shallow water monitoring, submerged aquatic vegetation and benthic invertebrate community evaluations. That same spirit codified the establishment of a basin-wide watershed monitoring network in 2004 consisting of 85 stations sampled 12-20 times per year with network expansion underway in 2011-12. Example applications of the CBP monitoring data have included establishment of science-based management segmentation, water quality criteria development, ecosystem model calibration and verification supporting the TMDL and water quality standards assessment. Programs have been supported by the integrated resources of Federal, State, local and academic partners. In recent years there has been the addition of nontraditional partners monitoring results applied to select regulatory water quality criteria assessments (e.g Citizen monitoring). Examples of Citizen monitoring contributions to CBP assessments include the inclusion of data meeting regulatory levels of quality assurance and control from the Virginia Department of Environmental Quality's Level III Citizen Monitoring Program with pilot work to include Maryland tidal data from the South River Riverkeepers into the Clean Water Act 303d listing evaluations. The continued evolution of the CBP partnership's monitoring program now involves developing and incorporating procedures and planning a suite of products for regulatory and nonregulatory uses that incorporate a greater diversity of data sources than the existing program. Such products are desired for depicted Bay and basin status and trends in aquatic resource health at resolutions beyond those available with the long term monitoring networks.

Since 2007, I have served USGS at the Chesapeake Bay Program Office as the Chesapeake Bay Watershed Monitoring Coordinator. I spent most of the previous decade working with the Maryland Department of Natural Resources as a Project Leader on Harmful Algal Blooms then Chief of Quantitative Ecosystem Assessment. I received my PhD from SUNY-College of Environmental Science and Forestry in Fisheries Science, have a MS from West Virginia University in Wildlife Ecology and Management and a BS also from SUNY-ESF in Forest Biology. In my spare time I'm often out on roads or in the water training, volunteering with or competing in running races and triathlons.

[101] Citizen Involvement and the Chesapeake Bay Executive Order

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The recent Executive Order (E.O.) requires the federal government to increase citizen stewardship throughout the Chesapeake Bay (Bay) watershed. One way to increase citizen stewardship in the Bay watershed is through greater federal government engagement with existing citizen science organizations that provide water quality monitoring data for Bay restoration projects. On-going citizen science water quality monitoring projects represent cost-effective solutions to produce large data sets suitable for Bay restoration efforts. Additionally, these volunteer organizations provide increased citizen stewardship in the Bay through hands-on, scientifically-monitored volunteer opportunities to interested individuals. Interviews with selected citizen science water quality monitoring groups in Virginia, Maryland, Delaware, and Pennsylvania, revealed areas for citizen stewardship collaboration within E.O. 13508. These areas include federal sponsorship of a centralized data clearinghouse for data collected by citizen science water quality monitoring organizations, streamlining the federal grant process to improve access to federal funds to citizen science organizations conducting water quality monitoring, and collaborating with citizen science organizations to increase citizen stewardship.

Ms. Ryan's volunteer Chesapeake Bay volunteer experience includes oyster reef restoration, native habitat restoration, water quality monitoring, environmental education, and outreach. Michelle recently completed a masters in natural resources at Virginia Tech, and will be entering the doctoral program in environmental science and public policy at George Mason University to pursue research in citizen science and its impact on Chesapeake Bay restoration efforts. Michelle is a certified Virginia Master Naturalist, and a volunteer at the National Aquarium in Baltimore. She also works as a systems engineer in the defense industry.

[102] Choose Clean Water - Engaging Local Organizations

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Citizens of Maryland and the Chesapeake region have an unprecedented opportunity to make clean water plans in their communities which will finally restore water quality to our local rivers and streams. Ryan and Jennifer will discuss the efforts by the 200 member organizations of the Choose Clean Water Coalition as they engage in this process known as the Watershed Implementation Plans (WIPs). Most importantly, they will be discussing how citizens, local organizations and volunteer stream monitors can and should engage in their community plans, and will be offering resources and information to you to help you make your local community plans the best clean-up plans possible.

Ryan Ewing serves as Communications and Outreach Coordinator for the Choose Clean Water coalition. He is employed by the National Wildlife Federation for this effort. Previously, Ryan has worked for the Maryland League of Conservation Voters, building grassroots support for environmental issues, managing volunteers, and working with local groups in Maryland. Prior to that, he worked as the Action Network Coordinator for the Natural Resources Council of Maine and served on the Town Council of Brunswick, Maine. Ryan has a graduate degree in Political Management from The George Washington University, and graduated Western Maryland College with a Bachelor's degree in Political Science and Theatre Arts. Ryan lives in Easton, Maryland with his wife Amy and son Liam.

[103] The Chesapeake Commons Database

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This session will show citizens how to upload, analyze, and publish geo spatial data within the Chesapeake Bay Watershed. The Chesapeake Commons Data Tool is the latest geo spatial repository where users can download, map, and collaborate around Chesapeake Bay issues from a single location. See how local watershed organizations, non-profits, funders, and government are using this tool to make their data tell a story to the public. This session will give users a general overview of the Chesapeake Commons system as well as full training in all features of the data tool. Attendees will get to learn through experience and leave with a solid foundation in preliminary geo spatial analysis, have a solution to creating highly customized maps with their own data, and begin to think about how various system functions of the Commons can serve their organization.

John graduated in 2009 from Juniata College with a BA in Environmental Policy. He serves as the Administrator of the Chesapeake Commons Data Tool and provides data management and GIS consultation to non-profits, Chesapeake Bay Funders Network, and local organizers. The goal of his work is to make Chesapeake Bay data easily accessible, locally relevant, and salient, so that government, stakeholders, and nonprofits, can transparently make better policy decisions. In his spare time John can be found paddling Great Falls of the Potomac or paragliding select sites in MD, PA, or VA.

Money Behind Water Quality Initiatives

[104] Advancing Watershed Restoration at the Local Level

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With the Chesapeake Bay TMDL now in place (as of December 2010), Maryland is tasked with achieving ambitious goals on a strict timeline. Realizing that State initiatives alone will not achieve our implementation goals, Maryland has put in place programs and strategies that target valuable resources at the local level. Aimed at increasing capacity and accelerating large-scale restoration initiatives, the unique partnerships of the Watershed Assistance Collaborative and funding provided through Chesapeake & Atlantic Coastal Bays Trust Fund have already given many communities a boost in tackling these goals. The Watershed Assistance Collaborative (Collaborative) is a federal, state, and nonprofit partnership that fits very well into the overall goals and restoration strategies that Maryland Department of Natural Resources & the State are working toward for the Chesapeake Bay TMDL and the state level Watershed Implementation Plans. The Collaborative offers the tools, support, and technical assistance to help local governments and communities plan, target and implement on–the-ground projects, as well as build the capacity to implement best management practices and environmental policies that relate to improved water quality. Two examples of successful local watershed groups that utilized the Collaborative and how they have expanded their restoration and outreach efforts will be discussed. The measure of success for the Collaborative is the ability to undertake large scale restoration initiatives, similar to the types of projects funded with the Chesapeake & Atlantic Coastal Bays Trust Fund. The Chesapeake & Atlantic Coastal Bays Trust Fund (Trust Fund) is a unique source of funding dedicated to the reduction of nonpoint source pollution and is a cornerstone to achieving Maryland's portion of the Chesapeake Bay TMDL. Funds are prioritized through geographic targeting based on potential nutrient load into the mainstem of the Bay, strength of local government and partner support, ability to leverage maximum funding, and the potential to demonstrate a measurable difference in a relatively short amount of time. This targeting strategy as well as a new accountability tool in development will be discussed in further detail.

Jennifer Raulin, Nonpoint Source Program Manager
Administers grants to coastal cities and counties for the implementation of nonpoint source pollution control projects. Manages the Chesapeake Bay and Atlantic Coastal Bays 2010 Trust Fund, Chesapeake Bay Implementation and coastal non point source grants. Works with local governments in identifying and developing projects and proposals and oversees project management.

[105] Water-related Funding Opportunities Provided by the National Fish and Wildlife Foundation's Chesapeake Bay Stewardship Fund

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Mandy Chesnutt will be speaking about National Fish and Wildlife Foundation's Chesapeake Bay Stewardship Fund. There are multiple funding opportunities available for water quality work through the program including the Innovative Nutrient and Sediment Reduction grant program, the Small Watershed Grants program, and the Technical Assistance program.

Mandy Chesnutt is the Manager of Chesapeake Programs for the National Fish and Wildlife Foundation. In addition to running the two grants programs, she also focuses on performance measurement, GIS analysis, and quality assurance. Before joining the program, Mandy was a Research Specialist and Project Manager at University of Vermont doing research on sustainable agriculture and pollution reduction from agricultural lands. She holds a Bachelors Degree in Zoology from the University of Maryland and is currently working on her Master's Degree in Natural Resources at Virginia Tech.

[106] Water-related Funding Opportunities Provided by the Chesapeake Bay Trust

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The Chesapeake Bay Trust is the only nonprofit, grant-making organization dedicated to sparking on-the-ground change for the Chesapeake Bay and its tributaries in Maryland. Our goal is to increase stewardship through grant programs, special initiatives, and partnerships that support environmental education, demonstration-based restoration, and community engagement activities.

Kacey has her MS from Johns Hopkins University and a BS ftom Rollins College. She manages the Trust's Outreach and Community Engagement and Mini-Grant programs.

Stream Geomorphology

[107] Applying Fluvial Geomorphic Monitoring Techniques to Evaluate Stream Restoration Project Success in the Red Hill Branch Subwatershed

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Based on recommendations in the Upper Little Patuxent River (ULPR) Watershed Management Plan, Howard County has initiated implementation of numerous restoration projects including stream restoration and stormwater management retrofit projects in the Red Hill Branch subwatershed. Subsequently, a comprehensive monitoring program was developed to evaluate the effectiveness of implemented restoration projects and strategies and track progress towards meeting the overall watershed restoration goals. In 2009, KCI implemented a geomorphic monitoring program to evaluate the Bramhope stream restoration project, which consists of survey and analysis of cross-sections and longitudinal profile, installing and monitoring bankpins and scour chains, mapping substrate facies, evaluating substrate particle size distribution, and measurement of sediment load. Geomorphic monitoring of three stream reaches was conducted during fall 2009 to evaluate bed and bank stability, channel profile and bed features prior to restoration activities. The resulting baseline data will be used to compare future post-restoration data in order to demonstrate the effectiveness of retrofits and stream channel restoration in reducing loading of nitrogen, phosphorus, and sediment, with a secondary goal of evaluating the success of restoration efforts at the broader subwatershed scale.

Colin Hill is an environmental scientist in the Natural Resources practice at KCI Technologies, Inc. For over ten years, he has been performing stream and watershed assessments throughout Maryland and in numerous states across the country. Colin holds a Master of Science degree in environmental science from Towson University, and a Bachelor of Science degree in Biology from Loch Haven University of Pennsylvania.

[108] The Stream Functions Pyramid: A Conceptual Model for Setting Goals and Evaluating the Functional Improvement of Stream Restoration Projects

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Stream restoration practitioners have long been struggling with how to determine the success of restoration projects. Part of the problem lies in failure to link stream restoration with the restoration of stream function. For example, many restoration project goals fail to recognize the full range of stream functions and how they support each other. Federal mitigation guidelines already require stream restoration practitioners to determine the functional improvement of their project. Functional lift is therefore defined as the difference in the pre-restoration functional condition and the post restoration functional condition. The functional lift can then be used to develop stream mitigation credits or to quantify the overall benefit of any stream restoration. The functional lift pyramid provides a framework for assessing stream functions, setting design goals, and evaluating performance. The pyramid shows that restoration of functions must occur in a certain order for maximum functional lift to occur. Hydrology functions create the base of the pyramid. These functions determine how much water is produced by the watershed and include measures such as the rainfall-runoff relationship and bankfull discharge determination. Hydraulic functions are shown above hydrology functions and describe the flow dynamics in the channel and floodplain where floodplain connectivity and flow dynamics are critical measures. Geomorphic functions are next and integrate the hydrology and hydraulic functions to transport sediment and create diverse bed forms. Once this structure is in place, physiochemical functions can improve; e.g. increased dissolved oxygen, lower stream temperature, denitrification, and organic processing. At the top of the pyramid are the biological functions because they rely on all of the below functions. These functions include the life cycles of fish and macroinvertebrates, riparian condition, and more. The functional lift pyramid helps practitioners set goals to ensure that the design addresses the appropriate functions. This may sound obvious, but other research has shown that many assessment protocols and project designs ignore the base level functions of hydrology, hydraulics, and geomorphology. In addition, the pyramid can be used to design monitoring plans that quantify functional lift by assessing the baseline functional capacity of the stream corridor. The design should then focus on improving impaired functions, rather than just focusing on channel form, i.e. improving channel dimension, pattern and profile. The monitoring should then quantify the

improvement or lift in each of those functions.

Richard Starr is Chief of the Habitat Restoration Division within the U.S. Fish and Wildlife Service –Chesapeake Bay Field Office, Annapolis, Maryland. He manages the Partners for Wildlife Program, Stream Habitat Assessment and Restoration Program, and Schoolyard Habitat Program. Richard has over 20 years experience in watershed assessment, planning management, and restoration. He has conducted numerous geomorphic watershed and stream assessments; implemented stream restoration and fish passage projects; developed a variety of stream assessment protocols and tools; and developed and delivered training courses on stream protection, assessment, and restoration.

[109] Fish Passage Barriers and Mitigation Options

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In recent years unnatural fish migration barriers for resident and anadromous fish, such as dams, infrastructure, and culverts, have been identified as concerns and targeted for removal or repair. In each situation there are similarities for mitigating the barrier (e.g. identifying target species, setting design criteria) as well as specific site considerations (e.g. channel slope, costs) at each. More natural solutions called nature-like fishways like flow constrictor/step pool system or roughened rock ramp are commonly applied solutions. A rock ramp or boulder cascade system can also be used to raise the channel invert to pass through cross channel infrastructure or perched culverts that are blocking migration. The considerations, approach and solution to each of the three major types of barriers will be discussed as well as ways to identify which barriers to remove and ways to ensure future blockage does not occur with new infrastructure and road culverts.

Kathy Hoverman is a stream restoration designer with KCI Technologies, Inc. in Sparks Maryland. She has a BS in Civil Engineering and an MS in Biology and is a registered professional engineer in Maryland. She has 10 years of experience in stream assessment and design in the Midwest, Mid-Atlantic, and New England with specialization in nature-like fishways and aquatic organism passage.

Mattawoman Creek: A Fragile Gem

[110] Evaluating Anadromous Spawning Habitat Changes in a Changing Landscape

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The Chesapeake Bay watershed is rapidly developing in response population. Attendant to that development is an increase in impervious surfaces in developed watersheds. Numerous studies have reported negative impacts of impervious surfaces on aquatic resources. To evaluate the impact of development on migratory spawning habitat, we recreated a historical study conducted in the 1970's and early 1980's. We sampled numerous stations in four tributaries that historically supported spawning habitat for white perch, yellow perch and herring species. We used changes in numbers of stream sites with spawning as an indicator of the effect of development. Comparisons of historical presence with observed presence today, showed a decline in spawning habitat occupation in watersheds where impervious surface increased. Spawning was rare in habitats where impervious cover exceeded 15%. In Mattawoman and Piscataway Creeks, historical stream and estuarine conductivity data (an indicator of inorganic acids, bases, and salts in freshwater) were compared to 2008-2009 monitoring data to determine if changes in stream water quality were observed. Conductivities were elevated above baseline historical conditions in mid reaches of the watershed, potentially to increases in human impacting use of the spawning areas for anadromous fish.

Margaret is a biologist with the Fisheries Ecosystem and Habitat Program. Since 2003 she has invested in evaluating habitat responses to landuse change in watershed. Prior to that Margaret worked in the Resource Assessment Program at DNR where she evaluated habitat impacts of nutrient enrichment on fish communities and fish habitat.

[111] Migrating to Mattawoman Creek—Or Not: icthyoplankton surveys of anadromous-fish spawning in the nontidal river

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Bonnie Bick (Mattawoman Watershed Society), Haven Carlton (Mattawoman Watershed Society), Kevin Grimes (Mattawoman Watershed Society),Sherry Hession (Mattawoman Watershed Society), Yvonne Irving (Mattawoman Watershed Society), Edward Joell (Mattawoman Watershed Society), Katrina McConkey (Mattawoman Watershed Society), Julie Simpson (Mattawoman Watershed Society), Stan Steptura (Mattawoman Watershed Society), Barbara Stepura (Mattawoman Watershed Society), Russ Talcott (Mattawoman Watershed Society), Ken Hastings (Mason Springs Conservancy), Bob Boxwell (Mason Springs Conservancy), Frank Cowherd (Mason Springs Conservancy), Roy Parker (Mason Springs Conservancy), Jim Uphoff (Maryland DNR Fisheries Service), Margaret McGinty (Maryland DNR Fisheries Service), Jim Mowrer (Maryland DNR Fisheries Service) and Bruce Pyle (Maryland DNR Fisheries Service)

During their annual spawning runs, migratory fish once vacated the sea in vast numbers to surge throughout the Chesapeake Bay. Today, populations are depressed dramatically, though some tributaries have historically remained as bright spots of spawning and nursery activity. One of these is Mattawoman Creek, a twenty-mile river and seven-mile tidal-freshwater estuary flowing into the Potomac River 25 miles south of the nation's capital. Evidently the creek's location beyond Washington's urban gradient, combined with its placement near the Potomac's oligohaline-freshwater boundary, provides an especially productive nursery and spawning ground for white perch, alewife and blueback herring, and semi-anadromous yellow perch. In addition, the larger fish community has exhibited an unusually healthy trophic structure that helps support a vibrant recreational largemouth bass fishery. Unfortunately, surveys by the Department of Natural Resources (DNR) spanning four decades point to an outstanding waterway now entering a long-predicted decline as its watershed is subjected to increasing urbanization. In particular, the abundance of anadromous fish juveniles in the estuary is faltering. In an effort to help the DNR Fisheries Service better understand the connection between tidal estuary populations and fluvial-stream spawning usage by migratory fish, volunteers have been conducting icthyoplankton surveys in the Mattawoman main stem and selected tributaries. This assessment technique, in which drifting eggs and larvae are intercepted by a net for later counting, is highly amendable to volunteer contributions. Comparing presence/absence data and quantitative egg counts from the early 1970's, early and late 1990's, and the end of the first decade

of 2000 finds that upstream habitat usage by river herring has been declining, with an accelerated pace occurring between the late 90's and late 2000's. The accelerated loss mirrors a decline in fish abundance in the estuary that DNR has measured and correlated to urbanization metrics. If the prognosis for this charismatic waterway is to be improved, changes in land-use policies are urgently needed, making the current revision of Charles County's comprehensive plan a subject of keen interest.

Jim Long is a physical research-scientist by occupation who has also been active in conservation issues affecting water resources in southern Maryland for over fifteen years. During this time, he has assisted biologists in assaying Mattawoman Creek's terrestrial and aquatic resources, including surveys of habitat usage by migratory fish. He is speaking today as president the .

[112] Interpretation of a Ten-Year Record of Discrete and Continuous Water-Quality Data for a Rapidly-Urbanizing Coastal Plain Watershed

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Co-authors: Joseph M. Bell, Brenda Feit Majedi, David P. Brower and Cherie V. Miller

Effective watershed management requires a comprehensive understanding of hydrology and water quality within the context of a watershed's geography and land use. Mattawoman Creek, a tributary of the tidal freshwater Potomac River, drains 94 square miles in the southern Maryland coastal plain. While predominately forested, the watershed is urbanizing rapidly and continues to experience development pressure due to its proximity to Washington, D.C. Since October, 2000, the USGS has been collecting discrete samples and continuous (fifteen-minute) water-quality data in the non-tidal portion of the creek (USGS 01658000; drainage area 55 square miles), with the intent of characterizing ambient water quality, potential contaminant sources, runoff processes, loads to the tidal Mattawoman estuary, and trends in water quality. A total of 354 discrete samples were collected, 98 representing baseflow conditions and 256 representing the range of conditions encountered over the course of storm hydrographs. On the basis of these samples, the median suspended-sediment concentration was 24 mg/l, with minimum and maximum concentrations of one mg/l and 2890 mg/l, respectively. Total nitrogen ranged from 0.21 mg/l to 4.09 mg/l, with a median of 0.69 mg/l; total phosphorus ranged from < 0.01 mg/l to 0.98 mg/l, with a median of 0.07 mg/l. Seasonal trends in total phosphorus, and to a lesser degree total nitrogen, were observed, with higher concentrations in summer months and lower concentrations in winter months. Data collected at fifteen-minute intervals included discharge, water temperature, pH, specific conductance, dissolved oxygen, and turbidity. Episodic variability in specific conductivity suggested two-component mixing, with a high-conductivity end-member representative of groundwater inflow with long residence times, and a lower-conductivity end-member representative of rainfall and shallow subsurface flow. Episodic variability in turbidity suggested supply-limited conditions, with the stream channel and adjacent floodplain as potential sources of much of the suspended material. Stepwise regression models were developed, using fifteen-minute data corresponding to the times at which discrete samples were collected as candidate proxies for suspended sediment, total phosphorus, and total nitrogen. Turbidity and discharge were both included in the model for suspended sediment (R2 = 0.76, n = 185); only turbidity was selected as a robust predictor of total phosphorus and nitrogen (R2 = 0.68 and 0.61, respectively, n = 186 for both). Estimates of sediment and nutrient loading to the Mattawoman estuary, and comparisons with other Chesapeake Bay tributary watersheds of comparable size, are under development. Together, the tabulated data, regression models, load and trend estimates, and comparison data will provide a strong foundation for interpreting water quality in Mattawoman Creek in terms of the watershed's geographic setting and land use.

[113] Development, Stressors, Habitat and Fish Community Changes in Mattawoman Creek

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Co-authors: Margaret McGinty (MD DNR, Fisheries Service)

Long- and short-term data on development, stream flow, water quality, anadromous fish stream spawning, larval fish dynamics, and estuarine fish community composition in fresh-tidal Mattawoman Creek were examined to describe ecological changes associated with its transition from a rural to a suburban watershed. These changes were contrasted with two adjacent southern Maryland watersheds: more

developed Piscataway Creek and Nanjemoy Creek, one of Chesapeake Bay's least developed watersheds. Stream sites with anadromous spawning in Piscataway and Mattawoman creeks in 1971 (rural watersheds) were resampled in the late 2000s (suburban watersheds); fewer stream sites in Mattawoman Creek had spawning and it had nearly ceased in Piscataway Creek. Feeding success of yellow perch larvae in the three subestuaries during 2010 was negatively related to watershed development. As Mattawoman Creek's watershed became suburban during the 2000s, its open water tidal fish community's abundance and species richness underwent a major declines. Changes in stream habitat of Mattawoman Creek indicated presence of multiple stressors consistent with urbanization: increased conductivity (salts, inorganic acids and bases), altered flow characteristics, and increased sediment and associated nutrients. Levels of suspended organic matter in subestuaries that positively influenced occurrence of copepods in larval fish guts in spring declined with watershed development and indicated possible food web disruption. Estuarine habitat changes were heavily influenced by a large increase in acreage of submerged aquatic vegetation (SAV) that was concurrent with the transition from rural to suburban watershed in the early 2000s. Dissolved oxygen (DO) dynamics shifted from algae blooms to SAV-related dynamics. Water clarity increased as SAV acreage increased. Levels of DO in the open channel fell from supersaturated levels, but remained suitable for aquatic organisms. Measurements of DO at a continuous monitor in a dense SAV bed have become increasingly unsuitable and indicated potential for unexpected, negative conditions.

[114] The Role of Mattawoman Creek in the Largemouth Bass Fishery of the Potomac River

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Largemouth bass (LMB)(*Micropterus salmoides*) is arguably the most popular sportfish in tidal fresh Potomac River (Maryland). Each year, thousands of anglers competitively fish for largemouth bass tournaments and many are Maryland residents. In addition, non-resident anglers in 2006 spent more time fishing for black bass than any other species – 1,350,000 days. Recreational angling and competitive sports tournaments for largemouth bass yield considerable direct and indirect economic revenue to local counties. In 2010, the FLW American Fishing Series estimated a single tournament provided over $700,000 directly into the local economy of Charles County. One of the most popular locations for fishing and for conducting sportfish tournaments on the tidal-fresh Potomac River is Smallwood State Park, near Mattawoman Creek of the Potomac River. In 2010, Smallwood State Park hosted at least 92 tournaments, which was half of all tournaments registered in tide waters of Maryland in 2010. As a consequence of the numerous tournaments held each year at Smallwood State Park, hundreds of largemouth bass are released in Mattawoman Creek each year. While a fraction of these leave the Creek, many remain to reproduce in quality habitats that comprise Mattawoman Creek. The suitability of Mattawoman Creek for largemouth bass is relatively high because of the availability of grasses as refugia for juveniles, the abundance of fish and macroinvertebrates, high water clarity, and relatively low levels of eutrophication. Recent concerns of water quality degradation and expansions of invasive species, such as northern snakehead, may adversely impact largemouth bass populations. It is essential to protect water quality and habitat integrity of subwatersheds, such as Mattawoman Creek, for the sake of sportsfishing, anglers, and top predators such as largemouth bass.

Joe is the tidal bass specialist for Inland Fisheries. He began working for Inland Fisheries in 2009. His duties include assisting in the management and research related to tidal largemouth bass in the Chesapeake Bay watershed.

Stream and Watershed Education II

[115] RiverWebs: A Documentary film about Life, Death, Science, and Streams

Keith Williams
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This presentation will discuss the opportunities afforded by the movie RiverWebs to teach cross cultural community, river ecology and conservation, scientific exploration and the effect one person can have on the larger world. RiverWebs takes a close look at an international group of river ecologists who share a story of tragedy, growth, and recovery. Across Eastern and Western cultures, this unlikely circle of friends shows us a very human side of science, while demonstrating how the process of discovery works. The inspiring lives and experiences of these scientists build a rich story of hope and interconnectedness, while providing a personal window through which to view rivers, ecology, and conservation. This presentation will show selected clips from the movie and discuss curricula that exemplify scientific exploration, cross cultural community, river ecology, and ecosystem links.

Keith is the founding Director of Education at NorthBay an environmental education facility on the upper Chesapeake Bay. He also runs Creek Snorkeling Adventures, an educational stream snorkeling outfitter. He has a BS in Environmental Biology and MS in Ecological Teaching and Learning From the Lesley University Audubon Expedition Institute. Keith currently serves as the treasurer for the Maryland Association of Environmental and Outdoor Educators and was appointed to the Maryland Governors Working Group for Environmental Literacy. Keith lives in Conowingo, near the lower Susquehanna River with his wife and three kids, and sticks his face in creeks every chance he gets.

[116] The View Below: Using Creek Snorkeling to Connect People with Rivers

Keith Williams
Creek Snorkeling Adventures
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At first glance, the idea of snorkeling most of our mid-Atlantic streams may seem a bit odd. But once we look below the reflective plane of our local stream a whole new world is revealed. Creek snorkeling is one of the most powerful experiences we can have with a stream. This presentation will discuss what life below the surface looks like, will provide an overview of stream snorkeling programs, and will discuss how creek snorkeling can be used to engage monitoring volunteers and the larger community.

Keith is the founding Director of Education at NorthBay an environmental education facility on the upper Chesapeake Bay. He also runs Creek Snorkeling Adventures, an educational stream snorkeling outfitter. He has a BS in Environmental Biology and MS in Ecological Teaching and Learning From the Lesley University Audubon Expedition Institute. Keith currently serves as the treasurer for the Maryland Association of Environmental and Outdoor Educators and was appointed to the Maryland Governors Working Group for Environmental Literacy. Keith lives in Conowingo, near the lower Susquehanna River with his wife and three kids, and sticks his face in creeks every chance he gets.

[117] Volunteering: What you can do Beyond Monitoring - Join TEAM DNR!

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Teaching Environmental Awareness in Maryland (TEAM) is a volunteer program started in 1997 to help DNR teach about the Chesapeake Bay and other environmental issues to elementary and middle school students throughout the State. TEAM volunteers reach approximately 5,000 students annually. TEAM has 6 classroom programs that volunteers bring into the schools. The programs were created as a partnership between scientists and educators with the guidance of MSDE. All of the programs are correlated to the Maryland Voluntary State Curriculum. TEAM volunteers do not need a background in science. They just need to care about the Chesapeake Bay and enjoy working with children. Volunteers go through an extensive training process. Two of the TEAM programs focus on Maryland Streams. Streams I is a 90 minute classroom program where students learn stream habitat identification, basic insect anatomy and macro-

invertebrate identification (8 taxonomic orders). The Streams II program lasts for 2 hours and gives students a hands-on experience using stream biological monitoring techniques to collect data and evaluate steam health. This talk will walk the participants through the basics of each of the two programs and explain the training process for becoming a TEAM volunteer.

Amy has a B.S. in Natural Resources and Environmental Education from the University of Michigan. She has experience teaching elementary school science, as a naturalist at an outdoor school and she has been an environmental educator for DNR since 1987.

[118] Discovery, Fun and Watershed Education – Right in Your Own Backyard!

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Learn how to conduct a fun MWEE (Meaningful Watershed Education Experience) with this proven successful and popular technique that both kids and adults enjoy! Save time and gas by conducting a 20 item watershed scavenger hunt in your own backyard or area. Learn popular search items ranging from different species of trees, native plants, invasive plants, storm drains, etc. and teach others about how they affect water quality!

Betsy McMillion is the Executive Director of the Friends of Patapsco Valley & Heritage Greenway. She has a Masters Degree from the University of Baltimore in Public Administration and has over ten years of environmental education experience. For the past 6 years, Betsy has developed a successful stream watch program including over 6,800 volunteers, 174 stream cleanups, removing over 218 tons of trash/junk from the lower Patapsco River watershed. She has also conducted over 100 workshops, exhibits, presentations and is the creator of a popular watershed scavenger hunt for participants of all ages.

[119] Observations in Action: An Elementary School Teacher's Experience with the Maryland Biological Stream Survey

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The National Assessment of Educational Progress (NAEP) recently reported that just 20 percent of 4th grade students met with proficiency on a 2010 national science assessment. Achievement in middle and high school students posted similar results, with 17 percent of 8th grade students and just 12 percent of 12th grade students meeting with proficiency. Science education that is neither relevant nor fun has stifled young learners' curiosity and perpetuated an unfortunate pattern of indifference into adulthood. Amidst the mandates, teachers need to battle this growing epidemic by boldly and bravely assuming the exhilarating responsibility to engage, inspire, and nurture budding scientists. Curriculum theorist, Michael Schiro describes social reconstructionists' expectations for public education: "Schools should provide children with the ability to perceive problems in society, envision a better society, and act to change society so that there is social justice and a better life for all people." Likewise, "Learning best occurs when a student confronts a real social crisis and participates in the construction of a solution to that crisis." In an America where children can recognize and correctly identify more commercial logos than they can living organisms in their own backyard, educators face an "observation crisis". Engaging learners in the field of science requires an astute understanding and awareness of one's surroundings. Building on students' innate ability to ask questions, wonder and explore, teachers need to explicitly model and teach how to make an observation and how to make sense of recorded observations. Above all, teachers need to structure their units of study around real environmental problems that are local and relevant to their students. Building on her own experience with the Maryland Biological Stream Survey, this fifth grade teacher will present a series of mini-lessons that tackle how to make, record, and comprehend field observations. This introduction to practicing and mastering the art of observation will construct a solid foundation for young scientists.

Lauren is a Baltimore Partnership for Environmental Literacy RET (Research Experiences for Teachers) summer fellow working with Dan Boward at the Maryland Department of Nature Resources. She is excited to begin her fourth year as a 5th grade teacher at Sandy Plains Elementary School in Dundalk, Baltimore County. Lauren is also a graduate student enrolled in the Leadership in Curriculum and Instruction masters program at Loyola University Maryland.

Making Your Voice Heard

[120] Maryland Stream Waders- Providing the Mega-phone

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Since the program began in 2000, Maryland Stream Waders volunteers have sampled benthic macroinvertebrates from over 6,600 sites across Maryland. These data are used by the Maryland Department of Natural Resources, Maryland Department of Environment, and other state and county agencies, but they are also made available online for use by the public. The availability of these data has proved to be invaluable to many different watershed organizations, conservation clubs, and concerned citizens. From getting the attention of decision makers to educating land owners to the state of the watersheds that they live in, the Maryland Stream Waders Program provides the tools to lobby for change that starts at home.

Sara Weglein is a Natural Resources Biologist II for the Maryland Department of Natural Resources in the Monitoring and Non-tidal Assessment division. Sara works on the Maryland Biological Stream Survey and has been serving as the volunteer coordinator of the Maryland Stream Waders program since 2008. She received her B.S. degree in Biology with a concentration in Zoology from Towson University in 2008.

[121] Mattawoman Matters

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Mattawoman Creek has been characterized by Maryland state fisheries biologists as possessing “near to ideal conditions” and being perhaps the “most productive tributary to the Chesapeake Bay.” Yet a wastewater treatment plant built two decades ago near the base of the drainage basin opened the watershed for development and, according to some, doomed Mattawoman. Or did it? The creek inspires passion with its stunning seven-mile estuary opening to the Potomac River, with its remarkable productivity, and with the outstanding natural attributes of its river and forests. This passion is reinforced by scientific evidence from state and federal resource-agencies and non-profit organizations showing a resource too good to lose. As a result, Mattawoman has prompted a wide coalition to join a local watershed society in an effort to protect this treasured landscape. Today over twenty groups organized as the Smarter Growth Alliance for Charles County is working to replace a history of sprawl development—epitomized by an ill-conceived highway proposal—with a new vision of Smarter Growth land-use decisions. In fact, the creek has two possible futures. One continues the decline that has recently been discovered in the estuary’s vaunted fish communities. The brighter future leverages public interest, a renewed commitment to restore the Bay at state and federal levels, and tools such as watershed implementation plans, water resources elements, and comprehensive plans to compel meaningful changes in local land-use decisions. Here is a place to enact such changes, that could serve as a wider model: for how can you save the Bay if you let its gems slip away?

Bonnie Bick has been an environmental activist in Maryland for more than twenty years. Her work on issues affecting the Potomac River and Mattawoman Creek are exemplified by the successful campaign to save Chapman Forest. More recently, she has worked to instigate Smart Growth solutions to save Mattawoman Creek by protecting its forested watershed. For her efforts to preserve Bay resources, Bonnie was recently recognized by the Chesapeake Bay Foundation as its Maryland Environmentalist of the Year.

[122] How to Create Change: Strategies and Very Cool Tips for Making a Difference

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Ever try to change the status quo, or even get your monitoring information used? There is a reason our systems are so resilient to change, but with the right approach, success is much more likely. From social marketing principals to learned leadership skills, the pointers and lessons learned from this talk will help you get the results you want, and all without using a gun or high explosives to get noticed.

[123] How The MBSS Uses the Internet to Spread the Word

Luke Roberson

NO ABSTRACT SUBMITTED

Volunteer and Professional Monitors, Unite!

[124] NO TITLE

James Beckley

NO ABSTRACT SUBMITTED

[125] TMDLs, Pollution Trading and the Need for Volunteer Monitoring

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As it becomes more and more apparent that Pollution Trading may be a large part of the states' Watershed Implementation Plans, it is imperative that citizen monitoring become an integral part of the verification and assurance components of the WIP's and the TMDL. Reductions based on model input decks are well and good, but only stream monitoring can verify that reductions are being made. This program will be an open discussion on the need for physical verification, the concerns with the upkeep and management of credited Best Management Practices, and the basic but necessary techniques of the physical and chemical monitoring that will assure us that credit is given where credit is due.

Michael Helfrich is your Lower Susquehanna Riverkeeper. He has held this position since 2005. As part of his advocacy and enforcement efforts, he has used physical and chemical monitoring of streams in agricultural areas to assess pollution contributions from individual facilities to our waterways.

[126] Partnering with Watershed Organizations to Produce Tributary-Specific Report Cards

Sara Powell

NO ABSTRACT SUBMITTED

[127] Partnership in Stream Monitoring - Loudon County, Virginia

David Ward

NO ABSTRACT SUBMITTED

[127] Meeting Community Needs: Developing Partnerships Between Local Governments and Volunteer Water Monitors

Chris French

NO ABSTRACT SUBMITTED

Stream Water Temperature

[129] Maryland's Temperature Criteria:

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Water Quality Standards are comprised of three main parts: 1. Designated Use (goal for a waterbody); 2. Criteria to support the designated use; and 3. Antidegradation Policy. In Maryland, temperature criteria are in place to support and protect aquatic life uses and, in one case, a recreational use. Non-tidal warmwater streams and all of the tidal waters in Maryland (Use I and Use II respectively) have a temperature criterion appropriate for protecting aquatic species tolerant of relatively warm water. Two other designated uses in Maryland have temperature criterion in place to protect trout as well as recreational trout fishing (Use III and Use IV respectively). In all cases, the criteria is written for, and directly used as, discharge limitations for permits. Because of this, assessing whether the designated use is being supported has been challenging. Methods for sampling and analyzing stream temperature were needed. In addition, Maryland recognized the need to establish written protocols for determining the appropriate designated use of waterbodies. To help meet these needs, the Maryland Department of the Environment (MDE) has enlisted the aid and expertise of Maryland Department of Natural Resources (DNR) staff. The results of their findings will provide a methodology for re-designating waterbodies to uses that more appropriately characterize the unique biological assemblages and their corresponding temperature regimes. In addition, this work will establish a methodology for assessing use attainment for the purposes of the Integrated Report.

Adam received his BS at Frostburg State University in Fisheries and Wildlife Management and an MS at the University of Missouri-Columbia in fisheries ecology, with a focus on watershed impacts on stream function. He has been working for the state of MD for 5 years. He started as the "Corsica Guy" for MDE, and then moved to Water Quality Standards Development. Prior to MDE, Adam worked for 2 years as biologist for Tetra Tech's Ecological Services Division in Owings Mills. Adam is interested in restoring and conserving aquatic and terrestrial ecosystems and researching, monitoring, and managing the effects of land use activities on structure and function of aquatic and terrestrial ecosystems; and encouraging connectivity between natural resources and the public through recreation and sensible use. Adam grew up in Waynesboro, PA (3 miles north of the Mason-Dixon Line), along the banks of the East Branch of the Antietam. So with the exception of his time in Missouri, he has spent his entire life boating, biking, hunting, hiking, fishing, and working in ecosystems familiar to Maryland.

[130] Thermal Regimes of Maryland's Non-Tidal Streams

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Temperature data for streams sampled by the Maryland Biological Stream Survey (MBSS) were used to derive thermal regimes for Maryland's non-tidal streams. Characteristics of the State's Use Classes I and IV streams were quite variable and difficult to relate to biotic condition. Thermal characteristics of Use Class III streams were always colder on average than other Use Class streams, and their attributes closely paralleled those of trout-bearing streams in the MBSS data base. Despite their cooler temperatures, a substantial number of these cold water streams had maximum temperatures above 24 C, and a small percentage had daily average temperatures exceeding 20 C. There was also a strong association between higher temperatures and lower fish abundances in trout-bearing streams. Should stream temperatures increase, many existing trout streams in Maryland may exceed thermal maxima. There was strong evidence that increasing the amount of impervious surface area or urbanization in the watershed increases stream temperatures. The results suggest that urbanized streams may be a good analog for future temperature increases should climate change occur.

Robert Hilderbrand is an associate professor at the Appalachian Laboratory, University of Maryland Center for Environmental Science in Frostburg, MD. His main research interests revolve around the conservation and management of fish and benthic macroinvetrebrates in headwater streams.

[131] Improving the Thermal Protection for Maryland Streams: Getting the Most Out of Designated Uses

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Co-author: Tony Prochaska (Maryland Dept. of Natural Resources)

The Maryland Department of Natural Resources (MDNR), working with Maryland Department of the Environment (MDE), has undertaken an extensive review of current designated uses (listed in Code of Maryland Regulations, Section 26.08.02.02) to determine if all non-tidal streams and rivers in Maryland are afforded adequate thermal protection. Using existing fish and temperature data (2000 – 2008) collected at 1076 Maryland Biological Stream Survey (MBSS) sites and recently collected data (2009-10) from targeted stream efforts, MDNR has recommended that multiple stream reaches in the Youghiogheny, Potomac, Patuxent, Patapsco, Gunpowder and Lower Susquehanna River basins be redesignated to more protective use classes. In addition, MDNR has analyzed benthic macroinvertebrate and stream temperature data to empirically derive a list of temperature sensitive indicator organisms, other than trout, that can be used to identify coldwater streams in Maryland. We will present the methods used to identify coldwater benthic macroinvertebrate taxa, provide information on the ecology of these organisms, and discuss how these indicators may be used in Maryland to protect other coldwater habitats that currently do not support trout, but should be afforded additional thermal protection.

Michael Kashiwagi is a Natural Resources Biologist working for the MDNR. Originally from Montgomery County, Michael has been working for the agency for the past four years. Prior to returning to Maryland, he work for the Massachusetts Division of Fish and Game conducting fisheries research on watershed community models. He has a Masters Degree in Wildlife and Fisheries Science from Mississippi State University.

[132] Tailwater Trout Management in Maryland. Where Did All the Cold Water Go?

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Cold water releases originating from deep water impoundments present a very unique and specialized opportunity for the development and management of cold water trout populations. Maryland Fisheries Service currently manages seven tailwaters throughout the state. Each one of them presents a cascade of individual conflicts and challenges in searching for and arriving at a balance to meet the conflicting and often competing needs of water managers and recreationists to secure adequate water supply and the cold water storage necessary to support a quality cold water trout fishery. Since trout require water temperatures that generally stay at or below 68ºF, a sustainable cold water reserve is a key element in the development and maintenance of a viable wild trout population. A brief discussion of Maryland's seven tailwaters will introduce the audience to a diverse array of competing uses and strategies that have been employed to balance the distribution of a very "limited" amount of cold water. Management of each tailwater requires a balancing act in order to meet and resolve issues relating to the need to provide potable water supplies, hydropower generation, white water releases, pool elevation control, minimum flow maintenance, flood control, water quality abatement, and much more! Several of Maryland's biggest and best wild trout waters are characterized as cold tailwater habitats. Escalating competition for water supply becomes more challenging daily, and in some cases, it is clear that ever increasing water demands will one day threaten the future of some of our most important and best known tailwater trout fisheries.

Charlie has worked for the Maryland Department of Natural Resources, Inland Fisheries Unit for more than thirty-one years. He has helped develop and manage many of the MD trout tailwaters. He currently serves as Inland Fisheries Regional Operations Manager.

[133] Thermal Regime and Stream Characteristics in the Prettyboy Reservoir Watershed

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Baltimore County, Carroll County, and Maryland DNR monitored water and air temperatures in streams flowing through a variety of land use types within the Prettyboy Reservoir Watershed. Concurrently, the fish communities were sampled, with the focus on native brook trout. As expected, fish communities of cold stream and warm streams differed. Streams with brook trout had lower mean and maximum daily temperatures than streams without brook trout. Colder streams had more forest cover than warmer streams. Physical habitat was more intact in colder streams than in warmer streams. Several stations were classified as high, medium, and low brook trout densities, and were sampled annually for three years to document the stability of the brook trout populations. Brook trout density varied annually, and was related to air and water temperature and precipitation patterns.

Dennis has managed the biological and geomorphological sampling programs at the Baltimore County Department of Environmental Protection and Sustainability since 2007. He is responsible for benthic and fish field data collection and analysis, and is the primary macroinvertebrate taxonomist. He also collects and analyzes cross-sectional and longitudinal profile data for stream restoration projects in Baltimore County.

Poster Abstracts

Sampling Freshwater Stream Benthic Macroinvertebrates: Does Habitat Selection Really Matter?

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Co-Authors: Michael Kashiwagi (Maryland Department of Natural Resources) and Kascie Herron (Sassafras River Association)

Many volunteer stream monitoring programs use benthic macroinvertebrates as indicators of stream health. Proper training and quality control are essential for the success of such programs. Even with rigorous training, questions remain about volunteers' ability to understand and follow proper sampling protocols. Maryland Stream Waders' volunteers are trained to sample benthic macroinvertebrates in multiple stream habitats including riffles and woody debris. These habitats are to be sampled in proportion to their occurrence in the sample site. To evaluate sample differences and the response of the family level Benthic Index of Biotic Integrity (BIBI), we intentionally sampled habitats incorrectly in two high and two low quality streams. NMS plots show that communities from healthy and unhealthy streams are different regardless of habitat sampled. Reference samples, collected according to protocol, fall between the all-riffle and all-wood samples. Although certain metrics score higher in reference samples, BIBI results are comparable among riffle and wood samples in both stream types. This suggests that the robustness of the BIBI may accommodate for the improper selection of sampled habitats.

Dan Boward has a B.S. in Zoology from the University of Maryland College Park and a M.S. in Environmental Science and Policy from Johns Hopkins University. Dan joined the Maryland Department of Natural Resources' Maryland Biological Stream Survey (MBSS) in 1995. In addition to his work with DNR, he teaches part time in graduate programs at Johns Hopkins University and Towson University.

Water Quality Monitoring in the Rock Creek Park in the District of Columbia

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Monitoring water quality in surface waters is important because of its impact to human and environmental health. Rock Creek, located within the District of Columbia, is one of the tributaries of Anacostia River that is subjected to Combined Sewer Overflow (CSO) and other serious effects of stormwater, including erosion and fertilizer runoff from fields. Previous studies in 2007 have shown that during storm events the concentrations of nitrate and BOD decreased and the concentrations of phosphate and fecal coliform increase. This study will demonstrate whether any of the proposed means of stormwater control have been enacted and CSOs improved. The objective of this study was to determine if there had been any significant changes in water quality. Two sample sets were taken, one after a rainfall event and one during dry weather. The samples were tested for phosphate, Fecal Coliform, and BOD. The findings and conclusions of the study will be demonstrated in this poster presentation.

Rapid Stream Restoration Monitoring Protocol

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In recent years, there has been a strong emphasis by the restoration community to evaluate the success of their stream restoration projects. Restoration monitoring is critical in assessing the achievement of restoration objective(s), improving restoration science to improve future restoration projects, and evaluating benefits to Federal Trust Resources and other species of concern. However, time and financial constraints often hinder opportunities for restoration project monitoring. The U.S. Fish and Wildlife Service, Chesapeake Bay Field Office

(Service) developed a rapid stream restoration monitoring protocol to promote monitoring by reducing the financial and time demands necessary to evaluate the success of a project.

The protocol is a three-tiered stream restoration monitoring methodology to evaluate the stability and functional success of stream restoration projects that use a natural channel design approach.
At this time, the Service has only prepared protocols for the first tier survey. The first tier is a rapid monitoring survey that visually evaluates the stability and qualitative functional success of the restoration project. The purpose of the first tier is to visually evaluate the stability and functional success of a restoration project. It consists of seven main components: A) bankfull determination, B) limits of investigation, C) rapid stream restoration monitoring form, D) evaluation parameter definitions, E) monitoring procedures, F) limited stream measurements, and G) monitoring/restoration thresholds. Although it relies primarily on observation, this tier can effectively evaluate the success of a project and provide consistent and comparable results/recommendations when implemented by an experienced and prepared evaluator. The criteria for determining whether to recommend additional monitoring (i.e. second tier) or restoration repair (i.e. third tier) are the severity of the impact and the potential consequences of the impact.

If the impact is localized and does not pose a significant threat to the success or function of the restoration, the second tier survey can be implemented. During the second tier survey, the Service proposes that project evaluators establish monumented surveys to determine the trend of instability and to compare the existing stream conditions to the proposed design criteria and reference data to determine if remediation is required. The third tier survey should be performed if the impact is widespread and poses a significant threat to the success or function of the restoration and restoration repair is required. If remediation is required, the third tier survey includes restoration design and implementation.

Establishing a Baseline of Critical Data Impacting Brook Trout at Catoctin Mountain Park

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The purpose of this study is to provide information towards the development of the best management strategy of the aquatic resources in the park, particularly the temperature sensitive species brook trout Salvelinus fontinalis. Catoctin Mountain Park is divided into two basic watersheds that feed into either Owen's Creek or Big Hunting Creek, both of which have native, naturally replenished brook trout populations. Throughout the study period, a total of ten sites recorded air temperature, stream temperature, and water level data at 15 minute intervals to maximize the quantity and quality of the readings. Background water quality readings were taken to ensure no other variable has had a significant effect on the trout populations. Coupled with precipitation information and GIS analysis, this data has isolated specific areas of each creek that have already exceeded the threshold for brook trout survival and are in need of restoration efforts (riparian planting, etc.). This study has given detailed information towards the effect of precipitation and land management on stream temperature and, in turn, how temperature has altered the population within the park. Climate change is predicted to extirpate all brook trout from Frederick County (and most of Maryland), and now scenarios can be predicted using the stream-reach specific data to isolate areas of future concern.

Abiotic and Biotic Stream Conditions within Maryland Protected Areas: Do Parks act as Effective Filters of Water Quality?

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The water quality and ecological conditions of headwater streams can be greatly influenced by the surrounding landscape features. Protected areas are one important type of anthropogenic land use that has been shown to effectively conserve terrestrial species diversity. The effectiveness of how protected areas influence aquatic systems is not well understood, however. The relationship that exists between protected area land use and stream conditions was explored in this study to determine if and how parks influenced the abiotic and biotic factors of stream ecosystems. Landscape features surrounding sampling sites within 148 protected areas across three physiographic regions of Maryland were compared to adjacent sites in unprotected areas. The Maryland Biological Stream Survey dataset was then examined to characterize the water quality of both protected and adjacent unprotected stream sites. Water chemistry, nutrients, and biological assemblages of protected streams were compared statistically to adjacent and similar unprotected stream sites to determine the effectiveness

of protected areas for aquatic systems within the park boundaries. Within protected areas, associations between land use and water quality were further explored at three spatial scales to determine the type and strength of these relationships. The three spatial scales in this study included watershed (up stream catchment area), riparian buffer, and in-stream habitat. The park sites were found to contain significantly greater forested area and significantly less urban and agricultural area compared to unprotected sampling sites. Streams within protected areas also revealed significant differences for many nutrient and biota metrics, but water quality response exhibited considerable variation across geographical regions. Protected areas of the Appalachian Plateau region demonstrated the highest degree of water quality differences. These results would suggest that protected areas can significantly improve water quality and ecological conditions in regions containing minimally impacted land uses, but are less able to overcome degradation to improve stream conditions in regions containing intensive human land uses. Implications of these results include additional understanding of the importance of protected areas as conservation strategies and offers new landscape-water quality analysis that includes a protected area context.

John is a high school biology and environmental science (AP) teacher at Thomas Wootton High School, in Montgomery County, Maryland. Throughout his teaching career, he has made local environmental and conservation issues a high priority by working with numerous agencies and organizations that help students get involved with the issues. He recently finished a Master of Science program in Environmental Sciences and Policy (Ecological Management Concentration) at the Johns Hopkins University, which led him to pursue his independent research thesis in the area of stream ecology and landscape ecology throughout the state of Maryland. He lives in Kensington, Maryland with his wife and two daughters.

Comparing Macroinvertebrate Field Collection Devices and Identification Level for Assessing Stream Health

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Rapid biological assessments are a cost and time efficient way to assess the health of streams. Where volunteer monitoring incorporates biological assessment, the most common approach is macroinvertebrate sampling and identification in the field. The Maiden Creek Watershed Association is a volunteer-based, non-profit organization that has recently adopted rapid macroinvertebrate assessments using a kick net to assess stream health, in addition to chemical monitoring. The objectives of this study were to compare: (1) the kick net to a more quantitative Surber sampler, and (2) field identification to lab identification to determine the most accurate way of assessing stream health. The Maiden Creek Watershed is located in central eastern PA and drains into the Delaware River Basin. In April 2011, we sampled water quality (temperature, dissolved oxygen, conductivity, pH, nitrate, and turbidity) and macroinvertebrates (kick net and Surber net in riffle habitats) in eight streams with a range of forest land cover (5-75%). Macroinvertebrates were identified to order in the field, and Surber samples were re-identified to family level in the lab and enumerated. When comparing the field collection devices, taxa richness values were significantly higher for the kick net (14.1 ± 1.3) than the Surber net (9.9 ± 0.8), suggesting that a kick net is better if the objective of the study is to capture the highest macroinvertebrate biodiversity. When comparing the Surber samples identified in the field and lab, the tolerance index, richness, abundance, and density were significantly higher in the lab, reflecting the taxa that are missed during field sorting without a microscope. The Surber sample identified in the lab was better able to distinguish sites based on land cover in terms of richness (r2 = 0.47), than the kick net (r2 = 0.43) or Surber net (r2 = 0.01) when identified in the field. Thus, the Surber is the most accurate method for assessing the health of a stream, but only when in conjunction with lab analysis, which may not be feasible in volunteer monitoring programs. Regardless of the method used for collection or identification, the pollution tolerance index value, which does not incorporate abundances of taxa, rated nearly all streams as excellent water quality, even though land cover and water quality indicated poorer quality stream. Well-tested metrics that assess richness and abundance (e.g., total richness; Shannon diversity; relative abundance of Ephemeroptera, Plecoptera, and Trichoptera) may be better for assessing stream health.

Cassie Flemming graduated in May from Kutztown University with a B.S. in Environmental Science. While at Kutztown, she was co-President of the Environmental Action Club and participated in numerous volunteer activities. She is currently working for Lutron Electronics and is looking into employment in the field of ecology. The research she will be presenting was part of her senior research project at Kutztown.

A Tool to Evaluate the Health of Streams and Rivers within the Chesapeake Bay Watershed

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The Chesapeake Bay Program and its partners developed a benthic index of biotic integrity ("Chessie B-IBI") that provides a regional assessment of the health of the streams and rivers in the Chesapeake Bay watershed. More than twenty state, federal, and local monitoring programs collect benthic macroinvertebrate samples in the 64,000 square mile Chesapeake Bay watershed. These programs use somewhat similar field methods and calculate a common suite of indicators from the data. The challenge is that each program uses different protocols to score and evaluate these indicators in order to assess waters for regulatory purposes. The objective of the Chessie B-IBI is to evaluate non-tidal benthic community health in a uniform manner and in the context of the entire Chesapeake Bay watershed. This approach incorporates the data into an overall watershed-wide B-IBI that standardizes the indicators at the family level.

The Chessie B-IBI was applied 7,886 locations associated with random or systematic sampling designs to evaluate small and moderate-sized watersheds for the 9-year period of 2000 – 2008. By using only random or systematic sites, B-IBI scores can be averaged across a large watershed area without introducing bias associated with sampling designs that target areas with known degraded or high quality waters. Results showed that of the 7,886 locations, 13.9% rated Excellent, 13.0% rated Good, 18.5% rated Fair, 15.2% rated Poor, and 39.4% rated Very Poor.

Variation in the Chessie B-IBI can be linked to land-based activities in individual watersheds. The best stream communities tend to be in forested areas with little land disturbance, low levels of pollution, and undisturbed in-stream and streamside habitat. The worst stream communities usually occur in watersheds with high levels of urbanization, agriculture and mining activities. Streams in these areas are compromised by extreme land disturbance, high levels of pollution, altered water flow, and poor quantity and quality of streamside vegetation. The most important implication of this method is that the results can be compared across jurisdictional boundaries. As such, the Chessie B-IBI is an example of a tool that can be developed to standardize and utilize multi-jurisdictional data for regional water quality assessments. The results from this B-IBI will help managers and watershed groups focus efforts to restore streams needing improvement and protect the quality of the healthiest streams. Future work will focus on calculating changes in Chessie B-IBI scores over time from a subset of consistently sampled sites in order to assess community health in response to restoration and protection activities.

Katie Foreman has been the non-tidal water quality analyst for the University of Maryland Center for Environmental Science at the U.S. EPA Chesapeake Bay Program Office since 2007. She coordinates the non-tidal water quality workgroup at the Bay Program where she heads teams of state, federal, and local partners to coordinate the monitoring and assessment of the health the Chesapeake Bay watershed. She is an Iowa native, where she received her undergraduate and graduate degrees in geography from the University of Iowa and worked for 7 years as a water quality specialist at the Iowa Department of Natural Resources. Most recently, her work focuses on developing indicators of health of streams and rivers within the Chesapeake Bay watershed.

Assessment of Diadromous Fish Presence and Extent around Bloede Dam on the Patapsco River

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The Maryland Biological Stream Survey (MBSS) is investigating the presence and extent of diadromous fish species around Bloede Dam on the Patapsco River near Ellicott City, Maryland. The work is part of a larger scale monitoring effort coincident with the removal of two other dams on the river- a joint project with American Rivers, the Maryland DNR Fisheries Service, and NOAA. Two dams, Union and Simkins, have already been removed and the feasibility of removing Bloede Dam is currently being investigated. Of particular interest in this investigation is Bloede Dam's function as a migration barrier, as it is the first major obstacle encountered by fish moving upstream from the Chesapeake Bay. A fish ladder was installed in 1992 and data collected at the time showed small numbers of American shad, sea lampreys, and blueback herring using the structure soon after its completion. No more data had been collected since that time, leaving the current status of these and other diadromous fish, as well as the functionality of the ladder, largely unknown. To fill in the gaps the MBSS began a targeted monitoring effort for diadromous fish using electrofishing equipment and a fyke net at four sites downstream from Bloede Dam and one site upstream during spring 2011. Sampling occurred weekly from 6 April 2011 to 12 May 2011. Seven species of diadromous fish were collected at the four sites below the dam, but only two of those, American eels and sea lampreys, were also collected above the dam. This absence above Bloede Dam of over 70% of the diadromous species observed in the Patapsco River indicates that the fish ladder is no longer functioning in the capacity for which it was originally designed, suggesting the dam is currently an impassable barrier for the majority of fish trying to migrate upstream.

William Harbold graduated from the State University of New York College of Environmental Science and Forestry in Syracuse, NY with a B.S. in conservation biology in May 2010. He has been working as a biologist for the Maryland Biological Stream Survey since June 2010.

Pre-settlement Habitat Stability and Post-Settlement Burial of a Tussock Sedge (Carex stricta) Wetland in a Maryland Piedmont River Valley

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Ancient, buried sedge-dominated wetlands in dark, organic-rich deposits have been discovered recently at the base of river banks in the Piedmont of Maryland and southeastern Pennsylvania. Little is known how long these wetlands persisted at any one location, although 14C dates varying from 10,500 ybp to 300 ybp indicate that they flourished through much of the Holocene. In this study, a paleoecological analysis of macrofossil seeds and charcoal from a core (LFC1) extracted from an organic-rich river bank stratum 0.54 cm thick was combined with geomorphic data and a record of historical land use to provide a 5000-yr history of a river valley wetland site in north-central Maryland. Analysis of LFC1 shows that a triad of dominant Carex species (*C. stricta, C. stipata, and C. scoparia*) occurred from 4300 ybp to ~300 ybp, indicating a tussock sedge wetland persisted unchanged for 4000 years, despite major storm events, regional beaver activity, fire, and anthropogenic disturbances. A spike in charcoal around 4,000 ybp indicates an intense period of fire within the watershed during an extended dry period, but no significant change occurred in the wetland. Burial of the wetland occurred rapidly in the late 18th and early 19th centuries when 1- 2 m of silt and clay sediment from land clearance accumulated in mill ponds behind downstream dams. Eventual breaching of the mill dams created an incised, high-banked meandering channel, exposing the post-settlement lacustrine sediment, paleo-wetland layer, periglacial basal gravels, and valley bedrock. To further understand the environment indicated by the fossil seed record, a study of species composition from seeds in surface samples within a local modern tussock sedge wetland was undertaken. Analysis of seeds in quadrats revealed that 97% of seeds fall within a 5 m radius of the source plants. Hence, seeds in a sediment sample can represent important plant species within an "80-m2 quadrat (r=5 m) and that a series of core samples can represent an "80-m2 quadrat-through-time". An analysis of Sorenson's Similarity Indices of seed species between surface samples provided a quantitative measure of habitat stability; a series of indices >0.40 in sequential core samples would indicate habitat stability through time. Fossil seeds in LF1 produced a running Sorenson's index average of 0.58 (range = 0.40 – 0.82), thus confirming quantitatively the 4000-yr period of stability in the tussock sedge wetland. Based on the ground level saturation of the water table that characterizes modern tussock sedge wetlands, the hydrologic regime of the paleo-wetland must have been primarily spring-fed from the valley wall, rather than from overbank flow from a river channel meander. This assumption is further supported by the absence of paleo-channels. These results have important implications for other Piedmont river valley wetlands regarding pre-settlement wetland biodiversity, stream restoration, and causal factors in the decline of the endangered bog turtle (*Clemmys muhlenbergii*).

Restoring Stream Habitat in Watts Branch, Washington D.C.: Challenges of Improving Diversity and Function in Urban Stream Systems

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Urbanization is one of the leading causes of stream degradation which includes wide-spread bank instability and loss of critical aquatic habitat. A variety of challenges arise when trying to address habitat concerns in urban areas. Storm water conveyance and capacity are typically the driving factors behind urban restoration with little or no consideration given to aquatic habitat or biologic function. Using natural channel design concepts, it is possible to control urban induced runoff with a stable, self-maintaining stream channel that also provides necessary aquatic habitat. This case study for urban stream restoration focuses on Watts Branch in Washington D.C. This project is

the result of a collaborative, multi-agency effort to restore nearly 11,000-ft of Watts Branch, a tributary to the Anacostia River. Pool-Riffle sequences, vital to aquatic habitat, were reintroduced into a system that suffered from extreme incision and entrenchment caused by dense urban development as well as multiple utility crossings and other infrastructure. A variety of challenges were faced during both the design and implementation process due to these urban constraints. Considerations had to be given to existing infrastructure as well as proposed. This project helps meet objectives set by the Presidents Urban Watershed Initiative as well as US Fish & Wildlife Service strategic plans.

Reinvigoration and Expansion of the Teaching Collection at an Urban HBCU

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Coppin State University is a Historically Black College/University (HBCU) in Baltimore, Maryland. Many of the university's undergraduates are from disadvantaged backgrounds and have limited exposure to the biodiversity found outside the urban ecosystems of the Baltimore-Washington metropolitan area. Ichthyologists and herpetologists will likely agree that photographs, illustrations, and video footage are sometimes insufficient substitutes for the tactile learning experiences of examining specimens. Thus the goal of this project is to replace the small, long-neglected collection of zoological material in the university's Department of Natural Sciences. Courses that are currently offered (e.g., General Zoology, Vertebrate Structure) or other courses that may be offered at Coppin in the future, such as Biology of Fishes or Marine Biology, would incorporate use of preserved materials. Students will perform special preparations (e.g., clearing and staining, tissue sectioning, DNA extraction) when feasible. Such exercises will reinforce the assertion that organismal biology is a dynamic, integrative branch of science. Donations of small (<0.5 m total length) specimens and/or appropriate containers will be gladly accepted, even when locality data are unavailable for specimens. Formalin-fixed, alcohol-preserved animals are especially appreciated. An open-source software package for collections, such as CollectionSpace, CollectiveAccess, or Madrona, will be used to manage data. Attaining the project goal will greatly improve the learning environment for a population of minority students that is underrepresented in biology.

Dr. Javonillo was recently appointed an Assistant Professor at Coppin State University. His research interests are in the phylogenetics and reproductive biology of fishes, especially those of the family Characidae (tetras). He earned his B.A. from Boston University, his M.S. from the College of Charleston, and his Ph.D. from George Washington University.

Aquatic Macroinvertebrate Communities of Agricultural Drainage Ditches on Maryland's Eastern Shore

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Agricultural drainage ditches provide arable land by removing excess water from field soils, and secondarily are engineered to improve water quality by promoting biogeochemical processes such as denitrification. Ditches are also aquatic habitats that may be significant sources of biodiversity within agricultural landscapes. We investigated the relationship between the aquatic macroinvertebrate community and environmental variables associated with physical and biogeochemical processes that affect water quality. Cluster analysis and multivariate ordination showed that aquatic macroinvertebrate communities are not homogeneous across all ditches, and that community composition is primarily related to physical habitat variables and not soil or water chemistry. Physical alteration of ditches to promote biogeochemical processes that improve water quality may change the suitability of ditches as habitat for different aquatic species. Future work should be done to directly investigate whether agricultural best management practices that alter physical characteristics of ditches change the quality of ditches as habitat for aquatic species.

Alan Leslie graduated with a bachelor's of science in marine biology from the University of Maryland in 2003. He then continued at Maryland to pursue a Ph.D. in entomology with Dr. William Lamp as his advisor. He is currently in his fourth year of his doctorate program, working on his dissertation project investigating the effect of bioturbation by aquatic invertebrates on phosphorus dynamics in agricultural drainage ditch soils.

Effects of Channel Morphology on Floodplain Inundation and Surface-Groundwater Interactions in an Urban Watershed

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Groundwater and surfacewater connectivity varies within different physiographic landscapes. Understanding various parameters influencing connectivity needs to be further studied. This study was conducted to determine the controlling factors of groundwater-surfacewater interactions in an urbanized system. Groundwater and surfacewater interactions in a tributary lying inside the Anacostia Watershed were studied from July 2009 to August 2010. The Little Paint Branch study reach consists of off channel features and active accretion of gravels bars onto the floodplain. Topography, sediment grain size and hydraulic conductivity, groundwater head, and floodplain/channel characteristics were measured. Determination of exchange, gaining, losing, and flow-through, within the floodplain and stream channel were examined. Construction of profiles representing groundwater flowpaths were created with reflection of scale of interaction, hyporheic zones, and off channel features. Water flowed from the stream into the adjacent gravel bars for the most of the year. Evapotranspiration and tropical storms influenced seasonal reversals in flow directions between the gravel bar and the floodplain. This study demonstrates the influence of floodplain morphology and shallow subsurface sediments on the hydrology of floodplain-stream interactions.

Dorothea Lundberg is a Ph.D. student in Marine Estuarine Environmental Science program at the University of Maryland. Her Masters of Science was from the same institution and program concentrating on groundwater surfacewater interactions between streams and floodplains. In continuation of her education she is pursuit of a Ph.D. in Ecohydrology with a project based on grid ditches on eastern shore Maryland focusing on hydrological impacts to the surrounding system.

Raising Trout in the Classroom

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During the 2010-2011 school year Northwest Middle School's Green School Club in conjunction with Trout in the Classrooms (TIC) and the Department of Natural Resources (DNR) participated in raising approximately 200 Oncorynchus mykiss, commonly called rainbow trout. From an environmental standpoint, trout are a key indicator species for water quality. Improving and monitoring local water quality in the Chesapeake Bay watershed are two of the main foci for our club. The eggs were delivered by a Trout in the Classroom representative and it was the responsibility of the Green School Club members to ensure that the trout were properly raised and released into a local trout stream. Parameters such as pH, ammonia levels, temperature, and dissolved oxygen levels were measured and recorded to ensure proper water quality for the trout. Results can then be compared with other programs or our own annual program to ensure sustainability of high quality research for the ongoing TIC mission. Northwest's club members were extremely successful, as 182 eggs were delivered and 180 trout were released into a trout stream as specified by DNR. At the time of release the fish were approximately two to three inches in length. These results are significant because consistently high survivability and normal growth rates indicate that the methods used are successful for our program.

Leanne Malat is a 7th grade research student in the Green School Club at Northwest Middle School and Shelby Sawyers is her club advisor.

Current Status and Population Trends of Brook Trout (Salvelinus fontinalis) in the Catoctin Mountains of Maryland

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Brook trout (Salvelinus fontinalis) populations in the Catoctin Mountain region of Maryland are currently restricted to very small headwater streams. Some of these populations are competing with naturalized populations of non-native brown trout (Salmo trutta) that provide popular sport fisheries. Long-term monitoring data since 1988 were examined to determine brook trout population trends and their relationship to populations of brown trout. Adult (yearling and older) biomass and density estimates were calculated from 3 pass removal – depletion data using linear regression and maximum likelihood estimates. Linear regression of natural log transformed time series population data was used to determine the rate of change and significance at the 95% confidence level. Four of the seven streams examined showed a significant positive trend in adult brook trout biomass. Three of the seven streams also showed a significant positive trend in the density of adult brook trout. Of the three streams that support both brook and brown trout, a significant positive trend in adult brook trout biomass was observed in two. Brook trout in the Catoctin Mountain region are continuing to flourish, even in the presence of naturalized populations of brown trout.

John Mullican graduated with a BS degree in Fisheries and Wildlife Management from Frostburg State University and has worked as a fisheries biologist/manager for the MD DNR Inland Fisheries Division for 22 years.

The Affects of a Spring Fish Kill on the Monocacy River Smallmouth Bass Fishery

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Smallmouth bass (Micropterus dolomieu) are an important recreational sport fish in the Monocacy River. A significant fish kill primarily affecting adult smallmouth bass and sucker species occurred during the spring of 2009. The extensive variety of opportunistic and primary pathogens isolated from clinically diseased bass suggests a generalized immunosuppression. The onset of disease caused by these organisms is most often associated with acute or chronic stress. Surveys of the bass population were conducted to document the impact this fish kill had on the sport fishery. Smallmouth bass biomass and density were estimated from 3-pass removal – depletion sampling data at two sites using maximum likelihood estimates during 2008 and 2009. Additional size distribution and catch per effort data were collected during 2010 by single-pass boat electrofishing. Total smallmouth bass biomass decreased 56% from 2008 to 2009. The biomass of quality-size (279 mm) and larger bass decreased 70%. Similar declines in density were also observed. The proportion of quality-size bass improved in 2010, but catch rates remained below pre-fish kill levels.

John Mullican graduated with a BS degree in Fisheries and Wildlife Management from Frostburg State University and has worked as a fisheries biologist/manager for the MD DNR Inland Fisheries Division for 22 years.

Mitten Crab WATCH: Citizen Scientist Key to Understanding the Spread and Population of Recently Introduced Chinese Mitten Crabs

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Chinese Mitten Crabs (Eriocheir sinensis) are native to East Asia and have only recently been discovered along the East Coast of the United States. In the United States they are established in San Francisco Bay, the Chesapeake Bay and the Hudson River. Several negative economic and ecological impacts have ensued in San Francisco Bay since their arrival in the 1980s, including damage to fisheries, fish passage facilities designed to help fish migrate, and the structural integrity of banks and levees due to crab burrows. The first confirmed mitten crab on the East Coast was caught by a commercial crabber in the Chesapeake Bay near Baltimore, MD, in 2005. Due to their recent arrival and low abundance in the Chesapeake Bay and in the Hudson River, their impact in this region is unknown. In order to stop their spread, the Smithsonian Environmental Research Center on the Chesapeake Bay has launched a new website (http://mittencrab.nisbase.org/) that makes it easier to report mitten crabs sightings. Understanding where these crabs are located and their abundance is a critical first step in controlling their spread and mitigating future impacts. Recruiting the help of observant and thoughtful citizens as well as local groups who are conducting stream surveys is a critical to this effort. We aim to inform participants of the Maryland Stream Third Maryland Streams Symposium and Mid-Atlantic Volunteer Monitoring Conference so they can include Chinese Mitten Crabs in their surveys and will know how to submit these data to Mitten Crab Watch.

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Identifying the Sources and Transformations of Nitrogen in Streams Using 15N and 18O of Nitrate

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Assessment of the most cost-effective and sustainable practices for restoring and preserving water quality in streams and down-stream receiving bodies requires identification of the sources and in-stream processing of nitrogen in surface waters. The major sources of nitrogen to aquatic environments in Maryland include fertilizers, mineralization in soils, animal and human waste, and atmospheric deposition. These multiple possible sources, as well as biogeochemical transformations of nitrogen (e.g. during denitrification), make it difficult to determine the relative importance of different sources of nitrate to surface waters using traditional measurements, such as concentration and flux data. Dual isotope (15N and 18O) analysis of nitrate in surface waters has recently emerged as a valuable tool for assessing the sources, sinks, and transformations of nitrate in surface waters thanks to the natural variations that exist in the isotopic composition of its major sources. For example, nitrate derived from nitrification of sewage and animal waste is typically more enriched in 15N-NO3- than nitrate derived from nitrification of fertilizers, and denitrification causes the residual nitrate pool to have more positive values of 15N-NO3- and 18O-NO3- than the original nitrate source. Recent studies in the northeastern United States also demonstrate that 15N-NO3- and 18O-NO3- of stream water are related to broad categories of land-use, such as urban, agriculture, and forest, and they also suggest that small to medium drainages dominated by one or two main forms of land use are most useful for distinguishing nitrate sources and hydrologic and biogeochemical influences on nitrate transport in streams. The recently established Central Appalachians Stable Isotope Facility (CASIF) at the Appalachian Laboratory is one of a limited numbers of labs in North America that performs dual isotope analysis of nitrate using the denitrifier method. Our poster will describe the isotopic composition of the major sources of N to ecosystems, strengths and weakness of the dual isotope approach, methodological details, as well as preliminary 15N-NO3- and 18O-NO3- data from MBSS samples.

Freshwater Sponges in the Mid-Atlantic Region

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A better understanding of freshwater sponges and their habitat in Mid-Atlantic States is needed. Spongillidae, the family of sponges (Porifera) that includes freshwater types are obscure, sessile, benthic, filter-feeding invertebrates that live in various freshwater systems. They filter organic particles from the water and also serve as a food source for other benthos. Freshwater sponges are potentially a biological control of the invasive Zebra mussel, Dreissena polymorpha. Water monitoring staff with the National Capital Region Network's Inventory and Monitoring Program (National Park Service) recently discovered colonies of freshwater sponges in Prince William Forest Park, Virginia. Klaus Ruetzler (Smithsonian Institute) identified it as Mueller's freshwater sponge, Ephydatia muelleri. Other recent observations indicate that sponges may be more common than we know in Virginia and Maryland. Little is known about these organisms due to the lack of research, specimens and published literature. Further study of freshwater sponges is necessary, including basic inventories of species and locations, as well as habitat and chemical characterization of where freshwater sponges are found. Because little is known about the presence and distribution of freshwater sponges, not only in the MD, DC, VA area but across the United States, this information should be widely distributed among natural resource professionals within the water monitoring community.

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