28th

Annual Conference

WHAT ARE YOU DRINKING?

Protecting the Source

Maritime Conference Center
Linthicum, Maryland

December 15th, 2022

2022 MWMC Annual Conference Sponsors and Vendors

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On the Cover - Down Stream - cover photo by Erika SneeringerCover artwork by Katherine Hanna (MD DNR)

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The 28th Annual Conference of the Maryland Water Monitoring Council
Welcome from the Chair of the MWMC Board of Directors- Matthew Stover

What are you Drinking? Protecting the Source

This year marks the 28th annual Maryland Water Monitoring Conference! I say that's pretty impressive! We've made it through budgets thin and thinner, and even weathered a global pandemic. Despite all of these challenges, the Conference continues, and we are super excited to hold this year's conference in-person! Thanks to all of you who have made the effort to trade in the work-from-home sweatpants for jeans and joining us in the flesh!

This year's conference, like those before it, would not have been possible without the efforts of the Conference Planning Committee, Board of Directors, volunteers, and many others at the Maryland Department of Natural Resources who worked in the background to make all of the logistics possible. I also want to especially thank Katherine Hanna, the soft-spoken MWMC Executive Secretary, who does so much to make this Conference happen. Since she took over the reins, it has never been easy but she has handled it all with patience and a steady hand.

That being said, the mission of the MWMC, including holding the Conference, can always benefit from your ideas and energy. So if you've ever considered helping out in ways small or large, I'd encourage you to reach out to a Board member or Committee member to see how you can contribute. There are many ways to do this including:

- Joining an MWMC committee (We have 10 with a variety of charges.),
- Helping organize a webinar or workshop through the MWMC on a topic that benefits the larger water monitoring community,
- Expressing interest and joining the MWMC Board of Directors, and
- Countless other small tasks to help the Council improve information sharing across the State.

Admittedly, I'm biased but I truly feel that the Council brings a lot of value to Maryland's water monitoring community. We are always looking for new ways to better serve the water monitoring needs of Maryland's citizens, businesses, and of course, the waters that we cherish. Please consider joining us in our efforts!

With that public service announcement out of the way, I'm delighted to introduce the theme of this year's conference "What are you drinking? Protecting the Source". This theme seeks to highlight the importance of protecting our waters not just for aquatic life but for that two-legged vertebrate that also requires it! In the United States, we often take it for granted that we have clean water to drink. But as we've all come to realize through the crisis in Flint, Michigan, the harmful algal blooms in Lake Erie, and even an emergency boil water advisory in Baltimore City, clean drinking waters are not guaranteed. It's something that we must actively manage for and requires ongoing vigilance. Luckily, the active management of drinking water quality and quantity offers no shortage of co-benefits for our water bodies, the aquatic life that reside in them, and many other beneficial uses. Today's agenda promises to elaborate on these benefits and management techniques and I look forward to learning much more about them.

To kick us off for today's conference, we have some great plenary speakers in Mr. Michael Nardolilli, Executive Director of the Interstate Commission of the Potomac River Basin, and Lee Currey, Director of the Water and Science Administration of the Maryland Department of the Environment. I look forward to hearing both of their perspectives on the topic of source water protection. In addition to these, the concurrent sessions of the conference will have speakers on a great variety of topics pertinent to today's water challenges including climate change, protection of drinking water supplies, environmental justice, road salt, microplastics, biological monitoring for results, stream restoration, TMDL implementation, and many more!

Continuing this year, the 16th year in fact, we will continue our tradition of awarding the Carl Weber award to an individual who has exemplified Carl's collaborative and generous spirit, and passion for stewardship. In addition, for the seventh year in a row, we will be awarding the Above and Beyond award to honor someone who represents the next generation of the monitoring community through their significant contributions to increasing watershed awareness, advocacy, education, and stewardship.

Closing Thoughts

It's been a long time and it’s taken lots of hard work to getting back to having an in-person conference. I, for one, am very excited to rekindle the fellowship that is difficult to replicate through a virtual setting. So here’s to seeing you at a talk, at lunch, or in the hallways of the Maritime Institute!

Cheers,

Matt Stover
Chair, Maryland Water Monitoring Council

Photo by Desiree Stover

The Carl S. Weber Awards

For Vision and Leadership in Monitoring Maryland's Waters

Our vision for monitoring 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 stake holders and will facilitate sound decision-making in environmental management and protection.

Dr. Carl S. Weber. Among 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 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 the 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

2021- Rupert Rossetti (Octoraro Watershed Association)

2020- Dan Boward (Maryland DNR-Retired)

2019- Jim Gracie (Brightwater Incorporated)

2018- Cathy Wiss (Audubon Naturalist Society)

2017- Dr. Walter Boynton (University of Maryland Center for Environmental Science)

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.

Previous Winners

2021- Daniel Savoy (Wicomico Environmental Trust; Wicomico River Creekwatchers)

2020- Andrew Sarcinello (Maryland Trout Unlimited Citizen Science Initiative)

2019- Suzanne Etgen (Anne Arundel Watershed Stewards Academy)

2018- Joseph Davis and Matthew Budinger (Baltimore County Educators)

2017- Rebecca Kenyon-Sisler (Garrett County Educator)

2016- Ann Strozyk (Howard County Educator)

Photo by John Ruffa https://flic.kr/p/2nLgmeQ

2022 Annual Conference Planning Committee

John Anthony	Maryland Department of the Environment
Andy Becker	KCI Technologies, Inc
Megan Brosh	Baltimore County Department of Environmental Protection and Sustainability
Lindsay DeMarzo	Howard County Office of Community Sustainability
Davonte Douglas	Maryland Department of the Environment
Jason Dubow	Maryland Department of Planning
Katherine Hanna	Maryland Department of Natural Resources
Clark Howells	Baltimore City Department of Public Works
Ken Mack	Montgomery County Department of Environmental Protection
Mike McMahon	Maryland Department of the Environment
Becky Monahan	Maryland Department of the Environment
Mat Pajerowski	United States Geological Service
Robert Peoples	Maryland Department of the Environment
Mark Southerland	Tetra Tech
Matthew Stover	Maryland Department of the Environment

Additional thanks to:

Nancy Hofmann, Maryland Department of Natural Resources (Conference Preparation)

Annalise Kenney, Maryland Department of Natural Resources (Conference Communications)

Najma Khokhar, Maryland Department of the Environment (Registration Table)

Jonathan Leiman, Maryland Department of the Environment (Registration Table)

Becky Monahan, Maryland Department of the Environment (Conference Preparation and Program Creation)

Kara Ogburn, Maryland Department of the Environment (Registration Table)

Scott Stranko, Maryland Department of Natural Resources (Registration Table)

Mark Trice, Maryland Department of Natural Resources (Digital Media)

Maryland Water Monitoring Council

28th Annual Conference –Thursday, December 15, 2022

What are you Drinking? Protecting the Source

Agenda

7:30 Registration/Poster Set-up/Continental Breakfast

Registration in A-100

8:30-10:00 Morning Plenary Session- Auditorium

MWMC Board Chair's Call to Order – Matthew Stover - Maryland Department of the Environment; Chair, MWMC Board of Directors

Plenary Speakers

– Mike Nardolilli - Executive Director, Interstate Commission on the Potomac River Basin

-Lee Currey – Director, Water and Science Administration, Maryland Department of the Environment

Carl S. Weber Award and Above & Beyond Award – Clark Howells, Baltimore City Department of Public Works; Chair, MWMC Awards Committee

10:00 Break/Poster Session

10:30-12:00 Concurrent Sessions: Stormwater BMPs and Stream Restoration, Maryland Biological Stream Survey I, Roles of Utilities, Microplastics and Other Contaminants, Salt. (See pg. 15 for room numbers and a more detailed description)

12:00-1:30 Lunch

1:00- 1:30 Poster Session, Exhibitor Session

Student Posters to present to judges at 1:00

1:30- 3:00 Concurrent Sessions: Stream Restoration, Maryland Biological Stream Survey II, Vernal pools–A Yes In My Backyard (YIMBY) Ecosystem, TMDLs, Contributed Talks. (See pg. 16 for room numbers and a more detailed description)

3:00-3:30 Break/Poster Sessions

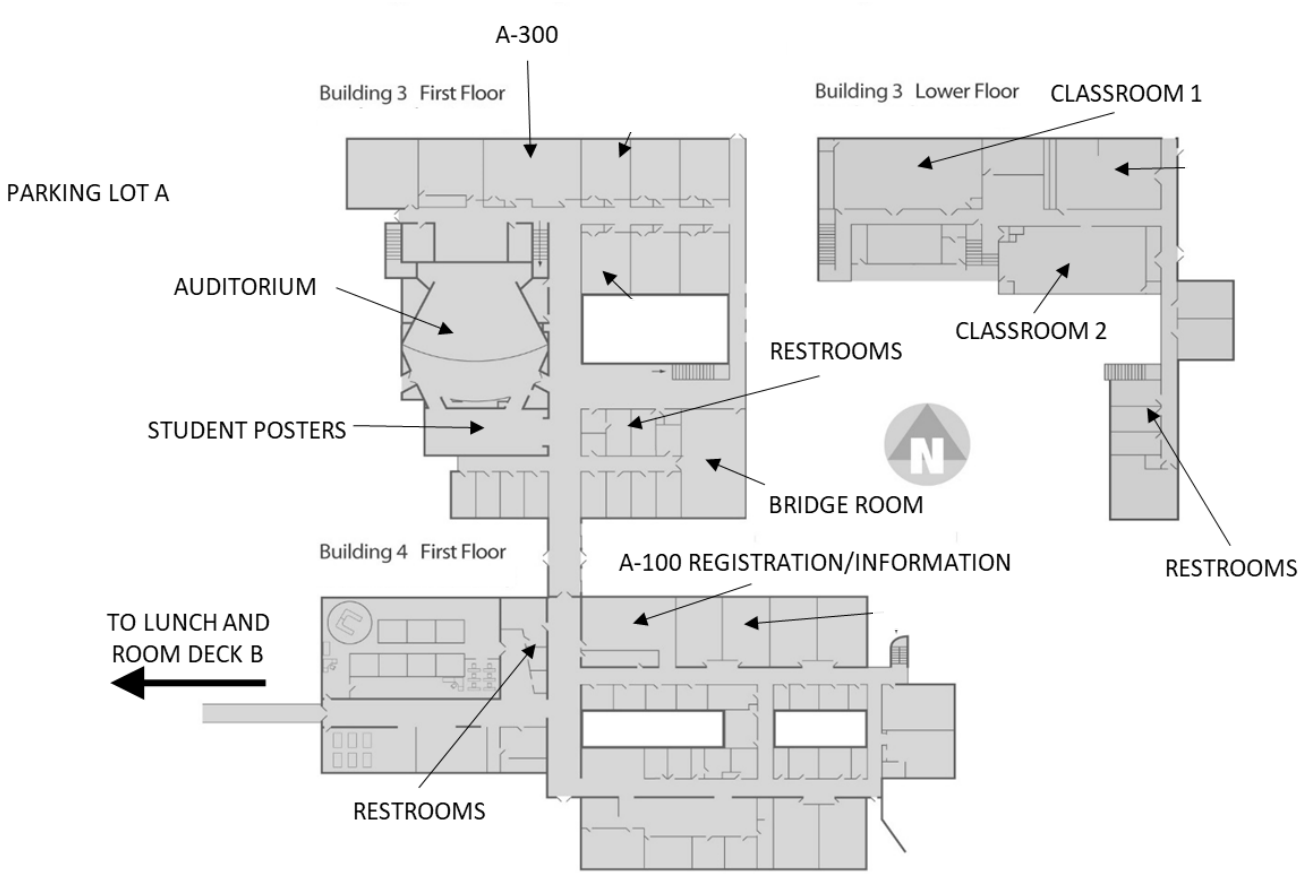
Announcement of Student Poster Award Winners (Auditorium)

3:30-4:30 Concurrent Sessions: Urban Runoff and Water Quality, Maryland Biological Stream Survey III, Forestry and Agriculture Best Management Practices, Environmental Justice, Climate Change. (See pg. 17 for room numbers and a more detailed description)

4:30 Adjourn- Social at Checkerspot Brewing Co. Starting at 5:00

Photo by Stephen Badger https://flic.kr/p/2gjnGAD

2022 MWMC Annual Conference Floorplan



Concurrent Session 10:30-12:00

10:30-12:00	Auditorium	Bridge Room	Classroom 1	Classroom 2	A-300
	Stormwater BMPs and Stream Restoration - Moderator: Michael Williams (University of Maryland)	***Maryland Biological Stream Survey I -*** Moderator: Scott Stranko (MDNR)	***Roles Of Utilities -*** **Moderator:** Clark Howells (City of Balt.)	***Microplastics And Other Contaminants*** - Moderator: Becky Monahan (MDE)	***Salt*** - Moderator: Lindsay Demarzo (Howard County Office Of Community Sustainability)
	Thermal Properties of Different Stormwater Best Management Practices- Robert Hilderbrand (UMCES) Detecting and Understanding Hydrologic Change in Developing Watersheds: Is Green Stormwater Infrastructure Making A Difference?- Keith Eshleman (UMCES) Phase I of The Campus Creek Restoration: Comparison of Its Pollutant Reduction Capability with Other RSCs -Michael Williams (UMD)	Maryland's Benthic IBI and Benthic Macroinvertebrate Trends Over a 14-Year Period -Kyle Hodgson (MDNR) Water Chemistry of Maryland Streams: Quantifying Changes in Stream Health over Time- Mary Genovese (MDNR) Analyzing the Physical Habitat Patterns of Maryland's Streams- Mia Lenzenweger (MDNR)	Developing a Comprehensive Watershed Management Plan for Baltimore's Water Supply Reservoirs - Josh Weiss (Hazen and Sawyer) Regional Planning for Source Water Protection- Sara Tomlinson (Baltimore Metropolitan Council) Wellhead Protection for Anne Arundel County DPW and Private Wells -Edward Cope (AA Co.)	Microplastics in the Potomac and Anacostia Rivers- Bob Murphy (Tetratech) Identification of Chloride Sources in Groundwater - Johanna Gemperline (Maryland Geological Survey) Detecting and Identifying Microplastics in Environmental Samples- Dr. Christine Knauss (UMCES)	Embracing Regional Collaboration for Salting Awareness- Nicole Horvath (WSSC) MDE Salt Management Programs- Nicole Christ (MDE) Quantifying Four Decades of Chloride Inputs to the Baltimore City Drinking Water Reservoirs- Kyle Hurley (Towson U.)

Concurrent Session 1:30-3:00

1:30-3:00	Auditorium	Bridge Room	Classroom 1	Classroom 2	A-300
	Stream Restoration - Moderator: Michael Williams (University of Maryland)	***Maryland Biological Stream Survey II*** - Moderator: Scott Stranko (MDNR)	***Vernal pools -- A Yes in My Backyard (YIMBY) Ecosystem*** - Moderator: Mark Southerland (Tetra Tech)	***TMDLs*** - Moderator: Nancy Roth (Tetra Tech)	***Contributed Talks*** - Moderator: Jason Dubow (Maryland Department of Planning)
	Measuring Urban Stream Restoration Success: Processes, Goals, Monitoring, and Regulations May Confound "Ecological Lift" - Chris Ruck (Fairfax Co) Urban Stream-Floodplain Increase Soil Phosphorus and Carbon Retention Along a Chronosequence of Restored Streams in Fairfax County, VA, USA- Katrina Napora (USGS) Stream Corridor Restoration and Unintended Consequences- Denise Clearwater (MDE)	Trends in Maryland Freshwater Fish Assemblages Over a 14-Year Period Illustrate A Changing Environment- Anastasia Simpson (MDNR) Using MBSS Data to Improve Our Understanding of Fish Species of Greatest Conservation Need: American Brook Lamprey and Pearl Dace- Tomas Ivasauskas (MDNR) Using MBSS Data to Assess Conditions and Trends in Maryland's Stronghold Watersheds: Antietam Creek- Jackie Sivalia - (MDNR)	Vernal Pools as Backyard Ecosystems and How to Find them in the Patapsco Valley- Mark Southerland (Tetra Tech) Vernal Pool Conservations in the Anacostia River Watershed and The District of Columbia- Jorge Bogantes Montero (Anacostia Watershed Society), Michelle Campbell (DC DOEE), and Cathy Wiss (Anacostia Watershed Society) Conservation Action at Your Fingertips: Documenting Ephemeral Wetlands Using a Tiered Approach in ArcGIS Survey123- Rachel Gauza (M-NCPPC)	Fairfax County's Use of the Northern Virgina Salt management Strategy (SaMS) to Address the TMDL for Chloride in Accotink Creek, VA- Marty Hurd - (Fairfax Co.) Seeing The Forest for the Trees: Incorporating Tree Planting and Reforestation into Local TMDL WIPS- Mark Sievers (TetraTech) PCB TMDL Implementation – Monitoring PCBs in the Sawmill Creek (Anne Arundel County, MD) Watershed- Douglas Griffith (AA Co.) & Nathalie Lombard (UMBC)	What Lies Beneath: Investigating Pre-Colonial Riparian Ecosystems in the Atlantic Coastal Plan, Maryland, USA- Zach Clifton (USGS/DOEE) Pooled Monitoring Initiative - What We Have Accomplished Together- Sadie Drescher (CBT) Freshwater Salinization Syndrome: Risk Factors, Stages, And Management- Sujay Kaushal (UMD)

Concurrent Session 3:30-4:30

3:30-4:30	Auditorium	Bridge Room	Classroom 1	Classroom 2	A-300
	Urban Runoff and Water Quality - Moderator: Michael Williams (University Of Maryland)	***Maryland Biological Stream Survey III -*** Moderator: Scott Stranko (MDNR)	***Forestry and Agriculture Best Management Practices -*** Moderator: Ken Staver (University Of Maryland)	***Environmental Justice -*** Moderator: Megan Brosh (Baltimore County DEPS)	***Climate Change -*** Moderator: Byron Madigan (Carroll County)
	Managing Urban Runoff: Non-Structural End-of-Pipe Strategies on Parkland- Jackie Hoban & Erin Mcardle (Montgomery Parks) Examining Surface and Subsurface Sediment Sources and Transport Processes in an Urban Watershed with an Entirely Buried Stream Network, Washington, D.C., USA- Zachary Clifton (USGS/DOEE) The Maryland River Input Monitoring Program: An Update on Nutrient Loads and Trends- Alex Soroka (USGS)	Evaluating a Regenerative Stormwater Conveyance Stream Restoration and Its Effects on Water Quality and Benthic Macroinvertebrates: A Case Study at Muddy Creek- Lindsay Powers (MDNR) Evaluating Stream Restoration Effectiveness: Water Quality and Biology at an Unnamed Tributary to the Sassafras River - Ally Bartell (MDNR) MBSS Documents Increased Passage of American Eels and Other Migratory Fish in the Patapsco River Following Dam Removal- William Harbold (MDNR)	Maryland Agriculture - Promoting and Achieving Stream Health- Elizabeth Hoffman (MDA) Farms, Fields, and Fish: A Landscape Perspective- Nancy Roth (Tetratech) Insect Evolution in Stream and River Ecosystems and the Consequences of Global Change- Bill Lamp (UMD)	DEIJ in the Chesapeake Bay- Briana Yancy (USEPA) What Do Our Existing Water Quality Models and Existing Monitoring Networks Tell Us About Conditions in Vulnerable Communities?- Leah Staub (USGS) Addressing Water Issues and Environmental Justice with Participatory Approaches - Priscila B. R. Alves (UMD)	Water Resources Element Guidance Update: Best Practices for Integrating Climate Change, Identifying Suitable Receiving Waters- Jason Dubow (MDP) How is Water Affected by Climate, Flora, and Fauna- Srinidhi Gadiyaram (Centennial High School) Do Harmful Algal Blooms Adversely Affect Wildlife in The Chesapeake Bay?- Barnett Rattner (USGS)

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

<STUDENT POSTER>**DOES ECTOPARASITE LOAD IN BND DEPEND UPON STREAM URBANIZATION OR PERSONALITY?** - Kara Branstad, Towson University, kbranst1@students.towson.edu

<STUDENT POSTER> **TRACKING HORSESHOE CRAB POPULATIONS WITH DNA BARCODING** - Emily Ernst, Anne Arundel Community College Environmental Center, erernst@aacc.edu

ASSESSING IRON ECOTOXICITY IN REGENERATIVE STREAM-WATER CONVEYANCE SYSTEMS IN ANNE ARUNDEL COUNTY - Megan Gaesser, Towson University, mgaess1@students.towson.edu

WATER MONITORING IN THE GUNPOWDER RIVER AND WATERSHED - Jenn Galler, Gunpowder River Keeper, jgaller1112@gmail.com

<STUDENT POSTER> **THE USE OF BENTHIC MACROINVERTEBRATES AS BIOINDICATORS OF WATER QUALITY IN FRESHWATER STREAMS** - Makala Harrison, Mount St. Mary's University, m.harrison@email.msmary.edu

BROOK TROUT LIMITED BY TEMPERATURE RATHER THAN NON-NATIVE TROUT IN A MARYLAND STREAM - Nathaniel (Than) Hitt, USGS Eastern Ecological Science Center, nhitt@usgs.gov

LONG-TERM EFFECTS OF URBANIZATION ON BLACKNOSE DACE SWIMMING PERFORMANCE - Jastine Honea, Towson University, jhonea1@students.towson.edu

THE VULNERABILITY OF ANNE ARUNDEL COUNTY ROAD TRANSPORTATION NETWORK TO FUTURE RELATIVE SEA LEVEL RISE - Sotonye Ikiriko, Morgan State University, soiki1@morgan.edu

THE IMPACT OF STREAM RESTORATION ON SEED DISPERSAL ACROSS FLOODPLAINS - Sara Kramer, Towson University, skrame10@students.towson.edu

RAINWATER HARVESTING WEBINARS TO INCREASE KNOWLEDGE - Taeilorae Levell-Young, University of Maryland- College Park, Maryland Institute for Applied Environmental Health, tlevell@umd.edu

RELATIVE SEA LEVEL RISE PROJECTION FOR BALTIMORE BASED ON TIDE GAUGE AND SATELLITE ALTIMETRY MEASUREMENTS - Yi Liu, Morgan State University, yi.liu@morgan.edu

MEASURING HEADWATER STREAM INCISION IN THE MARYLAND PIEDMONT USING LIDAR - Marina Metes, U.S. Geological Survey, mmetes@usgs.gov

CHESAPEAKE BAY WATER WATCH: CITIZEN SCIENTISTS ENABLING SATELLITE REMOTE SENSING OF WATER QUALITY - Patrick Neale, Smithsonian Environmental Research Center, nealep@si.edu

IMPACTS OF URBANIZATION AND SALT APPLICATION ON BENTHIC COMMUNITIES AND WATER QUALITY IN RED RUN WATERSHED OVER TWO DECADES OF URBAN DEVELOPMENT- Nguyen Tien Anh Quach, Towson University, nquach1@students.towson.edu

<STUDENT POSTER> **FACTORS INFLUENCING THE DISTRIBUTION AND ABUNDANCE OF FAIRY SHRIMP IN VERNAL POOLS, CORCORAN WOODS EXPERIMENTAL FOREST -** Shannon Pearce, Anne Arundel Community College, sbpearce@mymail.aacc.edu

<STUDENT POSTER> **YOUTH CLIMATE INSTITUTE AMBASSADORS INVESTIGATE DIFFERENCES IN STREAM TEMPERATURE IN HOWARD COUNTY FRESHWATER STREAMS -** Malachi Peavey, Youth Climate Institute Certified Ambassador, malachi.i.p.1@icloud.com

INITIAL LOOK: SAWMILL CREEK BIOLOGICAL INTEGRITY PROJECT - Bryan Perry, Anne Arundel County Bureau of Watershed Protection and Restoration, pwperr85@aacounty.org

PFAS IN THE CHESAPEAKE BAY AND DELMARVA REGION - Michella Salvitti, University of Maryland Eastern Shore, mpsalvitti@umes.edu

SURVEY OF THE BENTHIC ANNELID COMMUNITY IN FORESTED AND URBANIZED REACHES OF A FIRST ORDER MARYLAND STREAM - Andrea H. Shirdon, University of Maryland, ashirdon@terpmail.umd.edu

DETERMINING THE IMPACT OF WELL MAINTENANCE, CONDITION, TYPE, AND LOCATION FACTORS ON E. COLI AND TOTAL COLIFORM IN MARYLAND FARM PRIVATE DRINKING WATER WELLS - Cameron Smith, University of Maryland College Park, Maryland Institute of Applied Environmental Health, csmith51@terpmail.umd.edu

ACTIVITIES BEING CONDUCTED BY THE MARYLAND DEPARTMENT OF NATURAL RESOURCES TO SUPPORT FRESHWATER MUSSEL RESTORATION IN THE SUSQUEHANNA RIVER BASIN - Zach Taylor, Maryland Department of Natural Resources, zachary.taylor@maryland.gov

PREDICTIVE E. COLI MODELING AT LAKE LINGANORE IN FREDERICK COUNTY - Jill Tysse, Hood College, tysse@hood.edu

MONITORING STREAM THERMAL RESPONSE TO SUMMER STORMS IN A HIGHLY URBANIZED WATERSHED USING A HIGH-DENSITY, HIGH-FREQUENCY SENSOR NETWORK - Claire Welty, UMBC, Center for Urban Environmental Research and Education (CUERE), and Dept. of Chemical, Biochemical, and Environmental Engineering, weltyc@umbc.edu

Photo by Mark Andre https://flic.kr/p/YjN6r4

Plenary Speakers

Mike Nardolilli – Executive Director, Interstate Commission on the Potomac River Basin

Michael Nardolilli joined the Interstate Commission on the Potomac River Basin as its Executive Director on April 1, 2019. Previously, Mr. Nardolilli served as the Chairman of the Board of Directors of the Northern Virginia Regional Park Authority (operators of 33 parks in Northern Virginia), President of the Arlington Outdoor Lab (a 225-acre nature educational facility in Virginia), Executive Director of the Montgomery Parks Foundation (the fundraising arm of Montgomery Parks), President of the C&O Canal Trust (the official non-profit partner of the C&O Canal National Historical Park), and President of the Northern Virginia Conservation Trust (a regional land trust). Prior to his work in the non-profit field, Mr. Nardolilli had a successful 18-year legal career representing Fortune 500 companies suing their insurance carriers for delayed manifestation claims. In 2011, Mr. Nardolilli was selected as a "Green City Leader" by Washington Life Magazine and was named a WETA-TV "Hometown Hero" in 2007. Mr. Nardolilli received a Certificate of Executive Non-Profit Management from Georgetown University, a JD from the College of William & Mary and a BSFS from Georgetown University.

Lee Currey – Director, Water and Science Administration, Maryland Department of the Environment

Lee Currey serves as the Director of the Water and Science Administration at the Maryland Department of the Environment. In this role, Lee oversees the States Clean Water Act and Safe Drinking Water Act Programs striving for a vision of healthy, vibrant, and resilient communities and ecosystems. Lee is currently leading efforts on reducing the risk of forever chemicals, increasing climate resiliency and advancing Chesapeake Bay restoration. Lee has worked in the field of water

resources policy, management, engineering, and science for almost 30 years, and for the past 22 years with the Maryland Department of the Environment. Lee has Bachelors and Masters degree in Civil Engineering with a focus on Water Resources Engineering and is a registered professional engineer.

Photo by MDE **https://flic.kr/p/KjZENR**

Oral Presentation Abstracts

Addressing Water Issues and Environmental Justice with Participatory Approaches

Dr. Priscila Alves; pbralves@umd.edu; University of Maryland

This talk will focus on water issues and disasters, and their impacts to people's lives. We will discuss manners in which communities can adapt and address barriers within the human-built environment to effectively mitigate disastrous consequences from water disasters. Specifically, risk impacts can escalate and overwhelm cities' infrastructure, especially in the era of faster, more frequent, and intense disasters with climate change. In this sense, lower income communities, particularly of color, are expected to face even worse water problems in the future. Focusing on case studies in the United States and Brazil, we will discuss previous results from participatory approaches to understand how inequalities and the lack of environmental justice could have some notable consequences for marginalized communities considering everyday differential urban water management, flood and drought exposures, disaster damage outcomes, economic impacts, and resilience.

Dr. Alves work focuses on stormwater and participatory research including developing risk-based spatial-participatory frameworks for flooding mitigation in semiarid regions. She has developed several methods for integrated management of water resources to reduce water conflicts in semiarid regions and propose sustainable measures to improve quality of life for multiple international contexts, with examples in Brazil, United Kingdom, Thailand, and United States. She also has experience developing place-based citizen science projects for the collaboration of stakeholders to analyze social, structural, and institutional vulnerabilities of communities facing flooding and drought.

Evaluating Stream Restoration Effectiveness: Water Quality and Biology at an Unnamed Tributary to the Sassafras River

Ally Bartell; allyson.bartell@maryland.gov; Maryland Department of Natural Resources

A stream restoration project using a combination of Natural Channel Design and Stage Zero restoration techniques was applied to an Unnamed Tributary to the Sassafras River in Cecil County, Maryland in 2019. The project was funded by the Chesapeake and Atlantic Coastal Bays Trust Fund, implemented by EcoTone Inc, and monitoring conducted by the Maryland Department of Natural Resources. Pre-restoration water quality and biology monitoring began in 2017 and two years of post-restoration monitoring have been completed as of November 2021. Initial results show that dissolved oxygen is significantly lower in the post-restoration period compared to the pre-restoration period. Temperature increased in the first year of monitoring and decreased in the second year compared to the control. Fish IBI scores initially decreased one year after restoration, then rebounded by the second year of post-restoration monitoring. Benthic IBI scores did not significantly differ between pre- and post-restoration periods. All sediment and nutrient flow-weighted mean concentrations decreased in the post-restoration period compared to the pre-restoration period, with the exception of suspended sediment concentration. Continued monitoring is needed to determine whether any reductions are a result of restoration practices or other environmental variables.

Ally Bartell is a Natural Resource Biologist with the Maryland Biological Stream Survey. Her work is focused on stream restoration projects within Maryland. She attended Johns Hopkins University and has a B.S. in Environmental Science. While originally from Illinois, she has enjoyed living in Maryland for the past six years. In her free time she likes to crochet and spend time outdoors.

MDE SALT MANAGEMENT PROGRAMS

Nicole Christ; nicole.christ@maryland.gov; Maryland Department of the Environment

Coauthors: Gregorio Sandi, MDE; Kathy Stecker, MDE; Jacey Brooks, MDE

The Maryland Department of the Environment (MDE) is developing a voluntary private salt applicator training program. The program complements salt reduction requirements in stormwater permits, and public education and outreach efforts. The program is targeted at private applicators as well as property managers and municipality staffers. MDE also conducts monitoring at several drinking water reservoirs to determine whether in-lake conductivity reductions can be detected in response to watershed salt application reductions. MDE currently works with State Highway Administration, WSSC, and other states, but welcomes coordination with other organizations to track and reduce road salt use and impacts in Maryland.

Ms. Nicole Christ is a Natural Resource Planner III at the Maryland Department of the Environment (MDE). She has been working for MDE for over 3 years, and has been focusing on their Winter Salt Program since starting. Nicole has past experience in the landscape industry and is a certified Chesapeake Bay Landscape Professional as well as working on other programs for MDE. She has a Bachelor's of Science in Geography and Environmental Science from the University of Maryland, Baltimore County.

Stream Corridor Restoration and Unintended Consequences

Denise Clearwater; denise.clearwater@maryland.gov; Maryland Department of the Environment

Stream corridor restoration can be controversial and sometimes is subject to opposing viewpoints. Differences of opinion over the length of review times and resource tradeoffs occur. This presentation describes adverse effects which have been reported for some projects, according to peer-reviewed literature, gray literature, and observation. Recent Maryland Department of the Environment efforts to address permitting issues and provide additional

guidance are also described.

Denise Clearwater is the Special Projects Coordinator in the Wetlands and Waterways Protection Program in the Maryland Department of the Environment. She has a background in developing and implementing a regulatory wetland program; a mitigation program; policy development; and special projects for program improvement and grant management. Recent work includes revising regulations, improving wetland assessment, stream restoration guidance, wetland and stream mitigation, legislative review, managing grant projects, and responses to changes in to the Clean Water Act. She has represented the Wetlands and Waterways Program in the Maryland Department of the Environment on numerous interagency work groups for regulatory, wetland monitoring and conservation, restoration, stream health, and preservation. She is also currently serving as an at-large Board member of the National Association of Wetland Managers and is a member of the Society of Wetland Scientists. Denise has a B.S. in zoology from the University of Maryland and an M.S. in wildlife management from Frostburg State College (now University).

Examining Surface and Subsurface Sediment Sources and Transport Processes in an Urban Watershed with an Entirely Buried Stream Network, Washington, D.C., USA

Zach Clifton; zclifton@usgs.gov; US Geological Survey

Coauthors: Leah Staub, USGS; Allen Gellis, USGS; Cecilia Lane, DOEE; Christopher Conway, USGS; David Pilat, DOEE

Excessive fine-grained sediment runoff due to anthropogenic activities is a major environmental concern for watersheds worldwide, and especially so for urban areas such as Washington, D.C. Dated grey infrastructure, the human-engineered network of buried pipes and reservoirs used for managing water resources, can amplify existing issues with sediment runoff and associated pollutants. This infrastructure, generally designed to quickly transport stormwaters away from urban areas, contributes to urban stream syndrome and recent studies have suggested aging subterranean infrastructure may be an unaccounted-for source of sediments. The composition of

and the extent to which this possible sediment source contributes to urban sediment runoff is poorly understood and rarely accounted for. Our study examined sediment sources and transport processes for the Hickey Run Watershed, an urban watershed with an entirely buried drainage network, using sediment fingerprinting with specific attention paid to discriminating between surface and subsurface sources. We demonstrate here multiple novel approaches to sampling subterranean sources including augering, sampling manholes, and entering the buried drainage network itself. The results of this study will inform urban sediment reduction managers and infrastructure engineers and allow for targeted sediment reduction responses.

Zach Clifton is a Physical Scientist with the US Geological Survey's Maryland-DC-Delaware Water Science Center in Baltimore, Maryland. A former graduate of UMBC, his areas of study include fluvial sediments, urban hydrology and geomorphology, and remote sensing. When he's not working on studies that take him from the sewers under Washington D.C. to the foothills of the Appalachians, he is developing studies centered on understanding the interplay between the existing built environment, legacies of previous land use practices, and the current hydrologic landscape.

What Lies Beneath: Investigating Pre-Colonial Riparian Ecosystems in the Atlantic Coastal Plan, Maryland, USA

Zach Clifton; zclifton@usgs.gov; US Geological Survey

Coauthors: Matthew Cashman, USGS; Bryan Landacre, USGS; Chris Bernhardt, USGS

Previous studies in the Piedmont Physiographic Province have suggested that anastomosing stream complexes were ubiquitous across the pre-colonial landscape. However, it is to be determined if these findings are applicable to other provinces, such as the lower-gradient Coastal Plain. Our study sought to investigate the structure and ecology of pre-colonial stream environments for the Coastal Plain in Anne Arundel County via broad assessments across the County and detailed field investigations at 2 sites. Using GPR surveys and examining sediment cores for pollen, radiocarbon dating, and shifts in elemental composition, color, and magnetic

susceptibility, this study identified distinct structural differences between pre-colonial Piedmont and Coastal Plain stream systems. In contrast to prior Piedmont studies, our work suggests that pre-colonial Coastal Plain systems were typically wooded, canopied swamps dominated by alders and ferns, with both multi- and single-threaded channels. Following European colonization, these systems quickly filled with vast amounts of sediment such that there are virtually no exposed pre-colonial sediments, unlike the Piedmont. These results provide valuable context to understanding past and current conditions in Anne Arundel County, as well as a guide for management decision making for restoration applicability, design, and its intended goals.

Zach Clifton is a Physical Scientist with the US Geological Survey's Maryland-DC-Delaware Water Science Center in Baltimore, Maryland. A former graduate of UMBC, his areas of study include fluvial sediments, urban hydrology and geomorphology, and remote sensing. When he's not working on studies that take him from the sewers under Washington D.C. to the foothills of the Appalachians, he is developing studies centered on understanding the interplay between the existing built environment, legacies of previous land use practices, and the current hydrologic landscape.

Wellhead Protection for Anne Arundel County DPW and Private Wells.

Edward Cope; pwcope43@aacounty.org; Anne Arundel County Water Operations

Coauthor: Noelle Anuszkiewicz, Anne Arundel County DPW

Source water protection is very important because it allows water systems to depend on a consistent resource to supply the public with a safe product. Wellhead protection allows Anne Arundel County DPW to keep their 52 wells safe from contamination from any surface contamination. This presentation will review the different aspects of wells that protect them from contamination, the difference between a water table and artesian aquifers. A public outreach program to educate citizens and businesses on the need for wellhead protection is important to protect themselves and everybody else using that aquifer. Sampling and rehabilitation will also be discussed.

Since 1994, Eddie Cope has been sharing his knowledge of water and wastewater treatment with students from MD, Del, VA, WVA and PA. With 37 years as an Operator, Team Manager, Program Manager, Eddie holds various certifications such as: Class 4 Water Treatment, Superintendent, and a Certified Environmental Trainer (CET) certification. Eddie's true passion is teaching and coaching students. He enjoys connecting with operators and managers on all levels, sharing his knowledge and experience, and helping to expand interest and dedication to water in all forms. For Eddie, teaching is the best way to give back to an industry that has given him so much.

Pooled Monitoring Initiative - What We Have Accomplished Together

Sadie Drescher; sdrescher@cbtrust.org; Chesapeake Bay Trust

Efforts to restore our waterways call for a significant increase in the number of watershed restoration projects intended to improve both water quality and habitat. Questions about the performance and function of some of these practices persist in the regulatory and practitioner community that prevent more rapid implementation. As a result, the Pooled Monitoring Program was designed to connect key restoration questions posed by the regulatory and practitioner communities with researchers in the scientific community.

Pressing questions about the practices are compiled with input from the regulators and practitioners (e.g., the cumulative impacts of restoration practices at a watershed scale, trade-offs among different resources, pollutants of emerging concern). The Initiative articulates the "burning" restoration questions that regulators and practitioners need to make decisions. The novelty of the initiative is derived from identifying funds used for other types of monitoring that have more power in a pool. Results of the research are communicated back to the regulators and practitioners in a way that maximizes their ability to inform work in those realms.

This talk will focus on what we have accomplished and learned together, the current research questions posed in the RFP (open at time of MWMC), and the program's future. We welcome

input from the audience.

Sadie joined the Chesapeake Bay Trust in 2014. At the Trust she leads the restoration programs that include implementation projects, research efforts, and innovative watershed and community engagement award programs. She has background in environmental science with a M.S. in Environmental Studies from the College of Charleston and a B.S. in Environmental Biology from Tennessee Technological University. Sadie's work focuses on watershed restoration and stormwater management to support policy, training, and outreach initiatives. At the Trust, Sadie enjoys working with partners to form strong grant programs that benefit the water and people in the Chesapeake Bay.

Water Resources Element Guidance Update: Best Practices for Integrating Climate Change, Identifying Suitable Receiving Waters

Jason Dubow; jason.dubow@maryland.gov; Maryland Department of Planning

Coauthor: Matthew Rowe, Maryland Department of the Environment

The Water Resources Element (WRE), a statutory requirement for local comprehensive plans, is designed to ensure that local plans for growth and development can be supported given limitations and constraints of water resources and water, sewer and stormwater infrastructure. Local governments should complete the WRE in order to identify and analyze locally specific water-related limitations and to put forward strategies and recommendations for addressing them. Doing so will ensure that local water resources and infrastructure can adequately support local plans for growth and development.

MDE, MDP and DNR collaborated to produce an update to the state's WRE Guidance in December 2021 that provides best practices regarding analyses and approaches for: ensuring receiving waters are protected as the local land use plan is developed and implemented, reflecting changes to MDE's water resources programs over the past decade; and integrating climate change considerations, particularly flooding risks, into the drinking water, wastewater

and stormwater assessments of the WRE.

This presentation will provide an overview of the new WRE guidance update, including checklists of priority local actions and state expectations of local governments.

Jason Dubow, Manager, Resource Conservation & Management, has worked at the Maryland Department of Planning (Planning) for 15 years, where he is responsible for administering a variety of state environmental planning laws and regulations, many related to land preservation and water resources planning. Before working with Planning, he worked as a water resources and water/sewer planner for Worcester County, Maryland for three years, and as an environmental consultant with ERG (Eastern Research Group), Inc. for seven years, mostly serving federal clients. He has a Masters of Science degree in Sustainable Development and Conservation Biology from the University of Maryland at College Park.

Detecting and Understanding Hydrologic Change in Developing Watersheds: Is Green Stormwater Infrastructure Making a Difference?

Keith N. Eshleman; keshleman@umces.edu; University of Maryland Center for Environmental Science, Appalachian Laboratory

The objective of this hydrologic project was to determine the spatially-aggregated effectiveness of "green" stormwater infrastructure (GSI) at the watershed scale (relative to a comparable "control" watershed developed with mostly conventional stormwater management). The project was implemented in two adjacent watersheds in northcentral Howard County, Maryland: an unnamed tributary to the Little Patuxent River (UTLP); and Plumtree Branch (PLBR). Due in part to unanticipated delays in development in UTLP, the experimental design was modified to provide a statistical analysis of "pre-development" and "during-development" relationships between the two watersheds as a way of assessing hydrologic change and the efficacy of GSI. Monitoring data from 55 storm events over 2.5 years demonstrated statistically significant reductions in adjusted mean storm event runoff (~50%) and new water contributing areas

(~40%), but no differences in adjusted mean peak runoff or maximum new water contribution were observed. Annual runoff data from the two watersheds (and from other nearby gaged watersheds) suggested an anomalously large decline in UTLP during the development phase due to either retention or diversion. The evidence for water quality changes based on nearly 1,000 water samples collected and analyzed during the project will also be discussed.

Dr. Keith N. Eshleman is Professor at the University of Maryland Center for Environmental Science based at Appalachian Laboratory in Frostburg. Dr. Eshleman's research interests are in the areas of watershed hydrology; groundwater-surface water interactions; biogeochemical processes; water quality modeling; and ecosystem responses to disturbance, energy development, and land use change. Eshleman's field-oriented research program has broadly focused on man's impacts on the hydrologic cycle, specifically on examining the hydrological effects of acid deposition, forest disturbances, surface mining, shale gas development, urban stormwater management, and peatland drainage and restoration.

How Is Water Affected By Climate, Flora, and Fauna

Srinidhi Gadiyaram; srinidhigadiyaram69@gmail.com; Centennial High School

Climate and water quality correspond very well together. If the temperature rises, the water evaporates much faster, resulting in heavier rainfall and more active flooding. This process decreases our water quality which can lead to various health risks. Comparably, if water pollution continues, not only does the water quality go through degradation, the climate and overall environment are negatively affected by the absence of macro-invertebrates and other necessary providers. To begin my project, I took data from various watershed locations around Maryland and compared and contrasted their biological ratings, transparency levels, conductivity levels, measurement of overall life, nitrate levels, and phosphate levels when applicable. My research focused on how dissolved oxygen and temperature track closely with macro-invertebrates scores and theorized how those same macro-invertebrates/microbes can be preserved in their original habitats. I also looked at their annual flooding and rainfall rates to construct additional research on the detrimental effects that they have on environmental habits

and conditions. In my talk, I will explore all aspects of my data and research, and also discuss possible solutions to the problems presented.

Srinidhi Gadiyaram is a junior at Centennial High School dedicated to environmental justice. She is a part of many Green organizations including the Youth Climate Institute, and Our Revolution, and works as an Eco-ambassador for Howard EcoWorks. She's done extensive research on topics such as macro-invertebrate life in lakes, many factors of the water stream survey, and flooding zones and their formal effects on different habitats. Her presentation will explore the topics of the Maryland Biological Stream survey, the roles of contaminants in water, climate change, and solutions to combat the obstacles using environmental justice.

Conservation Action at Your Fingertips: Documenting Ephemeral Wetlands Using a Tiered Approach in ArcGIS Survey123

Rachel Gauza; rachel.gauza@montgomeryparks.org; Montgomery Parks, M-NCPPC

Montgomery Parks encompass more than 37,000 acres and 490 miles of streams, but what about wetlands? Wetland delineations and other field studies are used to inform land management decisions, but tend to overlook smaller, seasonally variable features and the unique biota that rely on them. Even when locations are known, conditions inherently change over time. The first step is documentation, where consistency is key. Then, multiple field visits can catalog seasonal shifts and detect discrete changes. Inventory and monitoring can be labor and resource intensive, but not with ArcGIS Survey123! A data collection survey was launched in 2021 to revitalize historic inventory efforts. Use of a tiered approach and prompts integrated into the form promote standardized data collection across multiple staff and specialties, minimal training, instant data access, and quick cataloging of vernal pools and other ephemeral wetland features, including ones associated with habitat restoration efforts. Learn how Survey123 has expanded information available for protecting vulnerable aquatic resources and identifying opportunities to enhance existing features to create a network of nearby habitats. Tool and protocol development, two-year pilot results, successes, challenges, future directions, and considerations for others looking to document these seasonal and sensitive features will be shared.

Rachel Gauza is a Principal Natural Resources Specialist for the Maryland-National Capital Park & Planning Commission and oversees aquatic ecology monitoring for Montgomery Parks. A champion for community science, Rachel served as the FrogWatch USA National Coordinator and continues to provide regional and local support to the program. Ms. Gauza specializes in herpetology and science communication and has worked on species inventories, biological monitoring, watershed assessment, and environmental education endeavors throughout the Mid-Atlantic for nearly two decades.

Identification Of Chloride Sources In Groundwater

Johanna Gemperline; johanna.gemperline@maryland.gov; Maryland Geological Survey

Chloride in groundwater can come from multiple sources. Natural sources include saline groundwater of geologic origin and saltwater intrusion near the coastal areas. Anthropogenic sources include road salt, septic effluent, water softeners, landfill leachate, animal waste, and agricultural chemicals. Differentiating between these sources is not always straightforward. Some potentially helpful constituents, such as bromide, are often found in trace concentrations and are not commonly tested. Others, such as nitrate, are not always conservative in groundwater and might therefore not be detected at a distance from the source. Future attempts to identify chloride sources might benefit from testing for a wider range of constituents at lower detection levels, as well as evaluating temporal variability and land use.

Johanna Gemperline has been a hydrogeologist at the Maryland Geological Survey for eight years. She has collected samples, measured water levels, and used numerical models to evaluate groundwater quality and quantity for studies throughout Maryland. She has a MS in Geology and BS in Civil Engineering from the University of Illinois at Urbana-Champaign.

Water Chemistry of Maryland Streams: Quantifying Changes in Stream Health Over Time

Mary Genovese; mary.genovese@maryland.gov; Maryland Department of Natural Resources

Coauthors: Kyle Hodgson, MDNR; Tomas Ivasauskas, MDNR

Water chemistry is one of the main environmental factors that determines stream health as all stream-inhabiting organisms have specific tolerances to water chemistry parameters. In this study, data from water chemistry grab samples, collected by the Maryland Department of Natural Resources Maryland Biological Stream Survey at randomly selected sites, were compared over a 14-year period. Samples collected at sites in the Maryland Sentinel Site Network were used in this comparison as a reference group. The goal was to determine how water chemistry of Maryland streams has changed over time, how these changes correlated with biological communities, and what this implies about Maryland stream health. Due to increasing anthropogenic influence, it was hypothesized that significant changes in water chemistry occurred at these streams over time and biological communities inhabiting these streams were negatively correlated with these changes, thus resulting in a reduction in Maryland stream health. Trends observed through these analyses identified conductivity and chloride as parameters that changed the most over the 14-year period and were correlated with stream biological community condition. Sites with conductivity and chloride levels falling outside thresholds for biological success had significantly lower percentages of intolerant benthic macroinvertebrate taxa. Further sampling and continued analyses may be required to verify these results and identify additional factors related to stream health and biological communities.

Mary Genovese works for the Maryland Department of Natural Resources – Resource Assessment Service as a Natural Resource Biologist. Since 2019, she has been involved with the collection and analysis of data for a variety of different stream monitoring projects throughout the state, the main being the Maryland Biological Stream Survey (MBSS).

PCB TMDL Implementation – Monitoring PCBs in The Sawmill Creek (Anne Arundel County, MD) Watershed

Douglas Griffith; pwgrif04@aacounty.org; Anne Arundel County Bureau of Watershed Protection and Restoration

Coauthors: Nathalie Lombard Ph.D., University of Maryland, Baltimore County; Upal Ghosh Ph.D., University of Maryland, Baltimore County

In 2011 a TMDL for Polychlorinated Biphenyls (PCBs) was established for the Baltimore Harbor, Curtis Creek/Bay, and Bear Creek portions of the Patapsco River Mesohaline Tidal Chesapeake Bay Segment. In 2016 Anne Arundel County developed a PCB TMDL Restoration Plan which includes PCB monitoring as a component to identify PCBs concentrations in surface waters and determine the geographic source(s) of PCBs. In 2020, the County, in collaboration with University of Maryland, Baltimore County's Chemical, Biochemical and Environmental Engineering department, began in-situ monitoring of PCBs in the Sawmill Creek watershed. This presentation will summarize the process of monitoring strategy development and implementation to include catchment and site selection, sampling methodology, analytical methods, and results to date.

Douglas Griffith is a watershed planner with Anne Arundel County; Dr. Upal Ghosh is a professor in the department of Chemical, Biochemical, and Environmental Engineering at UMBC. His group performs research in environmental engineering and science with a focus on the fate, effects, and remediation of toxic pollutants in the environment; Dr Nathalie Lombard is a postdoctoral research associate at UMBC, working with Dr Upal Ghosh on fate and transport of hydrophobic pollutants and their uptake in freshwater organisms

MBSS Documents Increased Passage of American Eels and Other Migratory Fish in The Patapsco River Following Dam Removal

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

The MBSS has documented immediate and in some cases dramatic increases in the passage of migratory fish in the Patapsco River following the removal of Bloede Dam that spanned September 2018 to May 2019. Using methods that included visual observation, fish trapping, electrofishing, and monitoring of upstream passage structures, the MBSS recorded expansions of nine migratory species into restored habitats upstream of the former Bloede Dam. A tenth species, American Eel, was present upstream of Bloede Dam pre-removal, but the dam's removal seems to have improved its ability to disperse upstream. Monitoring of an MBSS-maintained eel ladder on Daniels Dam, the next barrier upstream, revealed increases in juvenile eel passage up to three orders of magnitude within four years of the Bloede Dam removal downstream.

William Harbold is a biologist with the MBSS. He has worked on Patapsco River dam removal monitoring projects since 2010.

Thermal Properties of Different Stormwater Best Management Practices

Robert H. Hilderbrand; rhilderbrand@umces.edu; University of Maryland Center for Environmental Science, Appalachian Laboratory

My research quantified the thermal properties of 25 stormwater BMPs (Best Management Practice) across five different types: Bioswales, Detention Ponds, Grass Swales, Sand Filters, and Submerged Gravel Wetlands (SGW). No specific BMP type was noticeably better at preventing summer discharges from exceeding the 20C threshold where coldwater organisms can become physiologically stressed. BMP discharges in July and August were routinely above 20C with fewer than 25% of the observations spent below. Similar, but less frequent results occurred for the 24C threshold considered lethal for some coldwater taxa. Both Bioswales SGWs tended to have fewer thermal exceedances than Ponds and Sand Filters, but still discharged above 20C

for most of the summer as well as 24C for lesser amounts. Stream temperatures did not change during events downstream from Sand Filters, SGWs, or Grass Swales, but increased below Ponds. It appears that no existing stormwater BMP technology used in Maryland can be totally protective for cool- and coldwater streams. Nonetheless, the presence of a stormwater BMP resulted in overall lower temperatures that reached the stream than if there were no BMP present once the temperature of the runoff entering the BMP is considered.

Bob Hilderbrand is at the Appalachian Laboratory in Frostburg where he explores the relationships of the landscape and watershed attributes to the ecological condition of our streams.

Managing Urban Runoff: Non-Structural End-of-Pipe Strategies on Parkland

Jackie Hoban; jackie.hoban@montgomeryparks.org; Montgomery Parks, M-NCPPC

Coauthor: Erin McArdle, Montgomery Parks, M-NCPPC

As a stream valley park system, Montgomery Parks is on the receiving end of much of the county's storm drain network. Historically, storm drain outfalls were built discharging directly into stream channels or sited without much consideration to soil makeup, habitat conditions, or steep slopes, leading to decades of environmental degradation. Montgomery Parks has prioritized these nonpoint source pollution discharges for identification and restoration where more formal stormwater management approaches are not feasible or appropriate. Using environmentally sensitive designs to increase flow paths, daylight piped systems, reduce erosive flows, recharge groundwater, and restore adjacent wetland and terrestrial habitats, Montgomery Parks, in partnership with other agencies including MCDOT, has built robust programming and methods for outfall restoration. Data is now being collected using ArcGIS Survey 123 tool to evaluate the condition of outfalls throughout the county to prioritize outfall restoration work and monitor conditions over time. Here we present previous restoration projects that have used environmentally sensitive design and discuss lessons learned from qualitative review of methods, preliminary data from ArcGIS Survey 123 of current conditions, and approaches to outfall restoration prioritization and monitoring moving forward.

Jackie Hoban is a Senior Natural Resources Specialist for the Montgomery Parks Department. She joined Montgomery Parks in 2020 as part of the environmental review team where she manages projects proposed on parkland and assists in the design and implementation of environmental restoration efforts including wetland creation, outfall repair and stream restoration.

Erin McArdle is an Engineer for the Montgomery Parks Department of the Maryland-National Capital Park & Planning Commission. Erin has 17 years of experience as a restoration designer and project manager and currently leads Parks' Capital Improvement Programs of Stream Protection and Pollution Prevention.

Maryland's Benthic IBI and Macroinvertebrate Trends Over a 14-Year Period

Kyle Hodgson; kyle.hodgson@maryland.gov; Maryland Department of Natural Resources

Coauthors: Tomas Ivasauaskas, Maryland DNR; Mary Genovese, Maryland DNR

Benthic macroinvertebrate data collected at randomly selected sites in Maryland Biological Stream Survey's Round 2 (2000 - 2004) were compared against data collected at repeat site visits in Round 4 (2014 - 2018) to assess how Maryland's benthic IBI and macroinvertebrate trends have changed over a 14-year time period. Maryland's Sentinel Site Network was used as a reference dataset to compare against trends observed at random sites. Concerns about changes in taxonomic naming and laboratory methods between time periods were investigated; neither had major impacts on data interpretation and comparability remains strong. No statistical difference was observed among benthic IBI scores between Rounds at random sites or sentinel sites. Number of benthic taxa and number of EPT taxa significantly increased at both random and sentinel sites in Round 4; percentages of mayflies and percentages of macroinvertebrates that are sensitive to urbanization significantly decreased at both random and sentinel sites in Round 4. At random sites, IBI scores appear to be moderately correlated with conductivity, ANC, chloride, and epifaunal substrate scores. At sentinel sites, IBI scores appear to be strongly correlated with pH, DOC, embeddedness, pool extent, riffle quality, and percentage of days exceeding 24

degrees.

Kyle Hodgson is a Natural Resource Biologist at the Maryland Department of Natural Resources, Maryland Biological Stream Survey

Maryland Agriculture - Promoting and Achieving Stream Health

Elizabeth Hoffman; elizabeth.hoffman@maryland.gov; Maryland Department of Agriculture

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No Abstract Submitted

No Bio Submitted

Embracing Regional Collaboration for Salting Awareness

Nicole Horvath; nicole.horvath@wsscwater.com; WSSC Water

Coauthors: Michael Weyand, City of Gaithersburg; Ryan Zerbe, Montgomery County DEP

Over application of salt to roadways and sidewalks during winter weather events is an ongoing regional issue for a multitude of reasons. Recognizing this concern is shared by neighboring jurisdictions and partners, WSSC Water organized a Regional Salt Outreach Task Force focused on developing outreach materials backed by science to change the mentality of applicators. Sending a unified and recognizable message throughout the region increases effectiveness for two major target audiences: residents receiving messaging from countless sources (press, news, social media) and contractors working across jurisdictional lines. Utilizing an approach that includes developing Narrative Strategies, the Task Force is identifying which messages will most resonate with each group of applicators (residents, property managers, commercial applicators, etc.). The Task Force is utilizing this knowledge to share and develop easily understandable

outreach materials in multiple languages to be utilized by all regional partners, while also strategizing effective methods for dissemination. Collaboration and resource sharing is proving to be an efficient use of resources, as well as an effective outreach strategy.

Nicole Horvath is the Environmental Outreach Coordinator for WSSC Water. She serves as a liaison between the utility and stakeholder groups in Montgomery and Prince George's counties with a goal of encouraging community members to take positive actions that protect local sources of water. Ryan Zerbe is the Watershed Outreach Planner for Montgomery County DEP. In his role, he develops and executes the Public Outreach and Stewardship Plan to meet MS-4 permit requirements. Dr. Michael Weyand is the Watershed Restoration Specialist for the City of Gaithersburg and is passionate about using applied social science to make better decisions related to watershed protection and public outreach.

Fairfax County's Use of The Northern Virginia Salt Management Strategy (SAMS) to Address the TMDL for Chloride in Accotink Creek, VA

Marty Hurd; Martin.Hurd@fairfaxcounty.gov; Fairfax County

The Chloride TMDL for the Accotink Creek Watershed was approved by the U.S. Environmental Protection Agency in 2018. It is the first TMDL completed in Virginia focused on chloride as a pollutant. In an effort to assist both regulated and non-regulated entities efficiently and effectively manage and apply deicers/anti-icers consistent with the assumptions and requirements of the TMDL, the VA DEQ lead the development of the Accotink Creek Salt Management Strategy (SaMS). DEQ completed the toolkit in August 2020, and it is currently hosted online by the Northern Virginia Regional Commission (NVRC). The ultimate goal of SaMS is to raise awareness of these impacts, demonstrate how individuals and organizations can participate, and provide guidance for monitoring and research to support SaMS adoption. Fairfax County staff were active participants in the development of SaMS and began phasing components of SaMS into operations during the 2018 winter season. Additional SaMS best practices & recommendations are under development or planned for future adoption. This presentation will provide a status update and discuss next steps regarding SaMS implementation.

Marty Hurd is the MS4 Permit Coordinator for Fairfax County with the Department of Public Works and Environmental Services. Mr. Hurd has a Master's Degree in Biology from West Virginia University, and has worked for regional water quality monitoring, assessment, and regulatory programs with the state of Maryland (MDE & DNR) and the District of Columbia. Marty has also worked as an environmental and IT consultant with Tetra Tech, for clients like the EPA's NPDES & Chesapeake Bay Programs, as well as states in other regions of the country, such as California, Texas, and Utah.

Quantifying Four Decades of Chloride Inputs to The Baltimore City Drinking Water Reservoirs

Kyle Hurley; khurle6@students.towson.edu; Towson University

Coauthor: Joel Moore, Towson University

Road de-icing agents have caused salinization of surface waters across the northeast and mid-Atlantic United States. Three drinking water reservoirs serve 1.8 million people in the Baltimore City region, and increasing chloride (Cl) in the reservoirs and their streams as well as elevated concentrations of disinfection byproducts (DBPs) were reported as key emerging water quality concerns in 2011. This study is quantifying seasonal to decadal scale trends of Cl in the reservoirs' tributaries as Cl may carry implications for DBP formation. Historical Cl trends are assessed by weighted regressions on time, discharge, and season using four decades of data provided by Baltimore City Department of Public Works and Maryland Department of Environment. Recent winter season Cl concentrations are estimated from high-frequency specific conductivity (SC) sensors and linear regressions of Cl and SC. Preliminary results show annual Cl concentrations at least doubling since the early 1980's, winter season concentrations are higher and increasing at rates similar to or faster than summer concentrations, and winter season spikes in Cl at one stream can be over one thousand milligrams per liter and exceed EPA criterion. The conclusions of this study will have implications regarding the effects of road de-icing agents on stream chemistry, Baltimore City drinking water, and disinfection processes.

Kyle Hurley served 10 years on submarines in the US Navy before completing his double major in Earth-Space Science and Geology in 2019 from Towson University. During his undergraduate, he interned at Carnegie Institution for Science researching deep ocean redox controls on serpentinite minerals and NASA Goddard helping build the first three-dimensional photograph database of fossils for machine learning, and co-authored a paper in the Journal of Geoscience Education. He returned to Towson University in 2021 to complete a masters in Environmental Science. At present, he is researching current and historical road salt inputs to Baltimore City's drinking water reservoirs.

Using MBSS Data to Improve Our Understanding of Fish Species of Greatest Conservation Need: American Brook Lamprey and Pearl Dace

Tomas Ivasauskas; tomas.ivasauskas@maryland.gov; Maryland Department of Natural Resources

Coauthors: Jackie Sivalia, DNR; Jay Kilian, DNR

Data collected using the MBSS protocols are widely applicable to various applications, including improving our understanding of Maryland's rare, threatened, and endangered species. Within Maryland, the American Brook Lamprey is 'threatened' and state rank S2 (imperiled/state rare), and Pearl Dace is 'in need of conservation' and state rank S2S3 (imperiled or vulnerable). Both species are known to have restricted habitat ranges and relatively few established populations in the state. To develop a better understanding of these species, MBSS records spanning the state and dating back to 1995 were analyzed for correlations with the presence of these species. American Brook Lamprey was sampled within the Patuxent and Washington Metro Potomac Basins, in first through fourth order streams, typically at lower elevations in urbanized watersheds. Pearl Dace was sampled within the Middle- and Upper-Potomac Basin, and it was obligated to spring-fed limestone streams in agriculture-dominated watersheds. Within their ranges, American Brook Lamprey and Pearl Dace each co-occurred significantly with other fish species of greatest conservation need at sites with high biotic integrity, emphasizing the broad

importance of promoting healthy ecosystems.

Tomas Ivasauskas works for the Maryland Department of Natural Resources. His primary role is managing the data generated by the Maryland Biological Stream Survey, but he also works on a variety of analytical projects and assists with fieldwork. He earned his Ph.D. from NC State University, enjoys fishing, and has a toddler at home.

Freshwater Salinization Syndrome: Risk Factors, Stages, And Management

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Freshwater salinization is an emerging global issue impacting safe drinking water, ecosystem health and biodiversity, and infrastructure. The interactive effects of salt ions on degrading natural, built, and social systems is called Freshwater Salinization Syndrome (FSS). Over the past two decades, the impacts of FSS on drinking water supplies, aquatic life, and infrastructure have been documented in Maryland. During that time, FSS has become increasingly recognized as an emerging environmental problem across regional, continental, and global scales. We show that there are five risk factors for predicting the severity of FSS in watersheds such as climate, geology, flowpaths, human activities, and time. We also show that there are progressive stages of severity of FSS. Our risk factors and stages approach collapses the expanding diversity of freshwater salinization drivers and chemical contaminants into understandable categories. We also highlight the importance of monitoring and managing FSS along watershed flowpaths and understanding risks to urban water BMPs across our region. Evaluating risk factors, stages, and management approaches will be critical for reducing impacts of FSS on providing clean drinking water, protecting stormwater BMPs and infrastructure, supporting aquatic life and biodiversity, and other critical ecosystem services.

Dr. Sujay Kaushal is a Professor in the Department of Geology & Earth System Science Interdisciplinary Center at the University of Maryland College Park. He has been a professor in the University of Maryland System for 17 years. He has published over 100 scientific papers in peer reviewed journals related to freshwater salinization, water quality, and water resources. He

has taught well over 1,000 UMD undergraduate and graduate students through classes and thesis projects.

Detecting and Identifying Microplastics in Environmental Samples

Dr. Christine Knauss; cknauss@umces.edu; University of Maryland Center for Environmental Science

Identifying microplastics from the environment is time consuming and expensive because of the variety of plastic particles in the environment and the abundance of associated organic particles. To date, a reasonably accurate low-cost high-throughput method has not been developed, yet such a technique is needed to characterize microplastics in environmental samples. The objective of this study was to assess the ability of an automated image capture system to detect and identify microplastics using polarized light (PL) in conjunction with Nile red (NR) staining. Most plastic polymers are crystalline structures and, when illuminated under cross-polarized light, show birefringence. In this study, 15 particle types of known polymers, commonly found in the environment (e.g., polypropylene, polystyrene, polyethylene, PVC, nylon), were tested with the automated polarized light system, both with and without NR staining. A variety of sizes (0.4-5 mm) and colors were chosen to best represent environmental samples and microscope settings were optimized for microplastic birefringence. Once optimized, the combined technique of polarized light with Nile red staining (the "PLNR" method) was tested with suspected microplastics that had been density separated from 10 environmental sediment samples. These particles were also analyzed with attenuated total reflection Fourier-Transform Infrared spectroscopy (ATR-FTIR). Results indicate that of the known polymer types, 9 of 15 are birefringent, 10 of 15 are fluorescent with Nile red, and 14 of 15 are either birefringent or fluorescent with Nile red. PL microscopy consistently detected polypropylene and low density- and high density-polyethylene while NR staining could not. NR staining did not affect birefringence, hence 93% of the 15 plastic types could be detected as plastics with the PLNR technique. For the environmentally collected microparticles, 7 were identified as plastic from ATR-FTIR spectra, 3 as anthropogenic synthetic, 7 as anthropogenic natural, 18 as likely organic, and 3 as unknown. The PLNR method detected 7/7 of the ATR-FTIR-identified

microplastics, 2/3 anthropogenic synthetic, and 7/7 of the anthropogenic natural particles. However, 9/18 likely organic particles were detected therefore, an organic digestion step before PLNR analysis would greatly reduce false positive detections of microplastics. Because the PLNR technique could be coupled with image-based artificial intelligence, the combination of PL and NR staining shows clear potential for a low-cost high-throughput method to identify and quantify microplastics in environmental samples.

Dr. Christine Knauss is a Postdoctoral Researcher at the University of Maryland Center for Environmental Science (UMCES) Horn Point Lab. Her current work focuses on developing a more efficient and accurate method for identifying microplastics from environmental samples using polarized light, fluorescent light, and machine learning. She is also co-leading an effort in the US to create an international network of plastic pollution researchers, that aims to harmonize methods, support data sharing and database development, and foster more diversity in the field. Christine earned her PhD from UMCES in 2021, where she studied the effects of microplastics on oysters in the Chesapeake Bay.

Insect Evolution in Stream and River Ecosystems and the Consequences of Global Change

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Coauthor: Robert F. Smith, Massachusetts Department of Environmental Protection, Watershed Planning Program

Insects evolved in flowing ecosystems to survive in a dynamic environment that changes in structure and function from upland to lowland regions. Adaptations to flowing water, stream drying, seasonal temperature, and other conditions and specialized adaptations to diverse food resources such as leaves, algae, and suspended particulate organic matter differ along the river continuum and define, in part, the composition of assemblages in lotic ecosystems. Conditions in stream and river ecosystems are defined by local geology, topography, and climate, which control the species (and species traits) that occur in a stream reach. Human-induced changes to

the channel and catchment and changes to global climate can alter in-stream conditions and subsequently the assemblage of insects. The response of insect populations to anthropogenic change is dependent on interacting abiotic and biotic factors occurring at multiple spatial scales. Thus, insect assemblages in urban and agricultural-dominated landscapes typically differ, but the links between evolutionary and ecological processes that control population and community dynamics can help predict insect responses to anthropogenic change. We present case studies highlighting the complexity of insect responses to anthropogenic change and discuss the current, alarming trend of insect declines and species extinctions.

Bill Lamp has been a professor of entomology at the University of Maryland since 1985. His research interests include agricultural pest management and aquatic entomology. He teaches courses on topics such as sustainability, climate change, the insect biodiversity crisis, and aquatic ecology/entomology. His aquatic research has included the study of insects in wetlands, streams, and agricultural drainage ditches.

Dr. Bob Smith is an entomologist and environmental scientist with experience researching and teaching about the biology of stream insects in forested and human-impacted watersheds. He is currently a scientist with the Massachusetts Department of Environmental Protection, Watershed Planning Program where he performs outreach to volunteer monitoring organizations and data analysis for the Program's water quality assessments and Clean Water Act 305(b) and 303(d) decision making.

Analyzing the Physical Habitat Patterns of Maryland's Streams

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Physical habitat is crucial for maintaining the health of stream ecosystems. DNR's Maryland Biological Stream Survey (MBSS) works to address the biological, chemical, and physical statuses of non-tidal streams within Maryland. The MBSS has conducted rounds of sampling to assess these factors across the state. Currently, Round 4 (2014-2018) analysis is underway and is

being compared to data from Round 2 (2000-2004) to investigate changes that have occurred at MBSS random and sentinel sites over 14 years. We have begun analyzing various habitat metrics. Instream habitat, embeddedness, total count of woody debris, and total count of rootwads showed significant changes between Rounds 2 and 4 among both random and sentinel sites. Instream habitat and embeddedness displayed some moderate correlations between Fish Index of Biotic Integrity (FIBI) metrics, indicating there may be significant patterns present among biological stream conditions and physical habitat. Further investigation into habitat parameters and fish population characteristics can improve our understanding of these potential relationships.

Mia Lenzenweger is a Natural Resources Technician for the DNR's Resource Assessment Service Unit. She is specifically working on Maryland Biological Stream Survey-driven projects. Mia graduated from University of North Carolina Wilmington with Bachelor of Science degrees in Marine Biology and Environmental Sciences.

Vernal Pool Conservation in the Anacostia River Watershed and the District Of Columbia

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Coauthors: Michelle Campbell (District Department of Energy & the Environment)/ Cathy Wiss (Master Naturalist, Anacostia Watershed Society)

The Anacostia Watershed Society (AWS) and District Department of Energy & Environment (DOEE) share the goal to monitor and improve conservation of vernal pools in the Anacostia River watershed (Maryland/DC). Within the watershed, AWS has focused vernal pool monitoring efforts in Prince George's County, MD on Maryland-National Capital Park & Planning Commission (M-NCPPC) land, while DOEE has focused on DC resources. AWS has prioritized monitoring vernal pools that contain obligate species with the help of trained citizen scientists, mainly master naturalists, to identify conservation or restorations needs. For the past year, AWS's master naturalists have studied two vernal pools that provide breeding habitat for

obligate species, wood frogs and marbled and spotted salamanders, located in a floodplain of Paint Branch in Prince George's County. These vernal pools also support a host of other organisms that rely on vernal pools. DOEE launched a wetland monitoring program in 2022, which includes identifying vernal pools for sampling and monitoring condition over time. In 2021, DOEE issued new wetland and stream regulatory protections, including a Wetlands of Special Concern status for vernal pools.

Jorge Bogantes Montero is a Natural Resources Specialist at the Anacostia Watershed Society in Bladensburg, MD. He leads ecological restoration efforts on public parklands in the Anacostia River watershed (in both DC and MD), including wetland restoration, tree plantings, meadow creation, SAV propagation, mussel propagation, wildlife monitoring, and invasive plant management. Mr. Bogantes Montero has a Bachelor's degree in Natural Resource Management and Protection from the Universidad Estatal a Distancia in San Jose, Costa Rica, his native country.

Michelle Campbell is an Environmental Protection Specialist with District Department of Energy and Environment (DC DOEE), where she serves as the lead wetland expert for the District's ongoing Wetland Monitoring Program. She drafted and finalized the District's EPA-approved Wetland Program Plan and the Wetland Monitoring Program Plan. Michelle is also responsible for maintaining the District's Aquatic Resources Registry, which includes mapping for all known wetlands in DC. Michelle has a Master's degree in Natural Resources from Oregon State University.

For the past year, Cathy Wiss has been studying vernal pools in Prince George's County with the Master Naturalist Program of the Anacostia Watershed Society. She previously coordinated the Audubon Naturalist Society's volunteer Water Quality Monitoring Program and continues to monitor benthic macroinvertebrates in Montgomery County streams with that program. Cathy served on the Maryland Water Monitoring Council Board from 2009-2015 and received the Carl S. Weber Award in 2018.

Microplastics in the Potomac And Anacostia Rivers

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Coauthors**:** Ryan Woodland, UMCES-CBL; Meagan Criscuoli, UMCES-CBL; John Roberts, Tetra Tech

No Abstract Submitted

Mr. Murphy is an aquatic ecologist who specializes in fish ecology and habitat assessment & restoration with extensive experience in freshwater and coastal systems. His work has focused largely on examining how aquatic habitat alteration affects changes in biological communities, using fish as model organisms. He has worked closely with state and federal government resource managers, in addition to academia, to develop new approaches to habitat assessment and restoration in watersheds. Mr. Murphy has been a lead in writing Essential Fish Habitat Assessments, the Biological Resources section of Environmental Impact Statements (EIS), authoring technical reports, conducting data analyses, conducting broad, watershed scale monitoring and assessments, and potential impacts of microplastics in the environment. He co-chaired the 2019 Chesapeake Bay Program's Scientific & Technical Advisory Committee (STAC) two-day workshop focused on sharing the current state of the science regarding microplastics in the Bay and its watershed. The subsequent report spurred the development of a new Plastic Pollution Action Team as well as the development of an ecological risk assessment model for microplastics and striped bass.

Urban Stream-Floodplains Increase Soil Phosphorus and Carbon Retention Along a Chronosequence of Restored Streams in Fairfax County, VA, USA

Katrina Napora; knapora@usgs.gov; USGS and George Mason University

Coauthors: Gregory Noe, USGS; Changwoo Ahn, George Mason University; Meghan Fellows, Fairfax County

Stream restoration is a common management technique to meet efforts to improve water quality via nutrient and sediment retention. Many restoration projects do not have quantifiable measures of project success, and rarely collect pre-restoration data. Nutrient storage in floodplain soils can act as an easily quantifiable indicator of restoration success, particularly when the project goals include improved water quality. To determine how floodplains of restored streams change in their phosphorus and carbon storage as restoration projects age, floodplain sediment samples (10 cm depth) were collected from 18 streams in the urbanized Piedmont of Virginia along a chronosequence of age since restoration. Nutrient storage metrics measured include total carbon (TC) and total phosphorus (TP), whereas carbon efflux and equilibrium phosphorus concentration (EPC0) were measured for nutrient loss. Overall, soil characteristics demonstrated both increasing carbon and phosphorus storage and rates of C loss as a restoration project ages. Soil wetness, a key driver in nutrient retention, also increased as restoration projects aged. These findings indicate that restored stream-floodplains improve water quality over time through accumulation of soil phosphorus and carbon, supported due to increased soil wetness following restoration and suggesting restoration success for water quality goals.

Katrina Napora is a master's student at George Mason University, under the direction of Dr. Changwoo Ahn and working under Dr. Gregory Noe at the U.S. Geological Survey in Reston, Virginia. She previously graduated from Christopher Newport University with a Bachelor's in Environmental Biology. She has been researching wetlands for the past six years, and has previously worked in degraded peatlands, mudflats, salt and freshwater tidal marshes. Her current research focuses on stream-floodplains.

Evaluating a Regenerative Stormwater Conveyance Stream Restoration and Its Effects on Water Quality and Benthic Macroinvertebrates: A Case Study at Muddy Creek

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Coauthor: Kyle Hodgson, Maryland Biological Stream Survey, Maryland Department of Natural Resources

A regenerative stormwater conveyance (RSC) stream restoration project was constructed at North Branch Muddy Creek on the Smithsonian Environmental Research Center (SERC) property in Edgewater, Maryland, to address high channel incision and reduce sediment and nutrient loading rates. Completed in February 2016, the project reconnected Muddy Creek to the floodplain and restored riffle-pool sequences. Monitoring by SERC and the Maryland Department of Natural Resources was conducted to determine effects of the RSC on constituent loads, benthic macroinvertebrates, dissolved oxygen (DO), and temperature. Water chemistry analysis showed significant reductions in ortho-phosphate and total phosphorus loads, and marginally significant reductions in ammonium and total nitrogen leaving the restoration reach. DO concentrations and saturation levels were lower and temperatures were often higher at a monitoring station downstream of the reach, compared to an upstream station. Post-restoration benthic macroinvertebrate communities experienced significant declines in BIBI scores, taxa richness, and Shannon-Wiener diversity scores, and a shift toward more tolerant species. These findings indicate that some reductions in nutrient loads by the RSC were possibly paired with negative outcomes for benthic macroinvertebrate communities, DO concentrations and saturation levels, and stream temperatures.

Lindsay Powers is a Natural Resource Biologist with the Maryland Biological Stream Survey at the Maryland Department of Natural Resources.

Do Harmful Algal Blooms Adversely Affect Wildlife in the Chesapeake Bay?

Barnett Rattner; **brattner@usgs.gov**; U.S. Geological Survey, Eastern Ecological Science Center

Coauthors: Catherine E. Wazniak, Maryland Department of Natural Resources; Julia S. Lankton, U.S. Geological Survey, National Wildlife Health Center; Peter C. McGowan, U.S. Fish and Wildlife Service, Chesapeake Bay Field Office; Serguei V. Drovetski, U.S. Geological Survey, Eastern Ecological Science Center; Todd A. Egerton, Virginia Department of Health, Division of Shellfish Safety and Waterborne Hazards.

Chesapeake Bay provides critical habitat for wildlife, and there are extensive data on contaminant exposure and occasional adverse effects in some species (e.g., fish-eating birds). In contrast, scant attention has been given to effects of algal toxins and harmful algal blooms (HABs). Thus, we compiled information from reports and databases (e.g., USGS's Wildlife Health Information Sharing Partnership Event Reporting System, MD Departments of the Environment and Natural Resources, VA Pollution Response and Preparedness database) for the period of 2000-2020 associated with HABs. Few confirmed wildlife mortality incidents were definitively linked to HABs, with some events possibly being caused by HAB toxins, and more instances in which HABs may have indirectly contributed to or occurred coincident with mortality. Microcystins are the dominant group that could affect wildlife (levels have exceeded recreational use and drinking water thresholds at some locations). The risk to wildlife for anatoxin-a, cylindrospermopsin, domoic acid and saxitoxin, seems minimal. Other toxins (e.g., aetokthonotoxin, anatoxin-a(S), brevetoxin) are rarely detected or not consistently monitored. Information on HAB toxin exposure routes, consequences of sublethal exposure, and better diagnostic criteria would greatly assist in predicting algal toxin hazard and risk to wildlife.

Dr. Barnett Rattner is a scientist at the USGS-Eastern Ecological Science Center. He conducts research of regional, national and international scope that entails hypothesis-driven laboratory and field investigations, risk assessments and scholarly evaluations of the hazard and toxicity of legacy and contemporary pollutants to wildlife and the environment. He has 45 years of professional experience, published over 145 peer-reviewed articles, co-edited three reference texts, and serves on several editorial boards and statutory government panels. He is a Fellow and Past-President of the Society of Environmental Toxicology and Chemistry.

Farms, Fields, and Fish: A Landscape Perspective

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

Coauthors: Brian Pickard, Tetra Tech; Mark Southerland, Tetra Tech; Paige Hobaugh, Tetra Tech; Renee Thompson, USGS/Chesapeake Bay Program

Agricultural land uses have multiple influences on associated stream ecosystems and aquatic biological communities. Effects include hydrological changes such as increased runoff, flashier flows, and groundwater extraction. Contributions of sediment and other pollutants can have detrimental impacts on water quality and biota, but nutrient inputs may have mixed effects. Physical modifications such as stream channelization can reduce habitat quality, which can also be affected by removal of woody debris and reduced habitat complexity. The Maryland Biological Stream Survey provides long-term data for examining associations between agricultural factors and stream biota, both fish and macroinvertebrates. The recent Maryland Healthy Watersheds Assessment (MDHWA) incorporates landscape data as well as broadscale physical habitat, geomorphic, and pollutant load information. Geospatial analyses leveraged regional data including Chesapeake Bay high-resolution land use / land cover, USGS flow alteration and streambank sediment flux data, other state-specific metrics, and a refined definition of riparian areas. The MDHWA data can be used to examine the relative influence of agriculture-related factors through landscape-scale exploration of the associations between these potential influences and biological response, as represented by fish and benthic Indices of Biotic Integrity.

Nancy Roth, Senior Watershed Scientist at Tetra Tech's Center for Ecological Sciences in Owings Mills, Maryland, has a background in stream ecology and 28 years of experience in watershed restoration planning and stream assessment. Her research interests include landscape-scale analysis of watershed health, applying GIS tools for targeting conservation, and evaluating the effectiveness of stream restoration. She has supported the Chesapeake Bay Program, Maryland Biological Stream Survey, and several municipal stormwater (MS4) programs in Maryland and Virginia. She has a master's degree from University of Michigan, lives in Annapolis, and enjoys paddling on the Chesapeake and its rivers.

Measuring Urban Stream Restoration Success: Processes, Goals, Monitoring, and Regulations May Confound "Ecological Lift"

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Assessment Branch

Coauthors: Neely Law, Fairfax County Office of Environmental & Energy Coordination; Aaron Porter, USGS VA & WV Water Science Center

Urban stream restorations in Fairfax County, VA are typically driven by nitrogen, phosphorus and sediment load reductions required by the Chesapeake Bay TMDL. Most experts agree applying urban stream protocols will reduce sediment and nutrient delivery to the Bay. However, what represents the "recovery" or "ecological lift" of local stream functions is still debated. Highly complex inter-relationships regarding stream function, urbanization, and ecosystem responses to restoration (expressed as goals-based trade-offs) may be limiting factors for stream corridor recovery. Further, it takes concerted effort, time, and funding for both pre- and post-construction monitoring to identify noticeable changes in higher-level stream functions. We examine biological, chemical, and geomorphic data from County-implemented stream restoration projects for Bay TMDL crediting. Using a long-term dataset we illustrate how stream prioritization, design, and implementation processes to meet the Bay goals may be at odds (at least in the short-term) with higher-level functional lift. Despite more holistic efforts to approach stream corridor restoration (riverscape restoration), the data suggest more monitoring efforts are needed to effectively understand and restore urban streams impacted by multiple stressors.

Chris Ruck has been a Freshwater Ecologist with Fairfax County since 2014. He is currently the Chief of the Stream Monitoring Section in the Watershed Assessment Branch. Prior to the County, Chris worked as an environmental scientist in the private sector delineating, assessing, designing, implementing, and permitting stream restoration and wetland projects. He conducted graduate research on streams, estuarine systems and fish populations and spent many years as an environmental educator. When he's not kicking rocks in a stream, he's watching his son play soccer.

New MS4 Forestry Crediting Strategies

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Municipalities across Maryland and the Chesapeake Bay watershed are developing and implementing watershed implementation plans (WIPs) to address the Chesapeake Bay and local waterbody total maximum daily loads (TMDLs). Many are relying on stream restoration or traditional structural best management practices (BMPs), such as wet ponds or bioretention facilities. Riparian buffers, reforestation, and tree planting offer a cost effective way to reduce nutrients and sediment into receiving waterbodies, while also providing many co-benefits. In the Maryland Department of the Environment (MDE) 2021 Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated Guidance, MDE increased the equivalent impervious acre (EIA) credits for riparian buffers and tree planting to highlight the multi-benefits of these practices. At the same time, funds are now available to help municipalities, communities, organizations, and individuals plant trees through grants, loans, and the Right Time to Fund Restoration – State Tree Solutions Now Act of 2021. Preliminary cost analysis shows that forest planting can be more cost efficient than traditional wet ponds and ESD practices in reducing nitrogen. Along with EIA credits and load reductions, trees are beneficial towards carbon crediting and resiliency.

Mr. Mark Sievers is an environmental engineer with Tetra Tech out of Fairfax, VA. He has more than 20 years of experience performing and leading projects involving environmental monitoring, watershed restoration planning, watershed modeling, and TMDLs. He currently manages a large municipal MS4 on-call contract overseeing water quality monitoring, data and geospatial analyses, watershed and TMDL restoration planning, IT development, public outreach, and general MS4 permit support.

Trends in Maryland Freshwater Fish Assemblages Over a 14-year Period Illustrate a Changing Environment

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Coauthor: Gregory Matthews, MDNR

The Maryland Department of Natural Resources Maryland Biological Stream Survey collected fish assemblage data at randomly selected stream sites in 2000-2004 and resampled these sites in 2014-2018 to study potential changes in Maryland stream fish communities over time (14-year period). Sites from the Maryland Sentinel Site Network were used in this study as reference sites for their respective watersheds. Fish index of biotic integrity (FIBI) scores were produced from these data. Although lower FIBI scores in recent years were predicted, FIBI scores were significantly higher at randomly selected sites in recent years ($p = 0.006$) and remained unchanged at sentinel sites. In contrast, metrics influencing FIBI scores showed no change at random sites, while almost all FIBI metrics were significantly lower at sentinel sites in recent years. Abundances were expected to be lower in recent years for temperature and pollution-sensitive gamefish species such as brook trout and brown trout, and higher for species such as largemouth bass. Brook trout abundances were significantly lower in recent years at sentinel sites ($p = 0.005$). Abundances of all other gamefish species remained unchanged. Detection of non-native fish species was expected to be higher in recent years, due to insufficient control of already established populations. This was the case at both random and sentinel sites. From these analyses, it is clear that Maryland streams experienced significant changes to their fish communities during this 14-year period, with sentinel sites indicating the most contrast.

Anastasia Simpson earned her Bachelors degree from West Virginia University in biology. Her first introduction to fisheries was working on the final Maryland Darter survey. She is now working as a technician with the MBSS.

Using MBSS Data to Assess Conditions and Trends in Maryland's Stronghold Watersheds: Antietam Creek

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Coauthors: Tomas Ivasauskas, Ph.D., MDNR; Jay Kilian, MDNR

The Maryland Biological Stream Survey (MBSS) data is instrumental in determining the

watershed areas in Maryland where stream-dwelling Species of Greatest Conservation Need (SGCN) have their highest abundances and frequencies of occurrence. These areas have been established as stronghold watersheds which are the most important areas for protecting Maryland's aquatic biodiversity. The Antietam Creek watershed is a stronghold for three GCN fish species: Pearl Dace (S2S3 and designated as 'In Need of Conservation'), Checkered Sculpin (S2) and Brook Trout (S3S4). The historical set of MBSS data is used to improve our understanding of the Antietam Creek watershed by assessing and interpreting the GCN biota and the changing health and conditions within this stronghold watershed.

Jackie Sivalia is a biologist with the Maryland Department of Natural Resources Maryland Biological Stream Survey.

The Maryland River Input Monitoring program - an update on nutrient loads and trends

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Coauthor: Joel Blomquist, USGS

Maryland's River Input Monitoring (RIM) program is a critical water quality observation system for major tributaries near the freshwater and tidal interface of the Chesapeake Bay. The RIM program includes four stations on the Susquehanna, Potomac, Patuxent and Choptank Rivers, representing discharge from over 60 percent of the Chesapeake Bay watershed. In collaboration with the State of Maryland, the U.S. Geological Survey has monitored water quality and discharge at these stations at fixed intervals and during storm events since at least 1984. Annual loads and flow-normalized trends of nitrogen, phosphorus and sediment are calculated using a statistical approach called Weighted Regressions on Time, Discharge and Season (WRTDS). The WRTDS method was recently updated using the Kalman filter, greatly improving the accuracy of load estimates. Trend analyses show decreasing flow-normalized loads of nitrogen, phosphorus

and sediment in the Potomac and Patuxent Rivers, an indicator of improving conditions from management actions. The Choptank River on the Eastern Shore has increasing loads of nitrogen and phosphorus. Trend results at the Susquehanna River are complicated due to a well-known process of settling and resuspension within the reservoir system above Conowingo Dam. Trend results will be presented for the long term (1985-2021) and short term (2011-2021) time periods.

Alex Soroka is a physical scientist with the U.S. Geological survey, based out of Baltimore Maryland. Alex's career started monitoring an abandoned mine drainage site in rural New Hampshire and progressed to studying nitrogen transport under agricultural row crops on the Delmarva peninsula. His study of groundwater quality led to examination of non-tidal surface waters, which are now his main focus. Alex's time is currently split between the Maryland River Input Monitoring program and research to understand drivers of water quality in agricultural areas.

Vernal Pools as Backyard Ecosystems and How to Find Them in the Patapsco Valley

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Coauthor: Diana Devers, Patapsco Heritage Greenway

Vernal pools are a valuable and underappreciated part of the Maryland ecosystem. They combine stormwater runoff reduction and groundwater infiltration with biological diversity benefits of a unique habitat necessary for declining obligate species, such as wood frog, spotted salamander, and fairy shrimp. Because of their ephemeral nature (by definition, they fill with water over winter and dry out over summer, eliminating predatory fish), vernal pools continue to be missed during surveys and lost to development. Conservation of these "backyard ecosystems" requires increased education, more inventories, restoration or creation, and improved regulatory policies. Patapsco Heritage Greenway maintains a vernal pool public education program and provides volunteers with training to find and report vernal pools throughout the Patapsco Valley. This training also includes a data collection method so that what these community scientist learn can be combined with vernal pool data from other groups in Maryland. Howard County Conservancy

is proposing to create a vernal pool at its 232-acre Mount Pleasant location to serve both its conservation and education mission. The Conservancy will also undertake educational activities and prepare on-site signage with their partners, including PHG, Howard EcoWorks, and Howard County Public School System.

Mark Southerland PhD with Tetra Tech has spent 30 years monitoring, assessing, and restoring the ecosystems of Chesapeake Bay. Mark has chaired MWMC, Patapsco Heritage Greenway (PHG), and Howard County Environmental Sustainability Board, and is a member of the Howard County Conservancy Board. Diana Devers is Environmental Program Manager for PHG. Diana has a BA Biology from St. Mary's College of Maryland, MS Environmental Science from University of Maryland-College Park, and 10 years as an environmental scientist, educator, and Maryland Master Naturalist. At PHG, she works to inspire all ages to fall in love with the Patapsco Valley and to give them the tools they need to help protect it.

What Do Our Existing Water Quality Models and Existing Monitoring Networks Tell Us About Conditions in Vulnerable Communities?

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Coauthors:Andrew Sekellick, USGS MD-DE-DC Water Science Center; Tristan Mohs, MD-DE-DC Water Science Center

The conditions that affect public health often disproportionately impact historically neglected and marginalized communities. The social vulnerability index (SVI) is a measure used by the Centers for Disease Control to quantify the factors that increase a community's vulnerability to disasters or environmental hazards. This index was used alongside an existing Spatially Referenced Regression On Watershed attributes (SPARROW) water quality model to examine stream health in vulnerable communities within the Chesapeake Bay watershed. Areas above the 90th percentile for select SVI vulnerability factors, including minority status and English proficiency, were found to have degraded water quality conditions (in-stream nutrient loads). A network analysis of U.S. Geological Survey stream gauges that includes SVI factors was

conducted to improve understanding of community representation within current monitoring networks in the Chesapeake Bay watershed. These networks provide data on flow, water quality, and other parameters that are essential to water resources management and disaster preparedness. While they are designed for a variety of programs and objectives, they frequently do not consider community vulnerability factors. Network analysis that considers social vulnerability allows managers to better prioritize resources so that all communities can be adequately represented.

Leah Staub, Andrew Sekellick and Tristan Mohs are all Physical Scientists with the USGS at the MD-DE-DC Water Science Center and are all members of the Justice, Equity, Diversity, and Inclusion committee. Leah primarily has experience tracking sediment sources in select watersheds and working with various spatial data types. Andrew's current work focuses on developing and implementing innovative water quality modeling techniques, enhancing monitoring network design, and spatial data development. Tristan has a background in land surveying, flood science, and geomorphology and is interested in work related to the pairing of biotic and abiotic factors in an ecosystem.

Regional Planning for Source Water Protection

Sara Tomlinson; stomlinson@baltometro.org; Baltimore Metropolitan Council

The goal of the Baltimore Reservoir Watershed Program is to ensure that the three reservoirs (Loch Raven, Liberty, and Prettyboy) and their respective watersheds continue to serve as sources of high-quality raw water for the Baltimore Metropolitan water supply system. This Baltimore Water Supply System supplies 1.8 million people living in Baltimore City and several surrounding jurisdictions with drinking water. Raw water is stored in three reservoirs with watersheds that cover 467 square miles in Baltimore and Carroll Counties. City owned land makes up only 7% of the watershed area. The Reservoir Watershed Management Program has been around since the 1970's and is intended to be a cooperative regional program to reverse previous negative water quality trends through watershed management. It began as a TMDL approach before any TMDLs were required. The Baltimore Metropolitan Council now hosts the program, which coordinates reservoir watershed management efforts regionally. Success requires

cooperation and collaboration on land use and land management, relying on strategies developed and agreed on by participating jurisdictions. While there are now TMDL goals for the reservoirs and the Chesapeake Bay watershed, the coordination and implementation process is the same.

Sara Tomlinson manages the Baltimore Reservoir Watershed Program at the Baltimore Metropolitan Council. She has worked for BMC for 18 years, beginning her work at the Council coordinating air quality conformity determinations for transportation planning and performing environmental analysis of long range transportation plans. In 2017, Sara began coordinating reservoir management planning. Sara has a B.S. in Civil Engineering from Virginia Tech and a M.S. in Public Policy from the University of Maryland – College Park. She applied for and received her Professional Engineering License for the State of Maryland in 2022.

Developing a Comprehensive Watershed Management Plan for Baltimore's Water Supply Reservoirs

Josh Weiss; jweiss@hazenandsawyer.com; Hazen and Sawyer

Coauthors: Ben Wright, Hazen and Sawyer; Phoebe Aron, Hazen and Sawyer; Clark Howells, Baltimore DPW

For more than a century, Baltimore's water supply system has provided an ample, high-quality water source to meet the needs of the growing metropolitan area. In the late 1800s Baltimore looked beyond the City boundaries for a reliable supply of drinking water to meet an expanding population. One hundred years later the City expanded protection of the Liberty and Gunpowder supplies with a series of multi-jurisdictional agreements, culminating in the 2005 Reservoir Watershed Management Agreement. Currently, the City faces several important challenges that could impact long-term supply reliability, raw water treatability, finished water quality, and the cost of water production and delivery. In this presentation, we will describe an upcoming study to develop a Comprehensive Watershed Management Plan (CWMP) for the City's reservoir

watersheds. The CWMP will address wide-ranging issues, from the impacts of recreation and development on source water quality to vulnerabilities to emerging contaminants of concern to the reliability of the reservoir supplies through drought periods. The CWMP is an important step for the City that will help set the stage for the next hundred years of high-quality water delivery to the Baltimore region.

Josh Weiss is Hazen and Sawyer's Director of Water Resources Innovations. He holds a BS in Civil Engineering from Georgia Tech; MS and PhD degrees in Environmental Engineering from Johns Hopkins University; and is a Diplomate, Water Resources Engineer. Dr. Weiss specializes in water resources planning, source water quality, modeling, hydrology, climate change, and applications of remote sensing and forecasts for water resources management.

Phase I of The Campus Creek Restoration: Comparison of Its Pollutant Reduction Capability with Other RSCs

Michael Williams; miwillia@umd.edu; University of Maryland, College Park

Regenerative streamwater conveyance (RSC) structures are being extensively implemented in Maryland to reduce nutrient and sediment loads from urban watersheds. In the summer of 2019, an RSC was constructed in a degraded 800 m stream reach (Phase I) located on the University of Maryland campus. Precipitation, baseflow and stormflow runoff, and nutrient and sediment concentrations were measured throughout the pre- and post-construction periods (~17 and 36 months, respectively) to determine whether the RSC structure reduced pollutant loads. In a comparison pre- (2018) and post-construction (2020) years having similar annual rainfall, total annual runoff decreased by 13%, in part due to upgraded stormflow BMPs. Area yields of TN, TP and TSS were 32, 38 and 59 % lower in the post- compared to the pre-construction period, respectively. Phase II construction, slated to begin in the summer of 2023, will connect the Phase I restoration reach to the catchment outflow at the Paint Branch River. A comparison of the results of this study with those from several other stream restorations with similar designs

indicate that RSCs are consistently an effective means by which excessive nutrient and sediment loads from degraded urban catchments can be curtailed.

Michael Williams is an Associate Research Professor at the University of Maryland, College Park. Michael's expertise is in the fields of hydrology, biogeochemistry and estuarine ecology. His current research is primarily focused on stream restoration performance and carbon dynamics in wetlands on the eastern shore of Maryland.

DEIJ in The Chesapeake Bay

Briana Yancy; yancy.briana@epa.gov; U.S. Environmental Protection Agency

Coauthor: Bo Williams, U.S. Environmental Protection Agency

The Chesapeake Bay Program has been leading and directing restoration of the Chesapeake Bay since 1983. The work of implementing the Chesapeake Bay Watershed Agreement to restore the Bay is an ambitious and visionary undertaking. Success over the long-term will require tapping into the persistence, wisdom, creativity, motivations and political will of the full diversity of people who live in and contribute to the many ecosystems that make up the Chesapeake Bay watershed. Therefore, decision-makers and partners must leverage strategies for diversity, equity, inclusion and justice (DEIJ), including environmental justice (EJ). The Chesapeake Bay Program's DEIJ Strategy emphasizes the internal, cultural and policy changes needed to create a healthy, supportive organizational ecosystem where DEIJ and EJ goals can produce lasting results that advance the restoration of the Chesapeake Bay watershed.

B*riana Yancy is the U.S EPA Chesapeake Bay Program's Diversity Workgroup Coordinator where she leads collaborative efforts on diversity, equity, inclusion and justice to advance watershed restoration goals. She is a graduate from Miami University with a Master's in Biology. The focus of her work is on coastal ecosystem conservation and how science can advance environmental justice.*

Bo Williams works for the U.S. EPA and is a project manager with the Chesapeake Bay Program. He has an M.S. in Environmental Policy and Planning from the University of Michigan. Bo's interests include environmental decision making and building collaborative solutions grounded in science and community interests.

Poster Abstracts

Does Ectoparasite Load in BND Depend Upon Stream Urbanization or Personality?

Kara Branstad; kbranst1@students.towson.edu; Towson University

No Abstract Submitted

Tracking Horseshoe Crab Populations with DNA Barcoding

Emily Ernst; erernst@aacc.edu; Anne Arundel Community College Environmental Center

No Abstract Submitted

Assessing Iron Ecotoxicity in Regenerative Stream-Water Conveyance Systems in Anne Arundel County

Megan Gaesser; mgaess1@students.towson.edu; Towson University

Coauthor: Christopher J. Salice, Towson University

Regenerative Stream-water Conveyance (RSC) systems are a restoration method utilized to improve water quality draining urban catchments. Importantly, RSC systems may increase dissolved iron concentrations, precipitate, and flocculate in Anne Arundel County (AAC), Maryland streams via several pathways. It is important to note that iron is naturally present in AAC streams and soils given the underlying geology. Increased iron may impact benthic biota of these streams by coating and imbedding into aquatic habitat as well as increasing indirect and direct toxicity, but this is poorly understood. Ecosystem functions, such as nutrient cycling and decomposition, may also be affected by this change in structure (e.g., altered macroinvertebrate and microbial activity). This study aims to elucidate the biological and ecological impacts of iron in RSC systems and reference streams through water quality monitoring, and toxicological and ecological field experiments. We hypothesized that iron concentrations and toxicity will be higher in RSC systems while decomposition will likely be lower. Potentially exacerbated iron conditions as an unintended consequence of RSC restoration may have important implications for future restoration programs in AAC. This research applies field experimentation and survey methods to address concerns regarding RSC implementation and subsequent iron conditions.

Water Monitoring in the Gunpowder River and Watershed

Jenn Galler; jgaller1112@gmail.com; Gunpowder River Keeper

Coauthors: Theaux M. Le Gardeur

The Gunpowder River and its watershed is a critical resource for the state of Maryland for its economic, biological, and recreational value. The river and its reservoirs, Prettyboy and Loch Raven, provide the primary source of Baltimore City's drinking water and supply over 1.5

million area residents. In addition, the river is also a nationally recognized tail-water trout fishery and an important tributary of the Chesapeake Bay. Because of this there exists a pressing need for independent, comprehensive baseline environmental monitoring and mapping of the 53 mile long river and its 450 square miles of its watershed. This past summer Gunpowder River Keeper participated in monitoring projects that tested the water for bacteria, PFAS, and chlorophyll throughout the watershed. This data was visualized with GIS mapping and shared with regulatory agencies to keep them accountable to keep the Gunpowder river healthy and clean for humans and wildlife.

The Use of Benthic Macroinvertebrates as Bioindicators of Water Quality in Freshwater Streams

Makala Harrison; m.harrison@email.msmary.edu; Mount St. Mary's University

No Abstract Submitted

Brook Trout Limited by Temperature Rather than Non-Native Trout in a Maryland Stream

Nathaniel (Than) Hitt; nhitt@usgs.gov; USGS Eastern Ecological Science Center

Coauthors: Karli Rogers, USGS USGS Eastern Ecological Science Center; Karmann Kessler, USGS Eastern Ecological Science Center; Michael Kashiwagi, Maryland Department of Natural Resources; John Mullican, Maryland Department of Natural Resources

Warm stream temperatures and non-native trout are known stressors for native brook trout, but

their relative importance remains poorly understood. We conducted an experimental removal of non-native brown trout to evaluate the potential benefits for sympatric brook trout in Big Hunting Creek above Cunningham Falls (Monocacy River basin, Maryland). Brown trout removal treatments were conducted over 5 years (2018-2022) with fish moved downstream of Cunningham Falls. Results indicated the decline of brook trout abundance over the course of the study in conjunction with elevated stream temperatures (i.e., > 20 C). Our study demonstrates the primacy of water temperature for brook trout conservation streams.

Long-Term Effects of Urbanization on Blacknose Dace Swimming Performance

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Coauthor: Jay Nelson, Towson University

Urbanization leads to alterations in stream flow and watershed regimes causing an increase in water velocity during precipitation events. These alterations have been shown to affect fish locomotor performance, with the percent impervious surface cover (a proxy for urbanization) positively correlating with swimming endurance and sprinting. These effects have been shown to be a product of phenotypic plasticity (training effects) on a short-term basis, but whether there are longer-term changes to fish locomotor capacity from stream urbanization is unknown. To better understand the temporal effect of urbanization on swimming performance, we compared the blacknose daces' (*Rhinichthys atratulus*) swim endurance between 6 populations collected in 2004 and again in 2022. We will also discuss our plans to examine the potential effects urbanization may have on blacknose dace morphology, in relation to swimming performance.

The Vulnerability of Anne Arundel County Road Transportation Network to Future

Relative Sea Level Rise

Sotonye Ikiriko; soiki1@morgan.edu; Morgan State University

Coauthors: Yi Liu, Morgan State University; Sean Qian, Carnegie Mellon University; Xin Zhou, Morgan State University

With increased intensity of climate change, transportation systems become more vulnerable to relative sea level rise (RSLR). Roadway inundation, a direct consequence of RSLR, has become a global concern as sea level is expected to continue to rise for longer than a century. Therefore, this study identifies vulnerable roadway and bridge segments to RSLR in Anne Arundel County, Maryland. This study firstly projects 21st century RSLR by combining global mean sea level rise (GMSLR) scenarios with local land subsidence in the County. Secondly, roadway and bridge segments vulnerable to long-term RSLR are identified by comparing roadway elevations with RSLR related water surface elevation. Current quadratic trend of RSLR in the County projects that by 2100, RSLR for the County will be approximately 1.2 meters forecasting from 1992. Approximately 13.5% of the road network in the County is anticipated to flood by 2040 under the GMSLR intermediate-high and 1% tide scenario which is anticipated to increase to 24% by 2100 including low-water bridges. Approximately 27% of the County's road network is below 4.39 meters. These roads are expected to flood by 2100 under the GMSLR highest scenario and 1% tide. For the County's road network to become more resilient against long-term RSLR, it is important that these roads and low-water bridges are prioritized for future capital investment.

The Impact of Stream Restoration on Seed Dispersal Across Floodplains

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Coauthors: Laura Gough, Towson University; Vanessa Beauchamp, Towson University

Stream restoration via floodplain reconnection is a land management practice frequently used throughout Maryland to decrease the amount of nutrients and sediment entering the Chesapeake Bay. Floodplain reconnection lowers the floodplain to increase overbank flooding, letting the

water flow onto the floodplain, slowing the water velocity. We predicted that if restoration successfully increased floodplain connection, it would also result in increased dispersal of seeds onto the floodplain (hydrochory). To evaluate how floodplain reconnection stream restoration projects in Baltimore County, Maryland impact hydrochory, deposited sediment was collected from turf mats placed at fourteen streams (7 restored and 7 unrestored) throughout Baltimore County from May to August 2021. The contents of the turf mats were distributed into pots in the Towson University greenhouse and seedlings were censused as they germinated until January 2022. Hydrochory was assessed as the total number of seeds that germinated (germinants). Seedlings were identified to genus or species to determine the number of species (richness) collected on each mat. Preliminary results suggest an increase in germinants and richness at restored sites. The next steps include determining if watershed urbanization results in an increased proportion of non-native seeds being dispersed in floodwaters.

Rainwater Harvesting Webinars to Increase Knowledge

Taeilorae Levell-Young; tlevell@umd.edu; University of Maryland- College Park, Maryland Institute for Applied Environmental Health

Coauthors: Andrew Lazur, University of Maryland Extension; Marcus Williams, University of Maryland Extension, Kelsey Brooks, University of Maryland Extension; Rachel Rosenberg Goldstein, University of Maryland School of Public Health

Rainwater harvesting systems store rainfall for future use and can be an important alternative water source for irrigation. Rainwater harvesting has numerous benefits including self-reliance, reduced dependence on city water, and environmental benefits such as stormwater management. With an increase in extreme precipitation events and flooding, rainwater harvesting can reduce stormwater volume and capture nitrogen. As part of our Baltimore City Agricultural Irrigation Water Quality Project we held a series of six rainwater harvesting-related webinars for Baltimore farmers and gardeners from 2021-2022 on topics ranging from system design, maintenance, funding, treatments, and links between water quality and food safety. 150 people attended the webinars, and we collected survey information about rainwater harvesting experience and concerns. Most attended to learn about rainwater harvesting benefits (36%) and had either no

concerns (18%) or design concerns (18%).

Collaborators: Baltimore City Agricultural Irrigation Water Quality Project, the University of Maryland School of Public Health, Extension urban agriculture specialists, and the University of Maryland Extension funded by the Chesapeake Bay Trust and the Baltimore City Department of Public Works.

Relative Sea Level Rise Projection for Baltimore Based on Tide Gauge and Satellite Altimetry Measurements

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Coauthor: Xin Zhou, Morgan State University

Tide gauge Baltimore has the longest history of 121 years since 1902 in monitoring sea level in Maryland. It is situated on the Cretaceous Arundel clay (Kac) underlain by the Patuxent aquifer (Kxs) and the pre-Cambrian crystalline bedrock. Relative sea level rise (RSLR) measured here is the sum of absolute sea level rise (ASLR) due to global warming and land subsidence (LS) due to tectonic movement or glacial isostatic adjustment and possible aquifer compaction. In quadratic RSLR simulation, linear ASLR rate employs global mean sea level rise (GMSLR) of 1.10 mm/year before 1990, which was reassessed from tide gauge records over the world; while quadratic coefficient since 1992 adopts GMSLR acceleration of 0.120 mm/year2, which is identified by analyzing NOAA GMSL time series from altimetry measurements of TOPEX/Poseidon, Jason-1, Jason-2, and Jason-3. Simulated LS is 2.00 mm/year including groundwater pumping induced Patuxent aquifer compaction before 1992 in the 20th century and 1.70 mm/year since 1992, respectively. We estimate RSLR of 31 cm with LS of 20 cm in the

20th century and project RSLR of 98 cm with LS of 17 cm in the 21st century. This projection is 76% of the value for intermediate-high scenario of GMSLR. Results indicate that evaluating this intermediate-high scenario would be valid for resource-management and flood-hazard-mitigation strategies for Baltimore.

Measuring Headwater Stream Incision in the Maryland Piedmont Using Lidar

Marina Metes; mmetes@usgs.gov; U.S. Geological Survey

Coauthors: Andrew Miller, University of Maryland, Baltimore County; Matthew Baker, University of Maryland, Baltimore County; Kristina Hopkins, U.S. Geological Survey; Daniel Jones, U.S. Geological Survey

Headwater streams can contribute substantial amounts of fine sediment to downstream waterways, especially when severely eroded and incised. Identifying potential sediment sources across a watershed is crucial for effectively managing and restoring impaired streams. We developed a method to map incision from lidar-derived 1-meter digital elevation models in the Maryland Piedmont using topographic openness, an angular measure of the degree to which a focal area (i.e. inside of a channel) is open or enclosed within the surrounding landscape (i.e. stream banks). We conducted field surveys in one forested and two recently urbanized headwater watersheds in the Maryland Piedmont to characterize the level of channel incision (none, moderate, or severe) in the main stem of each watershed. Predictions of the severity of channel incision derived from lidar and topographic openness were compared against the field surveys. Channel incision was detected with an overall accuracy of 70%, with the best performance (80-85% accuracy) in reaches with either severe or no incision. This method was also applied to lidar collected over the same area in 2002 (pre-urban development) to measure incision changes over a 16-year period. Results showed increasing incision over time in all three watersheds, but also revealed areas of consistent severe incision in both the forested and urban watersheds.

Chesapeake Bay Water Watch: Citizen Scientists Enabling Satellite Remote Sensing

of Water Quality

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Coauthors: Alison Cawood, Smithsonian Environmental Research Center; Shelby Brown, Smithsonian Environmental Research Center; Maria Tzortziou, The City University of New York; Min-Sun Lee, The City University of New York;

Water quality monitoring programs can track overall ecosystem conditions using biological indicators like chlorophyll-a, physical indicators like turbidity, and chemical indicators like dissolved organic carbon (DOC) and its associated optical signature, colored dissolved organic matter (CDOM). There are long-term records of these parameters in many areas of the Chesapeake Bay, but the shallow tidal rivers are sparsely covered by existing programs. Satellite remote sensing provides a unique capability to synoptically monitor water quality and ecological health in these highly dynamic nearshore waters. Yet, more in-situ measurements are needed to validate algorithms to estimate these parameters. The Chesapeake Water Watch project at SERC was created to address this data requirement with the help of citizen scientists. Volunteers are trained to use smartphone apps and take measurements on samples with simple monitoring instruments and report data in a format that can be matched-up with satellite ocean color images. Results of a pilot program in the tidal rivers of Anne Arundel County (MD) validated citizen scientist measurements of turbidity, chlorophyll and CDOM as suitable for comparison to, and optimization of, algorithms to estimate these same quantities from satellite remote sensing. We are now recruiting volunteers to expand the project throughout the Chesapeake Bay.

Factors Influencing the Distribution and Abundance of Fairy Shrimp in Vernal Pools, Corcoran Woods Experimental Forest

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Coauthors: Lewis Riggs, Anne Arundel Community College; Susan Lamont, Anne Arundel Community College

Fairy shrimp (Eubranchipus sp.) are obligate freshwater invertebrates that are important members of vernal pool ecosystems in the eastern United States, yet little is known about the factors affecting their distribution and abundance. Previous research on various species of Eubranchipus has shown that temperature, precipitation levels, conductivity, and pH are among the factors that may help to explain the patchy distribution patterns and unpredictable population levels of Eubranchipus in vernal pools. This study seeks to understand the distribution and abundances of fairy shrimp among and within a series of vernal pools located in Corcoran Woods Experimental Forest. Data on pool water chemistry, pool depth, and precipitation levels were compared to presence and abundance of fairy shrimp in a series of vernal pools over a 5-year period

Youth Climate Institute Ambassadors Investigate Differences in Stream Temperature in Howard County Freshwater Streams

Malachi Peavey; malachi.i.p.1@icloud.com**;** Youth Climate Institute Certified Ambassador

Coauthors: Aryaa Badheka, Youth Climate Institute Certified Ambassador; Dominic Tiburzi, Capstone Project Mentor; Bess Caplan, Climate Change Program Manager; Ann Strozyk, HCPSS Environmental Educator;

The Earth's rising temperatures due to climate change have impacted the water. Water temperature is an essential parameter of stream water quality as it affects various aspects of the water. Ambassadors from the Youth Climate Institute wanted to investigate how temperature impacts stream quality. We collected the water temperature at several streams at the Howard County Conservancy in the Summer of 2022. Based on our data, we found that a higher ambient air temperature correlated to a higher water temperature. There was also a significant variance in our data with shaded and unshaded areas with foliage. On July 20th, 2022, the outside temperature was 31.6° C. An unshaded stream with surface water due to a beaver dam had a water temperature of 30°C; however, a spring-fed shaded stream had a water temperature of 21°C. This finding shows that there might be a difference in water temperature by 9°C on the

same day with the same ambient temperature at the same time. The only differences between the two streams were the shade provided by foliage and if the water was flowing or not. For this reason, we have decided to plant vegetation in an unshaded area of one of the streams. We will clear the land in October and plant shrubs and trees like River Birches. We expect to see a decrease in the water temperature after adding foliage to the area to provide shade.

Initial Look: Sawmill Creek Biological Integrity Project

Bryan Perry; pwperr85@aacounty.org; Anne Arundel County, Bureau of Watershed Protection and Restoration

Coauthor: Janis Markusic, Anne Arundel County, Bureau of Watershed Protection and Restoration

Sawmill Creek is a 5,500 acre subwatershed of tidal Furnace Creek located in the northern portion of Anne Arundel County, between the communities of Severn and Glen Burnie. Since the 1990s, multiple sites in the subwatershed have been periodically sampled for benthic macroinvertebrates periodically to measure biological integrity. Most recently, the resulting benthic index of biological integrity (BIBI) scores were much higher than anticipated, given the degree of land development in the subwatershed. Several factors were hypothesized to be affecting the biological integrity. To test the factors, fifteen sites (15) were selected to represent the proportions of the subwatershed drainage area. Over a five year period (2017-2021) benthic macroinvertebrates were sampled along with abiotic factors. The various abiotic factors and biotic communities were evaluated using multivariate statistical method to determine the abiotic factors that have the most significant influence on the biotic communities and by extension the BIBI.

Bryan Perry is an Environmental Scientist and Program Specialist with Anne Arundel County Bureau of Watershed Protection & Restoration. He has a Bachelor's Degree in biology and environmental science from the University of Maryland Baltimore County and a Master's Degree in environmental science from Towson University.

Impacts of Urbanization and Salt Application on Benthic Communities and Water Quality in Red Run Watershed Over Two Decades of Urban Development

Nguyen Tien Anh Quach; nquach1@students.towson.edu; Towson University

Coauthor: Susan Gresens, Towson University

The Red Run watershed was predominantly rural in 1987 and subsequently underwent extensive urban development in the 1990s, while BMPs were used to manage stormwater runoff and reestablish riparian buffers. Benthic data collected in 1987-1988 and 2009 were compared in a paired design to examine the response of the invertebrate community and the potential causes of decline. The watershed has three sub-catchments with different degrees of land cover change, including a nature reserve (reference), high-density residential housing areas, and a former quarry. Results indicated 73% total increase in developed land in the watershed from 1987 to 2009, while the reference sub-catchment had little development. Mean chloride concentrations increased at mainstem sites from 12 to 133 mg/L, but only increased from 5 to 24 mg/L in the reference sub-watershed. Specific conductivity at mainstem sites doubled, whereas the reference tributary had little changes. Multivariate analyses showed that benthic assemblages sampled in 1987 and 2009 were significantly different. Randomization tests on urban tolerance values and extirpation conductivity indicated the loss of intolerant taxa resulting from de-icing salts at several mainstem sites. The study demonstrated the inefficiency of reach-scale management and restoration on minimizing impacts of urban development and road salts on stream organisms.

PFAS in the Chesapeake Bay and Delmarva Region

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Coauthors: Eguono Omagamre, University of Maryland- Eastern Shore,
Joseph Pitula, University of Maryland- Eastern Shore

The group of per- and polyfluoroalkyl substances (PFAS) are synthetic chemicals that enter ecosystems most frequently through landfills, wastewater treatment plants, and industrial sites. Recently, the EPA updated the PFAS drinking water health advisory and lowered the acceptable Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS) levels exponentially than what they were previously. We investigated the levels of PFAS present in the Delmarva peninsula and Chesapeake Bay by collecting soil, ground water, and Bay water samples. In the Delmarva region, soil and groundwater samples were collected at 8 farms and 3 non-farm sites. Results detected a presence of PFAS in both soil and groundwater. Of the 8 farm sites, 36.5% detected at least 1 PFAS in the groundwater samples and 75% of farm sites detected at least 1 PFAS in the soil. All of the non-farm sites identified 7 or 8 PFAS. When evaluating the Chesapeake Bay waters, sites were selected by their proximity to land use areas that are known to have PFAS activity. Surface water samples were collected where the Potomac River meet the bay, a site with military and industrial activity, a site with high human and industrial activity, and the fourth site was in a river with landfill and agriculture activity. Results for relative PFAS concentration in Chesapeake Bay surface water and marine soil samples will be presented.

Survey of the Benthic Annelid Community in Forested and Urbanized Reaches of A First Order Maryland Stream

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Coauthors: Chris McMahon (Department of Biology, University of Maryland), and Alexa E. Bely (Department of Biology, University of Maryland)

Urbanization can have profound impacts on freshwater ecosystems. Altered abiotic conditions can lead to significant changes in biotic communities, both in the water column and in the benthos. Segmented worms (phylum Annelida) are abundant and ecologically important components of freshwater sediments. However, relatively little is known about how the annelid community responds to urbanization. To address this knowledge gap, we surveyed the annelid community in a first order stream in Maryland across a steep transition in urbanization. The

study region includes an upstream forested reach and a downstream urbanized reach, all within the span of one kilometer. We collected sediment samples and environmental data at four sites, two in the forested reach and two in the urbanized reach, bi-monthly across one year. All annelids, including micro-annelids, were extracted and enumerated from sediment samples; naids (asexual Naididae in subfamilies Naidinae and Pristininae) were identified to morphospecies. We found that the annelid community of this stream is diverse and also highly variable across space and time. Despite this considerable variation, we found several taxa whose abundance varied significantly between forested and urbanized sites. These findings suggest that urbanization may impact annelid communities even on a very local scale.

Determining the Impact of Well Maintenance, Condition, Type, and Location Factors on E. Coli and Total Coliform in Maryland Farm Private Drinking Water Wells

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In 1974 the Safe Drinking Water Act was passed to improve drinking water quality and set a limit for acceptable contaminant levels as provided by the U.S. Environmental Protection Agency (EPA). However, the EPA does not regulate or monitor the drinking water quality of private wells, although EPA estimates that in the U.S. “more than 23 million households rely on private wells for drinking water”. The potential for contaminants being present poses a public health risk for individuals that rely on private wells for drinking water. We are studying Maryland farm private well water quality by measuring Escherichia coli and total coliform bacteria to understand the risk of contamination and risk of negative health implications for Maryland private well owners. We are also evaluating the conditions, maintenance, and location factors that play a role in the presence or absence of E. coli and total coliforms. We collected 67 water samples from Maryland farms with private wells located in seven regions and 19 counties of Maryland. Well factors and location factors were analyzed along with survey results that each participant completed. Our preliminary results found that 10.45% (7/67) wells were positive for E. coli and 38.80% (26/67) wells were positive for total coliforms. Region was the most significant factor impacting E. coli levels.

Activities Being Conducted by The Maryland Department of Natural Resources to Support Freshwater Mussel Restoration in The Susquehanna River Basin

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Coauthors: Matthew Ashton, Maryland Department of Natural Resources; Tony Prochaska, Maryland Department of Natural Resources

The Maryland Department of the Environment and the Maryland Department of Natural Resources agreed to carry out portions of the 2019 Conowingo Dam Water Quality Settlement Agreement between the State of Maryland, MDE and Exelon Generation Company, LLC, and certain conditions of the FERC License P-405. In connection with the re-licensing, Exelon agreed to support the State’s efforts to undertake a significant mussel restoration initiative by providing $4.5 million in funding during the first three years after the effective date of the new license to assist with the cost of constructing the hatchery and $250,000 per year for the

remainder of the license term, to support the operation and maintenance costs of the restoration initiative. Freshwater mussels provide ecosystem services, including filtration and transformation of sediment and nutrients. MDNR shall implement activities including: mussel hatchery design and construction, development and implementation of site restoration plans, research and conduct alternative propagation and culture techniques, development of propagation plans to meet restoration goals, measuring survival and growth of juvenile mussels in accordance site restoration monitoring plans, along with conducting outreach, soliciting input, and seeking active partners for the mussel restoration effort in the Susquehanna River and its tributaries.

Predictive E. Coli Modeling at Lake Linganore in Frederick County

Jill Tysse; tysse@hood.edu; Hood College

The monitoring of E. coli levels in recreational waters is a desirable but notoriously expensive endeavor. In addition, because the associated lab procedures are time-consuming, there is typically a 24-hour lag between when water samples are taken, and when results are provided. This means that information provided by the water testing is outdated by the time it has been received. We present a statistical model that was constructed to predict E. coli levels at Lake Linganore, a recreational lake operated by the Lake Linganore Association in Frederick County, MD. We discuss how the model was created following guidance from the United States Environmental Protection Agency (USEPA) and using the free Virtual Beach software provided by the USEPA. In addition, we summarize the model's performance in predicting E. coli levels at the lake in summer 2021 and summer 2022.

Monitoring Stream Thermal Response to Summer Storms in a Highly Urbanized Watershed Using a High-Density, High-Frequency Sensor Network

Claire Welty; weltyc@umbc.edu; UMBC, Center for Urban Environmental Research and

Education (CUERE), and Dept. of Chemical, Biochemical, and Environmental Engineering

Coauthors: Mary McWilliams, UMBC/CUERE; Andrew Miller, UMBC/CUERE and GES; John Lagrosa, UMBC/CUERE.

In 2021, the State of Maryland began to consider setting its first stream temperature TMDL. Scientific, watershed-scale evaluation of stream temperature to assess tradeoffs between point and nonpoint sources of thermal pollution is viewed as being valuable to for further policy development. In particular, policymakers are concerned that various types of stormwater management facilities may have a disproportionate impact on stream thermal regime. To gain insight into the impacts of stormwater facility discharge versus direct runoff on stream thermal regime, in 2021-2022 we deployed Onset Tidbit MX2203 sensors every 100 m along 16 km of a stream network in a highly developed watershed in suburban Baltimore, MD. Data are recorded every 5 minutes, with continuous data collection intended for 2 years across all flow regimes. Evaluation of data has revealed dramatic spatiotemporal behavior of storm runoff as well as influences of groundwater on thermal responses. Heat pulses generated from piped areas draining stormflow can be tracked as they move downstream and the response times for heating and subsequent cooling throughout the stream network can be calculated. We will present examples of network-wide thermal responses from summer 2022.

Annual Standing Committee Reports

Maryland Water Monitoring Council

2021-2022 Annual Report

This report summarizes MWMC activities from October 2021 through October 2022.

The Council celebrated its 27th year in 2021. 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 second virtual Annual Conference drew 244 attendees. A multitude of exciting talks and posters were presented for

Board of Directors

The MWMC Board of Directors went through leadership changes at the end of 2021. Board Chair Sandy Hertz (Maryland State Highways Administration) handed the Chair baton to Matt Stover (Maryland Department of the Environment). The Board officially welcomed nine new members in 2022:

Lindsay DeMarzo (Howard County Office of Sustainability)
John Denniston (Maryland Department of Transportation)
Jason Dubow (Maryland Department of Planning)
Matt Harper (Maryland-National Capital Parks and Planning Commission)

Bob Hilderbrand (University of Maryland Center for Environmental Science - Appalachian Lab)
Ken Mack (Montgomery County Department of Environmental Protection)
Rupert Rossetti (Octoraro Watershed Association)
Brian Smith (Maryland Department of Natural Resources)
Alice Volpitta (Baltimore Harborkeeper/Blue Water Baltimore)

Outgoing members Jai Cole (Maryland-National Capital Parks and Planning Commission), Sandy Hertz (Maryland Department of Transportation), Clark Howells (City of Baltimore), and Mark Trice (Maryland Department of Natural Resources) were thanked for their service to the Council.

2021 Annual Conference

The 27th Annual Conference was held virtually on December 2nd and 3rd. With about 250 in attendance, the event's theme was "Environmental Justice in a Time of Climate Change". This conference explored themes relating to a more equitable application of strategies across communities to address the shift to a new climactic normal and the environmental problems faced disproportionately by residents of disadvantaged areas. An address by Dr. Sacoby Wilson, director of the Center for Community Engagement, Environmental Justice and Health in the University of Maryland School of Public Health and appointee to the US Environmental Protection Agency's Science Advisory Board, was featured at the plenary session. Concurrent session topics included Environmental Justice and Equity, Stream Restoration, Saltwater Intrusion, Managing PFAS and Other Contaminants, Maryland's Least Wanted, Climate Change: Tech and Digital Tools, and more.

Rupert Rossetti received the 15th Annual Carl Weber Award for his work with the Octoraro Watershed Association. Daniel Savoy was awarded the 6th Annual Above and Beyond Award for his work on the board of the Wicomico Environmental Trust, as well as his volunteer Wicomico River Creekwatcher efforts.

Thirty-five talks, four posters, and six exhibitor and sponsor participants all contributed to a diverse and well-rounded agenda.

Workshops

MWMC sponsored the 14th Maryland Stream Monitoring Roundtable, held virtually. The goals of the March 10, 2022 event were to 1) discuss who is doing what, where, when and how; 2) avoid potential duplication of effort by sampling at the same stream site; and 3) facilitate data sharing. The Roundtable drew 55 participants from state, federal, and local agencies, watershed associations, and consulting firms. Twenty-four groups presented on their programs. Prior to the gathering, presenters provided georeferenced site information to DNR to produce a statewide map of sampling sites in 2022. This map was displayed during the event so participants could examine site overlap, gaps, and sampling protocols to be used during 2022. For more information about the Roundtable, contact Andy Becker at andy.becker@kci.com or Katherine Hanna at katherine.hanna@maryland.gov.

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

The Information Management Committee met several times over 2022. Their goals are to determine and provide guidance on best practices for data collection and quality control and to eventually provide a means to facilitate data sharing between sources by standardizing data collection and storage guidelines.

In 2022, the Citizen Science and Community Stewardship Committee remained inactive, but plans include reactivation and membership recruitment in 2023.

The Monitoring and Assessment Committee sponsored and held the 2022 Stream Monitoring Roundtable. In collaboration with its Stream Restoration Monitoring Sub-committee, the Monitoring and Assessment Committee is organizing two sessions at the 2022 annual conference on stream restoration topics and one on runoff and water quality.

The Student Committee put on a virtual Student Career Chat with MWMC on October 25, 2021, featuring six professional panelists. The panelists discussed their career paths and fielded questions from student attendees.

What's in store for 2022?

2022 will be the 28th year for the Council and this year's annual conference will continue the tradition of offering an excellent opportunity for anyone in the water community to share their research, ideas and contacts. The Conference Planning Committee began planning the December 15 conference in April and the event will feature plenary talks by Mike Nardolilli (Executive Director, Interstate Commission on the Potomac River Basin) and Lee Currey (Director, Water and Science Administration, Maryland Department of the Environment).

The Monitoring and Assessment Committee plans to hold another Stream Monitoring Roundtable in early spring.

The Groundwater Committee, as noted in its report, is planning to reform after a period of inactivity. Participation is invited, with interest in new ideas for improving the understanding of groundwater in Maryland. Please contact Jason Dubow at jason.dubow@maryland.gov or Matthew Pajerowski at mgpajero@usgs.gov to join the next meeting.

Full committee reports can be found elsewhere in this program.

Submitted by Katherine Hanna
MWMC Executive Secretary
November 29, 2022

Maryland Water Monitoring Council

Citizen Science and Community Stewardship Committee

2022 Annual Report

Chair: Jeff Reagan (jeff@greentrustalliance.org)

Overview: This group works to design and implement programs, activities, and tools to facilitate and improve citizen science and community stewardship. These programs, activities, and tools of the Council will focus on and assist watershed organizations, volunteer monitoring programs, and other non-traditional monitoring communities in Maryland.

Annual Report: This Committee has been largely dormant since the start of the pandemic and is looking for active members who have ideas for how the Committee can better serve the needs of the State's non-governmental monitoring community. If you are interested, please contact Matt Stover (matthew.stover@maryland.gov) and Jeff Reagan (jeff@greentrustalliance.org).

Maryland Water Monitoring Council

Groundwater Committee

2022 Annual Report

Chair: Mat Pajerowski (mgpajero@usgs.gov)
Co Chair: Jason Dubow (jason.dubow@maryland.gov)

Overview:

This committee will promote and facilitate collaboration on issues related to the monitoring and assessment of the quality and quantity of groundwater. It will consider the current state of groundwater monitoring, and will explore the need for documenting and disseminating information on groundwater monitoring activities. The Committee 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.

Annual Report:

The Groundwater Committee is re-forming after a period of inactivity. If you are interested in bringing your ideas for improving the understanding of groundwater in Maryland, please contact Jason Dubow or Matthew Pajerowski.

Maryland Water Monitoring Council

Information Management and Communication Committee

2022 Annual Report

Chair: Najma Khokhar, Maryland Department of the Environment, (Najma.khokhar@maryland.gov)

Overview:

This committee explores existing data management procedures employed in Maryland and develops recommended procedures for data management and quality assurance. It also maintains the repository on water monitoring programs.

Committee Goals:

The goals of the committee include (1) exploring existing data management procedures employed in Maryland and developing recommendations for data management and quality assurance; (2) encouraging people in the local water resources community to make data and reports available online so they can be easily accessed by the Maryland water-resources community; (3) Promote the use of quality assured procedures for sample collection, data management, analysis and assessment; (4) provide a platform for better communication within Maryland Water Monitoring Council.

2022 Accomplishments:

Our committee had completed three successful meetings through conference calls as scheduled for 2022 with average 12 attendees whereby we discussed the implementation of the quality assurance protocols for data management for different projects.
We discussed and shared current practices for quality assurance of data management adapted in different organizations.

2023 Goals:
We continue to plan on regional approaches to curriculum development and interactions with universities to include Quality assurance practices in the labs.

Committee members agreed to help in improving the quality of data by adapting best data management practices to achieve “Tier one” highest quality data status.

Maryland Water Monitoring Council

Monitoring and Assessment Committee

2022 Annual Report

Co Chairs: Andy Becker (andy.becker@kci.com) and Michael Williams (miwillia@umd.edu)

Overview:

This committee identifies water monitoring topics about which information exchange is needed--- via establishing contacts with appropriate groups, hosting focused workshops, and organizing technical sessions at the MWMC annual conferences.

2022 Activities and Accomplishments:

The MAC is organizing a workshop partnership with Chesapeake Section of the American Water Works Association (CSAWWA). The MWMC and CSAWWA are largely unaware of the activities of the other group. MWMC members collect a vast quantity of data that could be useful to the drinking water utility community. The purpose of this workshop is for each group to become more familiar with the other, and to provide an opportunity for networking. The workshop will consist of short presentations throughout the day discussing the types of data that are collected throughout by MWMC members and partners. We hope that this can be an in-person workshop held in central Maryland in late spring or early summer 2023.

The 14th (mostly) Annual Maryland Stream Monitoring Roundtable took place virtually on March 10, 2022. There were 70 people registered, an exact count of attendees was not taken as people dropped in and out of the virtual meeting throughout the day. There were 23 presentations given about the 'what, where, when' of planned 2022 monitoring. Mark Trice (DNR) and Andy Becker (KCI) collaborated to produce an online map of all submitted point data for 2022 monitoring. The roundtable was organized by Andy Becker.

2023 Goals:

The MAC is planning several activities for 2023:

1. Commit to hold regular quarterly meetings beginning Q1 of 2023.
2. Organize and hold the 15th MWMC Stream Roundtable in late February/early March of 2023.
3. Develop a workshop along with the CSAWWA to open lines of communication between members of the water monitoring community and the water utilities community.

Maryland Water Monitoring Council

Student Committee

2022 Annual Report

Chair: Lindsay DeMarzo (ldemarzo@howardcountymd.gov)

Overview:

This group works to connect students (high school, undergraduate) with the Maryland Water Monitoring Council through workshops, projects, and the annual conference. These workshops and projects will link student's skill sets to the appropriate needs of the MWMC (i.e., monitoring, GIS, data management).

2022 Accomplishments:

After hosting a very successful student career chat in Oct 2021 while the annual conference was still virtual, the committee decided to try shifting the career chat to the live conference in 2022 with the hope of attracting even more attendees. The committee has been working to prepare for the student career chat which will be held during the conference lunch session and include a panel of experts in a variety of fields providing a short overview of their most influential lessons learned as they built their careers in water quality. The brief panel presentation will be followed by a few types of networking activities with the students to build relationships. The committee also assisted in providing outreach for the student poster session and will be involved in judging.

2023 Goals:

In 2023 the student committee is looking to expand both in members and in scope, hopefully hosting more career events. This coming year, the student committee will also likely merge with the portion of the conference committee that oversees the student poster session, aiming to ease logistics and bolster participation.

Maryland Water Monitoring Council

2022 Board of Directors

Matthew Stover- Board Chair
Maryland Department of the Environment

Mat Pajerowski- Board Vice Chair
U.S Geological Survey

Katherine Hanna- Executive Secretary
Maryland Department of Natural Resources

Andy Becker
KCI Technologies, Inc.

Megan Brosh
Balto. Co. DEPS

Lindsay DeMarzo
Howard County Office of Community Sustainability

John Denniston
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Jason Dubow
Maryland Department of Planning

Matt Harper
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Robert Hildebrand
Univ. of MD Center for Environmental Science- Appalachian Laboratory

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