MARYLAND WATER MONITORING COUNCIL 23RD ANNUAL CONFERENCE

MANAGING WATER QUALITY *in a Changing World*

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The 23nd Annual Conference of the Maryland Water Monitoring Council
Welcome from the Chair of the MWMC Board of Directors

Managing Water Quality in a Changing World

The 2017 MWMC Annual Conference Planning Committee and I would like to welcome you to the 23nd Annual Conference of the Maryland Water Monitoring Council. We are excited to have put together another great day of terrific speakers, posters and breakout sessions providing insight into the ways in which the monitoring community has helped to protect and sustain Maryland's waters. This year's conference theme "Managing Water Quality in a Changing World" was selected to help make a connection between the efforts of the monitoring community and the educators, volunteers, legislators and agency planners that help to implement policies and practices that support our efforts to preserve Maryland's water resources.

With the changing climate and increasing land use development, the monitoring community can once again play an important role in helping to guide the future of Maryland's waterways. By providing up to date and informative data, resource managers can make more informed decisions and design creative solutions to help mediate the effects resulting from our changing landscape. The conference today will illustrate and highlight those efforts, hopefully providing the spark for the next great idea.

We are honored to have with us for the morning plenary session two fantastic speakers - Jim Caldwell, Director, Howard County Office of Community Sustainability and Dr. Grace Brush, Professor, Johns Hopkins University. Director Caldwell will discuss the historic flooding of the town of Ellicott City, its recovery efforts and how agency planners are working to mediate future impacts to this historic town. Dr. Brush will prove insight into the impacts of climate change and land use development using the sediment record of the Chesapeake Bay. These talks should set the stage for another exciting and informative MWMC Annual Conference.

Also continuing this year, we will be awarding the Carl Weber Award as a way to recognize the extraordinary contributions that Dr. Carl Weber made to the field of water monitoring. The Council presents this award in Carl's name as a lasting reminder of the affection and respect that we hold for Carl and his work, and to inspire others to emulate his passion, dedication, and good humor. In addition, a second "Above and Beyond Award" will be presented to a member of the monitoring community who represents the next generation of Maryland's water monitors and has shown outstanding drive in increasing watershed awareness, advocacy, education and stewardship.

The MWMC and the Board of Directors would like to thank the monitoring community for their efforts and look forward to working with all of you to continue to find new ways to facilitate collaboration and cooperation between all of the individuals and organizations that work every day to maintain our valuable state water resources. As with any organization, the MWMC is only as strong as the members and individuals who participate in Council activities.

The MWMC continues today as an effective statewide collaborative body because of the many contributed hours that individuals and organizations have donated to furthering the Council's goal of serving as a vehicle for the

effective collection, interpretation, and dissemination of environmental data related to issues, policies, and resource management objectives involving water monitoring. We encourage you to strengthen the MWMC by getting involved, communicating your needs to us, and using the Council to enhance your water monitoring programs, resource management, and environmental stewardship initiatives. Talk with a MWMC member at today's conference at the MWMC table or in the halls and find out how the Council can help you help enhance water monitoring through the Council. To learn more about the MWMC, go to **www.marylandwatermonitoring.org**.

The Annual Conference is a "green" conference. We would like to thank the Maritime Institute who has partnered with us to provide on-site recycling, motion-activated lighting in the hallways, and washable/compostable tableware for our breaks. And the recently-renovated cafeteria now provides many vegan and vegetarian options to help us make healthy food choices. Please enjoy the facility and today's conference program.

Let's make this a great conference!

Clark Howells
Chair, Maryland Water Monitoring Council

The Carl S. Weber Awards

For Vision and Leadership in Monitoring Maryland's Waters

Our vision for monitoring in Maryland…

The MWMC envisions a time when monitoring methods, programs, projects, and data are the product of collaboration and comparability among agencies and organizations. The resulting information will be accessible for use by all stakeholders and will facilitate sound decision-making in environmental management and protection.

Dr. Carl S. Weber. Among many other things, Carl was one of the founding Board members serving a term on the MWMC Board in the mid-1990s representing the academic community. Today we honor Carl's life and work and celebrate the qualities that made him such an important part of the Maryland monitoring community with the annual presentation of the Carl S. Weber Award. Beginning in 2007, the Award has been presented annually to an individual involved in water monitoring in Maryland who exhibits the spirit, vision and leadership so exemplified by Carl. One person can make a difference!

Carl was a founding member of the University of Maryland-Baltimore County (UMBC) Biological Sciences Department and taught there for nearly 40 years. Although his training was in biochemistry, he developed an interest in stream ecology in the 1980s and became a self-taught aquatic biologist, eventually creating and teaching extremely popular courses on stream and river ecology at UMBC. Carl used Herbert Run, a Patapsco tributary that flows through UMBC, as a living classroom for his students that spurred research and restoration activities on the stream. In 2002, Carl won the UMBC 2002 Alumni Association Award for Mentoring. Many of the students Carl taught and mentored went on to internships and careers in the environmental protection field. Carl was instrumental in bringing the National Science Foundation's Long-Term Ecological Research Network to UMBC through the Baltimore Ecosystem Study. He also served as the first chair of the Patapsco Tributary Team.

Carl's entry into the monitoring world began when he got involved with the Friends of Gwynns Falls/Leakin Park in his home watershed. In 1989, he took on an amazing volunteer task—leading a unique and innovative new project for Maryland Save Our Streams and Baltimore County. "Project Heartbeat" was the first program in the United States to train volunteers to collect and analyze benthic macroinvertebrates and to assess physical habitat using EPA's 1989 Rapid Bioassessment Protocol. Carl jumped right in and became involved in every aspect of the program. Over a 10 year period, thousands of volunteers were trained to collect benthic samples and identify them to the taxonomic family level in a controlled lab setting. Through Carl, UMBC provided lab space and equipment, and for several years, Carl taught and supervised all the lab volunteers to ID 200-300 samples a year. He chaired both the community steering committee and the technical advisory committee, building a bridge among volunteers, watershed organizations, academia, the County, the State, EPA, and other stakeholders—all represented on these committees.

For years, Carl performed all the lab quality control and data analysis for Heartbeat. He co-authored Project Heartbeat's Quality Assurance Project Plan, the first of its kind for a volunteer biological monitoring program. In the 1990s, Project Heartbeat had a profound impact on volunteer water monitoring, environmental education,

and watershed collaboration— not only in Maryland, but across the country. Because of this program, Baltimore County has a quality baseline data set on the health of its streams spanning more than 10 years. Project Heartbeat maintained a high level of scientific credibility and the program contributed to advances made in stream assessment and analysis methods within the Maryland Department of Natural Resources and the Maryland Department of Environment. Certainly the road to DNR's "Streamwaders" program was paved, in part, by Project Heartbeat's success. No one person is more responsible for any of these accomplishments than Carl Weber.

Through this award, we celebrate Carl's life and work by acknowledging others who share his generous spirit, his commitment to Maryland's waters, his vision for collaboration, and his leadership in advancing monitoring and assessment.

Previous Winners

2016 – Bonnie Bick (Mattawoman Watershed Society)

2015 – Frank Dawson (Maryland DNR – retired)

2014 – Jim Long (Mattawoman Watershed Society)

2013 - Paul Kazyak (Maryland DNR)

2012 - Charlie Conklin (Gunpowder Valley Conservancy)

2011 - Bill Stack (Center for Watershed Protection)

2010 - Sally G. Horner (Magothy River Association)

2009 - Peter Bergstrom (NOAA)

2008 - Ron Klauda (Maryland DNR)

2007 - Susan "Abby" Markowitz (Tetra Tech) and Dr. Paul Massicot (Maryland DNR)

Above and Beyond Award

Many of the previous Carl Weber Award recipients have had lengthy careers and been a part of public agencies. The Above and Beyond Award will allow the MWMC to recognize someone who represents the next generation of Maryland's water monitors and the future of the MWMC. Presented annually to recognize contributions of an up-and-coming member of the Maryland's environmental community, the Above and Beyond Award is presented to a member who has volunteered time and energy towards the monitoring of Maryland's waters and has made a significant contribution to increasing watershed awareness, advocacy, education and stewardship. The MWMC is proud to include this new award in our 2016 conference and many more.

Previous Winners

2016 – Ann Strozyk (Howard County Educator)

2017 Annual Conference Planning Committee

Andy Becker	KCI Technologies, Inc.
Dan Boward (Chair)	Maryland Department of Natural Resources
Kevin Brittingham	Baltimore County Department of Environmental Protection and Sustainability
Clark Howells	Baltimore City Department of Public Works
Mike Pieper	KCI Technologies, Inc.
Charlie Poukish	Maryland Department of the Environment
Kathy Stecker	Maryland Department of the Environment
Mark Trice	Maryland Department of Natural Resources
Angel Valdez	Maryland Department of the Environment

Additional thanks to:

Katherine Hanna	Maryland Department of Natural Resources (MWMC Web Master and Graphics Guru)
Jackie Sivalia	Maryland Department of Natural Resources (Conference preparation)
Joanne Alewine	Maryland Department of Natural Resources (Conference preparation and registration table)
Karin O'Donnell	Maryland Department of Natural Resources (Conference preparation and registration table)

MARYLAND WATER MONITORING COUNCIL
23rd Annual Conference - Friday, December 8, 2017

Managing Water Quality in a Changing World

7:30 **Registration/Poster Set-up/Continental Breakfast** – Registration in Room A-100

Morning Plenary Session (8:30-10:00) in the Auditorium (simulcast in Classroom 1)

8:30 ***MWMC Board Chair's Call to Order*** – Clark Howells; Baltimore City Department of Public Works; Chairman, MWMC Board of Directors
8:45 ***The 2016 Ellicott City Flood: A 225-Year-Old Mill Town's Survival Story*** – James Caldwell – Director, Howard County Office of Sustainability
9:15 ***A 10,000 Year Record of Climate, Forests, Land Use, and Chesapeake Water Quality*** – Dr. Grace Brush – Professor, Johns Hopkins University
9:45 ***Carl S. Weber Awards*** – Sandy Hertz; Maryland Department of Transportation and Cathy Weber
10:00 **Break/Poster Session** – Authors Present

Only speakers are listed for oral presentations. The Oral Abstracts section contains the full list of authors, co-authors, contact information, and abstracts.

	Auditorium	Room A-300	Room A-111/113	Classroom 1	Classroom 2	Classroom 3	Room A-302
10:30 – 12:00	***STREAM RESTORATION MONITORING I*** – Moderator, Jai Cole (M-NCPPC)	***OPPORTUNITY OF THE COMMONS: DEFINING MARYLAND'S OCEAN FUTURE*** – Moderator, Joe Abe (MDNR)	***DOWN ON THE FARM: YOUR FOOD AND YOUR WATER*** – Moderator, Charlie Poukish (MDE)	***UPDATES ON THE STATE OF THE CHESAPEAKE BAY*** – Moderator, Diana Muller (Chesapeake BaySavers)	***CLIMATE RESILIENCY: THE NATURAL CAPACITY TO RESIST CHANGE*** – Moderator, Sandy Hertz (MDOT)	***MONITORING URBAN WATERS*** – Moderator, Chris Victoria (Anne Arundel County)	***CITIZEN SCIENCE: SAVING THE BAY ONE RIVER AT A TIME*** – Moderator, Richard Mitchell (USEPA)
	STREAM RESTORATION: TMDLS, BIOTIC UPLIFT, AND PERMITTING - ARE WE AT THE CONFLUENCE? - Jeff White (MDE) **FROM HORSE-DRAWN CARRIAGES TO CITY COMMUTER ROUTES: A STORY OF URBAN WATERSHED REVIVAL IN THE CHESAPEAKE BAY** -Matt Harper (M-NCPPC) **ADAPTIVE MANAGEMENT AND EVALUATING EFFICACY OF A FLOODPLAIN RESTORATION** - David Osgood (Albright College) **RESTORING WATER QUALITY AND BROOK TROUT POPULATIONS IN THE CASSELMAN RIVER** - Constance Lyons Loucks (MDE)	**THIS SESSION WILL HIGHLIGHT SOME OF MARYLAND'S WORK TO CONSERVE MARINE RESOURCES DURING A TIME OF NEW DISCOVERY, INTENSIFYING USE, AND A CHANGING CLIMATE. THE SESSION WILL INCLUDE A SHORT VIDEO, A JOINT PRESENTATION, FOLLOWED BY A DISCUSSION WITH THE AUDIENCE.** Presenters are: Joe Abe (MDNR), Catherine McCall (MDNR), and Kimberly Hernandez (MDNR)	**THREE DECADES OF PROGRESS ON REDUCING NUTRIENT LOADS FROM MD CROPLAND** - Ken Staver (University of MD) **CATTAIL CREEK STREAM RESTORATION AT MAPLE DELL FARM** - Lindsay DeMarzo (Howard County) **MARYLAND AGRICULTURE'S ROLE AND PROGRESS TOWARD THE CHESAPEAKE BAY RESTORATION** - Alisha Spears Mulkey (MDA) **AGRICULTURE AND LOCAL FISH HABITAT CONDITIONS IN CHESAPEAKE BAY** - Jim Uphoff (MDNR)	**STATUS AND TRENDS OF THE CHESAPEAKE BAY WATER QUALITY STANDARDS CRITERIA ATTAINMENT** - Qian Zhang (UMCES/USEPA CBPO) **USING SPARROW TO UNDERSTAND NUTRIENT TRENDS IN CHESAPEAKE BAY TRIBUTARIES, 1992-2012** - Scott W. Ator (USGS) **BASELINE ANALYSIS OF OILS, CDOM AND OPTICAL BRIGHTENERS IN SHALLOW ESTUARINE ENVIRONMENTS: POTENTIAL TOOLS FOR EVALUATING RESTORATION EFFECTIVENESS** - Andrew C. Muller (US Navy) **INTEGRATING MONITORING MODELING AND TRENDS ANALYSES FOR MANAGEMENT DECISIONS: A CHOPTANK RIVER EXAMPLE** - Emily Trentacoste (USEPA)	**THE MARYLAND HEALTHY SOILS INITIATIVE** - Susan Frick Payne (MDA) **USING NATIONAL ESTUARINE RESEARCH RESERVES TO UNDERSTAND CLIMATE CHANGE IN CHESAPEAKE BAY** - Jennifer Raulin (CBNERR) **STREAM MONITORING TO PRIORITIZE RESTORATION AND RESILIENCE** - Britta Bierwagen (USEPA) **INDICATORS: SMART FOR RESILIENCE** - Michael Kolian (USEPA)	**URBAN LEGACIES: AQUATIC STRESSORS AND LOW BIODIVERSITY PERSIST AFTER STORM-WATER MANAGEMENT IMPLEMENTATION** - Rosemary Fanelli (University of MD) **THE INFLUENCE OF GRAY AND GREEN INFRASTRUCTURE ON WATER QUALITY CHANGE IN THE GWYNNS FALLS WATERSHED, BALTIMORE, MARYLAND** - Ellen Woytowitz (USGS) **BIOENERGETIC SIGNATURES OF STRESS IN CADDISFLY LARVAE FROM STREAMS ALONG AN URBAN TO RURAL GRADIENT** - Madison Smith (Towson University) **DETECTION OF THE EFFECTS OF STORM WATER BEST MANAGE-MENT PRACTICE, BAYESIAN BACI POWER ANALYSIS** - Dong Liang (UMCES/CBL)	**WHAT CAN A TEENY-TINY NONPROFIT DO?** - Chuck Foster (Friends of the Bohemia) **CLEARING THE WATERS OF THE MUDDY BRANCH WITH CITIZEN SCIENCE** - Paul Hlavinka (Muddy Branch Alliance) **CREEK CRITTERS: ENGAGING PEOPLE IN STREAM STEWARDSHIP AND ADVOCACY** - Gregg Trilling (Audubon Naturalist Society)

Two Lunch Groups – 12:00 – 1:00 (Orange Name Tag Sticker) - 12:30 – 1:30 (Blue Name Tag Sticker)

12:00 - 12:30 and 1:00 – 1:30 Poster Session – Authors Present

	Auditorium	Room A-300	Room A-111/113	Classroom 1	Classroom 2	Classroom 3	Room A-302
1:30 – 3:00	***STREAM RESTORATION MONITORING II*** – Moderator, Mark Southerland (AKRF)	***WATER AND ELECTRICITY DO MIX!: NEW MONITORING TECHNOLOGIES*** – Moderator, Mike Pieper (KCI)	***PLANNING FOR CLIMATE CHANGE*** – Moderator, Clark Howells (Baltimore City)	***TOOLS OF THE TRADE; DATA RESOURCES FOR EFFECTIVE WATER MANAGEMENT*** – Moderator, Mark Trice (MDNR)	***COMMUNITY ENGAGEMENT, EDUCATION AND TRAINING*** – Moderator, Jeff Reagan (Biohabitats)	***MANAGING MARYLAND LAKES IN A CHANGING WORLD*** – Moderator, Sherm Garrison (NALMS)	***CHANGE IS UNDERFOOT: LESSONS FROM GROUNDWATER MONITORING*** – Moderator, Mat Pajerowski (USGS)
	IF YOU BUILD IT, WILL THEY (BENTHOS) COME? - Mark Southerland (AKRF) **ECOLOGICAL AND HABITAT RESPONSES IN PIEDMONT URBAN STREAM RESTORATIONS** - Joe Acord (UMCES/AL) **ECOLOGICAL IMPACTS OF REGENERATIVE STREAMWATER CONVEYANCE (RSC) SYSTEMS IN MARYLAND'S COASTAL PLAIN** - Rebecca Cope (USEPA) **SETTING EFFECTIVENESS GOALS FOR STREAM AND WATERSHED RESTORATION** - Nancy Roth (Tetra Tech)	**A NOVEL USE OF ELECTRICAL RESISTIVITY TO INVESTIGATE THE HYDROGEOLOGY OF SPRINGS SUPPORTING ENDANGERED AMPHIPODS** - Andrew Staley (MGS) **EXPLORING THE USE OF STRUCTURE FROM MOTION SURVEYING AS A COST-EFFECTIVE MEANS TO QUANTIFY LANDSCAPE CHANGE IN NEAR REAL-TIME** - Matthew J Cashman (USGS) **IMPROVEMENTS IN QUANTIFYING BANK EROSION FOR SEDIMENT BUDGETS WITHIN THE CHESAPEAKE BAY WATERSHED BY INTEGRATING STRUCTURE-FROM-MOTION PHOTOGRAMMETRY** - Joseph Bell (USGS) **REAL-TIME WATER QUALITY IN AN ACTIVE CONTROL WET POND** - Micah Strauss (OptiRTC)	**CAPACITY BUILDING FOR RESILIENCE, PART I** - Kristin Baja (Urban Sustainability Directors Network) **CAPACITY BUILDING FOR RESILIENCE, PART II** - Kimberly Grove (Baltimore City) **MARYLAND ROADWAY VULNERABILITY ASSESSMENT** - Elizabeth Habic (MD SHA)	**FLOODPLAIN MAPPING TOOLS AVAILABLE NOW AND E-COLLABORATION TOOLS UNDER DEVELOPMENT** - David Guignet (MDE) **FROM THE FIELD TO THE CLOUD - A REVIEW OF ONLINE RESOURCES FOR LOCAL WATER QUALITY DATA AND ASSESSMENT** - Mark Trice (MDNR) **EVALUATING LANDSCAPE-SCALE CHANGE DETECTION METHODS FOR LANDSAT TIME SERIES** - Emily Mills (Chesapeake Conservancy) **EXPLORING AMBIENT NUTRIENT MONITORING DATA WITH THE WATER QUALITY INDICATORS (WQI) TOOL** - Rusty Wasem (USEPA)	**BUILDING A 21ST CENTURY WORKFORCE - CHALLENGES, OPPORTUNITIES** - Joan Michelson (Green Connections Media) **INTEGRATING SOCIAL AND ECOLOGICAL RESTORATION FOR STACKED BENEFITS** - Lori Lilly (Howard EcoWorks) **NAVIGATING PROBLEMS TEACHERS FACE** - Lolita Kiorpes (Charles County Public Schools/North Point High School)	**THE STATE OF LAKES IN A CHANGING WORLD** - Lisa Borre (Cary Institute of Ecosystem Studies/NALMS) **OVERVIEW OF AQUATIC INVASIVE SPECIES MANAGEMENT AND ASSESSMENT IN MARYLAND LAKES** - Mark Lewandowski (MDNR) **MANAGING MULTI-PURPOSE LAKES AND PONDS IN COLUMBIA, MARYLAND** - John L McCoy (Columbia Association) **MANAGING LAKES-BUILDING A STATE FRAMEWORK** - Barbara Beelar (Friends of Deep Creek Lake)	**IRRIGATION ACCELERATES NITRATE TRANSPORT WITHIN THE GROWING SEASON** - Alexander Soroka (USGS) **INCREASING CHLORIDE AND SODIUM CONCENTRATIONS IN GROUNDWATER DUE TO ROAD SALT INPUTS AND LONG-TERM EFFECTS ON STREAM CHEMISTRY VIA BASEFLOW** - Joel Moore (Towson University) **COMPILING WELLWATER QUALITY DATA FROM MULTIPLE DATABASES IN MARYLAND: OPPORTUNITIES AND CHALLENGES** - David W. Bolton (MGS) **ASSESSING RIPARIAN HYDROLOGIC PATHWAYS AS CONTROLS ON FORESTED BUFFER FUNCTION IN FOUR SUBWATERSHEDS IN WESTERN MARYLAND** - Stephanie Siemek (UMCES/AL)

3:00 – 3:30 Break/Poster Session – *Authors Present* – Announcement of Student Poster Award Winners (Auditorium)

	Auditorium	Room A-300	Room A-111/113	Classroom 1	Classroom 2	Classroom 3	Room A-302
3:30 – 4:30	***STREAM RESTORATION MONITORING III*** – Moderator, Scott Stranko (MDNR)	***IT'S ALL CONNECTED: WATER QUALITY, WATER QUANTITY AND PUBLIC HEALTH*** – Moderator, Andrew Muller (US Navy)	***NEW APPROACHES TO STREAM AND WETLAND MONITORING AND RESTORATION*** – Moderator, Jeff Reagan (Biohabitats)	***COMMUNICATING CHALLENGES AND SUCCESSES IN A CHANGING WORLD*** – Moderator, Kathy Stecker (MDE)	***DATA TO DECISIONS*** – Moderator, Angel Valdez (MDE)	***SAVE THE TROUT!: MANAGING STORMWATER FOR HEALTHY WATERS*** – Moderator, Byron Madigan (Carroll County)	***STUDENT-PROFESSIONAL NETWORKING SESSION*** – Moderator, Dot Lundberg (Rowan University)
	INITIAL EFFECTS OF STREAM RESTORATION ON FISH AND INVERTEBRATE ASSEMBLAGES IN LITTLE TUSCARORA CREEK, MARYLAND - Jonathan Watson (MDNR) **IN-STREAM IMPOUNDMENT REMOVAL AND STREAM CHANNEL CREATION FOR BROOK TROUT RESTORATION AND CONSERVATION IN A GARRETT COUNTY, MARYLAND, STREAM** - Alan Heft (MDNR) **DAM REMOVAL MONITORING IN THE PATAPSCO-ESTABLISHING A BASELINE FOR BIOLOGICAL CONDITIONS PRIOR TO THE REMOVAL OF BLOEDE DAM** - William Harbold (MDNR)	**MANURE AND FERTILIZER INPUTS TO LAND IN THE CHESAPEAKE BAY WATERSHED, 1950-2012** - Jeni Keisman (USGS) **PUBLIC HEALTH IMPLICATIONS OF THE DEATHS OF TWO MARYLAND DOGS EXPOSED TO HARMFUL ALGAE** - David A. Crum (MD Department of Health) **FOCUS ON NONTRADITIONAL IRRIGATION WATER IN A CHANGING CLIMATE: ASSESSING FARMERS' NEEDS, WATER QUALITY, AND ACCESSIBILITY** - Rachel Rosenberg Goldstein (University of MD)	**WETLAND SOIL FUNCTIONAL ASSESSMENT USING IRIS (INDICATOR OF REDUCTION IN SOILS) TECHNOLOGY** - Martin C. Rabenhorst (University of MD) **LESSONS LEARNED IN PLANNING AND PRACTICE: USING "LESS IS MORE" AS A SUSTAINABLE RESTORATION APPROACH** - Catherine Hoy (Ecotone) **USING ECOSYSTEM SERVICES TO GENERATE TMDL CREDIT – OUTSIDE THE BOX THINKING FOR A CHANGING WORLD** - Scott McGill (Ecotone)	**THIS INTERACTIVE WORKSHOP FOCUSES ON WATER QUALITY OUTREACH TO DIVERSE AUDIENCES IN AN EVOLVING COMMUNICATIONS LANDSCAPE. HOW DO WE CRAFT OUR MESSAGES, TARGET OUR AUDIENCES, AND CHOOSE WHEN AND WHERE TO COMMUNICATE? HOW DO WE KNOW IF THE PUBLIC IS ACTUALLY HEARING OUR MESSAGES?** Presenters are: Steve Raabe (Opinion Works) and Bill Dennison (UMCES)	**TAKE A WALK ON THE REGULATORY SIDE** - Becky Monahan (MDE) **CHESAPEAKE MONITORING COOPERATIVE** - Liz Chudoba (Alliance for the Chesapeake Bay) **USING A MULTI-PARTY APPROACH TO MONITORING STORMWATER MANAGEMENT SYSTEMS IN PRINCE GEORGE'S COUNTY, MARYLAND** - Lia Mastropolo (AKRF/Clean Water Partnership)	**ARE BROOK TROUT POPULATIONS IN MARYLAND FUNCTIONALLY EQUIVALENT?** - Nathaniel (Than) Hitt (USGS) **TEMPERATURE MONITORING OF STORMWATER MANAGEMENT PRACTICES** - Sam Lee (MES)	**LEARN ABOUT CAREERS! MAKE CONNECTIONS! HIGH SCHOOL AND UNDERGRADUATE STUDENTS ARE INVITED TO INTERACT WITH PROFESSIONALS IN THE FIELDS OF AQUATIC BIOLOGY, FRESHWATER ECOLOGY, MARINE BIOLOGY, WATERSHED SCIENCE, INTEGRATED MANAGEMENT, SCIENCE COMMUNICATION, AND MORE!**

4:30 Adjourn

Poster Presentations (In Order of Primary Author's Last Name)

ST. ANDREW'S LANDFILL GAS (LFG) SYSTEM'S IMPACT ON A MID-SIZED LANDFILL - John Agnoli, Carly Cushing, and Kaitlyn Peterson (Maryland Environmental Service)

NON-TRADITIONAL APPROACHES TO IMPROVE MACROBENTHIC INVERTEBRATE COMMUNITIES FOR STREAM RESTORATION PROJECTS - J. Patrick Barber (Acer Environmental, LLC)

THE TENTH ANNUAL MARYLAND STREAMS ROUNDTABLE - Andy Becker (KCI Technologies) and Dan Boward (MDNR)

(STUDENT POSTER) - TRACKING CONDUCTIVITY WITH INCREASED TEMPORAL RESOLUTION BETWEEN TWO STORM WATER MANAGEMENT PONDS - Joe Broome, Gregory Woodward, and Joel Moore (Towson University)

(STUDENT POSTER) - WATER QUALITY IN BALTIMORE'S WATERSHEDS: A BIO-CHEMICAL INVESTIGATION - Tashawan Colbert, DaRae Solomon, Dr. Jiru, Dr. Tatiana Roth, Tamera Warrington, Malia Vester, Aaliyah McCollough, and Jasmynn George (Coppin State University)

USING STATISTICAL MODELS TO IMPROVE REMOTELY SENSED ESTIMATES OF TOTAL SUSPENDED SOLIDS IN THE CHESAPEAKE BAY - Nicole M. DeLuca and Benjamin F. Zaitchik (Johns Hopkins University)

THE FREDERICK COUNTY STREAM SURVEY: USING A COUNTYWIDE MONITORING PROGRAM TO BETTER INFORM RESTORATION DECISIONS ON A WATERSHED SCALE - Donald Dorsey and Shannon Moore (Frederick County), and Ginny Rogers and Ryan Corbin (Versar)

(STUDENT POSTER) - GREEN CONCRETE: A COMPARISON OF CONCRETE SUBTRATES FOR MACROINVERTEBRATE COLONIZATION - Samantha Francis, Dr. Patrick Kangas, and Dr. Peter May (University of Maryland), Ms. Evelyn Tickle (James Madison University)

EFFECTS OF ROAD DEICING SALT AND TEMPERATURE ON LARVAL GREEN FROGS IN CENTRAL MARYLAND - Frank Green, Raul Morin, Andrew East, and Christopher Salice (Towson University)

BENTHIC MACROINVERTEBRATE RESPONSES TO A REGENERATIVE STORMWATER CONVEYANCE RESTORATION IN A COASTAL PLAIN STREAM - Kyle Hodgson (MDNR)

IS RNA/DNA A GOOD INDICATOR OF LARVAL YELLOW PERCH HABITAT QUALITY? - Carrie Hoover, Alexis Park, Jim Uphoff, and Margaret McGinty, (MDNR)

(STUDENT POSTER) - FINGERPRINTING SOURCES OF NITROGEN POLLUTION ON SCHOOLYARDS IN WESTERN MARYLAND - McKenna Houser, Hailey Moore, and Rebecca Kenyon-Sisler (Northern Garrett High School), Andrew Elmore, Cassie Doty, David Nelson, Joel Bostic, and Cathlyn Stylinski (UMCES)

(STUDENT POSTER) - ANALYSIS OF BACTERIAL AND ALGAL DIVERSITY IN THE ANACOSTIA RIVER - Gabrielle Humlicek, Giovanna Vazquez, Dr. Caroline Solomon, and Dr. Gaurav Arora (Gallaudet University)

(STUDENT POSTER) - ESTABLISHING BASELINE CONDITIONS BEFORE STREAM RESTORATION IN BALTIMORE AND HARFORD COUNTIES - Ginny Jeppi, Vanessa Beauchamp, and Joel Moore (Towson University)

(STUDENT POSTER) - HOW TO SURVIVE AS AN OYSTER IN BALTIMORE'S INNER HARBOR - Natalie Johnson, Jonathan Mann, and Keith Johnson (Stevenson University)

INCORPORATING DIATOM COLLECTION AND ANALYSIS IN COMBINATION WITH BENTHIC MACROINVERTEBRATES AND FISHERIES SAMPLING TO PROVIDE A MORE HOLISTIC REPRESENTATION OF WATER QUALITY CONDITIONS - Sarah T. Koser (EA Engineering, Science, and Technology), Brian Cox (Maryland State Highway Administration), Jack Holt (Susquehanna University) and Matt Harper (M-NCPPC)

MBSSTOOLS, AN R PACKAGE - Erik W. Leppo (Tetra Tech)

A SUITE OF IONS INCREASES WITH URBANIZATION IN MATTAWOMAN CREEK - Jim Long and Laurie Fortis Snow (Mattawoman Watershed Society)

DIVERSE ORGANIC CHEMICAL COMPOSITION OF MARYLAND STREAMWATERS AND OPPORTUNITY FOR ENVIRONMENTAL TRACER DEVELOPMENT - Jenna Luek and Katherine R. Martin (UMCES), Mourad Harir (Helmholtz), Andrew Heyes and Lora Harris (UMCES), Philippe Schmitt-Kopplin (Helmholtz), and Michael Gonsior (UMCES)

(STUDENT POSTER) - ASSESSING THE APPLICATION OF THE BANK EROSION HAZARD INDEX MODEL TO PREDICT STREAMBANK EROSION AT LITTLE CATOCTIN CREEK, MARYLAND - Jeremy Malen (Towson University)

(STUDENT POSTER) - NATURAL VS ARTIFICIAL THE REEF THAT FISH PREFER - Jonathan Mann, Natalie Johnson, and Keith Johnson (Stevenson University)

CANCELLED - AN EVALUATION OF FOREST IMPACTS AS COMPARED TO BENEFITS ASSOCIATED WITH STREAM RESTORATION - Kevin McGuckin and Ginny Rogers (Versar), Verl Emrick (Virginia Tech), Jennifer Saville (Versar), and Nancy Roth (Tetra Tech)

AQUATIC SPECIES DIVERSITY AND HABITAT CHARACTERIZATION IN TIDAL PARKERS CREEK - Michael Molina (American Chestnut Land Trust)

USING STABLE WATER ISOTOPES TO CHARACTERIZE PATHWAYS OF SUBSURFACE P LOSS IN A DITCH-DRAINED FIELD - Lauren Mosesso (University of Delaware)

CANCELLED - SAMPLING MARYLAND'S STATE OWNED LAKES FOR INVASIVE SPECIES - Mike Naylor and Mark Lewindowski (MDNR)

(STUDENT POSTER) - EFFECTS OF STREAM RESTORATION ON FLOW AND WATER QUALITY - Emily O'Gwin, Tom Jordan, Carey Pelc, and Joshua Thompson (Smithsonian)

ASSESSING THREATS TO MARINE WATER QUALITY CONDITIONS ALONG ASSATEAGUE ISLAND NATIONAL SEASHORE - Judith M. O'Neil (UMCES) and Catherine Wazniak (MDNR)

MERCURY IN STREAM ECOSYSTEMS OF THE KILPATRICK MARSH WATERSHED: USING INVERTEBRATRES TO EVALUATE FOODWEB EXPOSURE - Jacob Oster, Andrew Heyes, and Laura Lapham (Chesapeake Biological Laboratory)

IDENTIFY AND CLASSIFY THE POTENTIAL NON-TRADITIONAL IRRIGATION WATER SOURCES IN MID-ATLANTIC REGION - Manashi Paul and Masoud Negahban-Azar (University of Maryland)

CANCELLED - (STUDENT POSTER) - DNA COMPARISON OF MARYLAND CRAYFISH SPECIES USING CYTOCHROME C OXIDASE - John Prettyman and Joe Matanoski (Stevenson University)

THE AGRICULTURAL WATER FOOTPRINT IN THE CHESAPEAKE WATERSHED - Mary Schmidt and Dr. Masoud Negahban-Azar (University of Maryland)

INVESTIGATING BIORETENTION PERFORMANCE THROUGH FOCUS ON LANDSCAPE ARCHITECTURE DESIGN SYNTAX - Behnaz Safavi, Archana Sharma, PhD, James Hunter, PhD (Morgan State University)

CURRENT STATUS OF WATER REUSE REGULATIONS AND GUIDELINES IN MID-ATLANTIC AND U.S. - Farshid Shoushtarian and Masoud Negahban-Azar (University of Maryland)

(STUDENT POSTER) - BACTERIAL SPECIES ISOLATED FROM THE JONES FALLS WITH ENHANCED GROWTH IN RESPONSE TO USED MOTOR OIL - Mychala Snead, Sergut Admasu, Madison Socks, and Kim Pause Tucker (Stevenson University)

(STUDENT POSTER) - LINKING WILDLIFE AND ECOSYSTEM HEALTH IN A WETLAND USING THE RED-EARED SLIDER AND PAINTED TURTLE - Emily Sunnucks (Towson University) and Laura Zimmerman (Millikin University)

(STUDENT POSTER) - PLANT DIVERSITY IN A HEADWATER STREAM AS A POTENTIAL INDICATOR OF STREAM HEALTH - Jason Swartz, Makaila Lyons, Anhette Palma, Allison Parker, and Dr. Holly Martinson (McDaniel College)

PHYSICAL MONITORING AND SEDIMENT MAPPING SURVEY OF THE PATAPSCO RIVER NEAR BLOEDE DAM HOWARD AND BALTIMORE COUNTIES, MARYLAND - Elizabeth Sylvia, Stephen Van Ryswick, Katherine Knipper, Anna Gillmor, Christopher Connallon, (MDNR - Maryland Geological Survey)

FRESHWATER MUSSEL RESTORATION IN THE PATAPSCO RIVER - Jennifer Tam and Matthew Ashton (MDNR)

LONG-TERM CHANGE IN THE PATUXENT RIVER ESTUARY - Jeremy Testa, Laura Lapham, Ryan Woodland, Carys Mitchelmore, Vic Kennedy, Zachary Gotthardt, Nicole Basenback, Katie Martin, Erin Crandall, Ginni La Rosa, Mathapelo Seopela, Natalie Peyronnin (UMCES)

(STUDENT POSTER) - ANALYSIS OF HUMAN INTESTINAL PARASITES IN BIVALVES AND WATER OF THE JONES FALLS WATERSHED AND CHESAPEAKE BAY AND INNER HARBOR OF BALTIMORE MARYLAND - Connor Wasilnak, Kim Pause Tucker, and Matt Tucker (Stevenson University)

DETECTING HARMFUL 'ALGAE' IN MARYLAND LAKES - Catherine Wazniak (MDNR), Rick Stumpf (NOAA), Charlie Poukish (MDE), Celia Dawson (MDNR), Blake Schaeffer (USEPA), and Chris Luckett (MDE)

A COMPARISON OF TWO BENTHIC SUBSAMPLING METHODS AND TWO IBIS - Adam Webb (Coastal Resources)

AUTOMATIC SAMPLER COLLECTION OF LARGE-VOLUME STORM SAMPLES FOR SUSPENDED SEDIMENT-BOUND ORGANIC CONTAMINANTS FOR TMDL MODEL DEVELOPMENT IN TRIBUTARIES TO THE ANACOSTIA RIVER, WASHINGTON, D.C. - Tim Wilson, Brian Banks, Deb Bringman, Shannon Jackson, Brenda Majedi, Charles Walker, and Timothy Wilson (USGS)

TEMPERATURE MODELING FOR TMDL DEVELOPMENT AND IMPLEMENTATION IN NONTIDAL COLD STREAMS IN MARYLAND - Guido Yactayo and Greg Busch (MDE)

Plenary Abstracts

A 10,000 YEAR RECORD OF CLIMATE, FORESTS, LAND USE, AND CHESAPEAKE WATER QUALITY

Dr. Grace Brush, Professor, Johns Hopkins University

Impacts of climate change and land use on the Chesapeake ecosystem are recorded in sediments deposited in the Bay since it became an estuarine system some 10,000 years ago. These surrogate records show the effect of non-human related climate events such as the retreat of the glaciers 10,000 years ago on forest composition throughout the watershed and the change of a river system to an estuarine system. The non-human related Medieval Warm Period 1000 years ago resulted in a shift in species of marsh plants from wet to dry, but did not appear to fundamentally change the Bay system. Changes on the land, brought about by deforestation, draining of the land, changing agriculture, conversion of large areas of land to hard surfaces resulted in the transport of materials including sediments and chemicals from fertilizers into Bay waters. Thus an increasingly eutrophic/anoxic estuary resulted in a change-over from bottom dwelling communities to a living system restricted to the oxygenated upper waters. The delivery of sediment and other materials from the land to the estuary is also affected by the discharge of fresh water into the Bay, an event regulated by climate, and now presumably exacerbated by human influence.

Dr. Brush is a Professor in Johns Hopkins University's Department of Environmental Health and Engineering. She is also Director of JHU's Integrative Graduate Research and Traineeship, "Climate, Water and Health". Her research has focused on the natural forests of Maryland and their relation to geology, hydrology and soils; and the paleoecology of the Chesapeake Bay using data contained in sediment cores collected throughout the Bay and tributaries. Among her many accomplishments, Dr. Brush has received awards from the Ecological Society of America, the Estuarine Research Foundation, and the Chesapeake Research Consortium. She received her PhD from Harvard University in 1956.

THE 2016 ELLICOTT CITY FLOOD: A 225-YEAR-OLD MILL TOWN'S SURVIVAL STORY

Jim Caldwell - Director, Howard County Office of Community Sustainability

Historic Ellicott City was established as a mill town in 1772 and for almost 150 years was a thriving industrial town that used water from the surrounding streams that powered mills to grind grain and make lumber. Today the town is full of restaurants and shops that draw people from around central Maryland. Unfortunately, due to its location, age, and building density, the town is no stranger to flooding. On July 30, 2016 the town experienced a devastating flash flood that destroyed main street. This presentation will describe the various factors that led to the flood, document the level of damage and describe the subsequent rebuilding and engineering studies underway to provide greater resilience in the future.

Jim has spent his career as a local government environmental manager in the Baltimore, Washington region. Jim was appointed the Director of the Howard County Office of Community Sustainability in December of 2014. Guided by principles of science, ingenuity, sustainability and stewardship, the Office engages in water quality, economic development, agriculture, energy and education initiatives. Jim worked for Montgomery County Maryland for 25 years, and for 12 years he served as Director of the Department of Environmental Protection, overseeing natural resource protection programs for water, air, energy, and pollution prevention. His long dedication to environmental protection is grounded in training in wildlife zoology from Ohio State University and a MS in Environmental Management from American University. Jim is a member of the Board of the Maryland Water Monitoring Council, and is also a member and past chairman of the Maryland Science Center's, Science Advisory Council.

Oral Abstracts

OPPORTUNITY OF THE COMMONS: DEFINING MARYLAND'S OCEAN FUTURE

Joe Abe; joseph.abe@maryland.gov; Maryland DNR

Coauthors: Katherine McCall; MDNR, Kimberly Hernandez; MDNR

The opportunity of our ocean commons is this - the opportunity to strike a balance between the need to conserve marine resources while also accommodating changing and intensifying human uses of our ocean. The challenge is that we are still discovering and understanding the resources themselves and our shared ocean waters are governed by a multitude of entities and more than 100 different laws and regulations. Over the past several years, Maryland has worked to respond to new and proposed uses of the ocean space and resources, such as offshore energy development and increases shipping. Alongside other state, federal and tribal partners, we helped develop the first Mid-Atlantic Ocean Action Plan, a collaborative effort that aims to strike that balance between sustaining a healthy ocean ecosystem and fostering sustainable ocean uses. This session will highlight some of Maryland's work on this resource-use balance during a time of new discovery, intensifying use, and a changing climate.

With over thirty years of diverse experience, Joe Abe's career bridges the worlds of environment, energy, technology and economic development. As Coastal Policy Coordinator with Maryland Department of Natural Resources, Joe currently staffs the Coast Smart Council, updates and clarifies Maryland's enforceable coastal policies to enhance state-federal coordination, and reviews hundreds of projects to advance sustainability and climate adaptation goals. Drawing from his current role and former work as a strategic planner/environmental futurist, Joe will describe tools for helping Maryland anticipate and manage its ocean future.

ECOLOGICAL AND HABITAT RESPONSES IN PIEDMONT URBAN STREAM RESTORATIONS

Joe Acord; rhilderbrand@umces.edu; Appalachian Lab, UMCES

Coauthors: Robert Hilderbrand, Appalachian Lab, UMCES; Timothy Nuttle, CEC Inc.; Ray Ewing, CEC Inc.; Jennifer Hein, CEC Inc.

Maryland invests millions of dollars annually in stream restoration. Most activities are intended to reduce nutrients and sediments to the Chesapeake Bay. However, we lack strong evidence that stream restorations have substantial benefits to the overall ecosystem and which aspects of restorations are the most effective. We investigated 20 urban stream restorations in the Piedmont ecoregion surrounding the greater Washington DC area. Each restoration project was sampled in the restoration as well as upstream and downstream in order to make within-stream comparisons for more powerful inference. Streams had significantly greater bank stability in restored versus unrestored reaches, with associated increases in cobbles and decreases in sand substrates. Dissolved oxygen upstream of restorations was significantly lower than either restored or downstream sections. In contrast, we found minimal responses of the stream ecosystem to restoration activities within the restored reaches themselves. However, benthic invertebrate richness and EPT seems to increase downstream of restored reaches as the time since restoration passes. These preliminary results provide evidence that stream restorations show some improvement in physical function in urban streams and possibly some ecosystem improvements.

Joe Acord is a masters student working with Bob Hilderbrand at the Appalachian Lab on the effectiveness of urban stream restorations for improving the stream ecosystem.

USING SPARROW TO UNDERSTAND NUTRIENT TRENDS IN CHESAPEAKE BAY TRIBUTARIES, 1992-2012

Scott W. Ator; swator@usgs.gov; U.S. Geological Survey

Coauthors: Ana Maria Garcia, U.S. Geological Survey; Gregory E. Schwarz, U.S. Geological Survey; Joel D. Blomquist, U.S. Geological Survey; Andrew J. Sekellick, U.S. Geological Survey

Adaptive management of water quality requires understanding the causes of past trends. We adapted spatially-referenced regression (SPARROW) modeling to infer causes of observed trends between 1992 and 2012 in nitrogen and phosphorus fluxes in Chesapeake Bay tributaries. The declining annual nitrogen flux to the bay from its watershed during this period was due primarily to a substantial decline in point-source inputs. Contributions from atmospheric deposition also declined, but represent a relatively minor source of nitrogen to the bay. Although changes in average annual nitrogen yields from agricultural and urban non-point sources suggest possible implications of evolving land management practices, changes in the total flux of nitrogen from these sources to the bay between 1992 and 2012 were relatively minor. Phosphorous contributions to local streams similarly changed little from non-point sources but declined substantially from point sources. Regardless of upstream trends, however, phosphorus delivery to the bay has increased since 1992 due to substantially reduced retention of phosphorus from the Susquehanna River in Conowingo Reservoir. Meeting nutrient flux targets mandated for 2025 by the Clean Water Act will require a reversal in phosphorus trends and accelerated nitrogen reductions over those observed between 1992 and 2012.

Scott Ator has been a hydrologist with the USGS in Baltimore since 1994. His current research focuses mainly on developing watershed models to improve our understanding of the natural and human factors affecting the occurrence, distribution, fate, and transport of contaminants in groundwater and streams over large regions, including the Chesapeake Bay watershed and the wider Northeastern United States.

CAPACITY BUILDING FOR RESILIENCE

Kristin Baja; kristinbaja@usdn.org; Urban Sustainability Directors Network

Coauthor: Kim Grove, Chief Office of Compliance & Laboratories, Baltimore City Department of Public Works

When planning for and responding to natural disasters and a changing climate it is vital that implementation of strategies provide multiple benefits, promote equity, and protect communities and the assets that underpin their well-being. Successful water management strategies are built on strategic partnerships across public and private sectors. This session will focus on local and regional level approaches that demonstrate effective resilience-building and collaborative efforts centered on high-impact practices and transformational change.

Kristin Baja is the Climate Resilience Officer for the Urban Sustainability Directors Network (USDN). In this role, she is responsible for helping cities identify strategic ways to advance climate resilience planning and implementation, and build capacity to take action.

MANAGING LAKES- BUILDING A STATE FRAMEWORK

Barbara Beelar; barbara@friendsofdcl.org; Friends of Deep Creek Lake

Of the 120 plus lakes, reservoirs and ponds in Maryland, 15 are State owned. Maryland lakes are man-made and manifesting of "aging"—sediment accumulation and decline of water quality. The 2015"State Lakes Aquatic Species" bill, intended to prevent further introduction of AIS in these lakes, was the first time the concept "state-owned lakes" was used, recognizing the state is owner and lead responsible party for sustainability of these waterways. In 2017 the State Lakes Protection and Restoration Fund was enacted into law as a fiscal mechanism. The next step is to secure state commitment to provide sustaining funding for protection programs and restoration projects for state owned lakes.

Barbara Beelar, Director of Friends of Deep Creek Lake, has been working to protect and restore this major state-owned natural, recreational resource in the Youghiogheny Watershed of Maryland. Beelar grew up at DCL and is striving to ensure that future generations will also be able to enjoy this special place. In the past couple years, Friends of DCL has become active in Annapolis and helped to secure passage of 2 laws and will be returning this winter to help secure allocation of state funding for the 15 state-owned lakes.

IMPROVEMENTS IN QUANTIFYING BANK EROSION FOR SEDIMENT BUDGETS WITHIN THE CHESAPEAKE BAY WATERSHED BY INTEGRATING STRUCTURE-FROM-MOTION PHOTOGRAMMETRY

Joseph Bell; jmbell@usgs.gov; US Geological Survey

Coauthors: Matthew Chasman, USGS; Lucas Nibert, USGS; Shannon Jackson, USGS

Piedmont streams in the Mid-Atlantic region of the United States are often characterized as incised with steep, erodible banks of legacy sediment that can contribute to high sediment loads. Sediment fingerprinting studies in this region show that stream banks can contribute a large proportion of the sediment load, but are frequently overlooked in sediment delivery models and Total Maximum Daily Load allocations. Direct quantification of bank erosion is essential to producing accurate sediment budgets to inform the targeted mitigation and remediation of degraded fluvial systems. This study contrasts the use of traditional bank pin measurements and structure-from-motion photogrammetric techniques (SfM) at an agricultural site near Frederick, MD. Bank pin measurements were found to be highly variable with subjective initial placement often missing nearby, large-scale bank failures. In contrast, SfM, were able to capture a more spatially-complete streambank profile. However, during summer months, SfM exhibited coverage gaps in areas of high vegetation density. An SfM approach of quantifying geomorphic change, when coupled with bank-sediment bulk density, has promise to accurately quantify volumetric change as well as sediment loads originating from bank erosion, and may provide valuable data of the quantification of bank erosion for incorporation into regional sediment models.

Joseph Bell is a hydrologist with the USGS Water Science Center located in Baltimore, MD. Joseph's work includes water-quality monitoring and modeling for TMDL compliance and restoration efficacy evaluation.

STREAM MONITORING TO PRIORITIZE RESTORATION AND RESILIENCE

Britta Bierwagen; bierwagen.britta@epa.gov; U.S. Environmental Protection Agency

Coauthors: Jen Stamp, Tetra Tech; David Gibbs, ORISE at US EPA; Anna Hamilton, Tetra Tech

The value of long-term monitoring is not only the documentation of condition and trends, but also the application of the data to identify sites ranging from vulnerable to resilient. Assessments of vulnerability to environmental change or extreme events paired with monitoring data can highlight sites at regional scales along such a gradient. This information could help to identify sites that could improve overall resilience, but that are currently in poor condition. Restoration of such sites would improve local stream conditions and contribute to broader long-term watershed resilience. We use the Biological Condition Gradient as a framework paired with vulnerability assessment to identify potential monitoring sites along a spectrum of condition and resilience. Sites also can be evaluated for their restoration potential. Monitoring of these sites can demonstrate effectiveness of these actions to improve stream ecosystem conditions in the near-term, as well as contribute to improving watershed resilience in the long-term. The goal of this work is to highlight sites that states and tribes can select for restoration that will ultimately improve environmental conditions and confer long-term resilience to aquatic ecosystems.

Disclaimer: The views expressed are the authors and do not reflect the views of the US EPA.

No bio submitted

COMPILING WELLWATER QUALITY DATA FROM MULTIPLE DATABASES IN MARYLAND: OPPORTUNITIES AND CHALLENGES

David W. Bolton; david.bolton@maryland.gov; Maryland Geological Survey

Coauthors: Heather Quinn, Maryland Geological Survey; David Andreasen, Maryland Geological Survey; Johanna Gemperline, Maryland Geological Survey

Wellwater quality data are routinely collected throughout Maryland by local, state, and federal agencies. The data are collected for varying objectives, and samples are analyzed for different water-quality constituents using different collection protocols, analytical techniques, and detection and reporting levels. County health departments test wells for nitrate and bacteria; some also require testing for arsenic, radioactivity, chloride, iron, cadmium, and other constituents before a Certificate of Potability can be issued. Public-supply wells are tested for constituents that have drinking water standards established by the U.S. Environmental Protection Agency. Groundwater studies have been conducted by federal, state, and local agencies to investigate specific research topics. Compiling and assessing data from multiple data sources into a GIS-based data set can help identify trends, suggest causative factors, spot data gaps, and examine data in relation to health issues. Challenges include accuracy of well-location data, transcription errors, different reporting and detection levels, and identifying treated versus untreated water samples. This talk will present the Maryland Geological Survey's experience with compiling wellwater quality data from multiple sources, focusing on Garrett and Anne Arundel Counties.

Mr. Bolton is Hydrogeology and Hydrology Program Chief at the Maryland Geological Survey (part of the Resource Assessment Service of the Maryland Department of Natural Resources). He has worked at the Maryland Geological Survey since 1989, focusing on groundwater quality and the distribution of naturally-occurring contaminants including arsenic, radium, and cadmium. Prior to working at MGS, he worked for 7 years as a petroleum geologist in Houston and New Orleans. He is a member of the State Water Quality Advisory Committee, and has served in the past on the Board of Directors of the Maryland Water Monitoring Council and the Maryland State Geologic Mapping Committee.

THE STATE OF LAKES IN A CHANGING WORLD

Lisa Borre; borrel@caryinstitute.org; Cary Institute of Ecosystem Studies/North American Lake Management Society (NALMS)

For inland waters, the impacts of climate change are perhaps not as obvious as rising sea levels and regular coastal flooding but no less real. With lake surface water temperatures on the rise, declining winter ice cover, and changing precipitation patterns, including more frequent and intense rain events as well as droughts and floods, climate change is already having an impact on lakes and reservoirs around the world. Changes in climate are creating more favorable conditions for harmful blooms of cyanobacteria, increased runoff of sediment and nutrient pollution, and the spread of invasive species. Climate change is also affecting the hydrology of lakes, creating water scarcity and/or flooding concerns depending on the local and regional situation. This talk provides an overview of global and national lake research and assessment activities as an introduction to a session about lake management in MD. The Global Lake Ecological Observatory Network (GLEON) uses team science, sensor technologies, and also relies on citizen science through the Lake Observer mobile app project. The EPA National Lakes Assessment (NLA) assesses the state of lakes in the U.S. The North American Lake Management Society (NALMS) is now in its 23rd year of the annual Secchi Dip-In event. All contribute to our understanding of water quality trends and how climate change impacts lakes and watersheds.

Lisa Borre is a Senior Research Specialist at the Cary Institute of Ecosystem Studies and provides research support for Dr. Kathleen C. Weathers, co-chair of the Global Lake Ecological Observatory Network (GLEON), and project coordination for Lake Observer, a mobile application for recording lake and water observations across the globe. She is Region 3 Director (2017-2019) of the North American Lake Management Society (NALMS); on the Advisory Council of the Lake Champlain Committee, and an investigator with the SAFER Project: Sensing the Americas' Freshwater Ecosystem Risk from Climate Change. She writes about global lake topics for National Geographic's Water Currents blog.

EXPLORING THE USE OF STRUCTURE FROM MOTION SURVEYING AS A COST-EFFECTIVE MEANS TO QUANTIFY LANDSCAPE CHANGE IN NEAR REAL-TIME

Matthew J Cashman; mcashman@usgs.gov; US Geological Survey

Coauthors: Joseph Bell, USGS; Lucas Nibert, USGS

Structure from motion (SfM) is a photogrammetric range imaging technique for estimating three-dimensional structure from a sequence of two-dimensional images. SfM surveys are capable of producing high-resolution landscape models with precision and accuracies that rival that of Light Detection and Ranging (LiDAR) surveying. SfM methods are a fraction of the cost of LiDAR surveys; however, ground-control and post processing is required to ensure the rendering of high-quality, accurate 3D structures. The US Geological Survey in Maryland is exploring the use of SfM surveys to characterize and quantify temporal and event-driven changes across a myriad of landscapes that include agricultural floodplains and coastal environments. Results from this pilot study support the use of SfM surveying to monitor and quantify changing landscapes in near real-time. State and local agencies may benefit from using repeated terrestrial or aerial SfM surveying to accurately monitor changing floodplains, streambanks, and channel morphology after a restoration, or quantify the total mass of sand eroded by a coastal storm at fractions of the costs of LiDAR surveys. Additionally, SfM surveying has applicability in the fields of habitat assessment, vegetation density, and species identification studies.

Dr. Matthew Cashman received his PhD in River Science from Queen Mary, University of London and the Free University of Berlin. He now works for the US Geological Survey in Baltimore as a hydrologist/geomorphologist. His work focuses on sediment fingerprinting, advanced survey methods, and the relationship between restoration, physical habitat, and ecological communities.

CHESAPEAKE MONITORING COOPERATIVE

Liz Chudoba; lchudoba@allianceforthebay.org; Alliance for the Chesapeake Bay

Coauthor: Emily Bialowas, Izaak Walton League

This presentation will discuss the benefits and success stories of the Chesapeake Monitoring Cooperative. The Chesapeake Monitoring Cooperative (CMC) is a group of leading organizations providing technical, logistical, and outreach support for the integration of new water quality and macroinvertebrate monitoring data into the Chesapeake Bay Program Partnership. This projects goal is to create a community where all data of known quality are used to inform watershed management decisions and restoration efforts by bringing together the grass roots volunteer monitoring organizations in a Cooperative to pool their data to support a larger use at the State and Federal level.

Liz Chudoba is the program manager for the Alliance for the Chesapeake Bay since August 2015. She graduated from the University of North Carolina Wilmington with a MS in Marine Science and Vermont Law School with a Masters of Environmental Law and Policy. Liz is the water quality program manager for the Chesapeake Monitoring Cooperative.

ECOLOGICAL IMPACTS OF REGENERATIVE STREAMMWATER CONVEYANCE (RSC) SYSTEMS IN MARYLAND'S COASTAL PLAIN

Rebecca Cope; cope.rebecca@epa.gov; US EPA Region 3

Coauthor: Greg Pond, US EPA Region 3

Regenerative streamwater conveyance systems include urban stream restoration techniques typically consisting of a series of rock weirs intended to impede the flow of stormwater runoff, reduce sediment transport, and increase nutrient uptake by directing water into the subsurface. Despite their increasing popularity, many questions remain about the effectiveness and unintended ecological impacts of RSC's. A year-long study of water quality and riparian vegetation at 16 restored sites revealed frequent hypoxic conditions, extensive iron oxidizing bacteria as well as substantial impacts to riparian vegetation structure. Extreme variability within and among sites suggests that impacts are highly dependent on local site conditions and external environmental factors. Benthic macroinvertebrates were sampled at a subset of RSCs and revealed that RSCs did not improve aquatic life compared to un-restored control sites, and in some cases, degraded the macroinvertebrate assemblage. Further sampling to estimate quality and quantity of riparian organic matter inputs is ongoing.

Rebecca Cope is a participant in the ORISE Research Program at EPA Region 3 in the Water Protection Division. Her research focuses on restoration ecology in coastal systems with an emphasis on geospatial modeling. She holds a Masters of Environmental Management from Duke University and a B.S. in Biology from Connecticut College.

PUBLIC HEALTH IMPLICATIONS OF THE DEATHS OF TWO MARYLAND DOGS EXPOSED TO HARMFUL ALGAE

David A. Crum, DVM, MPH; David.crum@maryland.gov; Maryland Department of Health

Coauthors: Cliff Mitchell, MS, MPH Maryland Department of Health; Nancy Servatius, Maryland Department of Health; Catherine Wazniak, Maryland Department of Natural Resources; Charles Poukish, Maryland Department of the Environment; Katherine A. Feldman, DVM, MPH Maryland Department of Health

Harmful algal blooms (HABs) occur worldwide, and when algae produce toxins, they can adversely impact human and animal health via potent hepatotoxic or neurotoxic mechanisms. When animals are affected, a diagnosis is typically made based on history, clinical presentation and occasionally, testing of tissues or water for algae or toxin. In 2009, two previously healthy pet dogs became acutely ill with lethargy, vomiting, diarrhea and seizures six hours after playing in a local pond. Despite aggressive therapy, both dogs developed liver failure and were euthanized. Necropsy of both dogs revealed evidence of liver necrosis consistent with blue-green algae toxicosis and in both cases, definitive diagnosis was made via detection of algal toxin in fresh liver extracts. A subsequent investigation, involving partners from local and state authorities, confirmed the presence of toxigenic algae and toxins in the pond where the dogs played. Public health messaging was posted at the pond and no further human or animal exposures were identified. This case illustrates how animals may serve as sentinels for human health risks and underscores the need for a One Health collaborative framework to encourage integration and communication among health disciplines, educate healthcare providers and veterinarians on HAB-related health events, and encourage timely reporting to public health authorities.

David Crum graduated from Cornell University College of Veterinary Medicine in 2002 and practiced exotic animal medicine for over 13 years. In 2016, he completed his MPH from George Mason University and made the transition from clinical veterinary practice to a career in public health. Dr. Crum joined the Center for Zoonotic and Vector-borne Diseases at the Maryland Department of Health in 2017 and has been active with rabies control and prevention activities. His interests include tick borne diseases and the promotion of the ONE Health concept, highlighting the relationship between human and animal health.

CATTAIL CREEK STREAM RESTORATION AT MAPLE DELL FARM

Lindsay DeMarzo; ldemarzo@howardcountymd.gov; Howard County Office of Community Sustainability

Howard County faces considerable regulatory and community pressure to address water quality and stream health. One of Howard County's main stormwater management challenges is finding available land to install stormwater treatment facilities. As available public lands are exhausted, the County will be forced to focus future stormwater projects on private land.

The Cattail Creek Stream Restoration at Maple Dell Farm is a public-private partnership project that includes 6,200 linear feet of stream restoration running through dairy pasture, making it the longest stream restoration in the County.

The project demonstrates the ability to implement and maintain good environmental practices on a modern farm, while highlighting the positive outcomes of combining these efforts for improved farming operations and improved stream health. The project includes perpetual easements that will protect both the stream and the farmland.

The project showcases multiple BMPs that curb runoff and reduce stream impact, while maintaining cost efficiency, and is accompanied by a robust monitoring program. Howard County intends that this unique multi-benefit, multi-party collaboration will serve as a model for future projects identified on private lands with similar varied community and environmental benefits.

Ms. DeMarzo manages Howard County's commercial and nonprofit stormwater programs, as well as oversees stormwater policy and pilot project development. Ms. DeMarzo has worked for Howard County for over 10 years in stormwater, sustainability, and environmental planning. Previously, she held a NOAA Coastal Management Fellowship with the Maryland Department of Natural Resources and worked on green infrastructure network development with The Conservation Fund and the Milwaukee Metropolitan Sewerage District in Milwaukee, WI. Ms. DeMarzo holds a double BS from Marquette University in Biology and in Urban and Environmental Affairs, and a Masters of Environmental Management from Duke University.

COMMUNICATING CHALLENGES AND SUCCESSES IN A CHANGING WORLD

Bill Dennison; dennison@umces.edu; Opinion Works

Coauthor: Steve Raabe, Opinionworks

It is increasingly important to engage the public in our work. This interactive workshop focuses on water quality outreach to diverse audiences in an evolving communications landscape. How do we craft our messages, target our audiences, and choose when and where to communicate? How do we know if the public is actually hearing our messages?

Participants will be invited to offer their own communication challenges and strengths. Examples of effective outreach strategies and evaluation processes will be presented, drawn from experienced science communicators. Original audience research will be shared. Additionally, participants will receive a suite of specific resources to enhance their organization's communication effectiveness.

No bio submitted

URBAN LEGACIES: AQUATIC STRESSORS AND LOW BIODIVERSITY PERSIST AFTER STORMWATER MANAGEMENT IMPLEMENTATION

Rosemary Fanelli; rfanelli@usgs.gov; University of Maryland-College Park MEES graduate program

Coauthors: Karen Prestegaard, University of Maryland-College Park Department of Geology; Margaret Palmer, University of Maryland-College Park Department of Entomology and National Socio-Environmental Synthesis Center

Multiple stressors from urbanization impair headwater stream ecosystems. Watershed managers implement infiltration-based stormwater control measures (SCMs) to mitigate the effects of urbanization, though most SCM implementation focuses on reducing sediment and nutrient loading. Much less is known about the effects of SCMs on other urban stressors, including those to which aquatic ecosystems are particularly sensitive (e.g. flow patterns, temperature, and conductivity). To address this research gap, we examined the hydro-ecological effects of SCM implementation in 11 headwater streams, including four forested streams, four urban streams, and three urban streams whose watersheds have been implemented with regenerative stormwater conveyances, a type of infiltration-based SCM. Mean annual baseflow and dissolved oxygen were significantly lower in urban streams, regardless of SCM implementation. Conductivity, runoff frequency, and daily maximum water temperatures increased with higher watershed impervious cover. Aquatic insect abundance and diversity was significantly lower in all urban streams, regardless of SCM implementation in their watersheds. Conductivity explained most of the variability in insect community composition across sites. These results highlight the need to identify drivers of ecosystem degradation to help guide the design of mitigation strategies.

Rosemary is a hydrologist with the U.S. Geological Survey at the MD-DE-DC Water Science Center, where she studies the effects of land use change and watershed management on water quality and quantity in the Chesapeake Bay watershed. Rosemary completed her Ph.D. in Environmental Science at the University of Maryland-College Park in 2016; her dissertation research is the focus of this presentation. Before completing her doctoral degree at the University of Maryland, Rosemary earned a MS degree at SUNY-ESF in Syracuse, New York, where her thesis focused on groundwater-surface water interactions, streambed biogeochemistry, and using heat as a tracer for understanding hydrological processes.

WHAT CAN A TEENY-TINY NONPROFIT DO?

Chuck Foster; friendsofthebohemia@gmail.com; President, Friends of the Bohemia, Inc.

In our new reality, with environmental groups facing challenges such as the evaporation of funding, regulatory attitude shifts and mounting pressure from those on the other side of the "environment vs. economics" balance scale, what can a small nonprofit organization do to make a difference? In this session we'll explore strategies employed by Friends of the Bohemia, Inc., an all-volunteer watershed improvement association. What do we do, where should we focus, how do we keep momentum going and how do we pay for it? Hopefully, sharing our story will encourage others to embrace the concept that even small steps can eventually lead to success.

Chuck grew up in Wilmington, DE and spent almost every weekend of his childhood on the Bohemia River. After a banking career that led them all around the country, Chuck and his wife, Linda, retired to the shores of the Bohemia in 2012. Remembering the clear waters of his youth and a river teaming with fish, crabs and grasses, Chuck resolved to do his part to preserve and protect the beauty around him. With the encouragement and strong support of the Sassafras River Association and Cecil County, Chuck and Linda spearheaded the formation of the Friends of the Bohemia.

FOCUS ON NONTRADITIONAL IRRIGATION WATER IN A CHANGING CLIMATE: ASSESSING FARMERS' NEEDS, WATER QUALITY, AND ACCESSIBILITY

Rachel Rosenberg Goldstein; msuri1@umd.edu; University of Maryland

As climate variability continues and places severe stress on high-quality agricultural irrigation water sources (e.g. groundwater), it is essential to explore alternative water resources for irrigating crops. To facilitate adoption of these nontraditional irrigation water sources, understanding of farmers' needs, water quality, and accessibility is critical. A needs assessment survey covering farmers' current irrigation water sources, familiarity with nontraditional water, and concerns was distributed to Maryland farmers (n=188) in 2017, online and at stakeholder meetings. Survey data was collected with Qualtrics and analyzed with STATA. Survey results found the majority of growers were concerned with water availability (66%), consider nontraditional water in agriculture at least moderately important (63%), and would use nontraditional water to supplement current water sources (73%) if available. Water quality and health risks were farmers' top concerns related to nontraditional water.

Dr. Rachel Rosenberg Goldstein specializes in environmental health focusing on environmental microbiology, water testing, and environmental communication. Dr. Goldstein received a Ph.D. in Toxicology and Environmental Health and an M.P.H. in Environmental Health Sciences from the University of Maryland, and a BA in Environmental Studies from the University of North Carolina-Chapel Hill. Dr. Goldstein is currently the Co-Project Director for the Extension Activity with CONSERVE: A Center of Excellence at the Nexus of Sustainable Water Reuse, Food, and Health.

CAPACITY BUILDING FOR RESILIENCE, PART II

Kimberly Grove; kimberly.grove@baltimorecity.gov; Baltimore City

Coauthor: Kristin Baja; USDN

When planning for and responding to natural disasters and a changing climate it is vital that implementation of strategies provide multiple benefits, promote equity, and protect communities and the assets that underpin their well-being. Successful water management strategies are built on strategic partnerships across public and private sectors. This session will focus on local and regional level approaches that demonstrate effective resilience-building and collaborative efforts centered on high-impact practices and transformational change.

Kim Grove is a professional engineer, whose 20+ years of experience has spanned the spectrum of civil engineering including stormwater management, land development design, environmental site assessment and remediation, geotechnical engineering and forensic analysis, construction management, and materials testing. A graduate of the Florida Institute of Technology, Ms. Grove spent most of her career as a private engineering consultant working throughout the Southeast and mid-Atlantic region, until she joined Baltimore City Department of Public Works in December 2010. Ms. Grove currently serves as the Chief for the Office of Compliance and Laboratories, which is committed to enhancing environmental regulatory compliance for the Department through collaboration, management program improvements, and regulatory enforcement. Starting in 2016, Ms. Grove served on the technical advisory committee for the National Green Infrastructure Certification Program (NGICP), a collaborative effort led by WEF to establish national certification standards for green infrastructure construction, inspection, and maintenance workers. She also works with the Urban Waters Federal Partnership Actionable Science Committee and the Baltimore Ecosystem Study to integrate scientific research with policy decisions for the Department.

FLOODPLAIN MAPPING TOOLS AVAILABLE NOW AND E-COLLABORATION TOOLS UNDER DEVELOPMENT

David Guignet; dave.guignet@maryland.gov; Maryland Department of the Environment

The Maryland Department of the Environment (MDE) has been coordinating a digital floodplain remapping effort in Maryland since 2006; and has developed a web site to convey up to date floodplain delineations and their related technical information to the public, local officials, and the Engineering community. The project is approximately 80% complete and has had more than 225,000 hits / views for information or data. More recently, MDE has undertaken the task of creating an e-Collaboration project to coordinate Inter-Agency review and comments on the State's Joint Permit Authority (JPA) for wetlands and waterways permits. The e-Collaboration project will utilize the framework and design of the Watershed Resource Registry (WRR) to house a public facing search portal of activities associated with JPA process. The project is currently evaluating the process of exchanging information between MDE, the U.S. Army Corps of Engineers (Baltimore District), SHA, MDOT, DNR, MHT, and Critical Area Commission. The MDE project manager will demonstrate both sites and their potential uses.

Dave has been the National Flood Insurance Program (NFIP) State Coordinator in Maryland, and the State's Cooperating Technical Mapping Partner (CTP) Project Manager since 2008. Until recently, Dave also was the chief of MDE's Regulatory Service Division in charge of the Permit Coordination Section, and the Mitigation Section in the Wetlands and Waterways Program at MDE. Dave is still in charge of the NFIP functions at MDE, but has recently transferred to Environmental Assessment and Standards Program to act as the project manager for the e-Collaboration effort at MDE.

MARYLAND ROADWAY VULNERABILITY ASSESSMENT

Elizabeth Habic; ehabic@sha.state.md.us; MDOT State Highway Administration

In 2014, SHA completed the "Maryland State Highway Administration Climate Change Adaptation Plan with Detailed Vulnerability Assessment" as part of a Climate Resilience Pilot Program that FHWA sponsored to "assess transportation vulnerability and evaluate options for improving resilience." MDOT SHA's team developed a vulnerability assessment methodology and GIS data consisting of water surfaces to analyze vulnerability to flooding due to sea level rise, storm surge, and precipitation. Sea level rise projections were recalculated and mapped using the best available elevation data to determine impacts. SHA utilized FHWA's Vulnerability Assessment Scoring Tool (VAST) to determine vulnerability of bridges and created the Hazard Vulnerably Index (HVI) for linear roadway assets, located in Anne Arundel and Somerset counties. Building on the approach and data MDOT SHA developed as part of the 2014 pilot study, flood depth grids were then developed for the 10%, 4%, 2%, 1%, and 0.2% storms using FEMA's HAZUS tool. These HAZUS layers were developed for the current mean sea level and mean higher high water in 2015 and for future years 2050 and 2100. In 2017, all HAZUS layers in the coastal areas were completed statewide. The results of this data development are already being used to support MDOT SHA project planning and design activities.

Elizabeth Habic is the climate resiliency and risk program manager at the Maryland Department of Transportation's State Highway Administration. Elizabeth has worked with MDOT in various capacities since 2002 and has been the climate change program manager since initiation in 2008 when the Maryland Climate Action Plan was completed. Elizabeth led the 2013-2014 FHWA climate adaptation pilot and completed the "Climate Change Adaptation Plan with Detailed Vulnerability Assessment" in October 2014. Elizabeth coordinates with both State and Federal partners to further the community of practice for infrastructure resiliency planning.

DAM REMOVAL MONITORING IN THE PATAPSCO- ESTABLISHING A BASELINE FOR BIOLOGICAL CONDITIONS PRIOR TO THE REMOVAL OF BLOEDE DAM

William Harbold; william.harbold@maryland.gov; Maryland Department of Natural Resources

The Maryland Department of Natural Resources Monitoring and Non-Tidal Assessment Division has been working to assess ecological changes in the Patapsco River associated with dam removal since 2009. During that time two dams have been removed- Union Dam in 2009 and Simkins Dam in 2010. The third and largest removal- Bloede Dam- is currently underway, on target for completion by the end of 2018. Monitoring has focused on four main areas to determine the removals' impacts on the Patapsco ecosystem: anadromous fish, American eels, resident fish, and benthic macroinvertebrates. Sampling before the removal of Simkins Dam (2009-2010) established a baseline that, when compared with data collected post-removal (2011-2014), illustrated some of the effects of Simkins' removal in the river's biota. These impacts were spurred primarily by habitat change, as lotic habitats returned to the former Simkins impoundment and fine grained sediments trapped behind the dam were released to disperse downstream. Sampling has continued beyond this post-Simkins period, transitioning to a pre-Bloede focus during 2015-2017. Data collected during this time serve to establish a pre-removal baseline for Patapsco River biota on the eve of Bloede's removal. Using the results from post-Simkins monitoring we can form hypotheses about how the ecosystem will respond to this latest restoration effort.

William Harbold is an aquatic biologist employed by the Maryland Department of Natural Resources. He has worked with the Maryland Biological Stream Survey to monitor dam removals on the Patapsco River since 2010.

FROM HORSE-DRAWN CARRIAGES TO CITY COMMUTER ROUTES: A STORY OF URBAN WATERSHED REVIVAL IN THE CHESAPEAKE BAY

Matt Harper; matthew.harper@montgomeryparks.org; Montgomery County Parks

Coauthor: Ken Mack, Montgomery County Department of Environmental Protection

Sligo Creek is a headwater tributary of the Anacostia River, draining over 6,000 acres of highly urbanized land across Silver Spring, Maryland. In the 1930's, a narrow strip of parkland along the entire length of this creek was acquired by Maryland National Capital Park and Planning Commission (M-NCPPC) to provide park users the opportunity to experience nature via a parkway. Subsequent development of the watershed pre-dated the modern environmental movement, leading to a gradual decline in watershed health. Over the past 30 years, a joint holistic restoration effort between local stakeholders and county, state, and federal agencies has helped the ecology rebound in this valuable natural resource and reinvent it as a nature-based recreational destination that is accessible for a wide variety of activities and uses. County-level biological monitoring data and historical archives will be used to tell the story of this transformation and the ongoing efforts that continue to improve the aquatic community in the watershed.

Matt is an aquatic ecologist with Montgomery Parks with over 10 years of experience in the field. Matt runs Parks' biological monitoring program and specializes in environmental review of stormwater management and stream restoration projects on parkland.

IN-STREAM IMPOUNDMENT REMOVAL AND STREAM CHANNEL CREATION FOR BROOK TROUT RESTORATION AND CONSERVATION IN A GARRETT COUNTY, MARYLAND, STREAM

Alan Heft; alan.heft@maryland.gov; Maryland DNR

Coauthor: Matt Sell; MD DNR

Restoring brook trout Salvelinus fontinalis habitat is a priority of Maryland DNR's Brook Trout Program. In 2008 an instream impoundment on the upper Savage River was identified as impacting the brook trout population, warming the water and acting as a blockage. The impoundment was a former water supply pond for the City of Frostburg, decommissioned due to sediment and a failing dam. An agreement was made to remove the pond and create 1,000' of stream channel. Partners included the City of Frostburg, Maryland Environmental Services, Canaan Valley Institute, Savage River Watershed Association, National Fish & Wildlife Foundation, Nemacolin Chapter of TU, and the Chesapeake Bay Trust. This project was the first high profile effort by the Savage River Watershed Association, helping to establish a positive image among local landowners. The project also serves as a demonstration site for stream restoration techniques, and is the first large scale restoration project in the watershed for brook trout conservation. Completed in 2010, a single brook trout was first found in the restored section in 2011, increasing annually to a high of 23 collected in 2017, ranging in size from 70 - 245mm. This project created 1,000 feet of new stream habitat and a recreational fishery for native brook trout, eliminated a fish passage blockage, and improved downstream water temperatures.

Alan Heft has been a Fisheries Biologist for the Maryland Department of Natural Resources Freshwater Fisheries Division for 29 years, managing statewide Brook trout activities and research since 2001. He is a member of the Eastern Brook Trout Joint Venture Steering Committee, a member and past chair of the Southern Division of the American Fisheries Societies' Trout Committee, and an American Fisheries Society Certified Fisheries Scientist. He received his B.S. in Fisheries Management from Frostburg State University, and is an Associate at the University of Maryland's Appalachian Laboratory in Frostburg, Maryland.

OPPORTUNITY OF THE COMMONS: DEFINING MARYLAND'S OCEAN FUTURE

Kimberly Hernandez; kimberly.hernandez@maryland.gov; Maryland DNR

Coauthors: Katherine McCall; MDNR, Joe Abe; MDNR

The opportunity of our ocean commons is this - the opportunity to strike a balance between the need to conserve marine resources while also accommodating changing and intensifying human uses of our ocean. The challenge is that we are still discovering and understanding the resources themselves and our shared ocean waters are governed by a multitude of entities and more than 100 different laws and regulations. Over the past several years, Maryland has worked to respond to new and proposed uses of the ocean space and resources, such as offshore energy development and increases shipping. Alongside other state, federal and tribal partners, we helped develop the first Mid-Atlantic Ocean Action Plan, a collaborative effort that aims to strike that balance between sustaining a healthy ocean ecosystem and fostering sustainable ocean uses. This session will highlight some of Maryland's work on this resource-use balance during a time of new discovery, intensifying use, and a changing climate.

Kim Hernandez has worked on ocean and coastal issues at the Maryland Department of Natural Resources for the past three years, first as a NOAA Coastal Management Fellow and now in the Center for Coastal Planning. A native of Kansas, Kim's interests in protecting the oceans stemmed from childhood visits to the beaches of South Padre Island, Texas, and then solidified while scuba diving the Great Barrier Reef during an undergraduate semester abroad. She holds a Bachelor of Science in Environmental Studies and International studies from the University of Kansas and a Master of Environmental Management from Duke University.

ARE BROOK TROUT POPULATIONS IN MARYLAND FUNCTIONALLY EQUIVALENT?

Nathaniel (Than) Hitt; nhitt@usgs.gov; US Geological Survey, Leetown Science Center

Coauthors: Erin Snook, USGS Leetown Science Center; Stella Barrat, USGS Leetown Science Center; Matthew Morgan, USGS Leetown Science Center; Mark Staley, Maryland Department of Natural Resources; Matt Sell, Maryland Department of Natural Resources.

Species conservation planning requires consideration of the substitutability of populations. In this study we used a common-garden experiment to compare the functional similarity of native Brook Trout (*Salvelinus fontinalis*) populations in Maryland. We sourced fish from 4 populations (separated by > 3 km): Crabtree Creek Upper (CTU), Crabtree Creek Lower (CTL), Walker Run Upper (WRU), and Walker Run Lower (WRL). These populations encompass relatively warm streams in eastern Maryland (Gunpowder River basin [WRU, WRL]) and cold streams in western Maryland (Savage River basin [CTU, CTL]). We acclimated the wild fish to experimental stream channels at the Leetown Science Center. No fish experienced acute acclimation mortality (i.e., within 48 hours), but most WRU fish became infected with cotton mold (*Saprolegnia* sp.) within 3 weeks of introduction, suggesting a secondary stress response unique to the WRU population. Statistical models revealed significant differences in growth among source populations: CTL fish exhibited greater increases in body condition than fish from other populations, despite equivalent conditions and feeding rates across experimental stream channels. Our results therefore suggest that Brook Trout populations in Maryland may not be functionally equivalent, even among populations within the same stream.

Dr. Nathaniel (Than) P. Hitt is a Research Fish Biologist at the U.S. Geological Survey's (USGS) Leetown Science Center in Kearneysville, West Virginia. He holds a B.A. in Biology from the College of Wooster, an M.S. in Organismal Biology and Ecology from the University of Montana, and a Ph.D. in Fisheries and Wildlife Sciences from Virginia Tech. Dr. Hitt's research investigates freshwater fish ecology from a landscape perspective, focusing on stream ecosystems in the Appalachian highlands.

CLEARING THE WATERS OF THE MUDDY BRANCH WITH CITIZEN SCIENCE

Paul Hlavinka; paul.hlavinka@maryland.gov; Muddy Branch Alliance Board Member

Volunteer organizations are limited by lack of resources or manpower in their role to protect or improve water quality. Add to this the challenge of engaging diverse communities which are often very transient, and the challenge grows. Activities such as water quality monitoring, especially Stream Waders, are easy ways to engage a smaller community while using social media to extend the reach and impact. The talk will discuss the activities underway in the Gaithersburg area along the Muddy Branch and how the Muddy Branch Alliance is dealing with this changing world to try clear the local waters.

Mr. Hlavinka has a Masters in Environmental Engineering from the University of Maryland and works in the environmental field. As an avid sailer, he has a personal interest in the health of the Chesapeake Bay. He has been active in many environmental organizations including Chesapeake Bay Foundation and Chesapeake Water Environment Association. He has also served in leadership with several churches and is very excited to work with several faith based groups within the watershed.

LESSONS LEARNED IN PLANNING AND PRACTICE: USING "LESS IS MORE" AS A SUSTAINABLE RESTORATION APPROACH

Catherine Hoy; choy@ecotoneinc.com; Ecotone Inc.

Coauthor: Clay Word, Ecotone Inc.

Approximately 2,400 linear feet of First Mine Run, located within a brook trout watershed in northern Baltimore County, were restored using a quasi-legacy sediment removal technique/natural channel design approach. The project was designed with the “Less is More” philosophy of sustainable restoration. The use of on-site material including logs, rootwads, and stream channel substrate was maximized. Efforts were taken to reduce the use of furnished materials. Where possible, furnished materials were sought locally. The project was implemented in the Summer of 2017. Results of the project will be presented including a comparison of salvaged verses furnished materials in planning and in practice. Post-construction stream stability assessments immediately after construction and in the months to follow after storm events will be included. Additionally, an estimate of the carbon savings accomplished by using furnished material will be presented. Any unexpected results and/or challenges will be included as Lessons Learned. This project is meant to serve as a case study for sustainable restoration.

Catherine Hoy is the Director of Design for Ecotone Inc.’s Mid-Atlantic Region. Catherine has 12 years of professional experience developing stream restoration and provides design support for construction and mitigation projects. Interestingly, she actually has an art background which allows her to use her artistic vision to inspire her team’s innovative and creative designs. By shedding the constraints of traditional stream restoration engineering techniques, Ecotone’s Design team is able to produce sustainable projects that focus on ecological uplift and harmony. Outside of Ecotone, she spends it with her family, hiking and painting.

MANURE AND FERTILIZER INPUTS TO LAND IN THE CHESAPEAKE BAY WATERSHED, 1950-2012

Jeni Keisman; jkeisman@usgs.gov; U.S. Geological Survey

Coauthors: Olivia H. Devereux, Devereux Consulting; Andrew E. Lamotte, USGS; Andrew J. Sekellick, USGS; Joel D. Blomquist, USGS

Understanding changes in water quality over time requires information on changing nutrient sources in contributing areas. We evaluated temporal and spatial patterns in nitrogen (N) and phosphorus (P) inputs from manure and fertilizer, and in associated agriculture, from 1950 to 2012 in the Chesapeake Bay watershed. The expected effect of agricultural best management practices (BMPs) on nutrient inputs between 1985 and 2012 was also modeled. Nitrogen and phosphorus inputs from manure increased gradually over time in the watershed as a result of increasing livestock and poultry production. Fertilizer-N inputs increased sharply from 1950 to the mid-1970s, after which they varied substantially from year to year. Fertilizer-P inputs increased moderately from 1950 through the mid-1970s, and declined slightly thereafter. Temporal and spatial patterns in the magnitude and intensity of agricultural nutrient inputs were consistent with changes in animal and row-crop production. Model results indicated that implementation of animal and land use change BMPs was expected to have little effect on agricultural N inputs. Animal BMPs were expected to reduce manure-P inputs in areas with large poultry populations. Documentation of these spatial and temporal patterns and drivers continue to support ongoing efforts to explain observed changes in N and P loads to rivers throughout the watershed.

Jeni Keisman is an ecosystem analyst with the U.S. Geological Survey in Catonsville, MD. Her research focuses on changes in sources of nitrogen and phosphorus applications to land in the Chesapeake Bay Watershed, and their relation to land use and conservation practices. She also works to advance our understanding of anthropogenic effects on Chesapeake Bay water quality by facilitating interdisciplinary collaborations among the region's scientists. Jeni holds a Ph.D. in ecosystem ecology from Princeton University, a M.S. in sustainable development and conservation biology from the University of Maryland, and a B.A. in History from St. Mary's College of Maryland.

NAVIGATING PROBLEMS TEACHERS FACE

Lolita Kiorpes; lkiorpes569@gmail.com; North Point High School, Charles County Public Schools

Students want the opportunity to be involved. Students want to learn why our watersheds and oceans are not as healthy as they should be. Students want to be Good Stewards of the Environment. Hear about activities and projects that give students a chance to take a stand and become knowledgeable on important issues. Hear what students say about being involved with hands on activities that take them outside to work in a native garden, go canoeing, conduct water quality testing and plant trees. Some of the biggest issues facing teachers is not finding opportunities for students to get outside and involved but blending the opportunity into the curriculum, navigating through the paperwork to go on a field outing and finding funding to cover transportation, sub and program costs. It seems that at the high school level, our curriculum is constantly in flux these days. We are told to provide hands on, real-world application and experiences. But, with a tightly packed curriculum and testing schedules to work around, taking the challenge to accomplish that can be daunting. Hear about some ways to navigate these issues.

Lolita Kiorpes is a 2016 Recipient of the Presidential Innovation Award for Environmental Educators. With a successful first year Ocean Guardian School grant in 2014, Ms. Kiorpes led her school to become the first NOAA Ocean Guardian School in Maryland and received the first of 3 banners. She received her 4th grant this year. To give students a fundamental understanding of different ecosystems and the human interaction component, Kiorpes brings as much of the natural environment into the classroom as possible. She participates with MD DNR programs such as Raising Horseshoe Crabs in the Classroom, Terrapins in the Classroom and Trout in the Classroom. Understanding water quality is a must.

INDICATORS: SMART FOR RESILIENCE

Michael Kolian; kolian.michael@epa.gov; U.S. Environmental Protection Agency

This presentation will discuss opportunities for using indicators to effectively communicate impacts and inform various levels of decision-making and resilience-related planning. EPA's Office of Atmospheric Programs compiles a set of key indicators related to the causes and effects of climate change, Climate Change Indicators in the United States, 2016. EPA partners with over 40 data contributors and experts from various government agencies, academic institutions, and other organizations to gather these data and analyses. The indicators are selected based on a standard set of criteria with a focus on data quality and transparency.

Mike Kolian is an Environmental Scientist at the United States Environmental Protection Agency's, Climate Change Division, where he has worked for over 15 years and specializes in climate change science and impacts. He currently manages EPA's Climate Change Indicators in the United States effort and is co-chair of the U.S. Global Change Research Program's Indicator Working Group.

TEMPERATURE MONITORING OF STORMWATER MANAGEMENT PRACTICES

Sam Lee; slee@menv.com; Maryland Environmental Service

Coauthors: Jen Wijetunga, Maryland Environmental Service; Martha Stauss, Maryland Environmental Service; Tracy Williams Jr, KCI Technologies

This project involved monitoring effluent temperature for two best management practices currently in use in Maryland and surrounding states, submerged gravel wetlands and wet ponds. Monitoring was conducted during the summer at sites to look at the impacts stormwater discharge has on the stream temperatures and how this will impact temperature sensitive aquatic species. This study found significantly lower temperatures effluents for submerged gravel wetlands in both cold and warm water streams. This confirms the pond limitations set in place in Maryland and provides information for future stormwater management construction decisions.

Sam Lee graduated from the University of Delaware in 2016 with be Bachelor of Science in Environmental Science. After graduation as park of the Chesapeake Conservation Corp he was placed at Maryland Environmental Service in the Geospatial and Engineering Services Department working on projects for Maryland State Highway Administration, Prince George's County Clean Water Partnership and other clients. As part of his capstone he conducted thermal monitoring on stormwater BMPs. He currently works as a GIS Specialist at MES.

OVERVIEW OF AQUATIC INVASIVE SPECIES MANAGEMENT AND ASSESSMENT IN MARYLAND LAKES

Mark Lewandowski; mark.lewandowski@maryland.gov; Maryland DNR

Since 2014, the Department of Natural Resources has been actively managing Deep Creek Lake to control hydrilla, which was discovered in 2013 during routine aquatic plant surveys. This is the fourth year of treatment to the southern end of the lake, and results have been positive thus far. As a follow-up to the hydrilla program, legislation was enacted which makes it unlawful to transport aquatic invasive species (AIS) in Maryland waters. This talk will provide an overview of the hydrilla management program in DCL, the new regulations, as well as review the findings of the state lake AIS survey conducted in summer 2016 by DNR.

Mark Lewandowski is a Natural Resources Biologist for the Maryland Department of Natural Resources in Annapolis, Maryland. He has a B.S. from the University of Maryland, College Park, and has worked in SAV restoration and invasive species control for 15 years. He is the program lead on the Deep Creek Lake Hydrilla control project and has created a launch steward program coupled with an outreach campaign to educate boaters to properly clean their vessels. Mark is an active member of the Mid-Atlantic Panel on Invasive Species, the Maryland Invasive Species Council and represents the Chesapeake Bay region to the Aquatic Nuisance Species Task Force.

DETECTION OF THE EFFECTS OF STORM WATER BEST MANAGEMENT PRACTICE, BAYESIAN BACI POWER ANALYSIS

Dong Liang; dliang@umces.edu; Chesapeake Biological Lab, UMCES

Coauthors: Vyacheslav Lyubchich, CBL/UMCES; Jeremy M Testa, CBL/UMCES; Lora Harris, CBL/UMCES

The National Pollutant Discharge Elimination System (NPDES) municipal storm water permitting process requires jurisdictions to develop comprehensive programs to provide watershed assessment, restoration of uncontrolled impervious surface, and assessment of load control. The unpredictable timing and magnitude of precipitation events and the spatiotemporal variability of loads are major complications to effective monitoring. The before-after-control impact (BACI) sampling design is often used to assess the effects of an environmental change made at a known point in time. However, the relative contribution of monitoring density and the number of paired control sites have not been studied in a river and stream monitoring context, i.e. “what is the tradeoff between maintaining several pairs of restored and control sites, versus increasing the monitoring density and duration?” Long term studies that provide estimates of the natural temporal and spatial variability of discharge and concentrations could provide useful information in designing a BACI study. Here we use data from the Baltimore Long Term Ecological Research sites to develop multiple statistical measures of the effectiveness of a given monitoring scheme in revealing the hypothesized restoration effects in terms of hydrology and nutrient loads.

Dong is a statistician with inter-disciplinary trainings in geography and epidemiology. Dong's work focuses on application of Bayesian spatial modeling in environmental modeling and monitoring. He has served as co-principal investigator and reviewers on several DNR and CBT projects in next phase of water quality monitoring and criteria assessments.

INTEGRATING SOCIAL AND ECOLOGICAL RESTORATION FOR STACKED BENEFITS

Lori Lilly; llilly@howardecoworks.org; Howard EcoWorks

Howard EcoWorks is a new nonprofit organization in Howard County, MD. We believe that social and ecological networks are strongly intertwined and therefore balance achievement of environmental outcomes with social strategies to strengthen our overall efforts and build sustainable communities. We have successful programming with young adults through the Restoring the Environment and Developing Youth (READY) program and have developing programming at the local Corrections Department where we are engaging in-mates in sustainable gardening education and hands-on training at our on-site native plant nursery. We want to promote integration of environmental social objectives to achieve bigger and better outcomes that will generate increased public and political support. In this presentation, we will communicate our progress and successes for these integrated and stacked efforts including a focus on our new watershed engagement campaign in Ellicott City.

Lori A. Lilly is the founder and Executive Director of Howard EcoWorks. Lori ran a successful environmental consulting business for the past 3 years with concurrent management of Howard County's Restoring the Environment and Developing Youth (READY) program. She has a background in non-profit management, watershed planning and restoration, and Illicit Discharge Detection & Elimination (IDDE). Lori has a B.S. in Natural Resource Management and an M.S. in Marine Estuarine and Environmental Science.

RESTORING WATER QUALITY AND BROOK TROUT POPULATIONS IN THE CASSELMAN RIVER

Constance Lyons Loucks; connie.loucks@maryland.gov; Maryland Department of the Environment Abandoned Mine Lands Division

The Casselman River (Casselman) covers 91 square miles in the Youghiogheny River Sub-Basin of which 20 miles are in Maryland. In 1996 the Casselman was listed on Maryland's 303(d) list for low pH impairment due to acid mine drainage (AMD) from mine lands either abandoned or reclaimed before the Surface Mining Control and Reclamation Act of 1977 and episodic acid rain deposition. Tributaries with pH impairment had shown significant reductions in the native brook trout population. The Maryland Abandoned Mine Lands Division (AMLD) received EPA 319 (h) funding to restore water quality to pH standards and improve native brook trout and other fish populations. Eighteen limestone treatment sites were constructed on public and private property. By 2017, annual in-stream pH monitoring results showed significant pH improvements along with remarkable brook trout population recovery. This presentation will describe the project goals, the results to date, photographs of limestone sands dump sites and leach beds, and report on the comparative results of pre-construction and post-construction water quality and biological monitoring. The project has been very successful and offers a low cost, low maintenance technology for watershed groups to address acidic impairments and improve brook trout populations.

Connie Lyons Loucks is an Environmental Program Manager with the Abandoned Mine Lands Division, an agency of the Maryland Department of the Environment. Connie has a Bachelors degree in Biology and a Masters degree in Wildlife Management. Connie has worked for the State of Maryland since 1979. Connie has managed the acid mine drainage remediation efforts of the agency since 1998.

USING A MULTI-PARTY APPROACH TO MONITORING STORMWATER MANAGEMENT SYSTEMS IN PRINCE GEORGE'S COUNTY, MARYLAND

Lia Mastropolo; lmastropolo@akrf.com; AKRF/The Clean Water Partnership

The Clean Water Partnership (CWP) is a community-based public-private partnership between Prince George's County, Maryland and Corvias Solutions that is committed to providing full delivery of stormwater management systems for a 30-year period, from design through construction and operations and maintenance. Through innovative partnership models, the program has developed a multi-party monitoring program to ensure its stormwater systems maintain optimal aesthetic and functional conditions for the full life cycle of the program leveraging the skills and capacity of local service providers. This presentation will outline the CWP's approach to monitoring a large portfolio of diverse water quality practices (including LID systems, stream restoration, and pond retrofits) utilizing a multi-party process of data collection, review, and consensus. Topics covered will include: routine and non-routine maintenance standards and frequencies; vegetation cover monitoring; sedimentation monitoring; functional and aesthetic condition assessments; partner roles, workflows, and tools; monitoring feedback for design and construction; and using monitoring data to budget for future repairs.

Lia Mastropolo has managed operations and inspection of large portfolios of LID and green infrastructure for municipalities, county governments, and institutions in Maryland, Pennsylvania, New Jersey, and New York. She has developed O&M specifications, manuals, and training programs for Philadelphia Water and New York City DEP, and is currently working with the Clean Water Partnership to implement a 30-year maintenance program for stormwater assets in Prince George's County, Maryland.

OPPORTUNITY OF THE COMMONS: DEFINING MARYLAND'S OCEAN FUTURE

Catherine McCall; catherine.mccall@maryland.gov; Maryland DNR

Coauthors Joe Abe; MDNR, Kimberly Hernandez; MDNR

The opportunity of our ocean commons is this - the opportunity to strike a balance between the need to conserve marine resources while also accommodating changing and intensifying human uses of our ocean. The challenge is that we are still discovering and understanding the resources themselves and our shared ocean waters are governed by a multitude of entities and more than 100 different laws and regulations. Over the past several years, Maryland has worked to respond to new and proposed uses of the ocean space and resources, such as offshore energy development and increases shipping. Alongside other state, federal and tribal partners, we helped develop the first Mid-Atlantic Ocean Action Plan, a collaborative effort that aims to strike that balance between sustaining a healthy ocean ecosystem and fostering sustainable ocean uses. This session will highlight some of Maryland's work on this resource-use balance during a time of new discovery, intensifying use, and a changing climate.

At the Maryland Department of Natural Resources, Catherine McCall works on a variety of coastal and ocean issues to build resilience and balance resource conservation with human uses. Catherine's interest in coastal management began while learning about kettle lakes and the shores of Lake Erie at Penn State. She shifted this interest to the estuarine environment while completing her master's degree at Georgetown University, working on research at the Dyke Marsh Wildlife Preserve along the Potomac River in Virginia.

MANAGING MULTI-PURPOSE LAKES AND PONDS IN COLUMBIA, MD.

John L. McCoy; john.mccoy@columbiaassociation.org; Columbia Association

Columbia is a planned community that has developed into a small city with a population of 103,000 residents. Within the towns 17,000 acres are nearly 3,600 acres of open space. Built with the vision that better cities make better people and this could be done while respecting the land, Columbia was built with the streams and riparian corridors preserved and committed as Open Space. Open space includes 3 lakes and 41 ponds and over 34 miles of stream valley.

Columbia's lakes and ponds, initially installed as dual purpose facilities to trap sediment during development and provide water features for residents, have become stormwater facilities. The stormwater management system conveys stormwater through the riparian zones and discharges stormwater directly into the streams, ponds and lakes. The ponds and lakes are eutrophic and suffer from extensive sediment loads. At the same time the ponds and lakes role as water features has evolved and expanded over time to become recreational features. Viewing water features and wildlife, boating and fishing, and wildlife photography are popular. Addressing concerns about aesthetics, water quality, water quantity, sediment management, and wildlife has created a unique lake management program that is based on decreasing pollutant inputs and stormwater volumes at the source.

John McCoy is the Watershed Manager for the Columbia Association in Columbia, MD. Previously he served for over a decade at Maryland DNR, including serving as the Director of the Ecosystem Restoration Center from 2005 to 2010, working on watershed related projects ranging from small reforestation projects to large comprehensive watershed restoration programs. John managed the evaluation of the State's non-point source pollution control programs at Maryland Department of the Environment and the Department of Health and Mental Hygiene from 1985 to 1995. John holds degrees in Biology and Agronomy.

As Watershed Manager for the Columbia Association, John is responsible for the implementation of the Columbia Watershed Management Plan and future watershed and water quality related endeavors. He also serves on the Patuxent River Commission, a Trustee for the Middle Patuxent Environmental Trust and as a member of the Board of Directors for the Patapsco Heritage Greenway.

USING ECOSYSTEM SERVICES TO GENERATE TMDL Credit – OUTSIDE THE BOX THINKING FOR A CHANGING WORLD

Scott McGill; smcgill@ecotoneinc.com; Ecotone, Inc.

Stream restoration projects which include riparian restoration, floodplain reconnection, and floodplain conservation easements create ecological conditions favorable to the North American Beaver (*Castor canadensis*). Restoration practitioners on multiple continents are employing adaptive management and the ecosystem services of the North American Beaver and the European beaver to generate landscape scale improvements to water quality and sediment storage. By designing a project to anticipate and encourage colonization of beaver and dam building as part of the project's long term ecological performance, designers and practitioners can utilize the ecosystem services provided by beaver to provide dynamic resiliency and regeneration as well as TMDL credits. Techniques and methods which encourage beaver colonization will be reviewed, including planting regimes to develop food sources, floodplain reconnection to maximize stream power distribution across the floodplain, designing for long term aggradation, requiring more expansive conservation easements, and incorporating analog dams within a design. Stream monitoring and success criteria that embrace beaver colonization as a sign of project success will also be discussed. A pilot project using ecosystem services generated by the beaver to deliver TMDL and stream restoration credit will be shared.

Scott McGill is the Founder and CEO at Ecotone, Inc. an Inc. 5000 ecological restoration company with offices in Forest Hill, Columbia, MD, and Charlottesville, VA. Scott has over 27 years of applied experience in both design and construction of ecological restoration projects throughout the United States. His "less is more" approach to design and construction that incorporate conservation biology and adaptive management is widely accepted as the model for sustainable cost effective ecological restoration.

BUILDING A 21ST CENTURY WORKFORCE - CHALLENGES, OPPORTUNITIES

Joan Michelson; joan@greenconnectionsradio.com; Green Connections Media

Coauthors: Joshua Greene, V.P. Government Relations, A.O. Smith Water Technologies, Caroline Donovan or other Maryland student voice, and Dr. Samanatha Joye, Oceanographer, Microbiologist, & Geochemist at The University of Georgia and Gulf of Mexico Research Institute

The water ecosystem workforce of today and tomorrow faces many issues, challenges and opportunities. They range from a dearth of plumbers, to a need for technical training for high-tech water systems (including those related to new energy sources), to the need to increase the diversity of all roles and across all water-related fields. Government, academia, and private industry all face these issues, from finding and recruiting high-quality appropriately-skilled talent, to keeping abreast of changing technologies.

In addition, we have mid-career talent whose skills we need today and are ready to advance, but feel stuck, and students who puzzle over which academic or other training program will best prepare them for the jobs that will be around when they are ready to join the workforce.

Buried in these challenges are opportunities. We'll discuss the challenges, unearth the opportunities, and talk about how to seize them for one's own career, agency and/or business, no matter what career level you are in currently.

Joan Bryna Michelson, MBA is an award-winning business, communications leader, journalist, and public speaker who specializes in the sustainability and clean energy space. She is Executive Producer and Host of the acclaimed podcast Green Connections Radio, chosen by USA Today as one of the top six podcasts, has a popular blog in the Huffington Post and has been a reporter with top media organizations. She has also worked with the U.S. Dept. of Energy, Chrysler's Global Electric Motorcars, Earth Day Network, the Clean Energy Alliance, American Express and Deloitte. She was nominated for a White House Champion of Change Award and a finalist for the C3E Award for women in clean energy in 2015.

EVALUATING LANDSCAPE-SCALE CHANGE DETECTION METHODS FOR LANDSAT TIME SERIES

Emily Mills; emills@chesapeakeconservancy.org; Chesapeake Conservancy

Coauthors: Cassandra Pallai, Chesapeake Conservancy; Mike Norton, Chesapeake Conservancy

Monitoring environmental changes is critically important for conservation, including assessing impacts of land cover change on water quality and ecosystem health. The public release of the Landsat satellite imagery archive in 2008 provided new opportunities to monitor landscape-scale changes at relatively high spatial and temporal resolution over long time periods. Since then, a number of change detection algorithms have been developed, which leverage the Landsat time series to automatically detect changes in land cover such as deforestation and urban growth. However, understanding different algorithms and how to use them can be challenging for decision-makers. In a case study in Prince George's County, Maryland, we evaluated six Landsat-based change detection algorithms for accuracy by comparing the results against each other and reference datasets. We found little agreement between change detection methods either spatially or temporally, and no single method outperforms the others. Rather, most methods offer a tradeoff between errors of omission and commission, so that selection of an algorithm may depend on user preference for error type and classes of interest. Change detection methods using the Landsat time series still need more attention to find areas of agreement and to accurately monitor changes in land cover and subsequent impacts on streams and rivers.

Emily Mills is a Geospatial Analyst at the Chesapeake Conservancy. She holds a Master's of Environmental Management and a Certificate in Geospatial Analysis from Duke University, and a Bachelor's of Science in Psychology from the Ohio State University. As part of the Conservancy's Conservation Innovation Center, she supports Chesapeake Bay Program Partnership projects, including high-resolution land cover classification and landscape-scale change detection. She also works with partners to apply the Conservancy's land cover data and enhanced flow path modeling to prioritize conservation and restoration opportunities throughout the Chesapeake Bay watershed.

TAKE A WALK ON THE REGULATORY SIDE

Becky Monahan; Becky.Monahan@maryland.gov; Maryland Department of the Environment

Coauthor: Matthew Stover, Maryland Department of the Environment

The Maryland Department of the Environment (MDE) is a regulatory state agency with the mission to protect and restore the environment for the health and well-being of all Marylanders. Part of MDE's responsibilities include implementing various portions of the Clean Water Act to protect, maintain and improve the quality of Maryland surface waters. MDE relies on water quality data from a variety of sources including federal and state agencies, local government agencies, researchers, students, and watershed organizations to get a complete picture of the health of Maryland's waters. MDE is encouraging our volunteer/NGO water quality monitors to consider submitting their data for a variety of regulatory, assessment, modeling, and restoration purposes. This presentation provides information on what MDE does and how they use water quality data, as well as how volunteer monitoring groups can get involved and submit their data to MDE. MDE hopes to strengthen its relationships with citizen scientists in order to collect and assess all available data, create an improved understanding of the health of Maryland's waters, and work together to protect and restore the environment.

Becky Monahan is a Natural Resources Planner with the Maryland Department of the Environment (MDE). She works with the Water and Science Administration as part of the Environmental Assessments and Standards Program. Her work revolves around The Clean Water Act where she assists in developing Water Quality Standards, writing the Integrated Report, coordinating departmental outreach opportunities and conducting field studies. Prior to her work with MDE, Becky taught high school biology and worked as a research intern for the Chesapeake Bay National Estuarine Research Reserve.

INCREASING CHLORIDE AND SODIUM CONCENTRATIONS IN GROUNDWATER DUE TO ROAD SALT INPUTS AND LONG-TERM EFFECTS ON STREAM CHEMISTRY VIA BASEFLOW

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Coauthors: Darcy Bird, Environmental Science & Studies Program, Towson University; Joseph Broome, Department of Physics, Astronomy, & Geosciences, Towson University; Gregory Woodward, Environmental Science & Studies Program, Towson University; Peter Groffman, Advanced Science Research Center of the Graduate Center of the City University of New York

Road salt application causes elevated concentrations of chloride and sodium ([Cl] and [Na], respectively) in streams. Elevated [Cl] and [Na] in streams detrimentally affects many freshwater organisms and reduces water quality. While elevated [Cl] and [Na] due to road salt have been well documented in streams across the northern US and elsewhere, much less is known about the impacts on groundwater and the subsequent long-term effects for stream chemistry via groundwater-fed baseflow. Water chemistry and discharge data for samples were collected from 1998–2016 from several watersheds in the Baltimore region along with shallow groundwater data. Groundwater contributions are leading to a long-term increase in [Cl] and [Na]. Shallow groundwater data show that [Cl] remains elevated year-round, and [Cl] is more variable (higher and lower) at 1 m below the surface than at 2.5 m. Average annual [Cl] in a forested watershed was constant across the study period at 2.5–3 mg/L. In contrast, average [Cl] in 2014 were 155 mg/L in a watershed with 21% impervious surface cover (ISC) and had increased by ~60 mg/L since 1999. An increase of ~90 mg/L in annual [Cl] was observed in a watershed with 17% ISC. If [Cl] continue to increase at the current rates, then average annual [Cl] in watersheds with 17 and 21% ISC will exceed the EPA chronic criteria for aquatic life (230 mg/L) in the mid-2030s.

Joel Moore is an Associate Professor of Geosciences at Towson University. He received his Ph.D. in Geosciences from Penn State University and was a postdoctoral fellow at Northwestern University. Since starting at Towson in 2011, a major focus for his research lab has been urban geochemistry, including road salt impacts on streams and groundwater.

MARYLAND AGRICULTURE'S ROLE AND PROGRESS TOWARD THE CHESAPEAKE BAY RESTORATION

Alisha Spears Mulkey; alisha.mulkey@maryland.gov; MD Department of Agriculture

Maryland's agricultural sector has long been an active partner in conservation. The Maryland Department of Agriculture, working collaboratively with its soil conservation districts and federal partners, assists agricultural producers in conservation planning and best management practice implementation. The delivery of conservation programs in Maryland relies on the soil conservation districts to serve as the primary interface to farmers, landowners, developers, and county governments to implement conservation practices where they are needed most—on the farm fields, pastures, and construction sites that can impact Maryland's streams, rivers and the Chesapeake Bay. Program delivery can include both technical and financial assistance. As a result, the agricultural sector has reduced its delivery of nitrogen to the Chesapeake Bay by more than 1.8 million pounds since 2009. These reduction efforts are annually tracked and reported for Maryland's Watershed Implementation Plan (WIP), the state's "roadmap" to achieving the required nutrient and sediment reductions by 2025. Achievement of the agricultural WIP will continue to require focused cooperation with our conservation partners and the optimum use of state and federal resources, especially as the state seeks to update its WIP according to the newly released Chesapeake Bay modeling tools.

Alisha Mulkey has served as the Program Coordinator for the Agricultural Watershed Implementation Plan at the Maryland Department of Agriculture since 2014. In this capacity she is responsible for the coordination of all agricultural conservation-related practices and program data that demonstrate Maryland's obtainment of its Chesapeake Bay water quality goals. She received her B.S. in Soil Sciences from the University of Tennessee, Knoxville and an M.S. in Soil and Watershed Science from the University of Maryland. She is nutrient management certified in Maryland, and is active with the Agronomy Society and Soil and Water Conservation Society.

BASELINE ANALYSIS OF OILS, CDOM AND OPTICAL BRIGHTENERS IN SHALLOW ESTUARINE ENVIRONMENTS: POTENTIAL TOOLS FOR EVALUATING RESTORATION EFFECTIVENESS

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Coauthor: Diana L. Muller, Chesapeake Baysavers

Watershed groups and municipal governments have recently accelerated their efforts to improve the water quality of the Chesapeake Bay through a number of restoration efforts. These restoration efforts include upland stream reconfiguration techniques and wetland regeneration, along with upgrades to sewer and septic tank technologies. As a result, baseline studies are needed to assess pre restoration conditions in order to eventually evaluate their ability meet the requirements set forth by the TMDL. Most of these studies are centered on measuring sediment and nutrients such as nitrogen and phosphorous in the upland reaches of the watershed, with little attention to the tidal sections. In this study we evaluate the baseline conditions of two areas in the Chesapeake Bay, the tidal South River and the tidal fresh Potomac River. A novel approach to capturing estuarine conditions is deployed using an" in situ" fluorometer capable of detecting concentrations of oils, organic matter in the form of CDOM and optical brighteners which is thought to be an endocrine disruptor. This study illustrates the usefulness in detecting leaky septic systems, outflows of sewage treatment plants and in the case of the South River, a guide to creek restoration prioritization.

Dr. Muller is an associate professor of estuarine physics at the United States Naval Academy, where he is focused on innovative methods in monitoring and modeling coastal environments.

ADAPTIVE MANAGEMENT AND EVALUATING EFFICACY OF A FLOODPLAIN RESTORATION

David Osgood; dosgood@albright.edu; Albright College

Coauthors: Kaitlin Kimmel, University of Minnesota; Stephanie Harper, Lancaster Labs; Kristen Kunkel, Albright College; Melissa Hartzler, Duke University

We studied a floodplain restoration, encompassing 600 m of stream and riparian buffer and 0.8 ha of marsh, outside Reading, PA for 12 years, including 3 pre-restoration years. We hypothesized that the restoration area would display gradual change in ecosystem function relative to the pre-restoration baseline. Wetland hydroperiod was different between the two wetlands, which were designed to accommodate different stormwater inputs. One floodplain wetland did not achieve the desired water table position. Adaptive management designed to modify the water table position resulted in a significant shift in water table position. The wetland vegetation community responded positively to the change in hydrology within one growing season. Sedimentation shifted from a uniform deposition pattern to deposition focused at stormwater inputs. Sedimentation rate was 20 times higher in the riparian buffer relative to the floodplain wetlands. Macrobenthic community indices indicated lower habitat quality within the restoration reach relative to the control reaches prior to the restoration. Community indices have approached values similar to the control reaches starting ~5 years post-restoration. Gradual changes in ecosystem-level function following the restoration suggest that long-term comprehensive monitoring (decadal scale) is necessary to quantify restoration goals.

David received his PhD in Environmental Science from University of Virginia. His research has focused on natural marsh development on Mid-Atlantic and SE US barrier islands with an emphasis on hydrology, nutrient dynamics, and their influence on the developing plant community. His background also includes study of Phragmites and other non-native plant species and their impact on the marsh ecosystem. More recently, he conducts research on restoration of headwater streams and floodplain wetlands of coastal watersheds of the Mid-Atlantic US. He is a full professor at Albright College in Reading Pennsylvania where he serves as director of the environmental science program.

THE MARYLAND HEALTHY SOILS INITIATIVE

Susan Frick Payne; susan.payne@maryland.gov; Maryland Department of Agriculture

Many are unaware of the role that soil health plays in not only water quality, but also the sequestration of carbon and the mitigation of other greenhouse gases. Maryland is among a handful of states that are looking to include soil health and climate friendly agricultural practices in their emission reduction policies. The Maryland Commission on Climate Change will include a Healthy Soils Initiative in its 40 by 30 plan, and a new group calling itself the Healthy Soils Consortium has been convened to bring together individuals, agencies, and organizations already active in soil health in the State. Moreover, in the last legislative session, the Maryland General Assembly passed a Healthy Soils bill providing for a program promoting the widespread implementation of farm management and land use practices that improve the health of the soil while increasing its sequestration and mitigation capacity. This presentation will address the potential and the multiple co-benefits of climate smart practices.

Susan Payne coordinates the Maryland Department of Agriculture's Ecosystem Markets and Certainty Programs and administers the Department's Agricultural Nutrient and Sediment Credit Certification Program. In addition to working with relevant federal and state agencies and entities, she sits on a number of national, regional, and inter-agency committees addressing water quality trading, interstate ecosystem markets, regenerative agriculture, climate change, and greenhouse gas reductions.

COMMUNICATING CHALLENGES AND SUCCESSES IN A CHANGING WORLD

Steve Raabe; kathy.stecker@maryland.gov; Opinion Works

Coauthor: Bill Dennison, Integration and Application Network, UMCES, dennison@umces.edu

It is increasingly important to engage the public in our work. This interactive workshop focuses on water quality outreach to diverse audiences in an evolving communications landscape. How do we craft our messages, target our audiences, and choose when and where to communicate? How do we know if the public is actually hearing our messages?

Participants will be invited to offer their own communication challenges and strengths. Examples of effective outreach strategies and evaluation processes will be presented, drawn from experienced science communicators. Original audience research will be shared. Additionally, participants will receive a suite of specific resources to enhance their organization's communication effectiveness.

No bio submitted

WETLAND SOIL FUNCTIONAL ASSESSMENT USING IRIS (INDICATOR OF REDUCTION IN SOILS) TECHNOLOGY

Martin C. Rabenhorst; mrabenho@umd.edu; Univ. of Maryland, Dept. of Environ. Sci. & Technol.

Wetlands are defined on the basis of three foundational parameters – hydrology, plants and soils, and the goal of wetland restoration and mitigation activities is to return important functions and ecosystem services. Often indicator metrics pointing to foundational parameters are substituted as surrogates for wetland function, and these are translated into performance standards. Standards related to hydrological monitoring are straightforward and numerous technologies are available for measuring water tables and saturation. Approaches to monitoring wetland plants are many and varied, and usually are related to vegetation dominance, areal cover, stem counts, survival, etc. With few exceptions, standards for soils are almost non-existent, and when present, are sometimes tied to morphological field indicators which, although useful in evaluating natural systems, are largely inappropriate for created or restored mitigation wetlands. One practical approach of linking soils performance standards to science-based processes has been the use of IRIS technology. Over the last decade, IRIS has moved from the periphery into common use in hydric soils studies. The appeal is the ease of use and conceptual simplicity, and IRIS technology has been approved by the NTCHS. Principles of IRIS technology will be illustrated, and new developments during the last two years will be highlighted.

Martin C. Rabenhorst is Professor of Pedology (Soil Science) in the Dept. of Environmental Science and Technology at the Univ. of MD. He received in B.S. and M.S. degrees from the Univ. of MD and his PhD from Texas A&M Univ. Since returning to UMD in 1983, his entire career has been focused on studying pedological and biogeochemical processes in Wetland Soils, and he is recognized as a world expert in hydric soils. He has been an active member of the Mid-Atlantic Hydric Soils Comm. for 20 years. He has authored more than 125 publications in refereed venues and more than 175 abstracts for presentations and posters, and he was elected Fellow of the Soil Science Society of America in 2001.

USING NATIONAL ESTUARINE RESEARCH RESERVES TO UNDERSTAND CLIMATE CHANGE IN CHESAPEAKE BAY

Jennifer Raulin; jennifer.raulin@maryland.gov; Chesapeake Bay National Estuarine Research Reserve - Maryland

Chesapeake Bay NERR sites in Maryland and Virginia and the National Weather Service were used as a sentinel site for monitoring regionalized climate changes. By using 26 climate extreme indices and 114 years (1895-2014) of meteorological data, researchers from University of Maryland Center for Environmental Science, NCCOS/NOAA, and Chesapeake Bay NERRs (Maryland and Virginia) and communicators from Chesapeake Environmental Communications found clear evidence that physical climate changes are well underway and that species and habitats are responding to those changes. Analysis of long-term climate data in the Chesapeake Bay region shows trends for increasing air and water temperatures, an expanding growing season, and increased precipitation. This project also developed several resources for stakeholders, resource managers, and teachers in the Chesapeake Bay region including a public friendly website, as well as a 'behind the scenes' blog at the process of this analysis enabling visitors to access data and code.

A native Annapolitan, Jenn's love of the Bay started at an early age. A summer trip with CBF in 7th grade inspired her to pursue a career in the environment. Jenn received her M.A. from the University of Miami in Marine Affairs and Policy. Returning home, she first interned for the South River Federation and then to the Chesapeake Bay Trust where she worked for 5 years as a Program Officer. She joined the MDDNR in 2008, managing nonpoint source pollution programs like the Chesapeake & Atlantic Coastal Bays Trust Fund. A desire for a deeper connection to the estuary that she loves led her to her current role as Manager for the Chesapeake Bay National Estuarine Research Reserve in 2014.

SETTING EFFECTIVENESS GOALS FOR STREAM AND WATERSHED RESTORATION

Nancy Roth; nancy.roth@tetratech.com; Tetra Tech

Coauthors: James (Sam) Stribling, Tetra Tech; Erik Leppo, Tetra Tech

We consider ecological restoration to have been most effective when actual biological condition, reflected by sampling and analysis of technically well-founded indicators, shows some similarity to minimally-degraded condition. The Maryland Biological Stream Survey (MBSS) uses two such indicators, the benthic and fish indexes of biological integrity (B-IBI and F-IBI, respectively). However, we also recognize value in demonstrating shorter-term, incremental improvements in condition, in the form of reduced stressors or occasional observations of more stressor-sensitive biota. Biological assessment of Quincy Run in Prince George's County in 1996 exhibited severely degraded conditions, with primarily stressor-tolerant midges (Diptera: Chironomidae) and worms (Annelida: Oligochaeta). Although more recent stream-specific assessments have not yet been done, considering Quincy Run in the context of its subwatershed will allow us to forecast trajectories of biological improvement. Using long-term, county-wide biological monitoring and assessment results, we will examine aspects of current and expected future condition relative to those of the county overall, the Anacostia River watershed, and the Upper Anacostia River subwatershed. From these direct comparisons, effectiveness goals can be quantified for both short-term stressor reduction and long-term biological condition.

Nancy Roth is a Senior Watershed Scientist with Tetra Tech's Center for Ecological Sciences in Owings Mills, Maryland. Ms. Roth has a background in stream ecology and brings 26 years of experience in watershed restoration planning, biological assessment, and support to the Maryland Biological Stream Survey and municipal stormwater (MS4) programs in Maryland and Virginia. She is a graduate of Carleton College in Minnesota and holds a master's degree from the University of Michigan in Conservation Biology and Ecosystem Management. She lives in Annapolis, Maryland, and has a goal to explore as many Chesapeake rivers as possible by canoe, kayak, or paddleboard.

ASSESSING RIPARIAN HYDROLOGIC PATHWAYS AS CONTROLS ON FORESTED BUFFER FUNCTION IN FOUR SUBWATERSHEDS IN WESTERN MARYLAND

Stephanie Siemek; ssiemek@umces.edu; University of Maryland Center for Environmental Science, Appalachian Laboratory

Coauthor: Keith Eshleman, University of Maryland Center for Environmental Science

Several reach-scale studies conducted mostly in coastal plain watersheds have provided empirical evidence that riparian forest buffer systems (RFBS) can help improve surface water quality by intercepting and transforming nutrients associated with agricultural activities. Very few studies have been performed in the Ridge and Valley (R&V) province to examine the function of RFBS in other hydrogeological settings, however. The primary objective of this research is to better understand basin-scale interactions of surface water and groundwater hydrology that may constrain RFBS biogeochemical functions within four representative basins, dominated by calcareous geology, in the R&V province of western Maryland. Synoptic stream surveys, including stream discharge measurements, were conducted under spring and fall baseflow conditions to characterize spatial variations in main-stem and tributary water chemistry and nutrient concentrations. Data was used to estimate relative and absolute exchanges of water and dissolved constituents between the stream and local groundwater system and to parameterize a steady-state stream network mixing model that enabled estimation of concentrations of dissolved constituents in the lateral groundwater inflow.

Stephanie Siemek is a PhD student at the University of Maryland Center for Environmental Science (UMCES) working at the Appalachian Laboratory in Frostburg, Maryland. Her research involves studying the effectiveness of riparian buffers in reducing nutrient pollution runoff from agricultural fields in the Ridge and Valley of western Maryland. As a native Marylander, she hopes her research will provide the data and information necessary to help with Chesapeake Bay restoration goals.

BIOENERGETIC SIGNATURES OF STRESS IN CADDISFLY LARVAE FROM STREAMS ALONG AN URBAN TO RURAL GRADIENT

Madison Smith; madison.smith769@gmail.com; Towson University

Coauthors: Kellie McCreesh, Towson University; Christopher J. Salice, Towson University

Urbanization is a prevalent feature of our modern environments, which alters stream hydrology via increased stormwater runoff, thus impacting imbedded or adjacent ecosystems. In the Mid-Atlantic, two important stormwater inputs to streams are organic matter and salt ions, which can lead to disturbances in organism physiology and, ultimately, stream function. A challenge lies in characterizing and quantifying these disturbances. Organismal macromolecule proportions may be used to quantify the connection between stressors and disruption of bioenergetic processes. Five streams in Baltimore City and County, across a rural to urban gradient (based on % impervious surface), were sampled to determine whether patterns in macromolecules in stream invertebrates were indicative of stressors from urbanization. Lipid, protein, and carbohydrate content of benthic invertebrates (Trichoptera hydropsychidae) were quantified. Basic water chemistry data were also collected, including conductivity, total organic carbon and sediment lipid concentrations. Preliminary data showed temporal and spatial patterns in macromolecule proportions among caddisflies from the five streams that seem to be indicative of the urban to rural gradient. Macronutrient patterns in invertebrates may provide a useful metric for exploring ecological effects of common anthropogenic stressors associated with urbanization.

Madison Smith is a current master's student at Towson University. Her primary research focus is on the impacts of urbanization on the energetics of stream systems and benthic macroinvertebrates. She has been working on this project for a year and a half. Her favorite hobby, besides catching bugs, is riding horses.

IRRIGATION ACCELERATES NITRATE TRANSPORT WITHIN THE GROWING SEASON

Alexander Soroka; asoroka@usgs.gov; United States Geological Survey

Coauthor: Judith Denver, United States Geological Survey

Irrigating corn in the Delaware and Maryland coastal plain stabilizes grain yields but may lead to higher nitrate in groundwater. Recent studies of nitrate transport, beneath irrigated and non-irrigated cornfields, indicate leaching losses are greater during the growing season than at other times of the year. Although in-season transport of nitrate occurred under both fields, increased soil moisture from irrigation increased recharge event frequency due to periodic intense precipitation. Concentrations of nitrate were 200 milligrams per liter as nitrogen at 1 foot below land surface, and over 50 milligrams per liter as nitrogen at 3 feet below land surface. The highest soil water nitrate concentrations were observed shortly after side dress fertilizer application in mid-June. Leaching of nitrate beyond the root zone occurred while the estimated nitrogen use efficiency was greater than 50 percent (uptake/applied) in high-yielding corn (approximately 250 bushels per acre). Nitrate transport modeling and GW load estimates from these studies indicate historical nitrate leaching was greater under irrigation. The studies also show that leaching concentration and frequency are related to antecedent soil moisture conditions. The results suggest that irrigation can increase nitrogen uptake efficiency in corn crops while simultaneously increasing nitrate transport past the root zone.

No bio submitted

IF YOU BUILD IT, WILL THEY (BENTHOS) COME?

Mark Southerland; msoutherland@akrf.com; AKRF

Coauthors: Chris Swan, UMBC; Andrea Fortman, AKRF

We compiled biological monitoring data from 18 stream restoration sites in Anne Arundel, Baltimore, Frederick, Howard, and Montgomery Counties. 625 sites from the MBSS and countywide biological monitoring programs in adjacent stream networks were included as reference sites. The hypothesis was that biological uplift (using the benthic macroinvertebrate Index of Biotic Integrity, B-IBI) at comparable stream restoration sites would be lower in stream networks with poorer biological conditions. Specifically, we identified reference sites with B-IBI of 2.75 or greater within a 15-km radius of each restored site, calculated the shortest along-stream-network (typological) distance between restored and reference sites, calculated the difference in B-IBI scores, and modeled the degree of biological uplift on typological distance. 12 sites with at least 2 years of monitoring post-construction and 3 or more reference sites were analyzed. Only 4 of 12 sites displayed significant uplift, but the overall multiple regression showed significant effects of typological distance and difference in time of sampling; the interaction was not significant, nor was the effect of drainage area. We recommend that the potential effect of source populations inform expectations for biological uplift and that practitioners consider incorporating good streams as "stepping stones" to enhance recolonization.

Mark Southerland, Ph.D., PMP, is Vice President at AKRF and 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 since 1993. Mark has served the Maryland Water Monitoring Council, Maryland Academy of Sciences, Howard County Environmental Sustainability Board, Howard County Conservancy, and Patapsco Heritage Greenway.

A NOVEL USE OF ELECTRICAL RESISTIVITY TO INVESTIGATE THE HYDROGEOLOGY OF SPRINGS SUPPORTING ENDANGERED AMPHIPODS

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The Maryland Geological Survey conducted geophysical work for the US Fish & Wildlife Service to gain insight into the hydrogeology and to identify the contributing areas of three groundwater seepage springs in Washington DC and Montgomery County Maryland where habitats of threatened and endangered amphipod species have been identified. This project employed a novel use of the direct-current electrical resistivity survey method to collect data from the subsurface without disturbing sensitive amphipod habitat. Processed resistivity data were interpreted, in concert with surficial geological mapping and hand-augered sediment sampling, in order to identify the locations of the water table and solid bedrock, as well as structural anomalies that may be indicative of joints, fractures, or faults. Results of the survey suggest the subsurface around the springs is highly complex. Low-resistivity areas interpreted as saturated zones are often directly beneath surface drainage features that are dry at the land surface, indicating local recharge from surface runs. Interpreted saturated areas are also commonly found in the highly permeable zone of the basal saprolite (weathered bedrock), directly above the crystalline metamorphic bedrock. Resistivity anomalies indicate that there may be fracture zones near all of the springs which could act as preferential flow conduits.

Andrew Staley is a hydrogeologist with the Maryland Geological Survey where his work has focused primarily on aquifer property and framework characterization, water-supply issues, and groundwater-level mapping. He received his BA in Geology and Environmental Studies from Macalester College, and his MS in Geology from the University of Wisconsin-Madison.

THREE DECADES OF PROGRESS ON REDUCING NUTRIENT LOADS FROM MD CROPLAND

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The effort to restore Chesapeake Bay is in its fourth decade. As the key state in this effort Maryland has been at the forefront of developing strategies to reduce nutrient losses from cropland. Early efforts focused on soil erosion, then expanded to include subsurface nitrate, and more recently have started to deal with dissolved P. This presentation will give an overview of this long term effort, summarize findings from over 30 years of monitoring edge-of-field and small watershed nutrient losses in the Maryland Coastal Plain, and identify the implications for meeting long term watershed restoration goals.

Ken Staver has worked at the Wye Research and Education Center since 1984 conducting research on water, nutrient and energy flows in Coastal Plain watersheds. The focus of his work has been on the development of strategies to minimize negative environmental impacts of agricultural activities while maintaining agricultural productivity and enhancing soil and water resources. He has been actively involved in varying roles as technical advisor to Maryland state agencies and the US EPA Chesapeake Bay Program to bring research findings into the watershed management process. He also is an owner/operator of a grain farm in the headwaters of the Choptank River watershed.

REAL-TIME WATER QUALITY IN AN ACTIVE CONTROL WET POND

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Coauthor: Conor Lewellyn, OptiRTC

Retention and detention ponds have historically been used throughout the country to control runoff for flood protection and, more recently, for water quality improvement. A new approach, known as Continuous Monitoring and Adaptive Control (CMAC) has emerged as an alternative to traditional, passively controlled solutions. CMAC solutions integrate information directly from field deployed sensors with real-time weather forecast data to directly monitor performance and make automated and predictive control decisions. This study evaluates water quality benefits of a CMAC technology deployed in a wet pond in Montgomery County, Maryland. The CMAC retrofit allows for release of water in the pond prior to a forecasted rainfall event, and increased retention time following a rain event. The increased retention time in the pond is hypothesized to increase particulate settling and allow for increased reduction of total suspended solids (TSS) and Nitrogen. Real-time TSS and Nitrate sensors were deployed to evaluate the impact of implementing a CMAC retrofit on pollutant reduction. Further, grab sampling and laboratory testing was performed to verify and compare findings using the real-time sensors.

Micah Strauss is a Project Manager at Opti and a graduate student in the Villanova Urban Stormwater Partnership. Micah has a background in biology and civil engineering. He is engaged in research around building and retrofitting infrastructure with continuous monitoring and adaptive controls in order to meet water quality objectives and understanding how these measures can be integrated into watershed planning.

INTEGRATING MONITORING MODELING AND TRENDS ANALYSES FOR MANAGEMENT DECISIONS A CHOPTANK RIVER EXAMPLE

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Coauthors: Jimmy Webber, US Geological Survey; John Wolf, US Geological Survey; Rebecca Murphy, University of Maryland Center for Environmental Science; Jeni Keisman, US Geological Survey; Matt Johnston, University of Maryland

Managers in Maryland are often concerned with both local and downstream water quality impacting the Chesapeake Bay. While significant advances have been made over the last decade in research to explain trends in water quality in the Bay and its non-tidal streams, these scientific analyses must be integrated with historical and current management information in order to inform management decisions moving forward. Using the Choptank River watershed as a case study, we performed an integrated analysis that synthesizes trends research with monitoring, modeling, and management data. By linking local tidal water responses to non-tidal water quality, watershed influences and current and past restoration efforts, we derive explanations and management implications for the future. We demonstrate the scientific tools that are currently available to help focus and target restoration efforts in the watershed, both geographically and by sector. Finally, we outline future efforts to create decision-support tools that allow managers to integrate scientific and management information in local areas. Integrated analyses like this will empower Maryland and its local partners to determine drivers and sources behind water quality and focus restoration efforts, resulting in better-informed water quality management decisions.

Dr. Emily Trentacoste is an environmental scientist and biologist with EPA's Chesapeake Bay Program Office in Annapolis, MD. She works with Bay Program research partners to integrate and synthesize current science in tidal and non-tidal areas, determine management implications, and communicate results with managers. She focuses on providing up-to-date science, data, and decision-support tools to inform management decisions and focus restoration efforts throughout the watershed. Emily previously worked for EPA's Office of Water and NOAA's National Marine Fisheries Service. She received her PhD in Oceanography and MS in Marine Biology from Scripps Institution of Oceanography at UC-San Diego.

FROM THE FIELD TO THE CLOUD - A REVIEW OF ONLINE RESOURCES FOR LOCAL WATER QUALITY DATA AND ASSESSMENT

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A plethora of water quality data exists online for use by researchers, consultants, managers and the public, but even in the age of Google, users may be unfamiliar with some of the available resources. A concise review of new features and upgrades on the Maryland Department of Natural Resources' Eyes on the Bay (www.eyesonthebay.net) and Stream Health (http://dnr.maryland.gov/streams/Pages/streamhealth) websites will be presented. In addition, other Maryland water quality related sites from federal, state and non-profit colleagues will be discussed.

Mark Trice heads the Water Quality Informatics Program at the Maryland Department of Natural Resources. The program manages continuous water quality monitoring and water quality mapping projects, and is responsible for data management of Maryland's tidal and non-tidal water quality data. The Eyes on the Bay website is the program's public face, providing millions of records of water quality data for download, as well as satellite imagery, fishing forecasts, algal distribution maps, and water quality assessment publications.

CREEK CRITTERS: ENGAGING PEOPLE IN STREAM STEWARDSHIP AND ADVOCACY

Gregg Trilling; gregg.trilling@anshome.org; Audubon Naturalist Society

The Audubon Naturalist Society has been running a volunteer water quality monitoring program for almost 30 years and delivering stream science programs to schools for over a decade. Three years ago, we developed the Creek Critters app to enhance that work and improve outreach around our clean stream initiatives. ANS uses the app to engage people through a stream health assessment activity based on finding and identifying macroinvertebrates. The activity empowers citizens to check on their local streams, and has helped ANS – and our partner watershed organizations – reach out to existing and new audiences, and to connect the audiences with stewardship projects and advocacy campaigns. Join us for this presentation to learn about the ways we've engaged thousands of adults and children using Creek Critters and how we've been working to move people up the ladder of engagement towards stewardship and advocacy for clean water and healthy streams.

Gregg Trilling is the Creek Critters Program Manager and an environmental educator for the Audubon Naturalist Society. He works with organizations throughout the region to engage people in protecting local streams. ANS reaches people of all ages through a variety of initiatives, including stream studies, teacher trainings, citizen science and stewardship programs, and advocacy workshops.

AGRICULTURE AND LOCAL FISH HABITAT CONDITIONS IN CHESAPEAKE BAY

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Coauthors: Margaret McGinty, MD DNR, Fishing and Boating Services; Alexis Park, MD DNR, Fishing and Boating Services; Carrie Hoover, MD DNR, Fishing and Boating Services; Marek Topolski, MD DNR, Fishing and Boating Services

Human population growth since the 1950s added a suburban landscape layer to Maryland's Chesapeake Bay watershed, while land in agriculture has been relatively stable but is used and managed intensively. During 2003-2016, we investigated the impact of land use on fluvial and subestuary fish habitat of 28 Bay watersheds. Agricultural coverage and development were strongly and inversely correlated. In general, fish habitat conditions in agricultural watersheds were better than in developed watersheds. Proportion of stream samples with herring eggs and-or larvae were consistently high in watersheds dominated by agriculture, while they declined with development. The proportion of samples in tidal subestuaries with yellow perch larvae was positively influenced by forest and agriculture, and negatively related to development. A dome-shaped quadratic model of median bottom DO during July-September and agricultural coverage for mesohaline subestuaries ($r2 = 0.61$, $P < 0.0001$) indicated an ascending limb (comprised entirely of western shore subestuaries) of median DO from near 0 to 5 mg/L when agricultural coverage went from 6 to 41%. Predicted median bottom DO peaked at 5.5 mg/L at 45% agriculture and declined to 4.2 mg/L at the highest level of agriculture observed; these measurements were from eastern shore subestuaries.

Jim Uphoff is a native Marylander who received his B.S. from University of Maryland, in 1976. He started with MD DNR in 1978. He has sampled and analyzed most everything that moves in Chesapeake Bay and some things that don't. He is the Fish Habitat and Ecosystem Assessment Program Chief.

EXPLORING AMBIENT NUTRIENT MONITORING DATA WITH THE WATER QUALITY INDICATORS (WQI) TOOL

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Coauthor: Robert Greenspun, US EPA

The Water Quality Indicators (WQI) Project integrates and normalizes available ambient monitoring data to help EPA, state, and tribal staff better identify water quality problem areas. EPA currently publishes information about the health of watersheds based on states' assessments conducted under CWA 305(b)) program. That data reside in EPA Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) and contain information about impaired watersheds (CWA 303(d)). Because a large number of watersheds have not yet been assessed under CWA 305(a), EPA began the WQI project to fill in data gaps. Specifically by using ambient water data in the Water Quality Portal (WQP) and comparing the WQP data to national or ad hoc water quality criteria (currently only nutrient concentrations). EPA used data analytic methods to stratify the WQP data and is now working to include data visualization tools that will help users display and assess the data. EPA envisions a wide-ranging set of uses for the data, including trend analysis, TDML development, and improved state and local permitting and compliance program administration.

Rusty Wasem is currently an environmental protection specialist in US EPA's Office of Enforcement and Compliance Assurance (OECA). Rusty currently works in OECA's Office of Compliance developing tools to improve use and access of enforcement and compliance data. Prior to coming to OECA in 2014, Rusty spent more than seven years in EPA's Office of Pesticide Programs evaluating older pesticides.

INITIAL EFFECTS OF STREAM RESTORATION ON FISH AND INVERTEBRATE ASSEMBLAGES IN LITTLE TUSCARORA CREEK, MARYLAND

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Stream restoration stabilizes stream banks and has been shown to effectively reduce sediment export and increase connectivity with the surrounding riparian zone. Additionally, stream restoration is often intended to improve stream biology and biodiversity by increasing habitat heterogeneity and suitability. However, results may largely depend on factors influencing the stream that are beyond the immediate vicinity of the project. The Maryland Department of Natural Resources - Maryland Biological Stream Survey is monitoring the response of fish and aquatic macroinvertebrate assemblages to a stream restoration project on Little Tuscarora Creek (Frederick Co., Maryland) relative to pre-removal conditions and upstream control sites. Preliminary results from two years of post-restoration surveys showed increased fish species richness and higher benthic index of biotic integrity scores at the restored site. Long-term monitoring at this site will document whether these preliminary results persist.

Jonathan is a freshwater biologist with the Maryland Department of Natural Resources (MDNR). He primarily contributes to monitoring efforts associated with the Patapsco River dam removals and the Maryland Biological Stream Survey. Before he recently started working with DNR, Jonathan finished his Master's degree in wildlife ecology at the University of Maine where he studied the effects of several large dam removals on fish assemblages in the Penobscot River. He has previously worked with the South Carolina Department of Natural Resources and as a NOAA groundfish observer in Alaska. His research interests include biological responses to stream restoration actions and migratory fish ecology.

STREAM RESTORATION: TMDLS, BIOTIC UPLIFT, AND PERMITTING - ARE WE AT THE CONFLUENCE?

Jeff White; Jeff.White@Maryland.gov; Maryland Department of the Environment

Coauthor: Denise Clearwater, Maryland Department of the Environment

The amount of stream restoration being done across the State has increased significantly over the past several years, due to Chesapeake Bay TMDL goals and MS4 permit requirements. This has prompted many researchers as well as State regulators to give closer examination of whether or not project designs achieve local water quality, habitat, and biotic endpoints. This presentation describes the many considerations that are evaluated by MDE's Wetlands and Waterways Program during the permitting process, relative to local water quality, habitat, and biotic endpoints. It also provides clarity on what these local water quality, habitat, and biotic endpoints are, and how they are derived. By doing so, the hope is to incentivize stream restoration designs that focus on biotic uplift, habitat improvements, and water quality improvements in the proposed project reaches

Jeff White is a Natural Resources Planner in the Watershed Restoration Division of MDE's Integrated Water Planning Program. His background is in the development and application of water quality models for local, State TMDLs.

Denise Clearwater has worked in Maryland's wetland programs since 1986. She has a background in developing and implementing programs in wetland regulation, wetland training, and mitigation, as well as managing special projects for grants and program improvement and assisting in policy development.

THE INFLUENCE OF GRAY AND GREEN INFRASTRUCTURE ON WATER QUALITY CHANGE IN THE GWYNNS FALLS WATERSHED, BALTIMORE, MARYLAND

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Factors influencing water quality trends in urban streams are not well understood at the watershed scale, despite regulatory requirements and investment in gray and green infrastructure. Long-term water quality trends and factors of influence were examined in the Gwynns Falls watershed over the Baltimore Ecosystem Study timeframe. Land cover and climate change can mask signals in water quality improvement. Analysis of land cover in the Gwynns Falls watershed indicated minimal change during the study timeframe indicating it is not likely a factor of water quality change. However, an increase in winter precipitation was apparent in the region. A higher proportion of runoff producing storms was observed in the winter and less in the summer. These precipitation changes may reduce the effectiveness of green infrastructure. Sanitary sewer overflows (SSOs, gray infrastructure) and best management practices (BMPs, green infrastructure) were identified as factors influencing water quality change. An increase in SSO number, volume, and duration were correlated to an increase in annual loads of nutrients and bacteria. An increase in BMP number, storage volume and drainage area were correlated to a decline in annual loads of phosphate, sulfate, and total suspended solids. Results suggest that investment in both gray and green infrastructure is necessary for water quality improvement

Ellen Woytowitz is a hydrologic technician with the USGS Maryland-Delaware-DC Water Science Center. She graduated with a degree in Environmental Science and certificate in Geographic Information Systems in December 2015. After completing her degree she spent a year in the Chesapeake Bay Trust Conservation Corps service program working on urban water data collection and analysis with the USGS and Baltimore Ecosystem Study scientists.

STATUS AND TRENDS OF THE CHESAPEAKE BAY WATER QUALITY STANDARDS CRITERIA ATTAINMENT

Qian Zhang; qzhang@chesapeakebay.net; University of Maryland Center for Environmental Science / USEPA Chesapeake Bay Program Office

Coauthors: Richard Tian, University of Maryland Center for Environmental Science / EPA Chesapeake Bay Program Office; Peter Tango, U.S. Geological Survey / EPA Chesapeake Bay Program Office

To protect the aquatic living resources of the Chesapeake Bay and its tidal tributaries, the Chesapeake Bay Program partnership has developed and published a guidance framework of ambient water quality criteria with designated uses and assessment procedures for dissolved oxygen, water clarity/underwater grasses, and chlorophyll-a for Chesapeake Bay and its tidal tributaries in 2003. These quantitative criteria serve as a critical basis for assessing the attainment of designated uses and measuring progress toward meeting water quality goals. Currently, the Chesapeake Bay Program reports to the public a single indicator to describe standards attainment of dissolved oxygen, water clarity/underwater grasses, and chlorophyll-a. In this presentation, we provide an overview on the most up-to-date results on the current status (the 2014-2016 cycle) and the long-term trends (1985-2016) of this attainment indicator. In addition, we have extracted information from the indicator assessment procedures to quantify the "attainment deficit" for a particular segment and designated use to better understand how far away it is from the desired status of "attaining." These results on "attainment deficit" provide more detailed information about how the estuarine water quality changes in space, time, and across different designated uses.

Dr. Qian Zhang is an assistant research scientist with UMCES at the EPA Chesapeake Bay Program. His main role is to work with scientists, professionals, and managers in the Chesapeake Bay partnership to explore natural and anthropogenic-based causes behind the current status and long-term trends in the water quality of the Chesapeake Bay and tributaries. Zhang is interested in applying scientific principles and statistical approaches to quantify nutrient and sediment export from watersheds. He obtained his Ph.D degree (environmental engineering) at Johns Hopkins University in 2016. He also holds two Master degrees from Johns Hopkins, environmental engineering (2011) and statistics (2014).

Poster Abstracts

ST. ANDREW'S LANDFILL LANDFILL GAS (LFG) SYSTEM'S IMPACT ON A MID-SIZED LANDFILL

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Coauthors: Carly Cushing, Maryland Environmental Service; Kaitlyn Peterson, Maryland Environmental Service

A LFG System was installed at St. Andrew's Landfill in St. Mary's County in March of 2007. An expansion was installed in September of 2014. Since its implementation, groundwater data has shown a statistically significant correlation between the operation of the LFG extraction system and declining VOC trends in many groundwater monitoring wells. A statistical evaluation of groundwater data from 2006 - present was conducted and one-hundred twenty-five (125) statistically-significant VOC reductions were observed in sixteen (16) monitoring wells. These statistically-significant VOC reductions correlate with the decreasing LFG trends discussed above.

NON-TRADITIONAL APPROACHES TO IMPROVE MACROBENTHIC INVERTEBRATE COMMUNITIES FOR STREAM RESTORATION PROJECTS

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There is increasing interest to improve macrobenthic invertebrate communities as a result of stream restoration projects. Compensatory mitigation projects often require the monitoring of macrobenthic populations for several years after the completion of restoration work, sometimes with success criteria tied to the results. Macrobenthic communities are also monitored as an indicator of water quality under TMDL programs and EPA's Stormwater Phase II rules. Whereas stream restoration projects have traditionally focused on stream stability, with a "if you build it, they will come" mentality, practitioners are increasingly being asked to consider higher functions and to specifically improve macrobenthic communities and biological functions. This poster will focus on non-traditional techniques that are specifically designed and implemented to improve macrobenthic invertebrate communities and populations. The poster will focus on two products HabiTubes & Habi-Mats restoration system that allow for the semi-permanent creation of leaf packs and woody debris in the riffles and glides of streams. These products and techniques can be used to jump-start the colonization process after restoration and promote macrobenthic communities into the future. Example projects will be discussed, along with pre- and post-monitoring data that document changes in macrobenthic communities as a result of the presented methods.

THE TENTH ANNUAL MARYLAND STREAMS ROUNDTABLE

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The MWMC organizes the Maryland Streams Roundtable to foster collaboration and cooperation among the many and varied groups sampling streams throughout Maryland. This gathering provides an excellent opportunity to learn where monitoring is being done and what's being sampled. The Roundtable is intended for professionals, non-profit organizations, and academic institutions monitoring streams. It serves as an opportunity for agencies, academic institutions, and groups to share what and where sampling will be done every year. Fifty-three people attended the 10th Annual Maryland Streams Roundtable that was held at the USGS Water Science Center on February 10, 2017. Twenty-three people gave 10-minute presentations on their sampling programs. Included were Federal agencies (3), state agencies (2), local/regional agencies (5), academia (3) consultants (3), and NGOs (7). Seventeen groups submitted 2017 sampling site point data for display on a web-enabled map. This map was used to locate areas of overlap and identify potential opportunities for collaboration.

TRACKING CONDUCTIVITY WITH INCREASED TEMPORAL RESOLUTION BETWEEN TWO STORM WATER MANAGEMENT PONDS

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Decreasing water quality due to road salt application is a growing problem. Cl concentrations [Cl] are positively correlated with percent urbanization in areas that apply road salt. [Cl] in many urban areas exceed EPA chronic water criteria for aquatic life with increasing frequency. At the same time, stormwater Management Basins (SMBs) have become a common solution to flashy discharge and flooding problems in areas with increased urbanization. Our study site is in Owings Mills, MD where two SMBs are upgradient of a floodplain of an unnamed tributary of Red Run. Previous studies of the site have shown that specific conductance (SC) driven by [Cl] in surface and ground waters increases with proximity to the SMBs and is higher in winter than summer. What is unknown is: the differing pathways that [Cl] moves through the site, the short-term (hourly to daily) variability in SC, and how SC and [Cl] vary with groundwater depth. To answer these questions, wells were installed across the floodplain at ~1 m and 2.5 m depths and [Cl] and SC were characterized via grab samples and in-situ conductivity sensors. Preliminary results show that SC in shallow wells is mainly contributed by large pulses in the winter-spring months (likely driven by surface outputs from the SMBs), while SC in the deeper wells remains elevated in all seasons (likely driven by infiltrating water from the SMBs).

WATER QUALITY IN BALTIMORE'S WATERSHEDS: A BIO-CHEMICAL INVESTIGATION

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Coauthors: DaRae Solomon, Dr. Jiru , Dr.Tatiana Roth , Tamera Warrington , Malia Vester, Aaliyah McCollough , Jasmynn George

How good is Baltimore's water system? Baltimore's water source is primarily surface water, which feeds into the Liberty, Loch Raven and Prettyboy Reservoirs. The focus of this multilayered research lies on investigating the socio-environmental and physicochemical factors contributing to water quality degradation in the Baltimore watersheds. The Socio-Environmental Synthesis (SES) approach was used to investigate the factors that contribute to water quality impairment. SES is a research method that integrates existing knowledge and data from natural and social sciences to advance understanding of socio-environmental systems. Water quality parameters including heavy metals (lead, mercury, arsenic and selenium), biological oxygen demand (BOD), nitrate-nitrogen and carbon dioxide were studied over a three year period by taking seasonal water samples from three reservoirs (Liberty, Loch Raven and Prettyboy). The study established that while water quality is generally good in the reservoirs, there is a growing concern with the levels of nitrate-nitrogen and carbon dioxide concentrations especially in the Liberty and Prettyboy watersheds. This study, in addition, is looking into synthetic pharmaceuticals (like estrogen) and disinfection bi-products (DBPs) of chlorine to examine possible bio-chemical contamination.

USING STATISTICAL MODELS TO IMPROVE REMOTELY SENSED ESTIMATES OF TOTAL SUSPENDED SOLIDS IN THE CHESAPEAKE BAY

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Water clarity in the Chesapeake Bay is an important environmental parameter to monitor due to its effects on pathogen abundance, submerged aquatic vegetation, and other aquatic life. The Chesapeake Bay is home to an extensive and continuous network of in situ water quality monitoring stations that include measurements of total suspended solids (TSS). However, in situ measurements can be limited in space and time due to the time, personnel, and expenses required. Satellite remote sensing can fill these gaps and has proven to be a valuable tool for monitoring water quality estuarine systems. Ondrusek et al. (2012) devised a polynomial algorithm using the normalized water-leaving radiance at 645 nm to estimate TSS from MODIS, which is used operationally in the Chesapeake Bay. While this algorithm performs very well for most applications, it underestimates many higher TSS values that could be important for purposes such as pathogen modeling. In this study, we combine multispectral MODIS reflectances and advanced statistical models to improve TSS estimates for the Chesapeake Bay, particularly for higher TSS ranges. We compare the Ondrusek et al. (2012) algorithm with our statistical models on a large validation dataset. We then evaluate the performance of each model on how well it predicts the top 20th percent of TSS values and calculate a Critical Success Index (CSI) for each.

THE FREDERICK COUNTY STREAM SURVEY USING A COUNTYWIDE MONITORING PROGRAM TO BETTER INFORM RESTORATION DECISIONS ON A WATERSHED SCALE

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The Frederick County Stream Survey (FCSS) is a probabilistic sampling program that assesses the biological, chemical, and physical habitat in wadeable streams throughout Frederick County. The Survey began in with Round 1 in 2008 and completed Round 2 in 2016, having sampled 400 sites during that time frame. Results can be used to assess the condition of County streams both at the County scale and at the scale of the County's 20 subwatersheds. With the completion of Round 2, the County has started to investigate any trends in stream condition since the initiation of the study. In addition, the County has recently initiated watershed studies that will include recommendations for restoration areas. The FCSS identified key stressors in each watershed for land use, habitat, water quality, and biological condition (based on values established by the MBSS), which will be used to target restoration opportunities in each subwatershed. This poster summarizes some key findings of Round 2 of the FCSS and highlights the Survey's applicability to prioritizing restoration projects, using the Catoctin Creek watershed as an example.

GREEN CONCRETE: A COMPARISON OF CONCRETE SUBTRATES FOR MACROINVERTEBRATE COLONIZATION

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Coauthors: Dr. Patrick Kangas, University of Maryland; Dr. Peter May, University of Maryland; Ms. Evelyn Tickle, James Madison University

Nutrient loading is increasingly viewed as a threat to water quality, forcing communities to seek techniques to remove sediments and nutrients, sometimes through removal of algae from water bodies. This experiment attempts to improve the bioreceptivity of concrete by sequestering the removed algae and its nutrients within. Bioreceptivity is contrasted between four substrate treatments: Ordinary Portland Cement (OPC) (the control), OPC combined with dried algae, CaCO3 concrete, and CaCO3 concrete combined with dried algae. The substrate samples are 10 cm diameter disks hung from a bulkhead in the Baltimore Harbor with one treatment set at three depths per rope. Samples are collected every three months for a year and analyzed for rates of colonization by macroinvertabrates. It is hypothesized that adding algae will improve the bioreceptivity of concrete by offering a biogenic signature, promoting increased settlement by organisms. Also, CaCO3 concrete will have higher rates of settlement due to its chemical composition being close to that of an oyster shell, which tend to increase colonization by mussels and barnacles. Initial data collection indicates CaCO3 concrete has the most colonization and concrete containing algae has the least. Algae may not improve the bioreceptivity of concrete, but mixing algae and concrete shows promise as a method of sequestering pollutants.

EFFECTS OF ROAD DEICING SALT AND TEMPERATURE ON LARVAL GREEN FROGS IN CENTRAL MARYLAND

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About 14 million tons of road de-icing salts are used each year in North America with NaCl accounting for 98% of total salt use. Increased salinity is an in important environmental stressor to aquatic organisms, including amphibians. Temperature is also becoming an increasingly important environmental stressor for amphibians but there are few studies that have explored these combined factors. We conducted a series of acute toxicity tests and a sub-chronic toxicity test to explore impacts of these two stressors on larval green frogs. Acute toxicity tests were conducted to determine an NaCl LC50 at 18 °C, and the results were used to inform the treatment levels of a sub-chronic test. For sub-chronic NaCl exposure testing we exposed green frog larvae to three temperatures (18, 22, and 25 °C), and three concentrations of sodium chloride (500, 1000, and 2000 mg/L Cl-) for 35 days. The larvae were observed for mortality and Gosner stage, as well as length and weight. While there was no significant effect of temperature on mortality, there was a significant effect of chloride. Mortality of individuals in the 2000mg/L Cl- treatment group was significantly higher than that of controls and other treatment groups. This study provides important insights into effects of two environmentally relevant anthropogenic stressors on commonly occurring Maryland amphibians.

BENTHIC MACROINVERTEBRATE RESPONSES TO A REGENERATIVE STORMWATER CONVEYANCE RESTORATION IN A COASTAL PLAIN STREAM

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In February 2016, a Regenerative Stormwater Conveyance (RSC) stream restoration project was completed in North Muddy Creek Branch (Muddy Creek) located on the Smithsonian Environmental Research Center property in Edgewater, MD. RSC is a relatively new restoration design that is gaining popularity in Maryland, despite sparse evidence of its impacts on resident biota. In 2014, Maryland DNR established 8 benthic macroinvertebrate monitoring sites in the Muddy Creek watershed to document changes in benthic communities pre- (2014 & 2015) and post-restoration (2016 & 2017) using MBSS protocols. Average pre-restoration BIBI scores were significantly ($p<0.05$) higher (3.4; fair) compared to post-restoration (2.1; poor), adjacent control (2.3; poor), and upstream control (2.5; poor) scores. A significant decrease in taxa richness, Shannon Diversity Index values, and percent predators was observed at post-restoration sites compared to pre-restoration sites. Pre-restoration sites were dominated by intolerant Synurella (0.4) and Stegopterna (2.4), and post-restoration sites were dominated by tolerant Diplocladius (5.9) and intolerant Stegopterna. The 2017 post-restoration sites significantly increased in taxa richness, Shannon Diversity Index values, and percent predators from 2016 sites, suggesting that ecological recovery may be occurring in the restoration reach of Muddy Creek.

IS RNA/DNA A GOOD INDICATOR OF LARVAL YELLOW PERCH HABITAT QUALITY?

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We used the ratio of ribonucleic acid (RNA) to deoxyribonucleic acid (DNA) concentrations in body tissue to see if RNA/DNA could be linked to a hypothesis that amount of organic material (OM) was negatively linked to watershed development and positively linked to feeding success of yellow perch (YP) larvae. We expected feeding success of early YP larvae examined for the OM hypothesis would be easily linked to RNA/DNA dynamics since the ratio is an indicator of nutritional status and somatic growth in larval fish. We also explored possible maternal effects by comparing the average amount of DNA present in 6-9 mm (first-feeding) larvae. We found that RNA/DNA ratios did not indicate consistent differences in larval condition between two watersheds below target level of development and two at or slightly above the threshold. These watersheds may be providing some indication of factors that mitigate impacts of development on YP larval abundance and OM, zooplankton, and feeding linkages when development is beyond, but near, the threshold. While wetland coverage in developed watersheds was less than those in rural "treatments", all four systems had fringing wetlands along the larval nursery region. Significant annual differences in initial size of first-feeding larvae were exhibited by amount of DNA per sample, indicating that maternal influence on size was not constant among years.

FINGERPRINTING SOURCES OF NITROGEN POLLUTION ON SCHOOLYARDS IN WESTERN MARYLAND

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Fingerprinting nitrogen sources across landscapes is useful for developing science-based management solutions to combat anthropogenic nitrogen pollution in the environment. During the past three years, we initiated and developed a unique student-teacher-scientist partnership between (1) high school environmental science classes in western Maryland and (2) scientists and education specialists at the Appalachian Laboratory. The goal of this partnership is to use the concentrations and stable isotopes ($\Delta 17O$ and $\delta 15N$) of nitrate to assess the amounts and sources (i.e. atmospheric vs. terrestrial) of nitrate pollution leaving schoolyards in runoff draining a variety of land-uses. In runoff samples collected in spring 2017 at two sites on each of six schoolyards our team observed large variation in (1) average atmospheric nitrate concentrations (0.02 to 0.20 mg N/L), (2) average terrestrial nitrate concentrations (<0.003 to 0.33 mg/L), and (3) average proportion of atmospheric nitrate (13 to >99 %). Runoff was dominantly atmospheric nitrate at 7 sites and terrestrial nitrate at the other 5 sites. Atmospheric nitrate concentrations were positively related to the percent of impervious surfaces ($r2 = 0.37$, $p < 0.05$). Our results indicate distinct nitrate sources within and across schoolyards and suggest that impervious surfaces reduce the uptake and/or processing of atmospheric nitrate.

ANALYSIS OF BACTERIAL AND ALGAL DIVERSITY IN THE ANACOSTIA RIVER

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Until recently, the Anacostia River as been plagued with pollution and toxic waste. Most of the pollution is due to an antiquated combined sewage system that brings excess nutrients that influences the composition of the viral, bacterial, and algal communities. Three sites along the river were sampled during during 2016/2017. The samples were filtered for bacterial and algal DNA, and categorization of bacterial and algal phyla was done using various environments. Two major algal groups, Opisthokonta and SAR, were identified as the most abundant at all three sites, yet the bacterial biodiversity fluctuated across three sites due to seasonal factors which had an impact on the volume of sewage overflow into the river. Bacterial beta-diversity had differences appear across different seasons. The mid-river site had the most changes in the microbial community. Algal beta-diversity remained fairly uniform across all sites and seasons observed. The data from this study will be used as baseline data to help determine the effectiveness of the Anacostia River Tunnel which is predicted to divert nearly 90% of the sewage from the river once it goes online in March 2018. Being able to compare the pre- and post-tunnel microbial communities will help determine whether changes to the ecosystem health and biodiversity has occurred.

ESTABLISHING BASELINE CONDITIONS BEFORE STREAM RESTORATION IN BALTIMORE AND HARFORD COUNTIES

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A major goal of stream restoration projects in the Chesapeake Bay watershed is to reduce the export of total suspended sediments, nitrogen, and/or phosphorous. We are investigating the effectiveness of restoration focused on legacy sediment removal and floodplain reconnection for streams across a gradient of impervious surface cover (ISC). Here we report preliminary baseline data for pre-restoration conditions in three streams in northern Baltimore and Harford counties: First Mine Run (FMR), Bear Cabin Branch (BCB), and Plumtree Run (PTR). FMR is 3.21 sq km with predominantly agricultural land use (~65–70%) and only 1.54% ISC. BCB is 8.24 sq km with a mix of forested (20.5%) and urban (48.4%) land uses and 20.5% ISC. PTR is 0.96 sq km with predominantly urban land use (95.9%) and 48.6% ISC. The average concentration of total nitrogen (TN) is highest at FMR (5.76 mg/L), the site with the highest agricultural land use. TN concentrations are somewhat lower at the suburban BCB site (2.61 mg/L) and lowest at the urban PTR site (1.36 mg/L). The pattern for average specific conductance (SC) is the opposite with the lowest value at FMR (240 µS/cm) and the highest at PTR (746 µS/cm). The increase in SC is likely the result of road salt and other inputs from urban areas. The range of baseline conditions is likely to result in differing responses to stream restoration.

HOW TO SURVIVE AS AN OYSTER IN BALTIMORE'S INNER HARBOR

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At one point in Chesapeake Bay history, the Eastern Oyster, *Crassostrea virginica*, was once so plentiful that their reefs defined major river channels and extended near the surface of the water. It was estimated that oysters, at one time, were able to filter all of the water in the Bay in about a week's time, and it now takes the current population almost a year to filter the same amount of water. After decades of damage to the reefs due to oyster harvesting, increased disease, significant drops in dissolved oxygen levels as you descend the water column, caused significant loss of hard bottom habitat, and put the oyster population in the Chesapeake Bay at less than two percent of the historic population. Oyster cages were placed at three different sites, varying in water flow, and three different depths, all located in the Baltimore Inner Harbor area, adjacent to the Baltimore National Aquarium. At each depth, community species numbers for cages with and without oysters were surveyed. Measurements of dissolved oxygen, temperature, salinity, and conductivity were taken twice a week. According to the readings produced for the abiotic conditions, the cages at the surface had higher levels of dissolved oxygen and exhibited higher survival rates than those at deeper depths. This experiment will serve as a basis for future projects involving oysters and water quality in urban areas.

INCORPORATING DIATOM COLLECTION AND ANALYSIS IN COMBINATION WITH BENTHIC MACROINVERTEBRATES AND FISHERIES SAMPLING TO PROVIDE A MORE HOLISTIC REPRESENTATION OF WATER QUALITY CONDITIONS

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Diatoms are photosynthetic unicellular, microorganisms (algae) that are distinguished by their silicified (SiO2-nH2O) cell walls. It is well-known that low-level, proximate factors, such as light, nitrogen (N), phosphorus (P) and stressors such as pH, temperature, and toxins directly affect diatoms. The sensitivity of diatoms to so many habitat conditions make these microorganisms highly valuable indicators, particularly if effects of specific factors can be distinguished. Diatoms have shorter generation times than fish and benthic macroinvertebrates. Therefore, we assume they reproduce and respond rapidly to environmental change, thereby providing early warning indicators of both pollution increases and habitat restoration success. Many diatom species have been calibrated to environmental measures that allow good estimates of environmental changes. The combined costs of sampling and sample assay are relatively low when compared to other organisms. Samples can be archived easily for long periods of time for future analysis and long-term records. Diatoms have become valuable elements in large-scale national and international assessment programs. Diatom assemblages and water chemistry have been studied but not applied to stream restoration success criteria in Maryland.

MBSSTOOLS, AN R PACKAGE

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MBSStools is an R library with functions to perform various analyses by MBSS staff and those working with MBSS data. The main features are the calculation of metrics and indicies for fish (FIBI), benthic macroinvertebrates (BIBI), taxa occurrence maps, stream flow calculations, ion contribution to measured conductivity and calculation of the PHI. Having these tools as an R package standardizes the calculation methods for MBSS staff, as well as, those outside of MBSS using MBSS data or their own data. Data submissions using MBSStools will be of known data (calculation) quality.

A SUITE OF IONS INCREASES WITH URBANIZATION IN MATTAWOMAN CREEK

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Urbanization degrades aquatic integrity through myriad factors. Yet amid the complexity, development in a watershed often correlates with the easily measured specific conductance of streams. The Maryland Fishing and Boating Services (FBS) is examining the relationship between conductance and habitat quality and finds, for example, that river-herring spawning drops when conductance exceeds ~1.6 times background. To more fully characterize the sources of elevated urban conductance, a limited number of monthly ion samples were collected by volunteers under FBS supervision in the Mattawoman Creek watershed. In the results presented here, summer samples collected under no-flow conditions are excluded. The three remaining months surveyed, October-December, had no snowfall and so should represent a period with a minimal direct-contribution from road salt. Nonetheless, the data show that sodium+chloride formed the majority of ions in all samples and correlated with catchment road-density. However, the concentration of all other ions (except nitrate) also correlated with road density, such that the relative contribution of sodium+chloride was uncorrelated with road density. While the role of road salts in elevating the conductance of urban streams is well established, these data suggest that a suite of additional ions also contribute to the elevated conductance of urbanized streams.

DIVERSE ORGANIC CHEMICAL COMPOSITION OF MARYLAND STREAMWATERS AND OPPORTUNITY FOR ENVIRONMENTAL TRACER DEVELOPMENT

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Stream water monitoring can provide crucial information on the health of Maryland streams and describe baseline conditions and diversions due to environmental contamination. Seasonal stream water was collected in Garrett County, MD, as part of MD-DNR assessment of baseline monitoring prior the possible advent of hydraulic fracturing. Similarly, a monthly survey of Calvert County streamwater was conducted in the context of possible septic system contamination. Stream water dissolved organic matter (DOM) was collected and analyzed using fluorescence spectroscopy and ultrahigh resolution Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS). Natural variability of the DOM fingerprints can be used to determine the background conditions for these streams, and can then be compared to fingerprints of possible contamination sources such as hydraulic fracturing wastewaters or septic systems. Indeed, when streamwater DOM fingerprints were compared to hydraulic fracturing wastewaters, more than 28,000 unique organic molecular ions were identified in hydraulic fracturing wastewaters and absent from streamwaters. This non-targeted tracer development technique could similarly be applied to other industrial, municipal, or agricultural fluids whose release is of environmental concern to identify a set of tracer molecular ions unique to the contaminant fluids.

ASSESSING THE APPLICATION OF THE BANK EROSION HAZARD INDEX MODEL TO PREDICT STREAMBANK EROSION AT LITTLE CATOCTIN CREEK, MARYLAND

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High streambank erosion has become an increasing issue in contributing sediment to streams in the Maryland Piedmont region. Agencies use sediment budgets to estimate different sediment inputs. Streambank erosion rates can also be estimated by these budgets. The erosion rates can be predicted by the Bank Erosion Hazard Index (BEHI). The BEHI protocol assigns a numerical value to field obtained metrics to determine potential erosion hazards. The goal of this project was to estimate streambank erosion rates for the Little Catoctin Creek stream using the BEHI method and compare these scores to bankpin measurements. Results showed that extremely high (> 40) and extremely low BEHI scores (< 9) correlated well with bankpin measurements. Scores that showed low to moderate erosion however, did not show a correlation between the BEHI scores and bankpin data. It was concluded that using BEHI scores to measure streambank erosion, even with its limitations, is a practical method to estimate streambank erosion.

NATURAL VS ARTIFICIAL THE REEF THAT FISH PREFER

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Wildlife is an important part our ecosystem. Human interactions have caused problems for the wildlife and resulted in some destruction of their habitats. For oceanic wildlife, reefs are important in providing shelter to various species. Humans have caused changes in the ocean and these reefs have become somewhat damaged, and one way to replace the damaged reefs is to put in artificial reefs. These artificial reefs can be made from concrete and rock and serve the same as a natural reef. Through research, data is gathered to see how much of a difference can actually be seen between the two. Data came from fishing in the Chesapeake Bay comparing fish caught on an artificial reef, no reef, and natural reef, and also from various factor such as water temperature, clarity, and salinity from each location. Through dredging, the artificial reef brought up mussels clumped on rocks, and the natural reef had oysters clumps, the no reef area had mainly dirt and clay. The natural reef and artificial reef had high fish abundance, compared to no reef site, which means the artificial is better than nothing. The natural had slightly higher fish abundance than the artificial, but over time the artificial could be as good as the natural. Rockfish and White perch were both present at the natural and artificial reefs. Restoration of reefs can have a positive impact on fish and other aquatic life.

CANCELLED - AN EVALUATION OF FOREST IMPACTS AS COMPARED TO BENEFITS ASSOCIATED WITH STREAM RESTORATION

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Stream restoration has become a growing practice in the Mid-Atlantic region, particularly as restoration offers benefits such as bank stabilization and reductions in sediment and nutrient loads to downstream waterways. Restoration designs often attempt to reconnect a stream to its floodplain. At present, restoration benefits in terms of water quality and habitat improvement are receiving attention; however, it is less well known whether the benefits outweigh the potential impacts to forest communities when a stream is reconnected to the floodplain. With funding from the Chesapeake Bay Trust, Maryland State Highway Administration, Maryland Department of Natural Resources, and Montgomery County Department of the Environment, our research is surveying trees, understory vegetation, and reptiles and amphibians to characterize species composition following restoration. Vegetation from surveyed plots were aggregated into primary functional groups to evaluate potential differences in forest ecological function in restored and unrestored sites in Anne Arundel and Howard Counties, Maryland.

AQUATIC SPECIES DIVERSITY AND HABITAT CHARACTERIZATION IN TIDAL PARKERS CREEK

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The American Chestnut Land Trust oversees the Parkers Creek Preserve through various land and water management practices. Baseline surveys of biota throughout the preserve were recently initiated to further direct management. This study investigated aquatic communities in tidal waters of Parkers Creek located in Calvert County, MD. Surveys were done in March, June, August, and October 2017. Twelve sites were sampled within a 2 mile section of the creek using a 12 m long seine and fish traps. Water quality and vegetation were measured at each site to characterize habitats. 1048 fish were collected in the creek with *Fundulus heteroclitus* as the most common species. Species from the families Clupeidae, Moronidae, and Sciaenidae were also collected. Species richness was 22, while species diversity was calculated using Simpson's Index of Diversity (0.685), Shannon-Wiener Index (1.623), and Evenness (0.521). Shoreline vegetation and water chemistry indicated a range of habitat for fishes, with salinity levels from 3.5 to 8.5 ppt. Dominant vegetation corresponded with the lower salinity concentration upstream as Spartina grasses shifted to Typha, Peltandra, and riparian forest shoreline. This study, novel to Parkers Creek, describes both seasonal and year-round fishes and also establishes a baseline on which to track changes and guide future management efforts within the watershed.

USING STABLE WATER ISOTOPES TO CHARACTERIZE PATHWAYS OF SUBSURFACE P LOSS IN A DITCH-DRAINED FIELD

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Phosphorus (P) loss by shallow subsurface flowpaths is a major concern in low-lying agricultural watersheds with artificial drainage and elevated legacy soil P. While lateral subsurface flow is hypothesized as the main pathway of P loss from ditch-drained agricultural fields, the flow components of subsurface drainage remain poorly understood. In this study, we will evaluate the relative contributions of macropore and matrix flow to subsurface leaching of P. We hypothesize that subsurface drainage consists of two isotopically distinct hydrologic pools, "mobile" and "old" water, which can be used to partition different flow components of subsurface P leaching. Additional subsurface hydrological components will also be evaluated, including soil water sampled from suction lysimeters and shallow groundwater sampled from piezometers. Pre-programed automatic water samplers will collect baseflow and stormflow components of ditch drainage. Also, 1 m soil cores will be collocated with lysimeters, divided into 10 cm sections, dried, and sieved for a routine soil analysis. Isotopic samples will be analyzed on a cavity-ring down spectrometer. Resulting water isotopic ratios will be used in mixing models coupled with water and soil P. Our results are intended help modify regional P Indices by improving conceptual representations of subsurface P loss in artificially drained agroecosystems.

CANCELLED: SAMPLING MARYLAND'S STATE OWNED LAKES FOR INVASIVE SPECIES

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Biologists from DNR's Resource Assessment Service conducted the first Aquatic Invasive Species survey in all sixteen state owned lakes in the summer of 2016. Surveys were conducted from kayaks, canoes and motor boats to assess the aquatic macrophyte communities in each lake. The purpose of the survey was to assess the current condition of the state lakes and assist in making management decisions related to aquatic invasive species. Overall, twenty-nine species of submerged aquatic vegetation and six species of floating or emergent plants were observed. Invasive species were found in eleven of the sixteen reservoirs. The report includes a list of recommendations that can be implemented at each lake, with specific recommendations for Deep Creek Lake and some smaller lakes with extensive invasive species populations.

EFFECTS OF STREAM RESTORATION ON FLOW AND WATER QUALITY

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We studied the effects that a step-pool system has on the quality of water within an urban watershed in Annapolis, Maryland. Our measurements of the volumes of the six pools showed that the amount of runoff occurring in most flow events was much higher than the capacity of the restored reach. We measured the concentrations of dissolved oxygen (DO), nitrate, and ammonium in each pool during a storm and subsequent a dry period. We observed a uniform DO concentration (averaging 4.14 mg/L) during high flows, and DO stratification during extended dry periods. During the dry periods, each pool showed different DO patterns, but each had lower concentrations in the morning than the afternoon, ranging down to 0.17 mg/L. The differences suggest hydrological disconnection during low flows, with diel variation resulting from photosynthesis and respiration. The nutrient concentrations in each pool also suggested hydrological disconnection, with ammonium and nitrate concentrations being more similar among the pools during high flows than during low flows. Ammonium concentration ranged from 86.3 to 161 μg N/L in the pools during high flow, but ranged from 49.8 to 136 μg N/L after a dry period. Nitrate was only detectable in the samples during the high flow event ranging from 148 to 229 μg N/L and, the day before this event, ranging from 43 to 148 μg N/L.

ASSESSING THREATS TO MARINE WATER QUALITY CONDITIONS ALONG ASSATEAGUE ISLAND NATIONAL SEASHORE

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The coastal ocean offshore Maryland is important both ecologically and economically. Annually, the MD seafood industry contributes ~$600 million to the State's economy, and more than 8 million people visit Ocean City. The Maryland Coastal Bays (MCB) and waterways which surround the Assateague Island National Seashore, are influenced by both land sources as well as tides and currents from the Atlantic Ocean. The inlet at Ocean City provides important tidal exchange into the embayment. Studies within the MCB have identified a general increase in nutrients and widespread degradation in water quality The results of two previous offshore water quality surveys revealed elevated chlorophyll (1.4-7.6 mg/L) and nutrients (TN 4.0-9.5;TP 0.7-2.4; PO4 0.3-1.75; NH4 0.2-6.6 μM) and detected potentially harmful algae. These included Dinophysis (i.e. diarrhetic shellfish poisoning), Karenia (i.e. neurotoxin shellfish poisoning) and Psuedo-nitzschia (i.e. amnesic shellfish poisoning). There is a need to better understand the linkages between nutrients in the coastal ocean and the MCB and potential ecosystem changes. Funding from the National Park Service will allow two more years of data collection to assess ocean water quality conditions and to help determine nutrient dynamics and phytoplankton species abundances. Data can be used to model bloom development and interactions with the MCB.

MERCURY IN STREAM ECOSYSTEMS OF THE KILPATRICK MARSH WATERSHED: USING INVERTEBRATRES TO EVALUATE FOODWEB EXPOSURE

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Bioaccumulation of methylmercury (MeHg) in lower trophic levels in small stream ecosystems has not been well characterized. To better inform management when making fish consumption advisories, we studied two streams with different watershed histories to monitor MeHg and total mercury (THg) trends. I sampled sediment, porewater, well water and benthic macroinvertebrates over the course of the summers of 2016 and 2017 to monitor seasonal trends in MeHg and THg concentrations across trophic levels. Our goal is to find an indicator species of MeHg exposure for small streams to aid in risk assessment. We selected a candidate amphipod genus that could serve as an indicator species for MeHg exposure in small forested streams.

IDENTIFY AND CLASSIFY THE POTENTIAL NON-TRADITIONAL IRRIGATION WATER SOURCES IN MID-ATLANTIC REGION

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Climate variability, growing water demand and depleting groundwater sources exact a necessity to explore the use of alternative water sources to sustain food production across the U.S. To explore the use of non-traditional water sources; it is necessary to assess their quantity and quality for different crop irrigation. This study aimed at identifying and classifying potential reusable water sources based on their quantity and quality, and make the data accessible via user-friendly spatial databases. By developing a geospatial platform, the water sources were linked to different agricultural point-of-use sites, factoring in proximity and ease of access. The preliminary research shows there are 1609 and 48 Wastewater Treatment Plants (WWTPs) in Maryland and Delaware respectively, that can be considered as non-traditional irrigation water sources. This study provides a systematic approach for the development of similar platforms in other regions and informs different stakeholders about non-traditional irrigation water sources.

CANCELLED - DNA COMPARISON OF MARYLAND CRAYFISH SPECIES USING CYTOCHROME C OXIDASE

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Coauthor: Joe Matanoski, Professor

The crayfish species, *Orconectes obscurus*, was historically found in the rivers and streams of Baltimore County. The Patapsco River has been home to invasive species of crayfish and has led to the spread of species such as *Orconectes virilis*, which are displacing *O. obscurus*, restricting their range, and causing a decline in their abundance statewide. In order to understand the spread of invasive crayfish as well as the distribution of remaining populations of native species, specimens were collected from several streams throughout Maryland. Through morphological features, crayfish were classified to the species level. Identification was then confirmed using genetic analysis. DNA was isolated from chela tissue using a DNeasy kit . Morphologically, the crayfish appear to be one species, but have different features that could match them to another species of the *Orconectes* genus. Using cytochrome c oxidase, the DNA was extracted for future comparison amongst the crayfish species found.

INVESTIGATING BIORETENTION PERFORMANCE THROUGH FOCUS ON LANDSCAPE ARCHITECTURE DESIGN SYNTAX

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Bioretention is a low impact development best management practice that improves stormwater quality and reduces stormwater quantity from developed urban areas. In this research, soil function of urban-based bioretention cells will be observed with related impacts on plants, water quality, and other observable ecosystem services. The study will consider criteria that constitute "failed" bioretention cells in the Baltimore area, with focus on newly established bioretention areas to those up to 10 years old. It will also research how soil amendments, including biochar, compost, and slag could improve soil function and plant establishment via laboratory column studies and greenhouse examination. Findings indicate that variables influencing the failure of bioretention practice includes landscape architectural design elements, that includes the shape and size of the practice, and design elements such as soils, plants, water, sub-surface hydrology and geology, and physical, chemical, biological, micro-climatic, properties and functions of those design elements.

THE AGRICULTURAL WATER FOOTPRINT IN THE CHESAPEAKE WATERSHED

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In the Chesapeake Bay Watershed, the annual rainfall is high enough to support crop growth without irrigation. As rain patterns shift with climate, however, spring rainfall is coming earlier, with more short, intense rain events, leaving the late summer dry. Irrigation is thus on the rise: Mid-Atlantic irrigated acres increased by 33% from 2003 to 2009, despite only a 6% increase in farmland acreage, and water use in agriculture increased by 100% to 250% (except in New Jersey) from 1985 to 2010. Observing other parts of the country experiencing water scarcity, it is evident that water should be considered a commodity. To this end, this project seeks to trace its use, from origin (green, blue or grey water) through crop irrigation, to production endpoint. The water footprint in agriculture is a multidimensional indicator, showing water consumption volumes by source and polluted volumes by type of pollution; all components of a total water footprint are specified geographically and temporally. We have compiled data on groundcover by crop. The known water use of each crop is used to calculate overall water use by area, and then cross-referenced with rainfall to see what optimal irrigation should be, and when. This research should provide a pathway to more responsible water use, as well as the foundation of information for East Coast water markets, should they become necessary.

CURRENT STATUS OF WATER REUSE REGULATIONS AND GUIDELINES IN MID-ATLANTIC AND U.S.

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The main purpose of this study was to evaluate the current status of existing regulations and guidelines for water reuse in the United States. In 2017, 43 states have either regulations or guidelines with respect to water reuse. Among these states, 31, 15 and 1 of them had regulations, guidelines and both, respectively. Every regulations and guidelines were examined in order to compile a comprehensive database including different water reuse categories, necessary treatments and their quality monitoring parameters. Reuse categories were consisting of urban, agricultural, impoundments, environmental, industrial, groundwater recharge, nonpotable reuse and potable reuse. Results showed that Arizona, California, Florida and Texas have the most comprehensive regulations and guidelines for water reuse comparing to other states in the U.S. This study provides a detailed comparison between water reuse regulations and guidelines in Mid-Atlantic and U.S.

BACTERIAL SPECIES ISOLATED FROM THE JONES FALLS WITH ENHANCED GROWTH IN RESPONSE TO USED MOTOR OIL

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Stormwater runoff contains a variety of harmful pollutants including particulates and bacterial contamination, as well as toxins such as fertilizers and pesticides. This study focuses on used motor oil pollution, a component of stormwater runoff. Prior research demonstrated that bacterial communities from the Jones Falls, in Baltimore County (39.417772, -76.670752), exhibited enhanced growth after exposure to used motor oil.

For this experiment, we replicated the previous experimental setup and grew sediment bacteria from the Jones Falls on oil-enriched agar. After incubation, colonies that grew on the enriched agar were isolated and characterized. Through 16s rDNA sequencing and characterization, three different bacterial genera had been isolated, with five unique species in all. We observed the growth and metabolism of the three Pseudomonas species in response to oil, and observed no distinct differences in their growth and metabolism. Learning more about the different genera which exhibited enhanced growth can provide insight to oil pollution due to stormwater runoff and help researchers gain new information about bacterial metabolic cycles and bioremediation.

LINKING WILDLIFE AND ECOSYSTEM HEALTH IN A WETLAND USING THE RED-EARED SLIDER AND PAINTED TURTLE

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With issues of habitat degradation increasing, it is becoming more important to define the effects of environmental change on wildlife health in order to advise conservation and policy. In particular, wetlands are important ecosystems that provide filtration of nutrient runoff as well as habitat for diverse species. However, little research has been done on the impact of a wetland's health on its inhabitants. Our objective was to link wetland health and immunological response in fresh water turtles. Over a two-week period, 42 red-eared sliders (*T. scripta*) and 9 painted turtles (*C. picta*) were trapped within the Rock Spring Conservation Area in Decatur, Illinois. XLT agar plates were used to determine salmonella presence and an enzyme-linked immunosorbent assay provided an antibody count from cloacal and blood samples. Statistical analysis revealed that there was a significant relationship between plasma LPS absorbency and salmonella presence, suggesting that these antibodies were preventative rather than reactive. In addition to water temperature and pH, nitrate and phosphate levels were measured in the lab using a HACH kit. However, we found no relationship between water quality and immune response. Short sampling time or insufficient methods for assessing wetland health could account for the lack of correlation. Further research is needed to address these questions.

PLANT DIVERSITY IN A HEADWATER STREAM AS A POTENTIAL INDICATOR OF STREAM HEALTH

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Headwater streams and the plants growing in and around them are essential to watershed health, especially those with a history of agricultural land use. Within these streams, vascular plant and bryophyte distributions are limited by substrate characteristics. Exposed surfaces within a riverine system allow for the study of plant biodiversity by substrate such as island, rock, and log. This study was conducted in a headwater stream at McDaniel College's Singleton-Mathews property in Carroll County. The purpose of this study was to determine whether size and type of substrate affect plant biodiversity in a stream environment. We hypothesized that larger substrates would support greater biodiversity and that islands would support the most diversity followed by logs and then rocks. Along the stream, four unique 5 meter long sites were set up from bank to bank, and all substrates within those bounds were categorized by type and size. The following responses were recorded for each substrate: counts of individual vascular plants present, estimations of percent cover of nonvascular plants, and total plant species richness. Our results support the hypothesis that substrate type and size affect plant biodiversity on exposed substrates in a sensitive headwater stream environment. Aquatic systems managers can use these results to promote biodiversity by ensuring substrate variety.

PHYSICAL MONITORING AND SEDIMENT MAPPING SURVEY OF THE PATAPSCO RIVER NEAR BLOEDE DAM HOWARD AND BALTIMORE COUNTIES, MARYLAND

Elizabeth Sylvia; elizabeth.sylvia@maryland.gov; DNR- Maryland Geological Survey

Coauthors: Stephen Van Ryswick, DNR- Maryland Geological Survey; Katherine Knipper, DNR- Maryland Geological Survey; Anna Gillmor, DNR- Maryland Geological Survey; Christopher Connallon, DNR- Maryland Geological Survey

Bloede Dam is located on the Patapsco River between Baltimore County and Howard County, Maryland. The dam was constructed in 1906-1907 for the purpose of hydroelectric power generation, but shortly after its construction, sediment began to accumulate behind the dam and in 1924 hydroelectric generation ceased. American Rivers and other partners wished to have the dam removed to open up this section of the river for fish passage. In order to monitor geomorphology changes throughout the River before and after the dam removal process, Maryland Geological Survey conducted 30 cross-sectional surveys (Spring 2016) along the Patapsco River prior to the start of construction. Facies maps were completed for each of the cross-section sites and hand drawn images were digitized with ArcGIS. Sediment samples and pebble count data were collected in the field and taken to be analyzed in a sedimentology lab. GPS Photographs were taken at each of the cross-sections to visually capture changes in the river system. Three photographs were taken from both the left bank and the right bank of the river, which included upstream, across stream and downstream. Images were loaded onto ArcGIS Online and images were linked onto a map. A digital elevation model and facies map were produced for the Bloede Dam impoundment. Construction for the removal of the dam is currently in progress at Patapsco State Park.

FRESHWATER MUSSEL RESTORATION IN THE PATAPSCO RIVER

Jennifer Tam; jennifer.tam@maryland.gov; Department of Natural Resources

Coauthor: Matthew Ashton, Department of Natural Resources

Mussel restoration via propagation and reintroduction is an important, yet often overlooked conservation tool in Chesapeake Bay drainage streams. Mussels provide food and habitat for other organisms along with ecosystem services, such as particle filtration, nutrient cycling and streambed stabilization. Distribution and abundance of Eastern Elliptio (*Elliptio complanata*), the most common mussel in Maryland, has been reduced in some Chesapeake Bay tributaries. This decline was likely caused by multiple factors including degraded water quality and habitat. In addition, the construction of dams restrict the movement of *E. complanata*'s host-fish the American eel (*Anguilla rostrata*). Recent studies suggest that conditions in the Patapsco River may facilitate restoration of *E. complanata* as American eel passage has seemingly improved with dam removal and eel ladder construction and water quality has improved after the implementation of the Clean Water Act. The Maryland Department of Natural Resources is proposing to restore *E. complanata* in the Patapsco River as part of larger watershed restoration efforts. Key points of this poster will focus on techniques required for planning and implementing mussel restoration suitability tests, reintroduction, propagation, and monitoring surveys.

LONG-TERM CHANGE IN THE PATUXENT RIVER ESTUARY

Jeremy Testa; jtesta@umces.edu; UMCES Chesapeake Biological Laboratory

Coauthors: Laura Lapham, UMCES CBL; Ryan Woodland, UMCES CBL; Carys Mitchelmore, UMCES CBL; Vic Kennedy, UMCES CBL; Zachary Gotthardt, UMCES CBL, Nicole Basenback, UMCES CBL; Katie Martin, UMCES CBL; Erin Crandall, UMCES CBL; Ginni La Rosa, UMCES CBL; Mathapelo Seopela, UMCES CBL; Natalie Peyronnin, University of Maryland

The Patuxent River estuary is a tributary of Chesapeake Bay with a rich history of scientific study. A variety of external pressures have driven change in the estuary over the last several decades, including land-use changes, increases in nutrient loading from both point and non-point sources, power plant discharges, climatic variability, and commercial fisheries harvest. Observed degradation of the estuary has motivated extensive collections of data via agency-funded monitoring and research programs that span basic oceanographic measurements to nutrient concentrations to plankton communities and macrofauna communities in the sediments and water-column. These data provide a rich and extensive source of data to quantify how changes in the estuary over the past 60 years have been realized throughout the ecosystem. In this study, we analyzed data for nutrient loading, water-quality and hydrographic measurements, plankton community dynamics, and fish and benthic organisms derived from federal and state agency monitoring programs and reports from historic studies in the Patuxent Estuary. We will report on how these components of the ecosystem have changed over time, both individually and as a coupled food web. Clear long-term, regionally-specific changes are evident for the Patuxent ecosystem, which have implications for other Chesapeake Bay tributaries.

EXPLORING AMBIENT NUTRIENT MONITORING DATA WITH THE WATER QUALITY INDICATORS (WQI) TOOL

Rusty Wasem; wasem.russell@epa.gov; US EPA

Coauthor: Robert Greenspun

The Water Quality Indicators (WQI) Project integrates and normalizes available ambient monitoring data to help EPA, state, and tribal staff better identify water quality problem areas. EPA currently publishes information about the health of watersheds based on states' assessments conducted under CWA 305(b)) program. That data reside in EPA Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) and contain information about impaired watersheds (CWA 303(d)). Because a large number of watersheds have not yet been assessed under CWA 305(a), EPA began the WQI project to fill in data gaps. Specifically, by using ambient water data in the Water Quality Portal (WQP) and comparing the WQP data to national or ad hoc water quality criteria (currently only nutrient concentrations). EPA used data analytic methods to stratify the WQP data and is now working to include data visualization tools that will help users display and assess the data. EPA envisions a wide-ranging set of uses for the data, including trend analysis, TDML development, and improved state and local permitting and compliance program administration.

ANALYSIS OF HUMAN INTESTINAL PARASITES IN BIVALVES AND WATER OF THE JONES FALLS WATERSHED AND CHESAPEAKE BAY AND INNER HARBOR OF BALTIMORE, MARYLAND

Connor Wasilnak; Mtucker3@stevenson.edu; Stevenson University

Coauthors: Kim Pause Tucker, Stevenson University; Matt Tucker, Stevenson University

The Chesapeake Bay (CB) is contaminated by many pollutants, including human microbial pathogens that may originate from streams or other water sources. Marine bivalves are known to accumulate microbes that may be indicators of fecal contamination. The aim of this study was to assess the prevalence of human protozoan parasites in bivalves and surrounding watersheds of the CB. Oysters and water samples were taken from the CB, inner harbor (IH), and areas of the Jones Falls watershed to test the presence and abundance of *Giardia intestinalis*, *Toxoplasma gondii*, and *Cryptosporidium parvum*. Genomic DNA was extracted from oysters (*Crassostrea virginica*), Asian clams (*Corbicula fluminea*), and water from the IH. The β-Giardin gene, a gene encoding a DNA-J like protein, and the GRA-6 gene were assessed by PCR and DNA sequencing. All clams tested contained *G. intestinalis* (assemblage B) and 33% of water samples from the IH contained this species. No bivalves or water tested positive for *C. parvum*. *T. gondii* was only detected in 50% of water samples from the IH. This study shows the presence of important human parasites in organisms and waters of the Chesapeake Bay. The prevalence of these parasites can threaten the health of the local population. Future research will focus on more bivalves and waters that feed into the CB and possibly determine sources of contamination.

DETECTING HARMFUL 'ALGAE' IN MARYLAND LAKES

Catherine Wazniak; catherine.wazniak@maryland.gov; MD Department of Natural Resources

Coauthors: Rick Stumpf, NOAA; Charlie Poukish, MDE; Celia Dawson, MD DNR; Blake Schaeffer, EPA; Chris Luckett, MDE

Cyanobacteria, also known as bluegreen algae, blooms can produce toxins that are harmful to bay life and humans. Cyanotoxins have been shown to travel long distances downstream and accumulate in estuarine organisms (fish, crabs, otters). Cyanobacteria composition from 43 Maryland lakes, ponds and reservoirs are discussed with emphasis on potentially harmful species. Data are from two special studies in 2015-2016, as well as data from three national lake surveys, special harmful algae studies, bloom response monitoring and satellite detection. A comprehensive study of inland waters needs to be conducted and systems selected for more routine sampling and analyses. Future work includes partnering with reservoir and lake managers to help identify and sample blooms as well as using satellites to help detect spatial and temporal changes in blooms over time through the new EPA cyanobacteria assessment network, CyAN, project. The CyAN project has identified 19 possible lakes that can be tracked using satellite algorithms for cyanobacteria.

A COMPARISON OF TWO BENTHIC SUBSAMPLING METHODS AND TWO IBIS.

Adam Webb; adamw@cri.biz; Coastal Resources, Inc.

The Maryland Biological Stream Survey (MBSS) and Montgomery County Department of Environmental Protection (MCDEP) administer programs to evaluate stream health using benthic macroinvertebrates. Although both programs use similar field methods, differences exist in their laboratory and reporting methods. An investigation was conducted into the differences associated with two dissimilar style sorting trays: a 20-grid Caton tray used in MCDEP subsampling methods, and a 100-grid tray used in MBSS subsampling methods. 6 samples were subsampled without replacement on each tray, and subsequently identified to genus, or lowest practical taxonomic level. Data were used to calculate both the MCDEP benthic index of biotic integrity (BIBI), and MBSS BIBI, and draw comparisons using a two factor crossed ANOVA. Little to no research is available on differences between subsampling methods, and particularly with regards to sample density and species richness, and the probability of selecting rare taxa. We present our findings here to elucidate these differences.

AUTOMATIC SAMPLER COLLECTION OF LARGE-VOLUME STORM SAMPLES FOR SUSPENDED SEDIMENT-BOUND ORGANIC CONTAMINANTS FOR TMDL MODEL DEVELOPMENT IN TRIBUTARIES TO THE ANACOSTIA RIVER, WASHINGTON, D.C.

Tim Wilson, Ph.D; blfeit@usgs.gov; USGS

Coauthors: Brian Banks, USGS; Deb Bringman, USGS; Shannon Jackson, USGS; Brenda Majedi, USGS; Charles Walker, USGS; and Timothy Wilson, USGS

The USGS designed and conducted a sampling program for TMDL model needs for urban tributaries in the Anacostia River system. Mobile sampling trailers with automatic samplers collected large-volume (~50-75 liters, to collect enough sediment for the lowest reporting limits) flow-weighted samples composited throughout the storm and during low flow to determine loads of suspended sediment and sediment-bound contaminants of polychlorinated biphenyls (PCBs) including congeners, polyaromatic hydrocarbons (PAHs), and organochlorine pesticides. Discrete suspended-sediment and particulate organic carbon (POC) samples were also collected monthly during storm events to determine the suspended sediment-bound organic-contaminant load. Continuous discharge, velocity, turbidity, and specific conductance were also measured and will be used to develop surrogate models to predict SSC and POC based on continuous records of turbidity and discharge. Preliminary results of this sample-collection system show that tens of grams of suspended sediment were successfully collected representatively over storms, which is sufficient for analysis of the PCBs, PAHs, and organochlorine pesticides.

TEMPERATURE MODELING FOR TMDL DEVELOPMENT AND IMPLEMENTATION IN NONTIDAL COLD STREAMS IN MARYLAND

Guido Yactayo; guido.yactayo@maryland.gov; MDE

Coauthor: Greg Busch, MDE

The Maryland Department of the Environment (MDE) assigns a Use Class to each of the State's waterbodies and must provide water quality for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water. Use Class III(-P) – Nontidal Cold Water streams have the potential for supporting the growth and propagation of trout and other coldwater species. MDE's water quality assessment methodology uses temperature observations taken between June and August to determine whether water quality standards are being met in Use Class III(-P) streams. The thermal regime of streams, which drives the distribution and abundance of aquatic species, is influenced by anthropogenic activities causing changes in the biological community. The objectives of this research are to 1) find or develop a tool to calculate numeric targets for attainment of stream temperature standards and 2) develop a stream temperature TMDL methodology for Use Class III (-P) – Nontidal Cold Waters in the State of Maryland. In this study, we assess the suitability of the Soil Water Assessment Tool (SWAT) model for simulating stream temperature dynamics in the Gwynns Falls Basin and we evaluate the impact of management actions, such as riparian shading and stormwater retrofitting, in order to find the conditions in which an appropriate temperature regime could be restored.

Annual Standing Committee Reports

Maryland Water Monitoring Council 2016-2017 Annual Report

This report summarizes MWMC activities from November, 2016 through November, 2017.

2017 marked the 23rd year for the Council and it was an exciting one. The Board of Directors continued to guide the Council toward its goals and new members provided fresh ideas that helped move the Council forward. The 2016 Annual Conference drew a record 510 attendees. Included were a host of exciting talks and posters and the third post-conference social at the Heavy Seas Brewery. Committee work continued in earnest, including some worthy projects and workshops. The Council will enter 2018 with a renewed commitment to pursue the three Cs – Communication, Coordination and Cooperation - among water monitoring agencies and organizations throughout the State.

Board of Directors

The MWMC Board of Directors maintained leadership from 2016. Board Chair Clark Howells (Baltimore City) continued to serve with Sandy Hertz (Maryland Dept. of Transportation) as Co-Chair. The Board welcomed new members Karen Wiggen (Charles County) and Byron Madigan (Carroll County). Board members Kevin Brittingham (Baltimore County) and Caroline Donovan (UMCES) will step down at the end of 2017. Outgoing members were thanked for their service to the Council. MWMC Board of Directors information can be found at http://dnr.maryland.gov/streams/Pages/MWMC/BoardofDirectors.aspx .

2016 Annual Conference

The 22nd Annual Conference was once again held at the Maritime Institute on December 2 and the gathering was bigger and better than ever. With about 510 in attendance, the event's theme was A RIVER RUNS THROUGH IT – STRENGTHENING NETWORKS AND CONNECTIONS. Enhancing environmental protection and restoration via strong connections and collaboration was emphasized throughout the day. A rousing plenary session started with a talk by Wayne Gilcrest (former US. Representative from Maryland's 1st district) who gave a very engaging and entertaining presentation on his work in the US House of Representatives, with plenty of personal experiences added. George Hawkins (District of Columbia Water and Sewer Authority) discussed the many challenges and successes he's encountered in his career in DC and elsewhere. Bonnie Bick (Mattawoman Watershed Society) received the 10th Annual Carl Weber Award for her work with in protecting Mattawoman waters and landscapes. And Ann Strozyk (Howard County teacher) won the inaugural Above and Beyond Award for her work with students in Howard County and beyond. Session topics included stream restoration monitoring, nutrient trading, road salt, urban waters, fisheries and climate change. Sixty-two, 41 posters (including 16 student posters, 17 vendors or sponsors, and 13 "special interest" exhibits all contributed to a diverse and well-rounded agenda.

Workshops

Stream Monitoring Roundtable

The 10th Annual Maryland Stream Monitoring Roundtable took place on February 10, 2017 at the USGS Water Science Center in Catonsville. There were 53 in attendance. Mary Kay Foley, the Center's Director, kicked off the gathering by welcoming all. During lunch, Tom Jordan (Smithsonian Environmental Research Center) provided a very enlightening lunchtime presentation on 40 years of nutrient monitoring in local Anne Arundel County streams. There were 23 presentations. Andy Becker (KCI) and Matt Stover (MDE) collaborated to produce an online map of all submitted point data for 2017 monitoring. This map was used to locate areas of overlap and identify potential opportunities for collaboration. The map will be updated annually. For more information about the Roundtable, contact Andy Becker at andy.becker@kci.com.

Eastern Shore Data to Decisions: Making Your Data Matter Workshop

On June 21st, 2017 the MWMC sponsored the second in a series of workshops - Eastern Shore Data to Decisions: Making Your Data Matter, at The Wye Research and Education Center in Queenstown. This was the follow-up workshop to the first one held at the Watershed Stewards Academy in Millersille in October, 2016. The focus of the workshop was engaging volunteer/NGO water quality monitors to consider submitting their data for government use. The agenda included a series of presentations from state agencies, the Chesapeake Bay Program, The Nanticoke Watershed Alliance, and the Chesapeake Monitoring Cooperative. Presentations provided attendees with information on data quality, data integration guidelines, and available resources and support. The workshop included question and answer sessions after each presentation to address specific questions and/or barriers that the attendees might perceive with working with government staff. The workshop also facilitated networking among volunteer groups, and with government staff. For more information, contact Becky Monohan at Rebecca.Lang@maryland.gov with questions.

Committees (full committee reports can be found elsewhere in this program)

The **Information Management Committee** completed an online mapping tool in early that that will be used to track current and past water monitoring activities in Maryland. The tool was posted on the MWMC website in November 2016 and an email was sent to potential data submitters in late November. This is a reincarnation of the "clickable map" that MWMC sponsored in the early-mid 2000s. In 2017, the Committee plans requested additional data and a few data-collection groups submitted site information for posting. Looking forward, the Committee hopes to engage student interns in improving the mapper by incorporating citizen and watershed association information to encourage users to connect with their local non-profit advocacy organization.

The **Citizen Science and Community Stewardship Committee** completed the second Data to Decisions workshop (see above) in June. The committee continues to run the MWMC Facebook page, posting on average once a week on a new item or reposting of "reminder" type posts. Facebook is a good medium for announcing

workshops and spreading news or job postings. The committee is currently planning a Habitat Assessment workshop for 2018 geared toward volunteer monitoring groups and practitioners looking to hone their skills. Caroline Donovan, the Committee Chair, is sadly departing the Board at the end of 2017. Jeff Reagan and Diana Mueller will work together to co-chair the committee following Caroline's departure.

The newly-formed **Student Committee** was busy in 2017. The Committee organized a second Student-Professional Networking Session to be held at the 23rd Annual Conference. It also developed a MWMC Student Intern Program to engage students in the work of the Council. Over 10 applications were received to work on projects at USGS in Catonsville, DNR in Annapolis, and MDOT in Hanover.

The **Groundwater Committee** has identified several topics of interest for further investigation going into 2018 that relate to well integrity, well water quality and road salt. The Committee worked with the Student Committee to create an internship opportunity for a student to assist with this effort. A series of talks on groundwater issues was organized for the Annual MWMC meeting. The Committee may plan a second road salt workshop in 2018.

The **Monitoring and Assessment Committee** completed an analysis of the 2016 MWMC Annual Conference Survey and presented the results at the MWMC Board Meeting on January 17, 2017. The MWMC Board and the Annual Conference Planning Committee use the results of the analysis each year to strengthen the conference program to best meet the needs of the council. The Committee is also organizing a session at the 23rd Annual Conference focused on new monitoring technologies, methods, and field applications. The session features four speakers on topics ranging from electrical resistivity, structure-from-motion survey using photogrammetry, and real-time water quality assessment.

The 10th Annual Maryland Stream Monitoring Roundtable took place on February 10, 2017 at the USGS Water Science Center in Catonsville (see description above).

The Stream Restoration Monitoring Subcommittee organized the all-day session at the 23rd Annual Conference where some of the latest results from stream restoration monitoring will be presented. There is a commitment to organizing a session on stream restoration monitoring at each subsequent MWMC annual meeting for the foreseeable future.

In 2018, the Committee hopes to assist the Citizen Science and Community Stewardship Committee with a stream survey/habitat assessment workshop to be planned for 2018. Members also hope to develop a workshop and instructional guide to provide details on calculation of the MBSS Benthic Index of Biotic Integrity (BIBI).

Submitted by Dan Boward

MWMC Executive Secretary

December 8, 2017

Maryland Water Monitoring Council Information Management and Communication Committee

No report submitted

Maryland Water Monitoring Council Groundwater Committee

2017 Annual Committee Report

Chair

Mat Pajerowski
U.S. Geological Survey
MD-DE-DC Water Science Center
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Committee Members	Organization
David Bolton	Maryland Geological Survey
John Grace	Maryland Department of Environment
Kevin Koepenick	Baltimore Co. Dept. of Environmental Protection and Sustainability
Steve Sherrard	Garrett County Environmental Health
Bill Ensor	Baltimore Co. Dept. of Environmental Protection and Sustainability
Joel Moore	Towson University
Brandon Fleming	U.S. Geological Survey

Committee Mission Statement

The Committee will promote and facilitate collaboration on issues related to the monitoring and assessment of the quality and available quantity of groundwater in the State. The committee will consider the current state of groundwater monitoring, and will explore the need for documenting and disseminating information on groundwater monitoring activities. The group may promote the sharing and accessibility of groundwater quality data; and may consider and make recommendations on the needs, protocols and quality standards for monitoring in relation to specific threats or stressors to groundwater.

2017 Accomplishments

The Committee met several times, and identified several topics of interest for further investigation. Topics included: the integrity of wells in the State monitoring network; water quality of individual wells; "road-salt" contamination of groundwater and wells; the need for speakers at the annual Groundwater Symposium; and a session on groundwater at the annual MWMC meeting.

Water quality of individual wells – The committee identified previous work done by MGS to survey some Maryland counties on their water-quality testing requirements, and discussed other possible sources of

groundwater quality data. We agreed that a complete county-by-county assessment of requirements and availability of data was needed as a starting point for work on this issue. The committee worked with the Student Committee to create an internship opportunity for a student to assist with this effort.

A series of talks on groundwater issues was organized for the Annual MWMC meeting.

Road-salt contamination of groundwater – Approaches were discussed regarding how to obtain information on salt application rates in Maryland. Discussed use of data from public supply wells to fill in gaps, and identified other possible sources of data. The committee is exploring a possible follow-up workshop in late 2018.

2018 Goals

1. Assemble a summary of County requirements for water-quality testing of individual wells and data availability, using a student intern.
2. Follow up on groundwater issues related to the application of salt as a deicer.
3. Expand membership to include representation from the Eastern Shore and southern Maryland.

Submitted by M.G. Pajerowski, November 17, 2017

Maryland Water Monitoring Council Monitoring and Assessment Committee

2017 Annual Committee Report

Co-Chairs

Mike Pieper	Mark Southerland (incoming end of 2016)
KCI Technologies, Inc.	AKRF, Inc.
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Committee Members	Organization
Capt. Diana Muller	South River Federation
Andrew Muller	U.S. Naval Academy
Bryan Perry	Anne Arundel County
Stan Kemp	University of Baltimore
Mike Pieper	KCI Technologies, Inc.
Andy Becker	KCI Technologies, Inc.
Chris Victoria	Anne Arundel County
Ron Klauda	Retired
Jim Cummins	ICPRB
Cherie Miller	USGS
Mark Southerland	AKRF
Doug Redmond	Retired
Clark Howells	Baltimore City RNRS
Sherm Garrison	MD DNR
Alice Volpitta	Blue Water Baltimore
Dr. Hany Sobhi	Coppin State University
Tatiana Roth	Coppin State University
Jai Cole	MNCPPC
Rob Mooney	Triad Engineering, Inc.
Marian Norris	National Park Service

2017 Activities and Accomplishments

The MAC completed an analysis of the 2016 MWMC Annual Conference Survey and presented the results at the MWMC Board Meeting on January 17, 2017. The MWMC Board and the Annual Conference Planning Committee use the results of the analysis each year to strengthen the conference program to best meet the needs of the council. The 2016 analysis focused on the following:

- Conference attendee make-up – e.g. affiliation, volunteer based, background
- Reviews of conference presenters, posters, and topics
- Reviews to enhance the conference experience – e.g. overall program, conference layout
- Solicitation of speakers and topics for future workshops and annual conferences

Detailed results were also presented to the Annual Conference Planning Committee in early 2017 to facilitate discussion of conference themes and session topics for the 23rd Annual Conference.

The MAC organized a session at the 2017 MWMC Annual Conference focused on new monitoring technologies, methods, and field applications. The session features four speakers on topics ranging from electrical resistivity, structure-from-motion survey using photogrammetry, and real-time water quality assessment.

The 10th Annual Maryland Stream Monitoring Roundtable took place on February 10, 2017 at the USGS Water Science Center in Catonsville. There were 53 in attendance. Mary Kay Foley, the Center's Director, kicked off the gathering by welcoming all. During lunch, Tom Jordan (SERC) discussed his perspectives gained over 40 years monitoring the land/water interaction in the Bay and its subestuaries focusing mainly on nutrients. There were 25 presentations. Andy Becker (KCI), Rebecca Lang, and Matt Stover (MDE) collaborated to produce an online map of all submitted point data for 2017 monitoring. The roundtable was organized by Andy Becker and Dan Boward (DNR).

Stream Restoration Monitoring Subcommittee

A sub-committee of the MAC was formed in early 2015 to address monitoring questions related to stream restoration practices. The sub-committee, chaired by Scott Stranko of MD DNR and Scott Lowe of McCormick Taylor, Inc., is titled 'Stream Restoration Monitoring'. The group is comprised of individuals from a variety of organizations and backgrounds. The sub-committee's mission statement is:

The Stream Restoration Monitoring Sub-Committee 1) provide a forum for the exchange of data and information about the effectiveness of stream restoration practices in Maryland, 2) coordinates among those involved with stream restoration monitoring throughout the state, and 3) communicates stream restoration monitoring results. The group is made up of representatives from county and state agencies, environmental consulting firms, practitioners, and academia with diverse experience, knowledge, and expertise in the applying monitoring to stream policy and management.

Sub-committee Members	Organization
Chris Victoria	Anne Arundel County
Colin Hill	KCI Technologies, Inc.
Emily Majcher	USGS
Jana Davis	Chesapeake Bay Trust
Jennifer St. John	Montgomery County
Michael Pieper	KCI Technologies, Inc.

Michael Trumbauer	Biohabitats
Michele Dobson	Harford County
Neely Law	Center for Watershed Protection
Robert Shedlock	USGS (retired USGS)
Nancy Roth	Tetra Tech
Sadie Drescher	Chesapeake Bay Trust
Sandy Hertz	MDOT
Scott Lowe (Co-Chair)	McCormick Taylor
Stanley Kemp	University of Baltimore
Jim Gracie	Brightwater Inc.
Scott Macomber	Stormwater Maintenance & Consulting
Mark Secrist	U.S. Fish and Wildlife Service
Mark Southerland	AKRF
Scott Stranko (Co-Chair)	Maryland DNR
Shannon Lucas	Stormwater Maintenance & Consulting
Alison Armocida	Maryland DNR
Greg Golden	Maryland DNR
Ed Doheny	USGS
Dave Ivy	CEM Science
Rich Starr	Ecosystem Planning and Restoration

During 2017, the sub-committee planned and organized the all-day session at the MWMC conference December 8th, where some of the latest results from stream restoration monitoring will be presented. There is a commitment to organizing a session on stream restoration monitoring at each subsequent MWMC annual meeting for the foreseeable future.

2018 Goals

The MAC is planning several activities for 2018:

1. Hold regular quarterly meetings.
2. Assist the Citizen Science and Community Stewardship Committee with a stream survey / habitat assessment workshop to be planned for 2018.
3. Develop a workshop and instructional guide to provide details on calculation of the MBSS Benthic Index of Biotic Integrity (BIBI). MBSS provides excellent instruction on the field techniques for sample collection and preservation; however the committee sees a need for more detailed instruction on the laboratory and data analysis phases of the process. A documented approach will provide better accuracy and consistency and will provide solutions to common issues with sample size, taxonomic identification levels, metric calculation, and quality control.

Maryland Water Monitoring Council Citizen Science and Community Stewardship Committee

2017 Annual Committee Report

Committee members and affiliations

Caroline Donovan, UMCES, Chair
Jeff Reagan, Biohabitats Inc., Board Member
Diana Muller, Chesapeake BaySavers Foundation, Board Member
Karen Wiggen, Charles County Dept. of Planning and Growth Management, Board Member
Mina Izadjoo, Trideum Biosciences, Community Member
Marla Duley, Community Member

2017 Goals from previous Annual Committee Report

- Repeat Data to Decisions Workshop in two other locations (Eastern Shore and Frederick)
    - The workshop was very successful and although we had participants from a variety of locations, we think providing a locally based workshop will improve the amount of information that is being provided and networks and connections that will be made
- Plan a new workshop
    - We have a list of potential workshops that may be useful to citizen scientists and the community at large. Several workshops are already being planned, such as a general benthic macroinvertebrate workshop (MDNR Explore and Restore) and trainings by the Chesapeake Monitoring Cooperative. Subcommittee members can participate in those workshops or we could plan a new workshop, such as IDDE Rapid Assessment for Citizen Scientists.

2017 Accomplishments

- Data to Decisions: Why your data matters (workshop)
    - Workshop was hosted in June at the Wye Research & Education Center (WREC)
    - The purpose of the workshop was to provide basic information on how volunteer and nontraditional data is incorporated into a variety of state and federal agency work.
    - The workshop included presentations by MWMC Board members (Matt Stover - MDE, Dan Boward - MDNR) as well as other partners (Bill Dennison - UMCES, Peter Tango – USGS @ the Bay Program, Beth Wasden – Nanticoke Watershed Alliance, Liz Chudoba – Alliance for the Chesapeake Bay).
    - The workshop also provided a networking opportunity between different groups to share knowledge.

    - The workshop was a great success and introduction to the Chesapeake Monitoring Cooperative for further training opportunities.

- Committee meetings/calls
    - The committee had face-to-face meetings after each Board meeting, although most of those meetings were *ad hoc*.
    - The committee had several conference calls to discuss 2017 goals and accomplishments and to brainstorm new workshop ideas (see 2018 goals).
    - Community members are an important part of this committee, but they cannot attend Board meetings in person. Therefore, committee calls between quarterly Board meeting should still be scheduled.
- Facebook
    - The committee continues to run the MWMC Facebook page, posting on average once a week on a new item or reposting of "reminder" type posts. The page has grown to 375 Likes, and posts with photos as the primary image get the most likes, followed by posts with links. While most people come to the MWMC Facebook page from Facebook, two websites have garnered engagement – the MWMC website and the Google search engine. Facebook is a good medium for announcing workshops and spreading news or job postings. It is an underutilized tool; we have an opportunity to increase ongoing engagement with our network and brand MWMC as a community resource.

<u>Current News</u>

- Caroline Donovan, the committee chair, is sadly departing the Board at the end of her term (2017). Jeff Reagan and Diana Mueller will work together to co-chair the committee following Caroline's departure.

<u>2018 Goals</u>

- The committee is currently planning a Habitat Assessment workshop for volunteer monitoring groups and practitioners looking to hone their skills. We are currently in discussion with the Howard County Nature Conservancy to host the workshop and use Davis Branch for the field component of training. We will provide instruction on using DNR Habitat Assessment Protocols, EPA Rapid Bioassessment Protocols, Stream Corridor Assessment Protocols, and introduce the USFWS Function-Based Framework for Stream Assessment.
- The committee is committed to organizing at least 2 events per year, and will schedule a face-to-face "Happy Hour" committee meeting in early January as a follow-up to the Annual Conference.
- Increase Facebook engagement with consistent and relevant content.

Maryland Water Monitoring Council Student Committee

2017 Annual Committee Report

Committee members and affiliations

Caroline Donovan, UMCES, Co-Chair, Board Member

Joel Moore, Towson University, Co-Chair, Board Member

Dan Boward, MDNR, Board Member

Byron Madigan, Carroll County, Board Member

Dot Lundberg, SERC, Community Member

Karin Olsen, Anchor Qea, Inc., Community Member

Tami Imbierowicz, Harford Community College, Community Member

John Munro, UMUC, Community Member

The Student Committee's goals are to connect students, both high school and undergraduate, with the Council through workshops, projects, and the annual conference.

2017 Accomplishments

- Our first endeavor was to plan and execute the Student Professional Networking Session at the 2016 annual conference. The session had a diverse set of mentors (e.g., women in science, private consulting) that students talked to. By engaging more students in the annual conference, we will also build relationships with students throughout the year, providing them with opportunities to attend quarterly Board meetings and work on Board-identified projects.
    - The session was well attended for the first attempt.
    - There were some last minute organizational issues that were solved quickly
    - There was a lack of participation by students because the session conflicted with other talks at the conference.
- A goal of engaging more Board members in 2017 was accomplished
    - Joel Moore became co-chair of the committee
    - Dan Boward and Byron Madigan joined the committee
- The 2017 Student Professional Networking Session will take place at the 2017 conference.

    - The style of the session has changed from individual mentors speaking with groups of students and then changing tables to an open plenary where mentors introduce themselves and then students ask questions.
    - The session is being held at the end of the day and does not conflict as much with the rest of the conference.
    - Student sign up has been good and we have six mentors recruited.
    - Dot Lundberg agreed to facilitate the whole session again this year, with Joel and I offering support when needed.
- The Student committee has facilitated the use of student internships for other MWMC committees. We want to engage students more in the Council. Therefore, setting up unpaid (but credited) internships with MWMC committee members that will help accomplish the goals of the MWMC and at the same time fulfill a student's need for experience and academic credit seems ideal.
    - Two internships have been advertised – one for a GIS specialist to help with the online Stream Mapper (MDNR and MDOT, Information and Management Committee) and one for a data analyst to help with groundwater water quality information on domestic service wells (USGS, Groundwater Committee)
    - Applications for both internships have been reviewed and the interview process to have one intern per project is taking place in November 2017
    - The internships can go through spring of 2018

<u>2018 Goals</u>

- Evaluate the success of the Student Professional Networking session that took place at the 2017 annual conference
- Evaluate the success of the two internships that started in 2017
    - Review and revise internship plan for fall 2018 semester start – will there be new internship opportunities through the MWMC? If so, start brainstorming those opportunities before July quarterly meeting
- Invite a graduate (Masters or PhD) student to attend and participate in the quarterly MWMC meetings
- Plan Student Professional Networking session for 2018 annual conference
- Solicit ideas from Student Committee Members and MWMC Board members about other activities that could be productive
- Recruit a new co-chair

Maryland Water Monitoring Council
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