THE 25TH ANNUAL
Maryland Water Monitoring Council
CONFERENCE

December 6, 2019 • Maritime Conference Center • Linthicum

Where We've
BEEN,

Where We're
GOING

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On the Cover - The Miles River - cover photo by Brooke Landry (MD DNR)

Cover artwork by Annalise Kenney (MD DNR)

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The 25th Annual Conference of the Maryland Water Monitoring Council
Welcome from the Chair of the MWMC Board of Directors

The 25th Annual MWMC Conference – Where We've Been, Where We're Going

The 2019 MWMC Annual Conference Planning Committee and I would like to welcome you to the 25th Annual Conference of the Maryland Water Monitoring Council. It's hard to believe that this began before some of you in the audience were even born! Since its inception in 1994, conference attendance has grown from about 150 attendees to include this year's record high of 640 participants from local, state and federal government, private industry, academia, and citizen and regional organizations. It's become one of the best one-day conferences for communicating trending issues, policies, and resource management concerns within the Maryland water monitoring community.

The theme of this year's conference is "The 25th Annual MWMC Conference - Where We've Been, Where We're Going". As we look back over past decades, we ask ourselves: Are our waters getting better or worse? Are we holding the line in protecting our waterways? Are restoration efforts working? How optimistic should we be looking into the future?" So… in the spirit of the conference theme – I'd like to walk us through how the efforts of this statewide community have really improved the quality of Maryland waters!

1994 marked the beginning of the Maryland Water Monitoring Committee, now known as the Maryland Water Monitoring Council, but it didn't mark the beginning of statewide monitoring efforts. The U.S. Geological Survey has been collecting discharge data since the late 1800s and water quality data since the 1940s. Don't worry –I'm not going to begin with the late 1800s. I mention the efforts of the USGS because many of us have used these historical data to evaluate trends and to monitor the performance of our restoration efforts. The efforts of the USGS and others are essential to assessing the conditions of our waters and determining whether they are getting better or worse.

In 1976, State agencies began sampling benthic macroinvertebrates at over 80 sites in large streams statewide in response to new Clean Water Act requirements. Now, over 40 years later, the "bugs" have helped us demonstrate the success of limestone dosing in acidified western Maryland streams or improvement in urban stormwater control in major urban areas. Maryland DNR has had its "Eyes on the Bay" since 1984. This long-term Chesapeake Bay Water Quality Monitoring Program includes comprehensive water quality and habitat data collection at 22 stations located in Maryland's Chesapeake Bay mainstem and at 60 stations in the tidal tributaries. The monitoring program includes nutrients as well as dissolved oxygen and water clarity.

Monitoring efforts have not been limited to federal and State agencies. Maryland has a vast network of citizen volunteers that conduct habitat assessments and identify benthic macroinvertebrates and fish to assess the condition of our waters. The Anacostia Watershed Society was founded in 1989 and has been generating report cards for the Anacostia since 2011. The Eyes of Paint Branch was formed in 1994 to preserve and enhance the ecology of the Paint Branch. Their website includes a quote from Margaret Mead that I'd like to share with you today – "Never doubt that a small group of committed citizens can change the world. Indeed, it's the only thing that has." Truer words were never spoken! There are now over 55 listed watershed organizations throughout Maryland that provide monitoring support, advocate for cleaner Maryland waters, and continue to collect the long-term trend data that is needed to assess and protect Maryland's waters!!

We are honored to have with us for the morning plenary session two amazing speakers - Mr. Ben Grumbles, Secretary of the Maryland Dept. of the Environment and Mr. Nick DiPasquale, former Director of the Chesapeake Bay Program. I'm excited to hear Secretary Grumble's perspective on Climate Change and Nick's thoughts on efforts to restore the Chesapeake Bay.

This year, we will be awarding the 13th annual Carl Weber Award as a way to recognize the extraordinary contributions that Dr. Carl Weber made to the field of water monitoring. The Council presents this award in Carl's name as a lasting reminder of the affection and respect that we hold for Carl and his work, and to inspire others to emulate his passion, dedication, and good humor. In addition, the "Above and Beyond Award" will be presented to a member of Maryland's environmental community who represents the next generation of Maryland's water monitors and has shown outstanding drive in increasing watershed awareness, advocacy, education and stewardship. 2019 marks the fourth year for this award.

The MWMC continues today as an effective statewide collaborative body because of the many contributed hours that individuals and organizations have donated to furthering the Council's goal of serving as a vehicle for the effective collection, interpretation, and dissemination of environmental data related to issues, policies, and resource management objectives involving water monitoring. We encourage you to strengthen the MWMC by getting involved, communicating your needs to us, and using the Council to enhance your water monitoring programs, resource management, and environmental stewardship initiatives. Talk with a MWMC member at today's conference. To learn more about the MWMC, go to www.marylandwatermonitoring.org.

Before I close, I would like to acknowledge the efforts of one of MWMC's very own. Mr. Dan Boward has been our Executive Secretary for over a decade and has been integral to the growth and success of our annual conference. Dan has been the Chair of the Conference Planning Committee for as long as I can remember. Recent updates to the program format, inclusion of a simulcast for plenary sessions, improved traffic flow during the event, and an increase in concurrent sessions can be traced back to Dan's leadership within this committee.

Without his attention to detail, ability to "nag" without nagging, and historical knowledge of all things MWMC, many of the remarks I've made would have remained unwritten. Thank you, Dan, for all that you have done for the MWMC and to further efforts of the monitoring community throughout Maryland!

25 years and still going strong! Let's have another great conference!

Sandy Hertz

Chair, Maryland Water Monitoring Council

The Carl S. Weber Awards

For Vision and Leadership in Monitoring Maryland's Waters

Our vision for monitoring in Maryland…

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

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

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

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

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

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

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

Previous Winners

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 Department of Natural Resources – retired)

2014 – Jim Long (Mattawoman Watershed Society)

2013 - Paul Kazyak (Maryland Department of Natural Resources)

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 Department of Natural Resources)

2007 - Susan "Abby" Markowitz (Tetra Tech) and Dr. Paul Massicot (Maryland Department of Natural Resources)

Above and Beyond Award

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

awareness, advocacy, education and stewardship. The MWMC is proud to include this new award in our 2016 conference and many more.

Previous Winners

2018 – Joseph Davis and Matthew Budinger (Baltimore County Public Schools)

2017 – Rebecca Kenyon-Sisler (Garrett County Educator)

2016 – Ann Strozyk (Howard County Educator)

2019 Annual Conference Planning Committee

Andy Becker	KCI Technologies, Inc.
Dan Boward (Chair)	Maryland Department of Natural Resources
Kevin Brittingham	Baltimore County Department of Environmental Protection & Sustainability
Megan Brosh	Baltimore County Department of Environmental Protection & Sustainability
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Mark Trice	Maryland Department of Natural Resources

Additional thanks to:

Katherine Hanna	Maryland Department of Natural Resources (MWMC Webmaster & Graphics Guru)
Jackie Sivalia	Maryland Department of Natural Resources (Conference preparation)
Joanne Alewine	Maryland Department of Natural Resources (Conference preparation & registration table)

MARYLAND WATER MONITORING COUNCIL

25th Annual Conference - Friday, December 6, 2019

The 25th Annual MWMC Conference – Where We've Been, Where We're Going

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

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

8:30 ***MWMC Board Chair's Call to Order*** **– Sandy Hertz - Maryland Department of Transportation; Chair, MWMC Board of Directors**

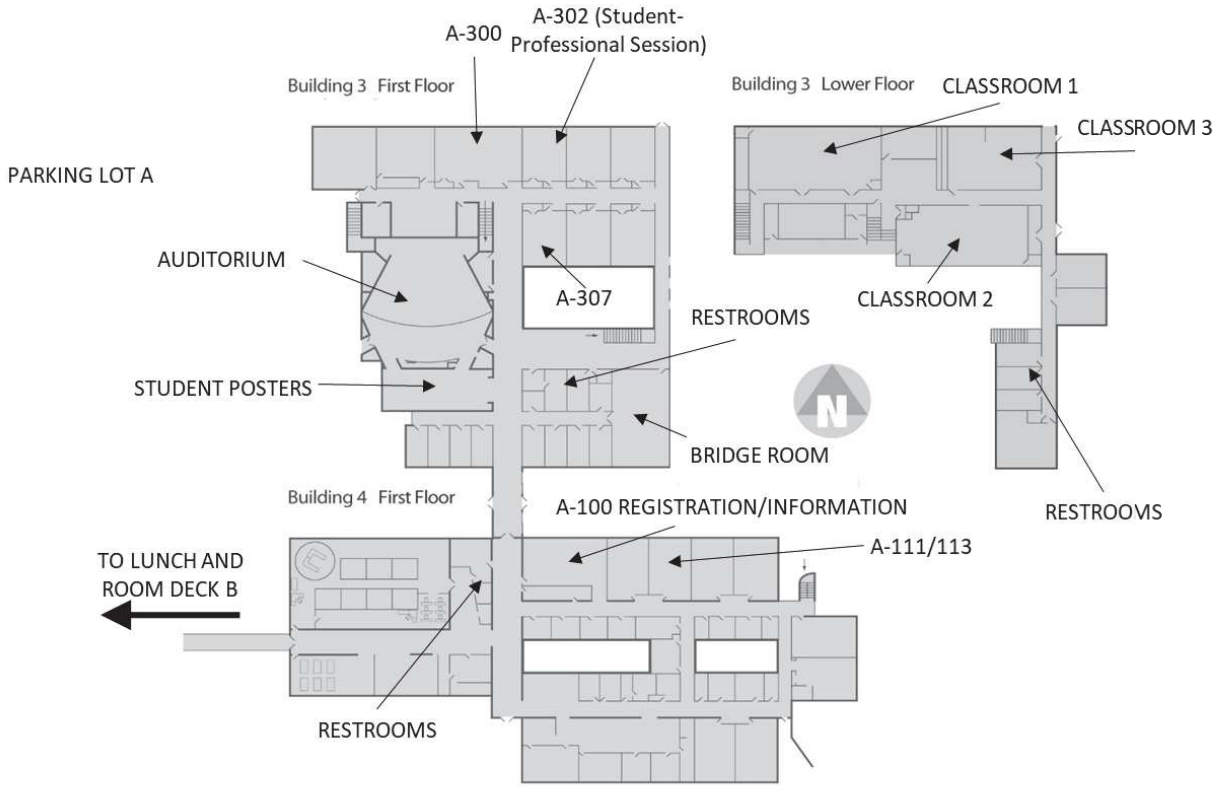
8:45 ***Climate Change is Water Change: Monitoring and Managing Both*** **– Ben Grumbles – Secretary, Maryland Department of the Environment**

9:15 ***Thoughts on a Large Ecosystem Restoration Initiative: The Chesapeake Bay Program*** **- Nick DiPasquale – Director, Chesapeake Bay Program (retired)**

9:45 ***Carl S. Weber Awards*** **– Clark Howells; City of Baltimore**

10:00 **Break/Poster Session – Authors Present**

2019 MWMC Annual Conference Floorplan



Thanks to the 2019 MWMC Annual Conference Planning Committee – Andy Becker (KCI), Dan Boward (MD DNR), Kevin Brittingham (Balto. Co.), Megan Brosh (Balto. Co.), Drew Budelis (Versar), Tim Fox (MDE), Sandy Hertz (MDOT), Clark Howells (Balto. City), Charlie Poukish (MDE), Mark Southerland (AKRF), and Mark Trice (MD DNR)

Only speakers are listed for oral presentations. The online conference Program contains the full list of authors, co-authors, contact information, and abstracts. The Program can be viewed and downloaded from the MWMC website at www.marylandwatermonitoring.org. Following the conference, this agenda will contain links to presentation files, if available.

The Student-Professional Networking Session will be held in Room A302 from 10:30 until noon with further discussion in Deck B.

Concurrent Sessions - 10:30 –12:00

AUDITORIUM - STREAM RESTORATION MONITORING I – Moderator, Scott Stranko (MDNR)

- **QUANTIFYING THE ECOLOGICAL UPLIFT AND EFFECTIVENESS OF DIFFERING STREAM RESTORATION APPROACHES IN MARYLAND** - Robert H. Hilderbrand (UMCES)
- **IMPLICATIONS OF MEASUREMENT METHODS AND THE BAY TMDL NUTRIENT AND SEDIMENT REDUCTION CREDITS FOR STREAM RESTORATION** - Neely L. Law (Center for Watershed Protection)
- **NEW GUIDANCE ON USING SITE-LEVEL DATA TO IMPROVE THE STREAM RESTORATION PROTOCOLS** - David Wood (Chesapeake Stormwater Network)
- **USE OF PROTOCOL 1 FOR PREVENTED SEDIMENT CREDIT BY MDOT SHA** - Steve Morsberger (McCormick Taylor)

ROOM A-300 – FISH DISEASE - LESIONS AND TUMORS AND POPEYE, OH MY! – Moderator, Charlie Poukish (MDE)

- **MELANISTIC AND MUCOID SKIN LESIONS OF SMALLMOUTH BASS -** Vicki S. Blazer (US Geological Survey)
- **HISTOPATHOLOGICAL ASSESSMENTS OF SMALLMOUTH BASS FROM LONG-TERM MONITORING SITES ON THE MONOCACY AND POTOMAC RIVERS -** Heather Walsh (US Geological Survey)
- **SEASONAL AND SITE DIFFERENCES IN SMALLMOUTH BASS IMMUNE FUNCTION -** Cheyenne Smith (West Virginia University)

ROOM A-111/113 – STORMY WEATHER! WHAT'S NEW WITH STORMWATER MANAGEMENT? – Moderator, Mark Southerland (Tetra Tech)

- **UPDATES ON MDE'S MS4 MONITORING AND ANALYSIS EFFORTS: 2019 SUMMARY AND 2020 PROJECTS -** Wencheng Katherine Slater (MDE)
- **REVIEW OF MARYLAND MS4 MONITORING DATA AT THREE PILOT LOCATIONS** - Deb Caraco (Center for Watershed Protection)
- **PASSIVE STORMWATER MANAGEMENT IS A THING OF THE PAST. SMART STORMWATER MANAGEMENT IS THE FUTURE** - Bob Bathurst (Century Engineering)
- **BIOCHAR - OVERVIEW, BENEFITS AND APPLICATIONS FOR BUILDING RESILIENT SYSTEMS -** Lori Lilly (Howard EcoWorks) and Paul Sturm (Ridge to Reefs)

ROOM A307 – VITAL SIGNS OF WATERSHED HEALTH – Moderator, Nancy Roth (Tetra Tech)

- **TAKING THE PULSE: WHAT IS WATERSHED HEALTH AND HOW DO WE MEASURE IT? -** Nancy Roth (Tetra Tech)
- **USING WATERSHED CHARACTERISTICS TO ASSESS WATERSHED (STREAM) HEALTH IN UNSURVEYED AREAS -** Kelly O. Maloney (US Geological Survey)
- **LANDSCAPE CHANGES AS SIGNALS OF WATERSHED VULNERABILITY AND RESILIENCE -** Peter R. Claggett (US Geological Survey)
- **MANAGEMENT RESPONSE: HOW CAN LOCAL AND STATE GOVERNMENTS RESPOND TO INDICATIONS OF WATERSHED HEALTH DEGRADATION -** Renee Thompson (US Geological Survey)

CLASSROOM 1 – HARMFUL ALGAL BLOOMS – Moderator, Clark Howells (Baltimore City)

- **INTEGRATED STRATEGIES FOR ADDRESSING ALGAE AND RELATED IMPACTS ON WATER SUPPLIES -** Josh Weiss (Hazen and Sawyer)
- **MONITORING AND MANAGEMENT OF HABS IN THE MID-ATLANTIC REGION OF THE UNITED STATES IN 2019 -** Fred S. Lubnow (Princeton Hydro)
- **HARMFUL ALGAL BLOOM MONITORING AT T. HOWARD DUCKETT AND TRIADELPHIA RESERVOIRS, PATUXENT RIVER, MARYLAND 2015–2019 -** Martin Chandler (WSSC Water)

CLASSROOM 2 – FRESHWATER MUSSELS: AN ENVIRONMENTAL INDICATOR'S GROWING INFLUENCE ON ENVIRONMENTAL POLICY – Moderator, Tim Fox (MDE)

- **STATUS AND DISTRIBUTION OF FRESHWATER MUSSELS IN MARYLAND -** James M. McCann (MD DNR)
- **TOOLS IN THE FRESHWATER MUSSEL CONSERVATION TOOLBOX: RECENT EXAMPLES IN MARYLAND -** Matt Ashton (MD DNR)
- **A YEAR OF FRESHWATER MUSSEL RESTORATION IN THE ANACOSTIA RIVER -** Jorge Montero (Anacostia Watershed Society)
- **A STATISTICAL MODEL TO DETERMINE THE ABSENCE OF FRESHWATER MUSSEL HABITAT: OPPORTUNITIES FOR WRITING BIOLOGICALLY APPROPRIATE AMMONIA WQBEL -** Timothy Fox (MDE)

CLASSROOM 3 – THE BAY'S SUBMERGED AQUATIC VEGETATION – Moderator, Brooke Landry (MD DNR)

- **FROM PLANTS TO SEEDS - THE HISTORY OF SAV RESTORATION IN MARYLAND -** Mark Lewandowski (MD DNR)
- **MICROPLASTICS IN COASTAL WATERS: DO SAV BEDS SERVE AS SINKS? -** Bob Murphy (Tetra Tech)
- **REMOTE SENSING OF SUBMERGED AQUATIC VEGETATION TO DETERMINE SUITABILITY OF CITIZEN SCIENCE MONITORING IN THE LOWER SUSQUEHANNA FLATS -** Morgan Jones (Havre de Grace Environmental Center)
- **DEVELOPING A THREE-TIERED HIERARCHICAL MONITORING APPROACH FOR CHESAPEAKE BAY SAV -** Brooke Landry (MD DNR)

BRIDGE ROOM – CLIMATE RESILIENCY – Moderator, Sandy Hertz (MDOT)

- **MDOT SHA'S TOOL FOR PROACTIVELY MANAGING CRITICAL TRANSPORTATION INFRASTRUCTURE -** Elizabeth Habic (MDOT)
- **FORMING A BALTIMORE URBAN WATERS FLOOD TEAM -** Robert J. Shedlock (US Geological Survey)
- **CASE STUDIES OF CLOUDBURSTS AND PLUVIAL FLOODING IN BALTIMORE: IMPLICATIONS FOR CLIMATE CHANGE RESILIENCE PLANNING -** Bernice R. Rosenzweig (City University of New York)
- **HISTORIC ELLICOTT CITY FLOODING: SAFE AND SOUND FLOOD MITIGATION PLAN -** Mark S. Richmond (Howard County DPW)

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

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

Concurrent Sessions - 1:30 –3:00

AUDITORIUM - STREAM RESTORATION MONITORING II – Moderator, Jai Cole (Montgomery Parks)

- **EVALUATING THE EFFECTIVENESS AND SUSTAINABILITY OF NOVEL STREAM RESTORATION DESIGNS FOR COASTAL PLAIN STREAMS IN MARYLAND: INTEGRATING EXISTING AND NEW DATA FROM RESTORATION MONITORING** – Solange Filoso (UMCES)
- **QUANTIFYING EFFECTS OF STREAM RESTORATION ON NITRATE LOADS IN AN URBAN WATERSHED USING A HIGH-FREQUENCY SENSOR NETWORK** - Claire Welty (UMBC)
- **STREAM RESTORATION AND LIVING SHORELINE INSTALLATION ON A TRIBUTARY OF THE MAGOTHY RIVER** - Sally Hornor (Magothy River Association)
- **ARE WE THERE YET? EVALUATING THE MONITORING TIME PERIOD REQUIRED TO DEMONSTRATE STREAM RESTORATION EFFECTIVENESS** - Colin Hill (KCI Technologies)

ROOM A-300 – NUTRIENTS AND THEIR UNINTENDED CONSEQUENCES – Moderator, Tom Parham (MD DNR)

- **DOWNPOUR DYNAMICS: NITRATE EXPORT DURING STORM EVENTS -** Joel Bostic (UMCES)
- **ILLUSTRATING NUTRIENT INPUTS IN THE CHESAPEAKE BAY WATERSHED OVER TIME** - Breck Sullivan (Chesapeake Research Consortium)
- **METHODOLOGY FOR DATA-BASED PRIORITIZATION OF ONSITE SEWAGE DISPOSAL SYSTEM UPGRADES FOR NITROGEN LOAD REDUCTION IN MARYLAND -** Jonathan Leiman (MDE)
- **THE EFFECT OF AERATORS ON WATER QUALITY IN IMPOUNDMENTS IN TWIN LAKES STATE PARK -** Irene Frentz (Virginia Dept. of Conservation and Recreation)

ROOM A-111/113 – THE LIFE CYCLE OF BIG ENVIRONMENTAL DATA – Moderator, Tim Fox (MDE)

- **WATER QUALITY MONITORING DATA STORY -** Najma Khokhar and Fred Schenerman (MDE)
- **HOW'S MY WATERWAY: TELLING THE WATER STORY -** Kiki Schneider (US EPA)
- **MULTI-STRESSOR AND MULTI-STATE APPROACH TO CREATING TOLERANCE VALUES FOR BIOLOGICAL CONDITION GRADIENT MODELS -** Richard Mitchell (US EPA)
- **THE IMPORTANCE OF DATA MANAGEMENT TO THE JAMES RIVER CHLOROPHYLL STUDY -** Tish Robertson (Virginia DEQ)

ROOM A-307 - CITIZEN SCIENCE AND EDUCATION – Jim Caldwell (Howard Co. Govt. – retired)

- **CITIZEN SCIENCE APPROACH TO WQ COLLECTION** - Thomas Guay (Severn River Association)
- **THE VALUE OF CITIZEN VOLUNTEER DATA** - James Beckley (Virginia DEQ)
- **FROM COLORING BOOKS TO FIELD JOURNALS: THE EVOLUTION OF OUTREACH MATERIALS -** Dionna Bucci (Fairfax County, VA)

CLASSROOM 1 - FROM ALEWIFE TO BROOK TROUT: THE IMPORTANCE OF HEALTY FISH COMMUNITIES – Moderator, Charlie Poukish (MDE)

- **THE EFFECT OF RUNOFF INDUCED TEMPERATURE CHANGE ON THE PHYSIOLOGICAL PERFORMANCES OF URBAN AND RURAL BLACKNOSE DACE (RHINICHTHYS ATRATULUS) -** Danielle Gruber (Towson University)
- **A PROGRESSIVE BROOK TROUT CONSERVATION FRAMEWORK: DEVELOPING A STATEWIDE CONSERVATION STRATEGY TO ENSURE RESTORATION EFFORTS HAVE LONG LASTING EFFECTS TOWARDS MEETING FISHERIES MANAGEMENT PLAN AND CHESAPEAKE BAY AGREEMENT GOALS -** Daniel Goetz (MD DNR)
- **DECLINING STATUS OF ANADROMOUS FISH SPAWNING HABITAT IN PATUXENT RIVER -** Jim Uphoff (MD DNR)
- **FISH ABUNDANCE TRENDS LINKED TO INCREASING SPRING FLOWS IN THE POTOMAC RIVER -** Nathaniel (Than) Hitt (US Geological Survey)

CLASSROOM 2 - AQUATIC INVASIVE SPECIES: THEN AND NOW – Moderator, Julie Bortz (MD DNR)

- **A TALE OF TWO FISH: NORTHERN SNAKEHEAD AND BLUE CATFISH -** Dr. Joseph Love (MD DNR)
- **EARLY DETECTION AND ERADICATION PROGRAM NEEDED FOR TRAPA BISPINOSA, A NEW SPECIES OF WATER CHESTNUT IN THE POTOMAC RIVER WATERSHED -** Jil Swearingen (In The Weeds)
- **INVASIVE AQUATIC VEGETATION MANAGEMENT USING A TARGETED HERBICIDE APPROACH -** William H. Kirkpatrick Jr. (Aquatic Environment Consultants)
- **ADVANCES AND APPLICATIONS OF EDNA METHODS -** Bane Schill (US Geological Survey)

CLASSROOM 3 – REMOTE SENSING AND THE BAY – Moderator, Mark Trice (MD DNR)

- **FROM SPACE TO SOCIETY: EXPLORING HYPERSPECTRAL REMOTE SENSING TO AID CHESAPEAKE BAY RESOURCE MANAGERS IN THE DETECTION OF POOR WATER QUALITY –** Stephanie Uz (NASA)
- **USGS NEXT GENERATION WATER OBSERVING SYSTEMS** - Mary Kay Foley (US Geological Survey)
- **TOPO/BATHYMETRIC DATA COLLECTION FOR NON-TIDAL POTOMAC RIVER -** Roger Barlow (US Geological Survey)
- **UTILIZING REMOTE SENSING DATA TO ASSESS SEAGRASS HABITAT CRITERIA IN MARYLAND'S COASTAL BAYS -** Cathy Wazniak (MD DNR)

BRIDGE ROOM – SALT LIFE: NOT JUST A COASTAL THING! – Moderator, Sandy Hertz (MDOT)

- **WIDESPREAD AND FREQUENT EXCEEDANCES OF CHLORIDE WATER QUALITY CRITERIA IN MID-ATLANTIC AND NEW ENGLAND STREAMS AS REVEALED BY HIGH-FREQUENCY DATA -** Joel Moore (Towson University)
- **NO SALT FOR YOU! - AN INCENTIVISED APPROACH TO CURBING THE OVER-APPLICATION OF WINTER DEICER -** Gregorio Sandi (MDE)
- **STATE OF MARYLAND PLAN TO ADAPT TO SALTWATER INTRUSION AND SALINIZATION -** Jason Dubow (MD Department of Planning)

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

Concurrent Sessions - 3:30 –4:30

AUDITORIUM - STREAM RESTORATION MONITORING III – Moderator, Chris Victoria (Anne Arundel Co.)

- **20 YEARS OF WATER QUALITY MONITORING IN FAIRFAX COUNTY (VA) -** Chris Ruck (Fairfax County, VA)
- **EVIDENCE OF NITRATE UPTAKE IN STEP POOL STORMWATER CONVEYANCES IN AN URBAN WATERSHED** - Thomas E. Jordan (Smithsonian Environmental Research Center)
- **EFFECT OF LEGACY SEDIMENT REMOVAL AND FLOODPLAIN RECONNECTION ON RIPARIAN PLANT COMMUNITIES -** Vanessa Beauchamp (Towson University)

ROOM A-300 – GROUNDWATER – Moderator, Mat Pajerowski (US Geological Survey)

- **CHANGES IN GROUNDWATER AND SURFACE WATER IN THE MARYLAND PIEDMONT AS A RESULT OF ROAD-DEICING SALT APPLICATION -** Tiffany VanDerwerker (Maryland Geological Survey)
- **WHY DOES MARYLAND NEED A REGIONAL GROUNDWATER MODEL? -** Emelia Furlong (Maryland Geological Survey)
- **HYDROLOGIC STUDY AT FARM CREEK MARSH, DORCHESTER COUNTY, MARYLAND FROM APRIL 2015 TO APRIL 2016 -** Christopher Nealen (US Geological Survey)

ROOM A-111/113 – POLLUTION DETECTIVES: BACTERIA MONITORING AND TRACKING– Megan Brosh (Balto. Co.)

- **CHASING COMPLIANCE: BALTIMORE'S USE OF IDDE METHODS FOR BACTERIA TMDL COMPLIANCE –** Van Sturtevant (Baltimore City)
- **DNA-BASED MICROBIAL SOURCE TRACKING AS A TOOL TO IDENTIFY THE SOURCE OF FECAL CONTAMINATION -** Wolf T. Pecher (University of Baltimore)
- **WHATS IN THE WATER: CITIZEN SCIENCE WATER MONITORING IN DC -** Robbie O'Donnell (Anacostia Riverkeeper)

ROOM A-307 – BE PART OF THE SOLUTION: LITTER OUTREACH AND EDUCATION – Drew Budelis (Versar)

- **LITTER REDUCTION IN PRINCE GEORGE'S COUNTY -** Tiaa Rutherford (Prince George's County)
- **ADDRESSING AND PREVENTING LITTER IN MARYLAND -** Ashley Van Stone (Trash Free Maryland)

CLASSROOM 1 – IT'S ALL ABOUT THE MODELS – Brian Smith (MD DNR)

- **USING DATA SCIENCE TECHNIQUES TO MODEL WATER QUALITY PARAMETERS IN THE CHESAPEAKE BAY AND ITS TRIBLETS -** Andrew C. Muller (United States Naval Academy)
- **USE OF LONG-RANGE, LOW-POWER NETWORKING TO ENHANCE WATER-QUALITY AND QUANTITY MONITORING AND MODELING -** Joseph Bell (US Geological Survey)
- **REVISITING CHESAPEAKE BAY RESOURCE LIMITATION: A RE-ANALYSIS OF BIOASSAY AND TIDAL MONITORING DATA AND IMPLICATIONS FOR WATER-QUALITY MANAGEMENT** - Qian Zhang (US EPA)

CLASSROOM 2 - AQUATIC INVASIVE SPECIES: THEN AND NOW – Moderator, Julie Bortz (MD DNR)

- **DEEP CREEK LAKE: A CASE STUDY IN AQUATIC INVASIVE SPECIES CONTROL, EDUCATION, PREVENTION AND MONITORING -** Julie Bortz and Seth Metheny (MD DNR)
- **WHAT'S NEXT FOR AIS? PANEL DISCUSSION AND RECOMMENDATIONS MOVING FORWARD TO CONTROL AQUATIC INVASIVES**

CLASSROOM 3 – IN PRAISE OF THE HUMBLE OYSTER AND ITS HABITAT – Byron Madigan (Carroll Co.)

- **LINKING ECOLOGICAL AND ECONOMIC MODELS TO ESTIMATE REGIONAL ECONOMIC IMPACTS OF OYSTER REEF RESTORATION –** Scott Knoche (Morgan State University)
- **FOUL PLAY: LONG TERM DATA TRENDS IN THE EPIBENTHIC COMMUNITY OF MARYLAND OYSTER BARS -** Margaret McGinty (MD DNR)

BRIDGE ROOM – UNDERSTANDING AND VISUALIZING BIG DATA – Diana Muller (Maritimas)

- **STREAMLINE THE LIFECYCLE OF YOUR DATA** - R. John Dawes, Jr. (The Commons)
- **GEMSTAT: A UNIFIED GLOBAL WATER QUALITY PORTAL -** Steve Elgie (KISTERS North America)

4:30 Adjourn

5:00 – 9:00 Social –Checkerspot Brewing Company

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

(Student Poster) DO DIFFERENT EXPOSURE PATTERNS OF MARCELLUS SHALE PETROLEUM PRODUCTION WATER EXERT STRESS ON A COMMON NORTH AMERICAN AMPHIBIAN (LITHOBATES CLAMITANS) - Carlos Barragan, Frank Green and Christopher J. Salice (Towson University) and Paula F.P. Henry (USGS)

THE TWELFTH ANNUAL MARYLAND STREAMS ROUNDTABLE - Andy Becker (KCI Technologies) and Dan Boward (MD DNR)

URBAN STREAM RESTORATION: CONVEYANCE AND MATERIAL PROCESSING CHANNELS – Maddie Berg (Stantec)

CLIMATE CHANGE: PLANNING FOR COASTAL RESILIENCY IN THE NORTHERN CHESAPEAKE BAY - Sanita Corum, Alyssa Calomeni, Mark Dhruv, Christopher Overcash, and Eric Yan (EA Engineering)

NITROGEN AND PHOSPHORUS CONTENT IN SHELLS AND TISSUE OF A WIDESPREAD FRESHWATER MUSSEL, EASTERN ELLIPTIO - Megan Davis (University of Alabama) and Matthew Ashton (Maryland Department of Natural Resources)

MICROBIAL SOURCE TRACKING IN MONTGOMERY AND PRINCE GEORGE'S COUNTIES - Michael Durbano Kandice Sermon, and Michael W. Powell, (EA Engineering), Martin Chandler (WSSC Water), and Rachel Noble and Matthew Price (UNC)

SAMPLING CYANOBACTERIA AT A D.C. LAKE - Catherine Gaudlip and Nathan Purser (Hood College Center for Coastal and Watershed Studies)

(Student Poster) EFFECTS OF PRODUCED WATER FROM HYDRAULIC FRACTURING ON METABOLIC RATE OF LITHOBATES CLAMITANS - Matt Godbey, Paulo Ribeiro, Carlos Barragan, Frank Green, and Andrew East (Towson University), Paula Henry (USGS), and Christopher J. Salice, (Towson University)

(Student Poster) THE EFFECT OF WHITE-TAILED DEER ON THE GWYNNS FALLS WATERSHED: IMPLICATIONS FOR WATER QUALITY - Kristen Gossage and Joseph Matanoski (Stevenson University)

USING STREAM INVERTEBRATES TO ASSESS THE MERCURY CONDITION OF MARYLAND STREAMS - Andrew Heyes, Jacob Oster and Laura Lapham (University of Maryland Center for Environmental Science), William Lamp (University of Maryland College Park), and Cynthia Gilmour (Smithsonian Environmental Research Center)

(Student Poster) STRESSED TO DEATH? MULTIPLE STRESSORS AND THE EFFECTS ON DAPHNIA MAGNA SURVIVAL, REPRODUCTION, GROWTH, AND BIOENERGETICS - Amanda M. Isabella, Andrew East, and Christopher J. Salice (Towson University)

RESTORATION MONITORING IN WHEEL CREEK WATERSHED - Thomas Jones, Beth Franks, Ryan Corbin, and Brent Hood (Versar)

STATE LAKES PROTECTION AND RESTORATION FUND - Yishen Li, Mike Naylor, Mark Lewandowski, and Cathy Wazniak, (MD DNR)

(Student Poster) USING HIGH-FREQUENCY DATA AND CONCENTRATION-DISCHARGE RELATIONSHIPS TO DESCRIBE SOLUTE MOBILIZATION AND TRANSPORT IN SUBURBAN AND URBAN WATERSHEDS - Melinda Marsh and Joel Moore (Towson University)

MOLECULAR CHARACTERIZATION OF LANDFILL LEACHATES - Katherine Martin (University of Maryland Center for Environmental Science), Nicole Robey, William Cooper and Timothy Townsend (University of Florida), Philippe Schmitt-Kopplin (Helmholtz Zentrum München) and Michael Gonsior (University of Maryland Center for Environmental Science)

IRON PRESENCE IN STREAM RESTORATION PROJECTS AND POTENTIAL IMPACTS TO THE AQUATIC BIOLOGICAL COMMUNITY - Martha McCauley (EA Engineering), Christopher J. Salice (Towson University), and Jamie Suski (EA Engineering)

EXAMINING CONNECTIONS BETWEEN ROAD SALT APPLICATION AND STREAM HEALTH IN BALTIMORE COUNTY STREAMS - Lauren McDonald and Dillon Mahmoudi (UMBC) and Ginny Rogers (Versar)

EXPORT OF NITROGEN AND SEDIMENT FOLLOWING LEGACY SEDIMENT REMOVAL AND FLOODPLAIN RECONNECTION RESTORATION PROJECTS - Patrick W. McMahon, Vanessa B. Beauchamp, Ryan E. Casey, Christopher J. Salice, and Joel Moore (Towson University)

THE EFFECT OF WETLAND RETROFIT PROJECTS ON PHOSPHATE LEVELS IN THE ESTUARINE AND COASTAL WATERS OF HAMPTON, VIRGINIA - Zachary Messegee (Hampton University)

THE ROLE OF PLACE ATTACHMENT IN VOLUNTEER MONITORING: A TRANSNATIONAL PILOT STUDY OF ENGAGING AND RETAINING VOLUNTEERS - Rachel Pierson (University of Vermont)

(Student Poster) EFFECT OF URBAN SEDIMENTATION ON EASTERN BLACKNOSE DACE ESCAPE PERFORMANCE - Olivia Saliger, Cassidy Hartke, Dr. Jay Nelson, and Dr. Christopher Oufiero (Towson University)

STREAM RESTORATION EFFECT ON WATER QUALITY IN STREAMS OF THE LOWER SUSQUEHANNA SUBBASIN - Rachel Smolinski, Jennifer Sliko, Shirley Clark, Elizabeth Bell, and Alan Strayer, (Penn State University)

COLLABORATIVE DEVELOPMENT OF A VOLUNTEER MONITORING PROGRAM FOR CHESAPEAKE BAY SUBMERGED AQUATIC VEGETATION - Suzi Spitzer (University of Maryland Center for Environmental Science), Brooke Landry (MD DNR), Sky Swanson, Katie May Laumann, and Bill Dennison (University of Maryland Center for Environmental Science)

COPING COMMUNITY RAISES RESILIENCY: THE DEAL ISLAND SHORELINE PROJECT - Rebecca Swerida and Nicole Carlozo (Maryland Department of Natural Resources)

ASSESSING CONDITION AND VULNERABILITY OF HEALTHY WATERSHEDS IN THE CHESAPEAKE BAY REGION - Renee Thompson (USGS - Chesapeake Bay Program) and Nancy Roth (Tetra Tech)

ASSESSING HARMFUL ALGAL BLOOMS IN STATE OWNED LAKES - Cathy Wazniak (MD DNR)

MONITORING SUBMERGED AQUATIC VEGETATION IN THE CHESAPEAKE BAY - Briana Yancy and Brooke Landry (MD DNR)

Plenary Talks

CLIMATE CHANGE IS WATER CHANGE: MONITORING AND MANAGING BOTH

Ben Grumbles, Secretary, Maryland Department of the Environment

THOUGHTS ON A LARGE ECOSYSTEM RESTORATION INITIATIVE: THE CHESAPEAKE BAY PROGRAM

Nick DiPasquale, Director, Chesapeake Bay Program (retired)

Oral Presentation Abstracts

TOOLS IN THE FRESHWATER MUSSEL CONSERVATION TOOLBOX: RECENT EXAMPLES IN MARYLAND.

Matt Ashton; matthew.ashton@maryland.gov; Maryland DNR

Session: Freshwater Mussels: An Environmental Indicator's Growing Influence on Environmental Policy; Classroom 2, 10:30–12:00

Freshwater mussels are relatively long lived, filter feeding bivalves that are acute and chronically sensitive to multiple stressors. They are among the most imperiled fauna in the nation with many species in decline. Mitigating impacts from resource conflicts and active management of species are increasingly common and occasionally legally required (e.g. state and federal Endangered Species Act's or NEPA) conservation practices. This presentation highlights recent uses of multiple conservation tools in Maryland, including mussel relocation, reintroduction, and propagation for population augmentation and ecological restoration. A general framework for a nexus to use each tool are also discussed.

Matt Ashton has been a Natural Resource Biologist with DNR's Monitoring and Non-Tidal Assessment Division since 2007 where he serves as the freshwater mussel expert for Resource Assessment Service and crew leader for the Maryland Biological Stream Survey. Since 2014, Matt has coordinated a growing, intra-DNR effort to restore freshwater mussels via artificial propagation. Prior to joining DNR, Matt earned his M.Sc. from Tennessee Technological University where he researched the ecology of rare fish and mussel communities in southeastern rivers. He previously worked for an environmental consultant conducting fish and mussel community impact assessments.

TOPO/BATHYMETRIC DATA COLLECTION FOR NON-TIDAL POTOMAC RIVER

Roger Barlow; rbarlow@usgs.gov; USGS-National Geospatial Program

Coauthor: John Young, USGS; Cherie Schultz, Interstate Commission on the Potomac River Basin

Session: Remote Sensing and the Bay; Classroom 3, 1:30-3:00

The USGS is partnering with the Interstate Commission on the Potomac River Basin (ICPRB) to collect in the fall of 2019 during low-water condition topo/bathymetric data for the Potomac River from Shepherdstown, WV downstream to Little Falls, DC using the Chioptera IV system. The primary ICPRB use case is to improve the 1D flow model for the Potomac River leading to numerous drinking water supplies to better predict the time and travel of harmful material spills into the river. USGS has planned comparative data collection in 4 study areas where acoustic depth data, Unmanned Arial Sysytem topo/bathy data and NASA satellite data will be collected and compared. Additional field measurements such as GPS data, lidar reflectance/absorbtion targets, secchi disk readings, and more will be collected to enhance the comparison of the different topo/bathymetric instruments. Topographic lidar data will be collected for all islands and for 100-meter buffer along both shorelines. Should acquisition happen on schedule, the topo/bathy data is anticipated to be available in May 2020.

Roger works with the 3D Elevation Program to coordinate the collection of elevation data in the mid=atlantic states including experimental datasets, other agency topo/bathymetric platforms like the Coastal Zone Mapping & Integration Lidar (CZMIL) operated by the U.S. Army Corps of Engineers, single-photon and geiger mode topographic lidar systems. Roger has been with USGS for 42 years and set up the first GPS base station and collected GPS data at Amundsen-Scott South Pole Station. Roger is the USGS Geospatial Liaison for Maryland and the Federal Representative and Elevation Work Group co-chair for the Maryland State Geographic Information Council MSGIC).

PASSIVE STORMWATER MANAGEMENT IS A THING OF THE PAST. SMART STORMWATER MANAGEMENT IS THE FUTURE.

Bob Bathurst; bbathurst@centuryeng.com; Century Engineering, Inc.

Session: Stormy Weather! What's New with Stormwater Management? Room 111/113, 10:30-12:00

Most hydrologic modeling procedures utilize NWS synthetic rainfall distributions and a 24-hour rainfall duration. However real rainfall events have durations and temporal distributions that vary wildly. The scientific community believes that climate change is the reason for the increase in the severity and frequency of recent rainfall events. As such it is necessary find a cost-efficient means to make stormwater management facilities become resilient to climate change. The state of wireless connectivity and microcomputer technology make it now practical to precisely control the timing, volume and rate of discharge from stormwater management facilities; thereby greatly enhancing their performance. Real-time NOAA precipitation forecasts and other live sensory data (e.g. water temperature, depth) can be ingested by onsite stormwater reservoir control systems which then make automatic changes to the state of the stormwater management facility's storage volume and release rate. Performance objectives such as maximize onsite retention or minimize discharge rate can be transformed into software algorithms that direct the stormwater management facility to achieve singular or multiple goals (e.g. enhance water quality, maximize groundwater recharge/runoff reduction, mitigate thermal pollution, reduce downstream erosion and/or flooding).

Mr. Bathurst is a Principal at Century Engineering in Hunt Valley, MD. Bob graduated from Drexel University with a BS degree in Civil Engineering and MS degree in Industrial Administration from Carnegie Mellon University. He has advanced education in civil engineering with specialization in water resources and has testified as an expert witness in matters regarding stormwater management. He holds Professional Engineer licenses in Maryland, Pennsylvania, DC & West Virginia. Bob has served as a consultant to the Maryland Department of the Environment - Water & Science Administration since 2002.

EFFECT OF LEGACY SEDIMENT REMOVAL AND FLOODPLAIN RECONNECTION ON RIPARIAN PLANT COMMUNITIES

Vanessa Beauchamp; vbeauchamp@towson.edu; Towson University

Coauthors: Patrick Baltzer, Century Engineering; Joel Moore, Towson University

Session: Stream Restoration Monitoring III; Auditorium, 3:30–4:30

Legacy sediment removal and floodplain reconnection (LSRFR) has emerged as a Best Management Practice in the Mid-Atlantic Piedmont to address floodplain aggradation behind colonial milldams and subsequent channel degradation through accumulated sediments after dam breach or removal. Very little information exists on the effect of this types of stream restoration on riparian plant communities, which are critical to riparian ecosystem function. We surveyed riparian vegetation at six LSRFR sites in central Maryland. An immediate result of LSRFR was a decrease in woody species richness and an 81% decrease in relative basal area. Other significant changes included an increase in herbaceous hydrophytic graminoid cover and an increase in native herbaceous cover. Species lost during LSRFR included many upland-associated species, but also included *Symplocarpus foetidus* (skunk cabbage), suggesting that this archetypal obligate wetland species is slow to or unable to recolonize these sites. Herbaceous indicators of restored reaches were largely native wetland-associated species. The three woody indicators of restored reaches were all intentionally planted at the project sites. Our results show that LSRFR projects can result in diverse native-dominated wetland plant communities.

Dr. Vanessa Beauchamp is an associate professor in the Department of Biological Sciences at Towson University where she teaches classes in ecology and evolution, botany, and wetland ecology. She received her B.S. in Biology at the University of California, Irvine and her Ph.D. in Plant Biology at Arizona State University. Her research interests focus on plant community ecology with emphasis on effects of invasive plant species on community diversity, and the ecology of streamside (riparian) plant communities. A large part of her research program involves practical applications related to management, conservation and restoration of plant communities.

THE VALUE OF CITIZEN VOLUNTEER DATA

James Beckley; james.beckley@deq.virginia.gov; Virginia Department of Environmental Quality

Session: Citizen Science and Education; Room A-307, 1:30–3:00

In 2018, The Virginia Department of Environmental Quality (DEQ) conducted a wide-reaching survey of citizen water quality monitoring groups. The goal of the study was to obtain an accurate estimate of the amount of time and money spent by volunteers when they perform water quality monitoring. The survey was conducted in two parallel sets of questions to obtain data from project managers and individual volunteers. The data from each set were used to help verify entries made by the other set. Based on the survey result, DEQ can reliably estimate that over $3.25 million is spent each year by volunteers in Virginia through volunteered time, out-of-pocket expenses, and analysis costs.

After graduating from Longwood College in 2000 with a Bachelor of Science in Biology, James became a water quality monitor for the local Soil and Water Conservation District. In 2002 he moved to work as Laboratory Manager for a wastewater authority. Since 2004, he has worked for the Virginia Department of Environmental Quality. In 2008 James became the agency's Quality Assurance Coordinator. James evaluates monitoring data used by the DEQ to ensure it is valid to make accurate water quality assessments. He also provides technical assistance for citizen water quality volunteers. Outside of work, James is as a Director of the Henricopolis Soil and Water Conservation District.

USE OF LONG-RANGE, LOW-POWER NETWORKING TO ENHANCE WATER-QUALITY AND QUANTITY MONITORING AND MODELING.

Joseph Bell; jmbell@usgs.gov; USGS

Coauthor: David Coyle, USGS

Session: It's All About the Models; Classroom 1, 3:30–4:30

Rapid advances and decreasing costs in environmental sensing systems technology are promoting a shift from discrete, single-mission observation stations toward cost-effective, high-fidelity ecosystem monitoring networks. Specific to Maryland and areas in and around the Chesapeake Bay watershed, this shift is driven by a need for fit-for-purpose monitoring across water bodies of varying scale such as first-order, non-tidal streams or expansive coastal waterways. This presentation will provide an overview of how long-range, low-power networking (LoRaWAN©, Internet of Things) is being used in conjunction with traditional methods to augment the monitoring and modeling needs of the United States Geological Survey and stakeholders alike. Additionally presented are practical examples of how these next-generation monitoring networks may be applied to stream restoration or large-scale Chesapeake Bay water-quality and quantity monitoring and modeling efforts.

Joseph Bell works with the USGS Hydrologic Networking Branch out of the Baltimore, MD office.

MELANISTIC AND MUCOID SKIN LESIONS OF SMALLMOUTH BASS

Vicki S. Blazer; vblazer@usgs.gov; U.S. Geological Survey

Coauthors: Luke Iwanowicz, U.S. Geological Survey; Adam Sperry, U.S. Geological Survey; Geoffrey Smith, Pennsylvania Fish & Boat

Session: Fish Disease - Lesions and Tumors and Popeye, Oh My! Room A-300, 10:30–12:00

The health of smallmouth bass in the Potomac and Susquehanna Rivers has been a concern of resource management agencies and anglers for many years. Annual large-scale mortality events of adult bass and other species occurred from 2003-2009 in various stretches of the Potomac, while young-of-year mortalities were observed in the Susquehanna. In more recent years, external and internal lesions continue to be observed and may indicate low chronic mortality is occurring. Two skin lesions observed in both rivers are non-raised, melanistic areas and slightly raised mucoid lesions. Temporal and spatial variations in prevalence have been documented between 2013–2019. During fish health assessment studies pieces of lesions as well as normal skin were preserved for microscopic pathology and molecular analyses. RNAseq analyses of normal and melanistic skin identified three unique sequences in the melanistic areas. Two were unidentified and one identified as a viral helicase. Further sequencing led to the discovery of novel viruses in the adomavirus family in both lesion types. Histology and gene expression findings will be presented. Microscopic pathology of the melanistic areas primarily showed a proliferation (or migration) of melanocytes in (to) the epidermis. In the mucoid lesions there was a proliferation of epithelial cells.

Vicki Blazer is a research fishery biologist with the National Fish Health Research Laboratory of US Geological Survey, Leetown Science Center in Kearneysville, WV. She is also an adjunct faculty member of West Virginia University and Penn State. She received a BS in Marine Science from Southampton College of Long Island and a PhD from the University of Rhode Island. Her main research interests are fish health, its relationship to environmental stressors, primarily chemicals of emerging concern and the effects of multiple stressors on fish populations.

DEEP CREEK LAKE: A CASE STUDY IN AQUATIC INVASIVE SPECIES CONTROL, EDUCATION, PREVENTION AND MONITORING

Julie Bortz; julie.bortz@maryland.gov; Maryland Department of Natural Resources

Coauthor: Seth Metheny, Maryland DNR- Maryland Parks Service

Session: Aquatic Invasive Species: Then and Now; Classroom 2, 1:30-3:00

In the fall of 2013, Maryland Department of Natural Resources' biologists found Hydrilla verticllata (an invasive aquatic plant) in Deep Creek Lake, Maryland. Because of the competitive nature of the plant and potential ecological and economic impacts of the aquatic invasive species (AIS) on the lake, the state acted quickly to control the population. This presentation will discuss the actions taken locally and at the state level in response to this finding as well as efforts to prevent further introductions of AIS into Deep Creek Lake and Maryland's waterways. Some of the response efforts include legislative bills that have been introduced, herbicide control efforts currently underway to treat the population, educational and prevention efforts concerning aquatic invasive species, and monitoring for the early detection of aquatic invasive species. While efforts at Deep Creek Lake represent great strides in AIS control, education, prevention and monitoring, potential recommendations for future work and improved collaboration at the local, state and regional level will also be discussed in an effort to further AIS prevention and education locally and statewide.

Julie is a Natural Resource Biologist with the Maryland Department of Natural Resources, Resource Assessment Service. Julie works primarily at Deep Creek Lake on aquatic invasive species, submerged aquatic vegetation, and water quality efforts in the lake and tributaries. Julie is also the Department's Representative to the Administrative Council, which works collaboratively to implement the Deep Creek Lake Watershed Management Plan. She has an undergraduate degree in Natural Resource Management from the University of Maryland and graduate degree in Environmental Science and Policy from Johns Hopkins University. Julie has 20+ years working in in applied research, science and education.

PANEL: WHAT'S NEXT FOR AIS? PANEL DISCUSSION AND RECOMMENDATIONS MOVING FORWARD TO CONTROL AQUATIC INVASIVES

Julie Bortz; julie.bortz@maryland.gov; Maryland Department of Natural Resources

Session: Aquatic Invasive Species; Room 300, 10:30-12:00

Scientists and managers currently working on AIS control, research and management issues will discuss current efforts to control aquatic invasive species at the local, state and national level along with recommendations to improve the management of AIS. Possible topics to discuss may include developing additional funding mechanisms for AIS research and control as well as increased collaboration and communication at the local, state and national level. Additional topics might include the future of AIS, with respect to climate change and how do we plan for those changes.

Julie is a Natural Resource Biologist with the Maryland Department of Natural Resources, Resource Assessment Service. Julie works primarily at Deep Creek Lake on aquatic invasive species, submerged aquatic vegetation, and water quality efforts in the lake and tributaries. Julie is also the Department's Representative to the Administrative Council, which works collaboratively to implement the Deep Creek Lake Watershed Management Plan. She has an undergraduate degree in Natural Resource Management from the University of Maryland and graduate degree in Environmental Science and Policy from Johns Hopkins University. Julie has 20+ years working in in applied research, science and education.

DOWNPOUR DYNAMICS: NITRATE EXPORT DURING STORM EVENTS

Joel Bostic; jbostic@umces.edu; University of Maryland Center for Environmental Science - Appalachian Lab

Coauthors: David Nelson, University of Maryland Center for Environmental Science - Appalachian Lab; Keith Eshleman, University of Maryland Center for Environmental Science - Appalachian Lab; Scott McKinstry, Frostburg State University

Session: Nutrients and Their Unintended Consequences; Room A-300, 1:30–3:00

Intense precipitation events could alter the amount and source(s) of nitrate (NO_3) exported from watersheds. However, this topic is poorly understood, which impedes projections of NO_3 export dynamics in response to projected increases in storm-event frequency. To assess storm NO_3 export dynamics, high-frequency samples were collected during eight storm events, in addition to monthly baseflow samples, in 2018-2019 from two watersheds, Gwynns Falls (GWN) and Gunpowder Falls (GUN), in Baltimore County, Maryland. Samples were analyzed for concentrations and isotopes ($\delta^{15}N$ and $\Delta^{17}O$) of NO_3 and oxygen isotopes of water ($\delta^{18}O$-H_2O). Concentration data indicate dilution of NO_3 during storm events across watersheds. Preliminary results show greater ranges of $\delta^{15}N$ and $\Delta^{17}O$ in GWN than GUN during storms, which suggests relatively greater variation in NO_3 sources in GWN. Additionally, the proportion of event water (inferred from $\delta^{18}O$-H_2O) in total storm runoff was relatively greater in GWN and, across both watersheds, was positively correlated with the proportion of unprocessed atmospheric NO_3 in total NO_3 loads. These initial results suggest that the more development and impervious surface impacts both water and atmospheric NO_3 transport to streams during storm events. The complete dataset will be presented to more fully assess NO_3 source and water flow path dynamics during these events.

Joel Bostic is a Ph.D. student at UMCES Appalachian Lab studying watershed nitrogen export dynamics across varying land uses and during storm events using isotopes as a tool to infer nitrogen sources and water flow paths. Joel holds a M.S. in Marine Science from the University of South Carolina and a B.S. in Science Education from Western Carolina University.

FROM COLORING BOOKS TO FIELD JOURNALS: THE EVOLUTION OF OUTREACH MATERIALS

Dionna Bucci; dionna.bucci@fairfaxcounty.gov; Fairfax County, VA Stormwater Management

Session: Citizen Science and Education; Room A-307, 1:30–3:00

Fairfax County seeks to inspire students to become environmental stewards by connecting them to their local watershed and the Chesapeake Bay. To this end, the Watershed Education and Outreach Section (WEO) offers several free programs and specialized tools to Fairfax County Public Schools (FCPS). In 2009, WEO developed their first outreach material: a coloring book. While this tool was great for public education, it didn't meet teachers' needs for materials that connected directly to school curricula. To tackle this problem, in collaboration with FCPS curriculum writers and stewardship groups, WEO created a Fairfax County Field Guide and then a Field Journal for use in 4th and 9th grade classrooms. The Journal allows WEO messages to reach over fifteen thousand students and provides a tool to connect students to nature while also addressing state-mandated standards of learning. This evolution of pre-existing education materials allows students across grade levels to: learn about their watershed and the importance of stormwater management, learn about and apply science curriculum skills and concepts, and get outside to connect with, explore, and protect their natural world. The Field Journal is also not only applicable locally, but easily transferable to other jurisdictions across the country to assist with environmental awareness and foster environmental stewards.

Dionna Bucci has been a Freshwater Ecologist with Fairfax County, Stormwater Management since 2019, and has degrees in Biology and English from St. Mary's College of Maryland. As an Ecologist, her duties include stream insect and fish surveys, bacteria sampling, and field assessments of habitat and water quality. She has also played an integral role in the development of the County's new Stream Physical Assessment program. Dionna has a passion for working with students and teachers to help promote the importance of stormwater management and clean water.

REVIEW OF MARYLAND MS4 MONITORING DATA AT THREE PILOT LOCATIONS

Deb Caraco; dsc@cwp.org; Center for Watershed Protection (CWP)

Coauthors: Rikke Jepsen, Interstate Commission on the Potomac River Basin (ICPRB); Lisa Fraley-McNeal, CWP; Katherine Slater, Maryland Department of the Environment; Claire Buchanan, ICPRB; Andrea Nagel, ICPRB

Session: Stormy Weather! What's New with Stormwater Management? Room 111/113, 10:30-12:00

As a part of Maryland's Phase I MS4 permit, regulated communities have been collecting water chemistry data for more than 20 years. Taken together, these data include approximately 5,000 sampling events of chemical and flow parameters taken from 69 monitoring locations. This pilot study focused on monitoring stations in three locations: Peter Pan Run in Frederick County, Moore's Run in Baltimore City, Airpark Business Center in Carroll County, and Urbana in Frederick County.. At each location, monitoring data were collected at both an instream site and a paired upstream outfall location. In addition, land cover data paired with a record of BMP implementation were used to characterize land cover change over time in each drainage area. At each station, the project evaluated data to answer the following questions: 1) Are the data of sufficient quality to detect changes in pollutant concentration over time and; 2) Have restoration activities in Maryland reduced pollutant concentrations in urban catchments? The study utilized both parametric and non-parametric methods to detect change, and the results help to identify the best methods for evaluating data at other monitoring stations in MDE's MS4 database.

Deb has worked at the Center for Watershed Protection since 1996, and during that time spent a few years working with the New York State DEC on their stormwater program and regulations, and as a design engineer with T.G. Miller Engineers in Ithaca, NY. She started her career working with ICPRB as an agricultural engineer. Her areas of interest include stormwater management, illicit discharge management, watershed modeling, data analysis, and applying research to help both private and governmental watershed stewards improve the health of our water resources.

HARMFUL ALGAL BLOOM MONITORING AT T. HOWARD DUCKETT AND TRIADELPHIA RESERVOIRS, PATUXENT RIVER, MARYLAND 2015–2019

Martin Chandler; martin.chandler@wsscwater.com; WSSC

Coauthor: Priscilla To, PhD – WSSC Water

Session: Harmful Algal Blooms; Classroom 1, 10:30–12:00

Starting in 2015, WSSC Water has developed a comprehensive monitoring program for Harmful Algal Blooms (HABs) at its Patuxent River reservoirs. The program focused initially on detection of algal toxins in paired samples of raw and finished water at the Patuxent Water Filtration Plant, Laurel MD. However, with the capability of conducting in-house algal speciation at WSSC Water's Laboratory, considerable additional information is now being learned about the algal populations and their typical seasonal bloom and decay cycles. A drinking water response plan was developed and refined during the 2015-2017 HAB monitoring seasons, with the goal of collecting reliable results in a minimum timeframe. In addition to monitoring parameters and frequencies, this presentation will share resources, suggested treatment process sampling points and bench-scale tests that are useful in understanding treatability of algal toxins. The 4th Unregulated Contaminant Monitoring Rule (UCMR) program was conducted at both WSSC Water's filtration plants in 2018, and has been continued subsequently to comply with Maryland State law. UCMR4 sampling focused on nine algal toxins in finished drinking water only. To date, while trace detections of microcystin have been observed in raw water, commonly near the end of blooms as cyanobacteria die off and intracellular toxins are released, no toxins have been detected in finished (treated) drinking water. Also since 2018, an enhanced upstream HAB monitoring program has been conducted at both the T. Howard Duckett and Triadelphia Reservoirs to determine algal population occurrence patterns, cell concentrations, algal species, and toxins. Recreational and human contact areas on the two reservoirs have also been monitored, and a response plan for posting Water Contact Advisories or Warnings is now in place. The recreational contact plan was activated in 2019 when very high algal cell counts were reported, and monitoring frequency was increased to track the peak and decline of the blooms.

Martin Chandler is a Senior Scientist with WSSC Water, where he manages the pollution prevention program and supports drinking water source protection, including reservoir monitoring

LANDSCAPE CHANGES AS SIGNALS OF WATERSHED VULNERABILITY AND RESILIENCE

Peter R. Claggett; pclaggett@usgs.gov; U.S. Geological Survey

Coauthors: Labeeb Ahmed, Attain LLC, Sarah McDonald, USGS

Session: Vital Signs of Watershed Health; Room A-307, 10:30–12:00

he concepts of vulnerability and resilience are intertwined. A stream is vulnerable if it and/or its' watershed are exposed to threats and susceptible to impact from them. A stream is resilient if it is either un-impacted by threats or quickly recovers from impact (e.g., streams in carbonate landscapes are more resilient to degradation from atmospheric acid deposition). Stream impacts of greatest concern are those that directly and adversely affect the health aquatic communities and the physical and chemical conditions required to support them. For example, the development of impervious surfaces in a watershed can increase the frequency and magnitude of peak flows resulting in stream bed and bank erosion, degrading habitat for benthic macroinvertebrates and fish spawning. The Chesapeake Bay Program Partners have begun monitoring landscape change every four years at 1-meter spatial resolution. In addition, they are overseeing the development of detailed hydrography data that will enable new ways of understanding and relating landscape change to changes in stream health. These data and analyses, together with information from the Chesapeake Healthy Watersheds Assessment and forecasts of future land use, management, and climatic conditions will form the basis for assessing watershed vulnerability and resilience.

Mr. Peter R. Claggett is a Research Geographer with the U.S. Geological Survey where he characterizes and simulates trends in land conditions. Mr. Claggett received a Bachelor's degree in Environmental Sciences from the University of California at Berkeley, and two Master's degrees from Miami University of Ohio, one in Environmental Science and the other in Geography. He is currently enrolled in the PhD program in Geography and Environmental Systems at the University of Maryland, Baltimore County. He started his career as a US Peace Corps Volunteer followed by work at the U.S. Environmental Protection Agency and the Canaan Valley Institute.

STREAMLINE THE LIFECYCLE OF YOUR DATA

R. John Dawes, Jr; dawes@chesapeakecommons.org; The Commons

Session: Understanding and Visualizing Big Data; Bridge Room, 3:30–4:30

Your data is more valuable than ever. Have yellowed data collection sheets jammed in a cabinet or stowed away gathering digital dust? Don't let data languish or get lost to a third party portal. This workshop is for you. Your hard-earned data are integral to drive change, educate your community, and motivate investment in improving your waterways. A picture tells a thousand words, an annual scorecard tells a compelling story, but a live interactive map displaying monitoring station scores or estimated load reductions daylights the daily reality of your river and your efforts to all inquiring audiences.

Participants will learn a new, easy-to-deploy process to collect, manage, and visualize data that has been adopted by groups with capacities ranging from a few retired volunteers to programs staffed by in-house scientists. Using a multi-year water quality monitoring dataset as the example and Water Reporter as the software platform, users will leave with a new skills to showcase interactive monitoring maps alongside integrated data from online sources such as USGS's NWIS and hardware such as the Stroud's Mayfly Data Logger. Learn best practices for managing data and investing in your data as a communication tool.

John is the lead for project strategy with a focus on system design and product development for The Commons. John grew The Commons into a nonprofit that delivers leveraged products and digital services to organizations working to improve water quality. Prior to founding the Commons, John worked at Environmental Integrity Project as a Research Analyst, mapping the proximity of drinking water wells to hazardous coal ash impoundments. John holds a B.A. in Environmental Policy from Juniata College and a M.S. in Geographic Information Systems (GIS) from Johns Hopkins University. He is a self-taught front-end software developer and is passionate about all outdoor activities.

STATE OF MARYLAND PLAN TO ADAPT TO SALTWATER INTRUSION AND SALINIZATION

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

Session: Salt Life: Not Just A Coastal Thing! Bridge Room, 1:30–3:00

Under Chapter 628 of the 2018 Laws of Maryland, the state legislature tasked the Maryland Department of Planning (Planning) to "establish a plan to adapt to saltwater intrusion", in consultation with the Maryland Departments of Natural Resources, Environment and Agriculture, by Dec. 15, 2019, and to update the plan at least once every 5 years. The plan is organized by each resource understood to be impacted by saltwater intrusion or salinization in Maryland, including groundwater aquifers, surface waters, agriculture, wetlands, coastal forests, and infrastructure. Each chapter describes the following for each resource: The scientific context for how saltwater moves within the physical environment and how it impacts different resources; The current knowledge of impacts, threats, and concerns regarding saltwater intrusion and salinization, and how climate change is expected to worsen those threats and concerns over time; Additional research recommended, based on current understanding of knowledge gaps; and Possible adaptation strategies.

No bio submitted

GEMSTAT: A UNIFIED GLOBAL WATER QUALITY PORTAL

Steve Elgie; stephen.elgie@kisters.net; KISTERS North America

Coauthors: Frank Schlaeger, KISTERS Aachen Germany; Matt Ables, KISTERS North America

Session: Understanding and Visualizing Big Data; Bridge Room, 3:30–4:30

The United Nations Global Environment Monitoring System Water Program (GEMS/Water) has a mission to support global, regional, and national environmental assessments and report on the state and trends of water resources. This presentation provides a background and technical overview of this program and the database / portal used to quality assure, store, and display these international datasets.

Steve Elgie is the KISTERS North America regional manager for Canada and the north eastern seaboard of the United States. He has an extensive background in surface / groundwater quality monitoring networks and modelling, and has implemented many State and Provincial water quality management platforms. In his free time he is collaborating with several Canadian agencies to develop a standardized and fully integrated data sharing network for continuous hydrometric, climate, water quality, and biology datasets.

EVALUATING THE EFFECTIVENESS AND SUSTAINABILITY OF NOVEL STREAM RESTORATION DESIGNS FOR COASTAL PLAIN STREAMS IN MARYLAND: INTEGRATING EXISTING AND NEW DATA FROM RESTORATION MONITORING

Solange Filoso; filoso@umces.edu; UMCES

Session: Stream Restoration Monitoring II; Auditorium, 1:30–3:00

Small streams constitute about two-thirds of fluvial drainage networks and exert a strong influence on the condition and functioning of downstream waters. Because of that, efforts to improve the health of Chesapeake Bay emphasize improving the functional capacity of small order streams to moderate the transport of water, sediment and nutrients and sediment from the landscape to downstream waters. In the past decade in Maryland, several different stream restoration projects focused on nutrient and sediment load reduction have been monitored and evaluated for performance, but results have been mixed. In this project, monitoring data obtained with comparable methods were compiled and expanded to assesses performance variability among different restoration projects and explore the influence of potential explanatory factors. Key potential factors included position of the restoration project in the watershed, percent imperviousness in the drainage area, and the relative contribution of sediment and nutrient annual loadings in baseflow versus storm flows. Results show that, despite the limited number of stream projects with comparable monitoring datasets included in the analyses (n=10), effectiveness patterns have emerged. Restored streams positioned at the top of the watershed performed consistently better than lowland channels at the bottom of the watershed, especially for reducing loads of total suspended solids (TSS). Performance among lowland channels was more variable but, when effective, lowland channels reduced loads of substantial magnitude. In the future, as more data from comparable monitoring studies become available, analyses can be expanded to increase robustness and examine the influence of additional factors such as restoration approaches and age.

Solange Filoso is an ecosystem ecologist with expertise in the biogeochemistry and hydrology of freshwater ecosystems. She is an Associate Research Professor at the University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, and much of her research in recent years has focused on evaluating the effectiveness of stream and wetland restoration at improving the quality of water transported downstream to tributaries and into Chesapeake Bay. She also has extensive experience developing programs to measure and evaluate the impacts of watershed management projects on water quality and quantity. Overall, the main objective of her research is to contribute with science based information that can help enhance our ability to protect and restore watersheds and aquatic ecosystems.

USGS NEXT GENERATION WATER OBSERVING SYSTEMS

Mary Kay Foley; mkfoley@usgs.gov; USGS

Session: Remote Sensing and the Bay; Classroom 3, 1:30-3:00

The USGS NexGen Water Observing System (NGWOS) is a new program to bring an integrated set of fixed and mobile assets, in the water, on the ground, and in the air to ten watersheds in the United States. NGWOS will measure, collect, and deliver data that can help address water resource challenges and decision-making needs of the future. The density of our current monitoring networks limit the ability to accurately understand and predict water resource conditions with advanced models. The NGWOS effort was piloted in the Delaware River Basin and included 17 new streamgages, enhancements to 28 gages including adding specific conductivity, temperature, new two-way communication, and web cameras. NGWOS Delaware River is also creating innovation spots to conduct research on new monitoring methods. NGWOS will augment the existing networks in these regions to allow more accurate predictions of streamflow, aquifer levels, and water quality conditions at unmonitored locations. Basin selection will be a combination of quantitative selection based on watershed characteristics, input from USGS Regions and Water Science Centers, and stakeholder input. The USGS MD-DE-DC, VA/WVA, and PA Water Science Centers have proposed the Potomac River as a future NGWOS basin. Selections are expected in 2020.

Center Director of the US Geological Survey Maryland-Delaware-DC Water Science Center (WSC). Mary Kay joined the USGS in 2015 after twenty three years with the US Army. She received her Bachelor's and Master's Degree in Civil Engineering from SUNY Buffalo, and is a licensed Professional Engineer and certified Project Management Professional. Before joining the USGS, Mary Kay spent eleven years with the US Army Corps of Engineers (Buffalo District) working as hydrologist, project engineer, and project manager. She spent twelve years working for the Army in Germany.

A STATISTICAL MODEL TO DETERMINE THE ABSENCE OF FRESHWATER MUSSEL HABITAT: OPPORTUNITIES FOR WRITING BIOLOGICALLY APPROPRIATE AMMONIA WQBEL

Timothy Fox; tim.fox@maryland.gov; Maryland Department of the Environment

Session: Freshwater Mussels: An Environmental Indicator's Growing Influence on Environmental Policy; Classroom 2, 10:30–12:00

The United States Environmental Protection Agency proposed updated ammonia criteria in 2013. These updated criteria are more stringent than the previous national criteria partly because they incorporated toxicity data from several sensitive freshwater mussel species in the Family Unionidae (and other gastropods) that had not previously been available. An analysis of over 2000 Maryland Biological Stream Survey (MBSS) sampling events has shown that freshwater mussel distribution in Maryland is not uniformly distributed, and can be predicted based on abiotic stream characteristics. Using the MBSS database, MDE identified a logistic regression model that estimates the probability of observing freshwater mussels given certain abiotic factors. When compared to actual data, the model does a poor job of predicting when freshwater mussels are present. However, nearly all streams with a predicted probability of below 0.03 had no mussel observations. So the model does well when used to predict the absence of freshwater mussels. MDE is considering using the logistic regression model as a tool to identify receiving streams that do not provide freshwater mussel habitat and potentially allow permit writers to use a "mussel absent" WQBEL when justified.

Timothy Fox has worked in the Environmental Assessment and Standards Program of the Maryland Department of the Environment for 10 years. He received a Bachelor of Science in zoology and minor in chemistry from the University of Maine and a Master of Arts in Marine Affairs from the University of Rhode Island. Mr. Fox also received a Master of Oceanography from the University of Rhode Island and a Graduate Certificate in Applied Statistics from Pennsylvania State University.

THE EFFECT OF AERATORS ON WATER QUALITY IN IMPOUNDMENTS IN TWIN LAKES STATE PARK

Irene Frentz; irene.frentz@dcr.virginia.gov; Virginia Dept. of Conservation and Recreation, Div. State Parks

Session: Nutrients and Their Unintended Consequences; Room A-300, 1:30–3:00

Goodwin Lake and Prince Edward Lake in Twin Lakes State Park (Prince Edward County, Virginia) are both stratified during the growing season, with decreasing dissolved oxygen concentrations in the epilimnion as the season progresses. This decrease is most likely associated with increasing temperatures, rather than algal blooms. As the shallow epilimnion of both lakes and their warm temperatures can place a significant amount of stress on fish, Twin Lakes State Park placed a Vertex bottom aerator with four submerged stations in Goodwin Lake in February 2015 and with eight submerged stations in Prince Edward Lake in July 2017. Monthly water quality monitoring during the growing seasons between 2013 and 2018 allowed for development of oxygen and temperature depth profiles, and demonstration of the effect of aerators on dissolved oxygen and temperature. As a result of the aerators, mixing increased in both lakes, with the thermocline retreating to a larger depth.

Irene Frentz has been the District Resource Specialist for the Central Virginia Region of Virginia State Parks since 2005. Among her various resource management responsibilities, water quality monitoring is a favorite. She obtained a bachelor's degree in microbiology from Indiana University, a master's degree in natural resources and environment from the University of Michigan, and a Ph.D. in environmental dynamics from the University of Arkansas.

WHY DOES MARYLAND NEED A REGIONAL GROUNDWATER MODEL?

Emelia Furlong; emeliaa.furlong@maryland.gov; Maryland Geological Survey

Coauthors: David Andreasen, Maryland Geological Survey; Andrew Staley, Maryland Geological Survey

Session: Groundwater; Room A-300, 3:30–4:30

The Maryland Geological Survey has developed numerical groundwater-flow models to assist local and county governments with estimating the water-supply potential of aquifers in Maryland's coastal plain, mapping areas contributing recharge to wells, and monitoring saltwater intrusion. However, an up-to-date and comprehensive groundwater-flow model of the entire coastal plain aquifer system is needed to assess the cumulative effects of withdrawals across the region. Such a model was envisioned as part of a science plan developed to address the recommendations of the Advisory Committee on the State's water resources (Wolman Commission). Groundwater resource managers need more comprehensive, robust, and interactive tools than are currently available to assess overall sustainability of groundwater resources. Water managers and planners also need to understand where and when groundwater withdrawals might reduce streamflow (baseflow), induce changes in groundwater quality (saltwater intrusion), or create other issues (well interference, excessive pumping levels, land subsidence) that could constrain the use of water. A regional groundwater-flow model that is accessible, regularly updated and calibrated could assist water resource planners to better insure a sustainable future for our critical groundwater resource and to address potential impacts of climate change.

Dr. Furlong received her PhD in Geochemistry from the California Institute of Technology. Following this, she joined the faculty of the Geology Department at Cal State Los Angeles where she supervised graduate research and taught hydrogeology and oceanography for three years. After a professional hiatus to raise three children with her husband Dave, she served for four and one-half years as a geologist and permit writer in the Water Supply Program at the Maryland Department of the Environment. She is currently employed as a geologist in the Hydrogeology and Hydrology Division of the Maryland Geological Survey.

A PROGRESSIVE BROOK TROUT CONSERVATION FRAMEWORK: DEVELOPING A STATEWIDE CONSERVATION STRATEGY TO ENSURE RESTORATION EFFORTS HAVE LONG LASTING EFFECTS TOWARDS MEETING FISHERIES MANAGEMENT PLAN AND CHESAPEAKE BAY AGREEMENT GOALS

Daniel Goetz; danielb.goetz@maryland.gov; MD DNR

Coauthors: Alan Heft, MD DNR; Matt Sell MD DNR

Session: From Alewife to Brook Trout: The Importance of Healthy Fish Communities; Classroom 1, 1:30–3:00

Brook trout are an indicator species for stream health and water quality. However, climate change projections and current land use practices pose extensive risks for brook trout across Maryland. A recently completed Maryland Department of Natural Resources (MD DNR) statewide five year (2014-2018) survey of all known brook trout occupied streams revealed a 27% decline during the last 30 years. Recent research studies have estimated that current land use practices in the Chesapeake Bay watershed coupled with a warming climate could result in a further 45% decline in brook trout occupied streams. Brook trout conservation is a land use/management issue and conventional fisheries management practices will not address the conservation needs alone. Given limited staff resources and funding the MD DNR's Freshwater Fisheries division has developed a strategic plan that prioritizes brook trout watersheds for conservation work where they are most resilient to climate change and other stressors. This effort will require strong partnerships with local, state, and federal governments as well as nonprofit organizations and landowners to accomplish these conservation goals. Additionally, development of a statewide strategic brook trout conservation plan will also benefit Maryland's efforts towards meeting the Brook Trout Outcome of the Chesapeake Bay Agreement.

Dan has been the statewide operations manager for MD DNR freshwater fisheries since January of 2019. He oversees the Brook Trout program which is run by Alan Heft and Matt Sell. They are in the process of implementing an action plan to address the threats Brook trout are facing in MD. He has a B.S. in Fisheries Biology from Mansfield University of Pennsylvania and a M.S. in Fisheries Science from Mississippi State University. Prior to his role with MD DNR he was a district fisheries biologist for VDGIF in Farmville, VA for five years. Dan resides in Adams county PA with his wife and three girls.

CHASING COMPLIANCE: BALTIMORE'S USE OF IDDE METHODS FOR BACTERIA TMDL COMPLIANCE

Kimberly Grove; Kimberly.Grove@baltimorecity.gov; City of Baltimore: Office of Compliance and Laboratories

Coauthor: Van Sturtevant, City of Baltimore: Office of Compliance and Laboratories

Session: Pollution Detectives: Bacteria Monitoring and Tracking; Room A-111/113, 3:30–4:30

The Severn River Association proposes a presentation about how we created our water quality monitoring program to collect weekly data from 41 stations in the Severn River. Our program relies heavily on recruiting and training volunteer citizen scientists to get a firsthand look at their river. We train volunteers to use YSI monitors and to follow our WQ protocol as they help out with the WQ tours. Our team approach, which has achieved Tier 2 certification with the Chesapeake Monitoring Cooperative, relies on: volunteer boat captains, a Team Leader to collect WQ data and lead each tour, 2 or 3 water quality crew members to deploy the YSI and Secchi gear during our visits to 41 stations on the Severn River. This approach has the advantage of training and educating about 25 volunteers who can and do share their experiences with friends and neighbors, which then helps raise community awareness of river conditions. We have three tours a week to cover the entire river, each about 3 to 4 hours on a weekday morning. SRA also provide the educational outreach component, taking pictures during tours and sharing data and pictures via social media posts from the river as well writing stories for the SRA newsletter and website.

Kimberly Grove is a professional engineer, whose 20+ years of experience has spanned the spectrum of civil engineering. A graduate of the Florida Institute of Technology, Ms. Grove spent most of her career as a private engineering consultant working throughout the Southeast and mid-Atlantic region, until she joined Baltimore City Department of Public Works in December 2010. Ms. Grove currently serves as the Chief for the Office of Compliance and Laboratories, which is committed to enhancing environmental regulatory compliance for the Department through collaboration, management program improvements, and regulatory enforcement. Ms. Grove serves as the liaison to MDE for the City's MS4 permit. Van Sturtevant works for the Baltimore City Department of Public Works' Office of Compliance- Water Quality Monitoring and Investigation Section. After graduating from Morgan State University with a BS in Biology, Mr. Sturtevant has worked as a pollution control analyst (field scientist) for DPW for over 25 years. He was recently promoted to supervisor last year. He helped developed the pollution source tracking system and protocols currently used by the City.

THE EFFECT OF RUNOFF INDUCED TEMPERATURE CHANGE ON THE PHYSIOLOGICAL PERFORMANCES OF URBAN AND RURAL BLACKNOSE DACE (RHINICHTHYS ATRATULUS)

Danielle Gruber; dgrube1@students.towson.edu; Towson University

Coauthors: Jay Nelson, Towson University

Session: From Alewife to Brook Trout: The Importance of Healthy Fish Communities; Classroom 1, 1:30–3:00

Urbanization has resulted in an increase in impervious surface cover (ISC) and decrease in vegetation surrounding waterways. As the amount of vegetation decreases, less precipitation is able to infiltrate the ground, leading to an increase in the volume of water entering streams. Lack of shading and an increase in heat-absorbing surfaces leads to warmer summer runoff and elevated stream temperatures. Changes in water temperature can alter the ecology of streams and impact the resident fish populations. The eastern blacknose dace, Rhinichthys atratulus, is a species of fish with an ability to succeed in degraded urban streams as well as rural and suburban streams. In this study, the thermal tolerance, oxygen consumption, and swimming performance of urban and rural blacknose dace, were tested after the fish were subjected to temperature pulses to determine if urban populations have developed adaptations to deal with these extremes in temperature. The blacknose dace's ability to cope with extremes in temperature may provide insight into fish populations' resiliency to increasing temperatures and magnitude and frequency of rain events due to climate change. Determining how different fish species have responded to these changes can help drive resource management and environmental regulations.

Danielle Gruber is an Environmental Science and Policy graduate student at Towson University researching how fish respond to changes in their environment. She obtained her undergraduate degree in Environmental Science from the University of Delaware and is currently a scientist at KCI Technologies in Delaware, specializing in water quality and storm water management.

CITIZEN SCIENCE APPROACH TO WQ COLLECTION

Thomas Guay; ECAlert@gmail.com; Severn River Association

Session: Citizen Science and Education; Room A-307, 1:30–3:00

The Severn River Association proposes a presentation about how we created our water quality monitoring program to collect weekly data from 41 stations in the Severn River. Our program relies heavily on recruiting and training volunteer citizen scientists to get a firsthand look at their river. We train volunteers to use YSI monitors and to follow our WQ protocol as they help out with the WQ tours. Our team approach, which has achieved Tier 2 certification with the Chesapeake Monitoring Cooperative, relies on: volunteer boat captains, a Team Leader to collect WQ data and lead each tour, 2 or 3 water quality crew members to deploy the YSI and Secchi gear during our visits to 41 stations on the Severn River. This approach has the advantage of training and educating about 25 volunteers who can and do share their experiences with friends and neighbors, which then helps raise community awareness of river conditions. We have three tours a week to cover the entire river, each about 3 to 4 hours on a weekday morning. SRA also provide the educational outreach component, taking pictures during tours and sharing data and pictures via social media posts from the river as well writing stories for the SRA newsletter and website.

Thomas Guay serves as Program Office for the Severn River Association, the nation's oldest river group, founded in 1911. He's been with SRA in this capacity since March 2017, when he became the group's first ever employee. Prior to 2017, Tom served on SRA's board of directors and as SRA's communication director from 2013-2017. Before joining SRA, Tom spent 20 years as a Capitol Hill reporter covering environmental issues and publishing newsletters advising industrial and government facilities about regulatory, permitting, compliance and legal issues related to implementation of the Clean Air Act, Clean Water Act and the hazardous waste law.

MDOT SHA'S TOOL FOR PROACTIVELY MANAGING CRITICAL TRANSPORTATION INFRASTRUCTURE

Elizabeth Habic; ehabic@mdot.maryland.gov; Maryland Department of Transportation, The Secretary's Office

Session: Climate Resiliency; Bridge Room, 10:30–12:00

The presentation will highlight an ArcGIS online tool called the MDOT SHA Climate Change Vulnerability Viewer (CCVV). The viewer displays models and scores on climate vulnerability to include a statewide analysis of bridges and structures using the Vulnerability Assessment Scoring Tool (VAST), a Federal Highway Administration resource. VAST scores have been calculated for bridges/structures statewide and are displayed with indicator descriptions in a geographical database for agency review of vulnerability and risk prior to project planning. The CCVV provides a single location for all vulnerability data and is continuously being updated as new requirements and demands arise. This viewer supports a suite of practical strategies that the MDOT SHA is taking to ensure that processes in offices across the organization are accounting for potential climate change risks and building resilience into their decision-making. This includes risks related to sea level change, potential storm surge, and inland flooding related to changing precipitation. More significantly, MDOT SHA also strove to “mainstream” consideration of these risks into the myriad project development, asset management, operations, and other decisions the agency makes on a day-to-day basis. The goal of this effort is to enable the organization to proactively manage climate risks to the transportation system.

Elizabeth Habic is the Climate Risk and Resiliency Program Manager at the Maryland Department of Transportation’s Secretary's Office. Elizabeth has worked with MDOT in various capacities since 2002 and has been a climate change program manager since the Maryland Climate Action Plan was initiated in 2008. Elizabeth led the 2013-2014 FHWA climate adaptation pilot and completed the “Climate Change Adaptation Plan with Detailed Vulnerability Assessment” for the MDOT State Highway Administration. Most recently Elizabeth has made the move to MDOT's headquarters to coordinate risk and resiliency assessments for all MDOT transportation business units.

QUANTIFYING THE ECOLOGICAL UPLIFT AND EFFECTIVENESS OF DIFFERING STREAM RESTORATION APPROACHES IN MARYLAND

Robert H. Hilderbrand; rhilderbrand@umces.edu; UMCES Appalachian Laboratory

Coauthors: Joseph Acord, UMCES Appalachian Laboratory; Timothy Nuttle, Civil and Environmental Consultants, Inc.; Ray Ewing, Civil and Environmental Consultants, Inc.

Session: Stream Restoration Monitoring I; Auditorium, 10:30–12:00

There is limited evidence for ecological uplift after urban stream restoration. We sampled 40 urban stream restorations across the Piedmont and Coastal Plain physiographic regions in the greater Baltimore/Washington DC Metropolitan area of Maryland. For each restoration we collected benthic invertebrates and physical attributes in restored sections, upstream unrestored sections, and downstream of the restoration. Physical aspects of streams were substantially improved by restoration activities, particularly in the Coastal Plain. Restorations stabilized streambanks and the channel, created more heterogeneous habitats, reduced fine sediments, and improved conditions for the biota. Unfortunately, the ecological aspects rarely improved despite the improved physical measures. Benthic macroinvertebrate communities in restored sections remained similar to unrestored sections on the same stream and were significantly dissimilar to MBSS Sentinel Sites. Similarly, the numerous metrics used in ecological assessments also showed a lack of response. We conclude there is little evidence that urban stream restorations can produce meaningful improvements in traditional measures of stream condition as measured with benthic macroinvertebrates. Unfortunately, the possibility of restoring the ecology of urban streams to resemble conditions of streams in lesser disturbed watersheds is limited.

Bob Hilderbrand is an associate professor at the Appalachian Laboratory in Frostburg.

ARE WE THERE YET? EVALUATING THE MONITORING TIME PERIOD REQUIRED TO DEMONSTRATE STREAM RESTORATION EFFECTIVENESS

Colin Hill; colin.hill@kci.com; KCI Technologies, Inc.

Coauthors: Mike Pieper, KCI Technologies; Mark Richmond, Howard County DPW

Session: Stream Restoration Monitoring II; Auditorium, 1:30–3:00

With support from Howard County and the Chesapeake & Atlantic Coastal Bays 2010 Trust Fund program, pre- and post-restoration monitoring was performed at the Brampton Hills stream restoration project site located in Ellicott City, Maryland. The restoration included bed and bank stabilization efforts for approximately 3,100 linear feet of stream channel in addition to outfall stabilization. Water quality sampling, both baseflow and stormflow, was performed for two years prior to restoration and for seven years post-restoration. Annual loads were estimated for total nitrogen, total phosphorus, and total suspended sediments, and compared between pre- and post-restoration loading rates to obtain estimates of load reductions. After just 3 years of post-restoration monitoring, the removal rates calculated annually began to level out and approach a consistent value that remained virtually unchanged with the inclusion of several additional years of monitoring data. With limited resources available to practitioners, knowing how long to continue monitoring to achieve the desired goals can help to maximize returns. Although not always feasible, investing more time and resources into pre-restoration monitoring can likely outweigh the returns from several additional years of post-restoration monitoring efforts.

Colin Hill is a Senior Environmental Scientist in the Natural Resources Group at KCI Technologies, Inc. Over the past 19 years, he has been performing stream and watershed assessments and studies throughout the Maryland and in numerous states across the country, with a recent focus on stream restoration monitoring. Colin is a certified Ecologist with the Ecological Society of America and holds a Master of Science degree in Environmental Sciences from Towson University and a Bachelor of Science degree in Biology from Loch Haven University.

FISH ABUNDANCE TRENDS LINKED TO INCREASING SPRING FLOWS IN THE POTOMAC RIVER

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

Session: From Alewife to Brook Trout: The Importance of Healthy Fish Communities; Classroom 1, 1:30–3:00

We present an analysis of abundance trends for 28 fish species over 43 years (1975-2017) in the Potomac River using seine-haul data collected by the Maryland Department of Natural Resources. We developed statistical trend models and applied life history theory to interpret observed abundance trends. Increasing species were characterized by opportunistic life history strategies (i.e., small-bodied species with rapid maturity; e.g., banded killifish (*Fundulus diaphanus*)), whereas decreasing species were characterized by periodic or equilibrium strategies (i.e., large-bodied species that delay reproduction to invest in growth or parental care; e.g., smallmouth bass (*Micropterus dolomieu*)). Although some increases are probably due to expansion from recent introductions, most increasing species are native to the study area. Results indicated that environmental conditions have become less stable and less predictable over time, consistent with observed increases in spring peak-flows as well as predictions from land-use and climate change research. Future research is needed to compare observed riverine fish trends with estuarian fish species trends in the Chesapeake Bay.

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

STREAM RESTORATION AND LIVING SHORELINE INSTALLATION ON TRIBUTARY OF THE MAGOTHY RIVER

Sally Hornor; sally.hornor@gmail.com; Magothy River Assn.

Coauthors: Robert Royer, Magothy River Assn.; Paul Spadaro, Magothy River Assn. President

Session: Stream Restoration Monitoring II; Auditorium, 1:30–3:00

The headwaters of Cattail Creek on the Magothy River are the site of a recently completed restoration project with a drainage area of 1517 acres, 33% of which is impervious. Pre-restoration monitoring of water quality in the creek was conducted for a year before construction and monitoring continued during construction (October to December 2018) and is continuing. The project includes a Regenerative Stream Channel, replacement of a bulkhead at the tidal interface with a living shoreline, bio-retention areas, and extensive planting of riparian vegetation. In addition, this project created or enhanced a non-tidal wetland, a tidal marsh and a small beach. This work was initiated by a Watershed Academy Steward and was funded by MD DNR's Chesapeake and Atlantic Coastal Bay Trust, Anne Arundel County Watershed Protection and Restoration Program/Chesapeake Bay Trust and the community. Water quality monitoring thus far has shown a trend of reduction in enterococci, suspended sediments and nutrients (nitrates, ammonia and phosphates) downstream of the restoration project although concentrations are highly variable and not significantly different from pre-restoration values. The first summer following completion brought a diversity of small fish into the restored stream and the growth of seeded wild celery (*Vallisneria americana*) and redhead grass (*Potomogeton perfoliatus*).

Sally Hornor received a BA in Biology at Goucher College and an MS in Microbiology and a PhD in Ecology at the University of Connecticut. She taught Microbiology and Ecology at Anne Arundel Community College for 30 years and has been involved in monitoring and ecological research on the Severn and Magothy Rivers for the past 35 years. She serves as a Vice President of the Magothy River Assn.

REMOTE SENSING OF SUBMERGED AQUATIC VEGETATION TO DETERMINE SUITABILITY OF CITIZEN SCIENCE MONITORING IN THE LOWER SUSQUEHANNA FLATS

Morgan Jones; mjones.hdgmm@gmail.com; Havre de Grace Environmental Center

Coauthor: Bruce Russell, Havre de Grace Maritime Museum

Session: The Bay's Submerged Aquatic Vegetation; Classroom 3, 10:30–12:00

Submerged Aquatic Vegetation (SAV) serves a significant role within ecosystems of estuarine and coastal areas. In the Chesapeake Bay and Lower Susquehanna, initiatives to monitor and evaluate SAV through active restoration procedures include multi-step, labor-intensive, and expensive undertaking. Environment modeling can help aid in the site- selection process as well as identify potential restoration areas or habitat areas at risk. Temporal availability of the Landsat 5 Thematic Mapper (TM) imagery provided an appropriate option to detect and assess location and density of SAVs within the Lower Susquehanna Region. The objective of this research is to review and compare SAV remote sensing techniques that can be used for multi-criteria analysis in ArcGIS. Suitability mapping through GIS techniques allows for the optimization of the relationship of enhancing SAV health while also allowing for citizen science monitoring initiatives to be concentrated in the most appropriate areas. The results of the study show that analysis of satellite imagery, combined with crowdsource observations and multi-criteria analysis, allows researchers to effectively prioritize citizen science monitoring sites for restoration and safeguarding efforts.

Morgan Jones is a geologist and geospatial analyst serving as the Environmental Center Manager for the Havre de Grace Maritime Museum. She has previous experience as an environmental chemist, field technician, and a QAQC technician specialist. Her focus is on water quality monitoring in the Upper Chesapeake Bay, geohazards management, and geospatial analysis. She has performed remote sensing assessments and facilitated environmental planning efforts on a local and international level. Currently, she is working on finishing her second master's in Geospatial Intelligence, her Environmental Engineering Certification, and will start her PH. D in the winter of 2020.

EVIDENCE OF NITRATE UPTAKE IN STEP POOL STORMWATER CONVEYANCES IN AN URBAN WATERSHED

Thomas E. Jordan; jordanth@si.edu; Smithsonian Environmental Research Center

Coauthors: Carey Pelc, Smithsonian Environmental Research Center; Sarah Giordano, Arundel Rivers Federation

Session: Stream Restoration Monitoring III; Auditorium, 3:30–4:30

We used automated flow-paced sampling to monitor concentrations and fluxes of nutrients and total suspended solids (TSS) at five points in a stream network draining an urban watershed. The stream network includes extensive step pool stormwater conveyances (SPSCs), which may enhance retention of nutrients and TSS. Comparing points entering and leaving an SPSC, we found that average nitrate concentration declined from 0.24 mg N/L to 0.07 mg N/L, indicating a retention of about 70% of the nitrate entering, while ammonium, phosphate, total phosphorus, and TSS were not retained. At a point downstream of that SPSC and downstream of a major tributary that lacked an SPSC, nitrate increased to 0.42 mg N/L, but, further downstream of additional SPSCs, nitrate dropped to 0.23 ug N/L. Nitrate concentrations also showed strong seasonal changes with the lowest concentrations in summer and the highest in winter. Ammonium showed a similar seasonal pattern at one location but not at others. Phosphate and total phosphorus concentrations did not show clear seasonal patterns. The spatial and temporal patterns of nitrate suggest that biological uptake in the SPSCs, possibly enhanced by summer hypoxia in the step pools, may play a role in reducing nitrate concentrations and fluxes.

Thomas Jordan is a Senior Scientist at the Smithsonian Environmental Research Center (SERC). He received a BS in Biology from Bucknell University, Pennsylvania; and a PhD in Biology from Boston University, Massachusetts. His research investigates the transport and transformation of nitrogen and phosphorus in ecosystems. Since starting at SERC in 1980, he has studied the sources of nutrient releases from watersheds; the uptake of nutrients by wetlands, riparian forests, and restored streams; and the fates and effects of nutrients in estuaries, especially in the Chesapeake Bay and its watershed.

WATER QUALITY MONITORING DATA STORY

Najma Khokhar; najma.khokhar@maryland.gov; MDE

Coauthor: Fred Schenerman, MDE

Session: The Life Cycle of Big Environmental Data; Room A-111/113, 1:30–3:00

The Ambient Water Quality Monitoring System (AWQMS) provides an effective tool for data collection, analysis, and statistics of monitoring data, and helps to guide the decision-making process. This presentation will introduce the data flow from the field to the Water Quality Portal (WQP) and describe the online analysis process. AWQMS provides a suite of data analysis tools including statistical and summary reports, graphs, and an integrated Google map. AWQMS has a built-in node client that can submit water quality data and Beach Notifications/Actions data using the proper XML format to the EPA's Water Quality eXchange (WQX). Users have control over which data is sent, what data is sent, and when data is sent. The WQX framework provides the main mechanism for providing data to the National Water Quality Monitoring Council's Water Quality Portal (WQP). The Water Quality Portal contains data including physical, chemical, radiological, and biological variables that describe the fitness of use of water for ecological, biotic, human, or other purposes. The goal of the WQP is to be a single point of access for national-scale water quality data to facilitate analysis and decision making at the local, regional, and national scales. The WQP includes results from the late 1800s through the present day.

Najma Khokhar received her M.S. in Environmental Science and Database Management Systems from Towson University; her M.S. in Botany from the University of Baluchistan, Pakistan; and her B.S in Zoology, Botany and Statistic from University of Baluchistan, Pakistan. She is an Oracle Database 12c Administrator Certified Associate and is CompTIA Security Plus certified and CompTIA A+ certified. She started her professional career with the Comptroller of Maryland in 2003. Then she moved to MDE, Ambient Air monitoring Group and worked in the Data analysis section for 10 years. After that she tried private sector for 1 year as a contractor for Department of the VA as a Database Architect. In June 2018, she rejoined MDE, Quantitative Data Analysis section.

INVASIVE AQUATIC VEGETATION MANAGEMENT USING A TARGETED HERBICIDE APPROACH

William H. Kirkpatrick Jr.; bill@aeclakes.com; Aquatic Environment Consultants, Inc.

Session: Aquatic Invasive Species: Then and Now; Classroom 2, 1:30-3:00

Controlling the spread of invasive species has been difficult as limited funding to control existing infestations has been slow and difficult to obtain. Early detection and control are critical to a successful management program. Hydrilla and water chestnut continue their spread to new aquatic resources each year. These aquatic invaders establish themselves very quickly and greatly impact the native habitat when they are allowed to become established. There continues to be confusion over the best options for their management. Over the years, management techniques have changed to provide better control of invasive species while allowing native species to survive. Both systemic and contact herbicides have produced predictable results. Different formulations of the same herbicide have been developed to provide better control at lower dosage rates. This presentation will review the management programs utilized in two different water bodies. Hydrilla was found in Deep Creek Lake in the summer of 2013. A management program was implemented in 2014 using a systemic herbicide and has continued on an annual basis since then. Water chestnut was found growing in a wetland impoundment and has been managed using contact herbicides. These projects have shown positive results for managing these two invasive aquatic species.

Bill was born and raised in Greencastle, PA. He went on to study fisheries and biology at Mansfield University; also adding post-graduate studies at Auburn University. Prior to starting AEC in 1987, Bill worked in fish hatcheries in Pennsylvania, Tennessee and Indiana. Bill is a past-president of the Midwest Aquatic Plant Management Society and previous board member for the Pennsylvania Lake Management Society.

LINKING ECOLOGICAL AND ECONOMIC MODELS TO ESTIMATE REGIONAL ECONOMIC IMPACTS OF OYSTER REEF RESTORATION

Scott Knoche; scott.knoche@morgan.edu; Morgan State University

Coauthor: Thomas Ihde, Morgan State University PEARL

Session: In Praise of The Humble Oyster and Its Habitat; Classroom 3, 3:30–4:30

In this study, we estimate socioeconomic metrics resulting from different oyster management strategies for recently restored, large-scale oyster reefs in the Choptank River Complex, Maryland - a major Chesapeake Bay tributary. First, we use an ecological model to simulate the young, restored reefs currently protected from oyster harvest by designated sanctuaries. We then simulate the effects of different oyster management strategies on harvests in the major fisheries of the region, for the following scenarios: 1) immature protected reef, 2) fully mature protected reef, and 3) open oyster harvest on the previously protected reefs. Species-specific commercial harvest estimates are translated to dockside values by applying historic species per-unit prices to biomass harvested. A regional economic impact model is then used to convert dockside values to economic measures such as sales, value-added, income, and employment. Results will be presented and regional economic impacts associated with the different scenarios discussed.

Dr. Scott Knoche is the Director of the Morgan State University Patuxent Environmental and Aquatic Research Laboratory (PEARL). As the Director of PEARL, Dr. Knoche oversees a vibrant environmental education program, a shellfish aquaculture and genetics program, and researchers with expertise in fisheries biology and Chesapeake Bay ecology. Dr. Knoche maintains an active environmental economics research program that focuses on estimating the economic benefits of outdoor recreation and ecological restoration.

DEVELOPING A THREE-TIERED HIERARCHICAL MONITORING APPROACH FOR CHESAPEAKE BAY SAV

Brooke Landry; brooke.landry@maryland.gov; Maryland Department of Natural Resources

Session: The Bay's Submerged Aquatic Vegetation; Classroom 3, 10:30–12:00

Submerged aquatic vegetation (SAV) in the Chesapeake Bay is an important but threatened resource. Consequently, monitoring SAV distribution, density, and diversity in the Chesapeake has been taking place in one form or another since the 1800s. In 1984, a baywide SAV monitoring program was initiated and conducted by the Virginia Institute of Marine Science and has been on-going since. This annual SAV survey maps SAV acreage and density throughout the Bay by interpreting data collected from aerial photographs. This broad-scale program is complemented by ground surveys conducted by Chesapeake Bay Program (CBP) partners and more recently, by the Chesapeake Bay SAV Watchers Program – a volunteer monitoring program that relies on watershed organizations to monitor SAV in tributaries throughout the Bay. Finally, the Chesapeake Bay Sentinel Site Monitoring Program for SAV is being established to collect in-depth data and monitor changes in SAV habitat characteristics and resilience indicators at sentinel sites around the Bay. Together, these interconnected Chesapeake Bay SAV monitoring efforts will form a three-tiered hierarchical monitoring approach that maximizes our efficiency and forecasting capabilities.

Brooke Landry is a Natural Resource Biologist at the Maryland Department of Natural Resources specializing in SAV research and management. As such, she is also Chair of the Chesapeake Bay Program's SAV Workgroup.

IMPLICATIONS OF MEASUREMENT METHODS AND THE BAY TMDL NUTRIENT AND SEDIMENT REDUCTION CREDITS FOR STREAM RESTORATION

Neely L. Law; nll@cwp.org; The Center for Watershed Protection, Inc.

Coauthors: Lisa Fraley-McNeal, Center for Watershed Protection; Bill Stack, P.E., Center for Watershed Protection; Bryan Seipp, Center for Watershed Protection; Mike Hickman, Center for Watershed Protection

Session: Stream Restoration Monitoring I; Auditorium, 10:30–12:00

Measurement methods are critical to interpret and understand the value of data generated through monitoring efforts. Recent work by the Chesapeake Bay Program Urban Stormwater Work Group and associated work groups have reinforced the need to explicitly define methods used to estimate sediment load reduction credits associated with stream restoration projects. Stream restoration is a key strategy adopted by Bay jurisdictions to address excessive nutrient and sediments loads as part of the 2025 Bay TMDL load reduction targets. While the 2014 Expert Panel Report recommended field-based measurements of bulk density, a bulk density value used in an example, of 125 lb/ft3, has been widely used to estimate the sediment reduction credit associated with Protocol 1 Credit for Prevented Sediment during Storm Flow. Monitoring studies report much lower streambank bulk density values ranging from 56-88 lb/ft3. The wide range in bulk density values has significant implications for nutrient and sediment load reductions for stream restoration projects and may be the result of site-specific conditions or measurement methods. This presentation will review bulk density sampling methods and illustrate the variability across sites along with different methods used to derive a value.

Neely Law is the Director of Education and Training with the Center for Watershed Protection with over 20 years of experience in the water resources field. In this position, Neely has the opportunity to broaden the use of the Center's applied research projects and tools of the Center. Neely is Co-Chair of the Chesapeake Bay Program Stream Health Work and has led multiple Expert Panels to define nutrient and sediment credits for BMPs.

METHODOLOGY FOR DATA-BASED PRIORITIZATION OF ONSITE SEWAGE DISPOSAL SYSTEM UPGRADES FOR NITROGEN LOAD REDUCTION IN MARYLAND

Jonathan Leiman; jonathan.leiman@maryland.gov; Maryland Department of the Environment

Coauthors: Shannon McKenrick, Maryland Department of the Environment, Hillary Yonce, Tetra Tech, Vic D'Amato, Tetra Tech, Bobby Tucker, Tetra Tech

Session: Nutrients and Their Unintended Consequences; Room A-300, 1:30–3:00

As the Chesapeake Bay Total Maximum Daily Load Watershed Implementation Plan continues to be implemented, identifying cost-effective projects at locally-refined scales is increasingly becoming the focus of planning efforts. A report rooted in GIS was developed to leverage diverse, spatially-referenced datasets for the State of Maryland to make more robust, scientifically-based decisions with regard to prioritizing onsite sewage disposal system (OSDS) upgrades or retrofits; that result in favorable nitrogen load reduction/cost ratios. A key outcome of this project was the development of a decision-support methodology, which includes (1) a methodology for data pre-processing necessary to generate a "baseline" GIS layer of potential projects (focused on areas with high densities of legacy OSDS) and (2) a multi-criteria decision analysis (MCDA) tool to both prioritize potential project sites by their risk (focused on nitrogen loading, but also including other co-benefits and confounding risk factors) and upgrade/retrofit feasibility. The utility of the MCDA tool is to illuminate projects falling into a "high risk/high feasibility" category so that they could be favored for additional analyses to validate the results and move forward with implementation as warranted.

Jonathan Leiman and Shannon McKenrick work in the Integrated Water Planning Program at the Maryland Department of the Environment (MDE) in Baltimore, Maryland. Mr. Leiman hold a B.S. from Cornell University and an M.S. from the University of Montana. Ms. McKenrick holds a B.S. from Shepherd University and an M.S. from Towson University. Mr. Leiman and Ms. McKenrick work on a variety of water issues at MDE on behalf of the citizens of Maryland related to the development of TMDLs and watershed implementation plans.

FROM PLANTS TO SEEDS - THE HISTORY OF SAV RESTORATION IN MARYLAND

Mark Lewandowski; mark.lewandowski@maryland.gov; DNR Resource Assessment Service

Coauthor: Mike Norman, Anne Arundel Community College Environmental Center

Session: The Bay's Submerged Aquatic Vegetation; Classroom 3, 10:30–12:00

Restoration of submerged aquatic vegetation (SAV) in Maryland began as a small scale education project called Bay Grasses in Classes in 1998. The Department of Natural Resources (DNR) and the Chesapeake Bay Foundation (CBF) partnered on a pilot project that trained twelve teachers to grow wild celery (*Vallisneria americana*) from seed in their classroom. Within a few years, 270 schools were joining DNR and CBF to grow and plant SAV in the Bay. Years later, outside funding provided the resources to conduct large-scale eelgrass restoration effort on the Potomac and Patuxent rivers using seeds. DNR developed new methodologies for seed collection and distribution, marking a substantial shift in restoration strategy from adult plants to seeds. Eelgrass habitat has declined in recent years due to increasing temperature, so restoration efforts have shifted up the Bay. Since 2015, DNR has partnered with Anne Arundel Community College (AACC) to restore vegetation in the oligohaline and mesohaline portions of the Bay. AACC established a successful seed collection and processing methodology that increased seed germination rates. ShoreRivers joined this partnership in 2017, providing volunteers to assist with the seed collection and monitoring.

Mark Lewandowski is a Natural Resources Biologist for the Maryland Department of Natural Resources in Annapolis, Maryland. He has a B.S. from the University of Maryland, College Park and has worked on SAV restoration and invasive species control for 18 years. His focus in the Chesapeake Bay region is monitoring SAV populations and conducting SAV restoration. Mark is a licensed aquatic herbicide applicator, focusing on control of aquatic invasive plants in Maryland state lakes. Mark is a member of the Mid-Atlantic Panel on Aquatic Invasive Species and represents the Chesapeake Bay region to the Federal Aquatic Nuisance Species Task Force.

BIOCHAR - OVERVIEW, BENEFITS AND APPLICATIONS FOR BUILDING RESILIENT SYSTEMS

Lori Lilly; llilly@howardecoworks.org; Howard EcoWorks

Coauthors: Paul Sturm, Ridge to Reefs

Session: Stormy Weather! What's New with Stormwater Management? Room 111/113, 10:30-12:00

Biochar is an organic based charcoal with tremendous demonstrated potential as a soil amendment for runoff reduction, water quality improvement, carbon sequestration and impacts to waste streams. Its use in stormwater management is relatively new and Chesapeake Bay TMDL crediting strategies are being explored. Applications vary from treatment of road runoff in rights-of-way to waste treatment on remote islands to runoff reduction in the Tiber Hudson watershed draining to Old Ellicott City. The speakers are Executive Directors of non-profits that have promoted the utilization of biochar in their respective and collaborative environmental restoration activities. They will provide an overview of biochar and its benefits, limitations, applications and approaches to use.

Lori Lilly is the founder and director of Howard EcoWorks, a non-profit organization based out of Howard County, MD that is developing an environmental restoration workforce. Lori's professional background is in watershed-based planning and restoration and her passion is centered around grassroots community organizing for protection of our natural resources.

Paul Sturm is the founder and director of Ridge to Reefs, a non-profit organization based of Sykesville, MD that protects and restores coral reef and coastal systems to create long-term resilient communities and ecosystems. Paul has worked on watershed plans, implementation projects and pollution issues around the globe.

A TALE OF TWO FISH: NORTHERN SNAKEHEAD AND BLUE CATFISH

Dr. Joseph Love; joseph.love@maryland.gov; Maryland Department of Natural Resources

Coauthor: Mary Groves, Maryland Department of Natural Resources

Session: Aquatic Invasive Species: Then and Now; Classroom 2, 1:30-3:00

Invasive fish continue to expand their range in many ponds and tributaries of the Chesapeake Bay. Current efforts to control two species of invasive fish, Northern Snakehead (*Channa argus*) and blue catfish (*Ictalurus furcatus*) will be discussed along with pertinent studies undertaken to better manage the respective population. In the case of the Northern Snakehead (*Channa argus*), the Maryland Department of Natural Resources used various tools to manage the species, some of which focused on expanding the fishery for Northern Snakehead. Other tools included regulation, a MDDNR-to-public information network, fishing awards, seafood marketing, and tournaments to reduce the population of Northern Snakeheads in Maryland's waters. This In the case of the Blue Catfish (*Ictalurus furcatus*), studies were undertaken to identify and target key spawning and overwintering areas so as to control the population. To achieve this, scientists used tracking devices attached to fish to monitor movement. Once location data is compiled commercial watermen and recreational anglers can target these areas with the desired effect of reducing the number of blue catfish in the river. In both instances, understanding the science behind the species has helped manage the population.

Dr. Joseph Love and Mary Groves are both Fisheries biologists with the Maryland Department of Natural Resources. Joe works largely with tidal bass species but sits on the Department's Invasive Species Matrix Team and is the Department's lead on the Northern Snakehead fish. Mary is the Southern Region Manager whose recent work looks at Blue Catfish spawning and overwintering areas.

MONITORING AND MANAGEMENT OF HABS IN THE MID-ATLANTIC REGION OF THE UNITED STATES IN 2019

Fred S. Lubnow; flubnow@princetonhydro.com; Princeton Hydro, LLC

Session: Harmful Algal Blooms; Classroom 1, 10:30–12:00

A number of waterbodies throughout the Mid-Atlantic region of the United States experienced harmful algal blooms (HABs) over the summer of 2019. These HABs were nuisance densities of various genera of cyanobacteria, the result of regional weather patterns and elevated nutrient concentrations, in particular phosphorus. In some cases, such as Harveys Lake, Luzerne County, PA, the HAB was relatively short-lived and ended in about a week. In other cases, such as Lake Hopatcong, Morris / Sussex Counties, NJ the HAB persisted through the summer and into the fall, negatively impacting the ecological, recreational and economic value of the lake and its associated watershed. This presentation will present data on how these HABs manifested around the same time, in the early summer season, and yet varied significantly in duration from lake to lake. Additionally, a Four-Point Strategy has been developed to address the HABs and includes the development of Watershed Implementation Plans; identifying locations for demonstration projects along select near-shore / beach areas to evaluate the potential of innovative in-lake and watershed technologies to reduce or avoid HABs; the development of Beach Restoration Plans to address or correct near-shore locations where people have direct contact with HABs; and designing / conducting scientific studies to evaluate measures to control HABs.

Dr. Fred S. Lubnow is the Director of the Aquatic Programs at Princeton Hydro. Dr. Lubnow received his Bachelors of Science in Biology from Susquehanna University (1988), his Master's degree in Environmental Sciences (1992) and his Ph.D. in Limnology (1994) both from the University of California Davis. Dr. Lubnow has been an environmental consultant for over 26 years and has worked throughout the Mid-Atlantic States. Dr. Lubnow is also an adjunct professor at Delaware Valley University, where he teaches a class on Watershed Management. In addition, Dr. Lubnow developed a professionally-credited course in Pennsylvania on the Management and Monitoring of HABs in Raw Water Supplies.

USING WATERSHED CHARACTERISTICS TO ASSESS WATERSHED (STREAM) HEALTH IN UNSURVEYED AREAS

Kelly O. Maloney; kmaloney@usgs.gov; U.S. Geological Survey

Coauthors: Kevin Krause, U.S. Geological Survey; Claire Buchanan, Interstate Commission on the Potomac River Basin; Rikke Jepsen, Interstate Commission on the Potomac River Basin

Session: Vital Signs of Watershed Health; Room A-307, 10:30–12:00

Ongoing stream monitoring efforts provide an effective assessment of stream condition for surveyed sites; however, many stream reaches remain unassessed. An evaluation of these unsurveyed reaches is necessary to optimize regional assessments of stream condition, which are useful in prioritizing conservation and restoration efforts. Watershed characteristics, such as land use, topography, and soils, are routinely linked to stream condition and we can leverage these data to predict conditions at unsurveyed locations given these data are widely available and can be easily summarized. We showcase an example using the composite Chessie BIBI indicator of stream health, which was generated from survey data across the Chesapeake Bay watershed, modeling this indicator using a suite of watershed characteristics. We then use this calibrated model to predict conditions to all streams in the Chesapeake Bay watershed. We will also show how a calibrated model can be used to project stream conditions to landscape and climate futures and detail our ongoing efforts on extending this approach to assess fish habitat. Results from these studies can be used to establish baseline conditions for restoration goals as well as monitor progress as additional data become available.

Kelly works a research ecologist with the U.S. Geological Survey's Leetown Science Center located in Kearneysville, West Virginia. His research focuses on the effects of anthropogenic activities on the quantity and quality of freshwater resources with a goal to synthesize scientific findings into tools to aid in the monitoring, assessment and management of these precious resources.

STATUS AND DISTRIBUTION OF FRESHWATER MUSSELS IN MARYLAND

James M. McCann; james.mccann@maryland.gov; MD Dept. Natural Resources, Natural Heritage Program

Session: Freshwater Mussels: An Environmental Indicator’s Growing Influence on Environmental Policy; Room 111, 10:30-12:00s

Freshwater mussels represent the most imperiled group of species in the U.S. Over two-thirds of the nation's ~300 mussel species are extinct, endangered or declining due to a wide range of factors (e.g., pollution, dams, invasive species, overharvest, etc.) that have eliminated or degraded our nation's streams and rivers. This pattern holds true for Maryland where 14 of the state's 16 species are of conservation concern. This includes two federally listed species, Dwarf Wedgemussel (Alasmidonta heterodon) and Yellow Lance (Elliptio lanceolata), along with five state listed species. An overview of the status and distribution of the state's freshwater mussel fauna will be presented.

Jim is the state zoologist with MD DNR's Natural Heritage Program. He coordinates revisions to the state's rare, threatened and endangered animal list. He and other DNR staff have been involved in freshwater mussel surveys, monitoring and conservation work over the past 25 years. Today, he will present an overview of the status and distribution of the Md's freshwater mussels.

FOUL PLAY: LONG TERM DATA TRENDS IN THE EPIBENTHIC COMMUNITY OF MARYLAND OYSTER BARS

Margaret McGinty; margaret.mcginty@maryland.gov; MD DNR Fishing and Boating Services

Coauthors: Jim Uphoff and Mitch Tarnowski, MD DNR Fishing and Boating Services

Session: In Praise of The Humble Oyster and Its Habitat; Classroom 3, 3:30–4:30

In response to stakeholder concerns about declining recreational fisheries in Maryland's portion of Chesapeake Bay and needs identified for an ecosystem based approach to fisheries management, we have mined data to attempt to examine declines in an ecosystem context. Recent concerns regarding declines in Spot and Atlantic Croaker, popular benthic gamefish, prompted us to evaluate benthic organism data. A water quality based survey of benthic organisms from soft bottom habitat that estimates density of food organism biomass has been conducted since 1998; however, a similar survey does not exist for hard bottom (primarily Oyster bars). Starting in 1970's, information on the benthic community (rank indices for various organisms) has been collected during an annual survey of Eastern Oysters, with electronic records available beginning in 1995. We acquired the data set to conduct the first known evaluation of these data. This effort allowed us to look at changes in the fouling organisms present in a sample to examine if hard bottom benthic forage availability has changed. We will present results of this work to highlight the value of mining old data records for management application.

Margaret McGinty has worked for the Maryland Department of Natural Resources for the last three decades, focusing on evaluating stressors to water quality and fish habitat. She presently works in the Fisheries Habitat and Ecosystem Program, which is engaged in assessing the impacts of land use change on fish habitat and applying results to promote effective landscape management in Maryland and the Chesapeake Bay Region.

MULTI-STRESSOR AND MULTI-STATE APPROACH TO CREATING TOLERANCE VALUES FOR BIOLOGICAL CONDITION GRADIENT MODELS

Richard Mitchell; mitchell.richard@epa.gov; U.S. EPA, Office of Water, Washington, DC

Coauthors: Jason R. Hill, Virginia DEQ; Emma V. Jones, Virginia DEQ; Larry D. Willis, Virginia DEQ; Lou Rynolds, U.S. EPA, Region 3; Ben Jessup, Tetra Tech

Session: The Life Cycle of Big Environmental Data; Room A-111/113, 1:30–3:00

The Virginia Department of Environmental Quality (VADEQ) in collaboration with Fairfax County, Maryland Department of Natural Resources, and West Virginia Department of Environmental Protection spearheaded an effort to establish a regional multi-stressor database in an effort to calibrate tolerance values. This effort included two Biological Condition Gradient (BCG) projects: Ecoregion 69 (Central Appalachians) and Ecoregion 64 (Northern Piedmont). VADEQ found that generalized taxa tolerance values are different between ecoregions in Virginia. The disparity between ecoregions is due to different primary stressors within each ecoregion; therefore, stressor specific tolerance values have been developed for Virginia. Integral to the development of these stressor specific tolerance values was a database of over 3,000 paired biology and stressor parameter samples which were analyzed using R.

Richard Mitchell is a biologist for the U.S. EPA and is the technical lead of the National Rivers and Streams Assessment.

A YEAR OF FRESHWATER MUSSEL RESTORATION IN THE ANACOSTIA RIVER

Jorge Montero; jmontero@anacostiaws.org; Anacostia Watershed Society

Session: Freshwater Mussels: An Environmental Indicator's Growing Influence on Environmental Policy; Classroom 2, 10:30–12:00

The Anacostia Watershed Society (AWS) is pioneering freshwater mussel restoration in the Anacostia River to help improve water quality and to enhance aquatic biodiversity. AWS has concluded the first phase of a mussel restoration effort after deploying 9,000 unionid mussels of three native species in the tidal Anacostia River for one year. With this project AWS is helping determine mussel restoration feasibility in the river and gathering other valuable information in the process (i.e. nutrient sequestration and microplastics content). Because mussels alter sediments and nutrients from the water column, the resulting improved water clarity will enhance submerged aquatic vegetation beds, providing habitat for other bottom dwelling invertebrates, which can support fish communities. The first phase of the project has shown promising results and AWS is already expanding the propagation efforts in the Anacostia River this year. AWS is educating school students through an innovative educational program called "Mussel Power"as well as the general public through education and volunteering.

No bio submitted

USE OF PROTOCOL 1 FOR PREVENTED SEDIMENT CREDIT BY MDOT SHA

Steve Morsberger; samorsberger@mccormicktaylor.com; McCormick Taylor

Session: Stream Restoration Monitoring I; Auditorium, 10:30–12:00

McCormick Taylor performed and managed stream assessment, monitoring, TMDL crediting, and reporting for 35 Maryland State Highway Administration stream restoration and outfall projects totaling over 40 stream miles within various MS4 jurisdictions. Using Protocol 1: Credit for Prevented Sediment during Storm Flow, following “Recommendation of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects” (Chesapeake Bay Program, 2014), we developed standard operating procedure documents or modified protocol for the Bank Assessment for Non-Point Source Consequences of Sediment (BANCS) model for estimating and quantifying erosion reduction, and crediting analysis for stream restoration projects. We managed and provided quality control review for all aspects of the monitoring, including field schedules, data analysis, crediting calculations, and reporting for 28 miles of full-delivery stream restoration projects. Applying these methodologies allowed our client to document the TMDL credits for their restoration projects and have the data spatial available for MS4 reporting. We will present the data and lessons learned from this effort in addition to commenting on trends and comparisons of the data per site.

Steve is a Senior Environmental Scientist and Project Manager specializing in using innovative techniques to evaluate and restore aquatic ecosystems with emphasis on stream restoration assessment and design, wetland assessment and mitigation design, and SWM BMP, and TMDL water quality opportunities.

WIDESPREAD AND FREQUENT EXCEEDANCES OF CHLORIDE WATER QUALITY CRITERIA IN MID-ATLANTIC AND NEW ENGLAND STREAMS AS REVEALED BY HIGH-FREQUENCY DATA

Joel Moore; moore@towson.edu; Towson University

Coauthors: Rosemary Fanelli, U.S. Geological Survey, South Atlantic Water Science Center; Andrew Sekellick, U.S. Geological Survey, Maryland–Delaware-District of Columbia Water Science Center

Session: Salt Life: Not Just A Coastal Thing! Bridge Room, 1:30–3:00

We used a dataset with ~30 million high-frequency and ~6400 discrete observations collected by the US Geological Survey to investigate specific conductance (SC) and modeled chloride concentrations [Cl] at 93 sites in the eastern US. SC and impervious surface cover (ISC) are moderately correlated in the Southeast and more strongly correlated in the Mid-Atlantic and New England where deicing salts are widely used. High-frequency data allow quantification of exceedances of the US EPA Cl criteria for aquatic life, evaluated over periods of four days (chronic, 230 mg/L) and one hour (acute, 860 mg/L). In the Mid-Atlantic and New England, ubiquitous and frequent exceedances of the EPA chloride criteria occurred at sites with more than 9–10% ISC and/or with median [Cl] greater than 30–70 mg/L. Exceedances in these streams sheds light on published work finding shifts in freshwater communities in streams with [Cl] of 30–110 mg/L. In the Mid-Atlantic and New England, [Cl] is increasing in all streams with the fastest increases at the sites with the highest [Cl]. By contrast, no increases in [Cl] were observed in the Southeast. Increases in [Cl] at urban sites with already high [Cl] strongly indicates a reservoir of Cl in groundwater and soil from legacy and contemporary deicer applications is driving changes in stream chemistry and will continue to have effects for many years to come.

Joel Moore is an Associate Professor of Geosciences at Towson University. A major focus for his research lab is the geochemistry of urban streams, including deicing salt impacts. On this topic, he has been working with the Maryland Department of the Environment and has been involved with the Salt Management Strategy development ongoing in northern Virginia, which is being led by the Virginia Department of Environmental Quality.

USING DATA SCIENCE TECHNIQUES TO MODEL WATER QUALITY PARAMETERS IN THE CHESAPEAKE BAY AND ITS TRIBLETS

Dr. Andrew C. Muller; amuller@usna.edu; United States Naval Academy

Coauthor: Diana L. Muller, Maritimas

Session: It's All About the Models; Classroom 1, 3:30–4:30

The Chesapeake Bay and its tributaries represent one of the best studied marine ecosystems. Despite the richness in long-term monitoring of numerous sites, coupled with the advent of better satellite measurements and continuous monitoring sondes, there still exists a lack of analysis and interpretation of high frequency data especially from its triblets (small tributaries and tidal creeks). Furthermore, there is also a lack of long-term predictions and the unresolved problem of how high frequency continuous monitoring data (CONMONS) can be incorporated with the long-term historical data, also known as the spatio-temporal dilemma. This is where big data or data science techniques can help. In this paper, we will describe how data science techniques including spectral analysis, and artificial neural networks can be used to answer these questions with examples from several sites around the Chesapeake Bay. Most importantly we will discuss a potential technique using the continuous wavelet transform to solve the spatio-temporal dilemma of how to stitch CONMON data to low frequency long-term measurements.

Dr. Andrew Muller is an Associate Professor of Oceanography at the United States Naval Academy specializing in coastal ocean dynamics. He has a B.S. in Earth Sciences from Adelphi University, NY and an M.S. and Ph.D. from Old Dominion University in Oceanography. His interests includes innovative monitoring and modeling of coastal water quality, spectral analysis and neural network modeling. Dr. Muller and his students have worked in a variety of environments including the Chesapeake Bay, the Virginia shelf and the Arctic Ocean. He has received funding from ONR, DTRA and NGA.

MICROPLASTICS IN COASTAL WATERS: DO SAV BEDS SERVE AS SINKS?

Bob Murphy; bob.murphy@tetratech.com; Tetra Tech

Coauthors: Phong Trieu, Metropolitan Washington Council of Governments

Session: The Bay's Submerged Aquatic Vegetation; Classroom 3, 10:30–12:00

Pervasive occurrence of microplastics in coastal systems has recently been recognized as potentially having enormous ecological impacts. Little is known about the fate of microplastics, much less the modes of transport through watersheds and into estuaries. We conducted a pilot study in the Potomac River to evaluate the idea that once microplastic particles reach coastal waters, they may accumulate in submerged aquatic vegetation (SAV) beds, similar to sediment particles. The canopy of mixed species SAV beds in the Potomac River (Washington DC) contained significantly greater abundance of microplastic particles than adjacent unvegetated water column. Additional sampling of the sediments (SAV vs bare bottom) in the Anacostia river further address the question of whether underwater grass beds are serving as sinks for microplastics. The implications for SAV-dependent species will also be discussed.

Bob Murphy is a marine ecologist with Tetra Tech, focusing on fish ecology, SAV ecology and habitat restoration. He recently co-chaired a workshop focusing on the emerging issue of microplastics in the Chesapeake Bay watershed, addressing the state of the science.

HYDROLOGIC STUDY AT FARM CREEK MARSH, DORCHESTER COUNTY, MARYLAND FROM APRIL 2015 TO APRIL 2016

Christopher Nealen; cnealen@usgs.gov; U.S. Geological Survey

Coauthors: Charles Walker, USGS; Todd Lester, USGS

Session: Groundwater; Room A-300, 3:30–4:30

In 2015, the United States Geological Survey began a hydrologic study to investigate the extent and cause of inundation at Farm Creek Marsh, in Dorchester County, MD. In combination with a tide and precipitation gage, a representative section of the marsh was instrumented with surface-water monitors and shallow groundwater piezometers to capture the spatial and temporal extent of inundation. In addition, water-quality data (major ions and nutrients) were collected to help discern the cause of inundation. Results indicate that during the initial year of the study, all sites were periodically inundated, ranging from a total of 108 days to the entire study period of 353 days. The depth of inundation was typically between 0 and 0.2 feet (ft) (above land surface), with the exception of large storm events. Less than 0.5 ft of elevation was the difference between a site being inundated during the entire study period of 353 days and a site being inundated for 36 consecutive days out of 108 total days of inundation during the study period. Collectively, the combination of water-quality, hydrologic, and soils data indicate that inundation is caused by tide and storm events rather than groundwater discharge.

Chris Nealen is a surface and coastal waters hydrologist with the USGS. He started with the Survey collecting streamgage data as a hydrologic technician and since converting to a hydrologist has worked on projects ranging from coastal storm surge inundation, flood frequency analyses, and hydrograph separation.

WHATS IN THE WATER: CITIZEN SCIENCE WATER MONITORING IN DC

Robbie O'Donnell; robbie@anacostiariverkeeper.org; Anacostia Riverkeeper

Coauthor: Olivia Anderson, Anacostia Riverkeeper

Session: Pollution Detectives: Bacteria Monitoring and Tracking; Room A-111/113, 3:30–4:30

Volunteer water quality monitoring is key for up-to-date knowledge about changing water health and conditions, as well as building community stewardship across District waters. In 2018 Anacostia Riverkeeper was awarded funds to design and carry out the first citizen science based monitoring program in DC waters. Riverkeeper's bacterial monitoring has expanded from four sites, to eight, to a total of 22 across the Anacostia, Potomac, and Rock Creek. Our DC water quality monitoring program is a citizen science based program that increases both community engagement and investment in waters around the District. In the first year of the program over 120 citizen science volunteers were trained from every Ward in DC, MD, and VA and over 550 samples were collected over 20 weeks in the summer of 2019. This talk will address the history of the program, successes and pitfalls of citizen science programs, QA/QC, and an interactive component exploring cutting edge data visualization tools for displaying data, freely accessible to non-profits and citizens alike.

Robbie O'Donnell is the Watershed Programs Manager for Anacostia Riverkeeper in Washington DC. He has a BS in Geology and a MS in Marine Science, with a focus on coastal change and ecosystems. He serves as the program manager for Riverkeeper's water quality monitoring program. Olivia Anderson has a BS in Biology and a Masters of Public Health. She currently serves as Anacostia Riverkeeper's project coordinator and development lead.

DNA-BASED MICROBIAL SOURCE TRACKING AS A TOOL TO IDENTIFY THE SOURCE OF FECAL CONTAMINATION

Wolf T. Pecher; wpecher@ubalt.edu; University of Baltimore

Coauthors: Eric J. Schott, University of Maryland Center for Environmental Science; Kimberly L. Grove, Department of Public Works, City of Baltimore; Joan White, Department of Public Works, City of Baltimore

Session: Pollution Detectives: Bacteria Monitoring and Tracking; Room A-111/113, 3:30–4:30

Baltimore Harbor and its main tributaries (the non-tidal Patapsco River, Gwynns Falls, and Jones Falls) are heavily impaired by nutrients and fecal bacteria. Sources of fecal contamination include runoff from impervious surfaces, leaking sanitary sewers, and storm drains that discharge fecal bacteria, often from humans, wildlife and possibly pets. Traditionally, fecal contamination is assessed through the enumeration of fecal indicator bacteria. However, these methods do not discriminate between fecal sources (e.g., human vs. dog waste). Methods to identify the source of fecal contamination have been developed, and are commonly referred to as “microbial source tracking” (MST) methods. Over the past 7 years we have conducted studies to assess the presence of human and dog waste at selected sites in the Baltimore Harbor watershed using DNA-based MST assays. Our data suggest that in addition to human waste, dog waste is a prominent source of fecal contamination. Furthermore, these methods allowed us to identify sites with unknown animal sources as major contributors to fecal contamination. These results show the potential of DNA-based MST tools to assist in the development and evaluation of targeted remediation strategies. To that effect we partnered with the City of Baltimore to evaluate the use of MST as a tool to identify and eliminate sanitary discharges of unknown origin.

Wolf Pecher holds a PhD in Marine Estuarine Environmental Sciences from the University of Maryland, College Park. He is an Associate Professor at the University of Baltimore and faculty of the Environmental Sustainability Major. His research interests focus on the biology and ecology of microbes in extreme and urban environments. Over the past few years, he has been working on tracking and identifying the sources of fecal contamination in the Baltimore Harbor watershed by using DNA-based assays, DNA fingerprinting, and metagenomic approaches. Furthermore, he is exploring the use of microbes as indicators of road salt pollution, and the effect of road salt on microbial communities.

HISTORIC ELLICOTT CITY FLOODING: SAFE AND SOUND FLOOD MITIGATION PLAN

Mark S. Richmond; msrichmond@howardcountymd.gov; Howard County Department of Public Works

Session: Climate Resiliency; Bridge Room, 10:30–12:00

On July 30, 2016 a destructive and historic flash flood hit Ellicott City, Maryland. More than six inches of rain fell in approximately two hours, completely overwhelming the natural streams and drainage structures and sending 6 to 8 feet of water down Main Street in some locations. Roughly 22 months later on May 27, 2018 another flash flood of similar intensity and duration hit the same area, with similar results. Since then significant effort has been put into studying what happened, planning for the future of a resilient Ellicott City, and starting the rebuilding process. These efforts have been both short term as well as long term master planning in nature. In April 2019 the Howard County Executive introduced his Safe and Sound Plan for flood mitigation efforts. The Plan will minimize the risk of damage and loss to the public and to critical infrastructure due to future large rain events. Numerous components of the Plan are currently in place or already under way.

Mark is the Chief of the Stormwater Management Division in the Howard County Department of Public Works. He has worked as a professional engineer in Maryland for over 30 years for both a private consulting engineering firm and for County government. Mark earned a BS degree in Civil Engineering from Lafayette College and an MS degree in Environmental Systems Engineering from Clemson University. His main area of expertise is in water resources, specifically leading projects in stream restoration, flood mitigation, stormwater management, and water quality treatment projects.

THE IMPORTANCE OF DATA MANAGEMENT TO THE JAMES RIVER CHLOROPHYLL STUDY

Tish Robertson; tish.robertson@deq.virginia.gov; Virginia Department of Environmental Quality

Session: The Life Cycle of Big Environmental Data; Room A-111/113, 1:30–3:00

The Virginia Department of Environmental Quality recently ended an eight-year long effort to review the Commonwealth's water quality standard for chlorophyll in the tidal James River. Numeric chlorophyll criteria were adopted in the early 2000s for the tidal portion of the Virginia's largest river to facilitate the control of nutrient loads into the Chesapeake Bay. The laboratory and field datasets generated and compiled under the study were crucial for improving DEQ's understanding of the water quality impacts caused by excessive phytoplankton, particularly those related to harmful algal blooms, in the James River estuary. Additionally, state-of-the-art monitoring technology enabled DEQ to perform a highly refined characterization of seasonal ambient chlorophyll dynamics in space and time. Over two million data points were used to develop alternative numeric chlorophyll criteria. The James River Chlorophyll Study not only highlights the value of research and enhanced monitoring to water quality standards development, but it is also showcases the usefulness of web-based data portals for managing and delivering temporally and spatially-intensive water quality datasets.

Tish Robertson is the Water Quality Standards Scientist for the Virginia Department of Environmental Quality, Richmond, VA. She has been with DEQ for twelve years, serving as the Chesapeake Bay Program Analyst and Water Quality Assessment Coordinator before moving into her current role. Tish provides technical oversight in the development and implementation of the Commonwealth's Water Quality Standards—the regulatory provisions that protect surface waters from the harmful effects of pollutants. Tish holds a B.S in Applied Biology from the Georgia Institute of Technology and a Ph.D in Biology from Rutgers University-Newark.

CASE STUDIES OF CLOUDBURSTS AND PLUVIAL FLOODING IN BALTIMORE: IMPLICATIONS FOR CLIMATE CHANGE RESILIENCE PLANNING

Bernice R. Rosenzweig; brosenzweig@gc.cuny.edu; City University of New York

Coauthors: Urban Resilience to Extremes Sustainability Research Network (UREx SRN)

Session: Climate Resiliency; Bridge Room, 10:30–12:00

Cloudbursts (short-duration, intense rain events) present a particularly significant flood hazard in dense cities. In many older cities, natural stream channels were replaced by subterranean sewers, designed to drain stormwater associated with only moderate rainfall intensity. When rainfall rates exceed those equivalent to the sewer network design storm, pluvial (overland) flooding can occur. This type of flooding is not required to be considered in U.S. National Flood Insurance Program hazard mapping, and these events remain poorly studied and underrepresented in conventional flood risk assessment. Using radar-based quantitative precipitation estimates, terrain analysis and integration of data on the built environment and socioeconomic exposure, I will present case studies of recent pluvial flood events in Baltimore, discuss the need for improved techniques for cloudburst monitoring and prediction to support climate change resilience planning. This work was conducted as part of the Urban Resilience to Extremes Sustainability Research Network (UREx SRN), and we hope to collaborate with regional practitioners to identify strategies and pathways for enhanced resilience.

Bernice Rosenzweig is an earth systems scientist at the Environmental Sciences Initiative of the City University of New York. Her current research focuses on ecological resilience and extreme weather events in highly-urbanized environments. She leads the Urban Flooding Task Force of the Urban Resilience to Extremes Sustainability Research Network (UREx SRN) and is a member of the Baltimore Urban Waters Flood Steering Committee.

TAKING THE PULSE: WHAT IS WATERSHED HEALTH AND HOW DO WE MEASURE IT?

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

Coauthor: Christopher Wharton, Tetra Tech

Session: Vital Signs of Watershed Health; Room A-307, 10:30–12:00

Maintaining healthy streams and watersheds is a key component of watershed management programs throughout the Chesapeake Bay region. Monitoring watershed health can involve a suite of metrics for assessing the ecological condition of streams as well as characterizing conditions across the broader landscape. Well-established stream indicators include biological indices based on fish, benthic macroinvertebrates, or other biota. Physical habitat indicators based on rapid assessments can be supplemented with more detailed geomorphic data, along with flow, temperature, and water chemistry. In addition, broadscale geospatial data can characterize watershed features and stressors across the landscape at a watershed or catchment scale. The Chesapeake Healthy Watersheds Assessment has compiled catchment-scale data on six aspects of watershed health: landscape condition, biota, habitat, hydrology, geomorphology, and water quality. In combination with stream data, these metrics can serve as useful monitoring tools to provide better understanding of current conditions in streams and within their watershed context. Furthermore, they can serve as signals of change, providing an early warning system indicative of declining watershed health.

Nancy Roth is a Senior Watershed Scientist with Tetra Tech's Center for Ecological Sciences in Owings Mills, Maryland. Ms. Roth has a background in stream ecology and brings 28 years of experience in watershed restoration planning and stream biological assessment. She has supported the Chesapeake Bay Program, Maryland Biological Stream Survey, and municipal stormwater (MS4) programs in Maryland and Virginia. She is a graduate of Carleton College in Minnesota and holds a master's degree from the University of Michigan in Conservation Biology and Ecosystem Management. She lives in Annapolis, Maryland, and enjoys exploring the Chesapeake and its rivers by canoe, kayak, and paddleboard.

20 YEARS OF WATER QUALITY MONITORING IN FAIRFAX COUNTY (VA)

Chris Ruck; christopher.ruck@fairfaxcounty.gov; Fairfax County DPWES, Watershed Assessment Branch

Coauthors: LeAnne Astin, Fairfax Co. DPWES; Jonathan Witt, Fairfax Co. DPWES

Session: Stream Restoration Monitoring III; Auditorium, 3:30–4:30

Fairfax County (VA) began conducting assessments of benthic and fish communities, habitat and chemical water quality monitoring in 1999. Data from 1999-2001 created baseline conditions published in the 2001 Stream Protection Strategy report. Data were used to provide resource management priorities, develop a local benthic index of biotic integrity (B-IBI) and helped provide a framework for the annual probabilistic monitoring program Fairfax County has maintained from 2004 to 2019. Since 1999, the monitoring programs evolved to include stream restorations, stormwater retrofits, lakes, bacteria, sediment and nutrients. Staff evaluated these maturing programs to determine the state of our streams and discovered trends among benthic populations. What have we learned through 15 years of increased biomonitoring? How well did we "protect" those sub-watersheds called out in the SPS report? How have stream restoration projects done at restoring benthic macroinvertebrates?

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 and wetland projects. He's conducted research on streams 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.

LITTER REDUCTION IN PRINCE GEORGE'S COUNTY

Tiaa Rutherford; trutherford@co.pg.md.us; Prince George's County Government

Session: Be Part of The Solution: Litter Outreach and Education; Room A-307, 3:30–4:30

Prince George's County is serious about removing blight and illegal dumping! This award-winning County is using technology, BigBelly and other programs to aid in quantifying the amount of trash that is being removed from its boarders. Learn more about these tools as Litter Reduction Program Manager, Tiaa B. Rutherford, CEP, provides an overview of the County's efforts.

Tiaa Booker Rutherford is a 20-year career professional with urban planning and environmental programs experience having worked for a council of government, a private sector engineering firm and a municipal government. She is the Litter Reduction Program Manager with Prince George's County Government and former Chief of Staff for the Maryland Department of Aging. An aspiring marathoner, mother, and wife and lifelong Girl Scout.

NO SALT FOR YOU! - AN INCENTIVISED APPROACH TO CURBING THE OVER-APPLICATION OF WINTER DE-ICER

Gregorio Sandi; gregorio.sandi@maryland.gov; Maryland Department of the Environment

Session: Salt Life: Not Just A Coastal Thing! Bridge Room, 1:30–3:00

The Maryland Department of the Environment (MDE) has been coordinating with programs inside and outside of the State of Maryland to build the foundation for a program that aims to curb the amount of salt applied during winter events. The approach we've chosen mirrors several national leaders including New Hampshire and Minnesota, but will have a Maryland specific concentration to meet the various geographical and climatological variability within the State. By using proven methods and expanding research, we hope to have a robust and defensible strategy to curb the over application of salt in winter events, and to protect the State's fresh water supplies into the future.

Greg is Head of the Chesapeake Restoration Section at Maryland Department of the Environment. This position serves in the Integrated Water Planning Program working with State and local partners throughout Maryland developing watershed restoration plans, managing Best Management Practice data, tracking and evaluating the Chesapeake Bay Model inputs and outputs as well as managing the State's Water Quality Trading Program. The main focus of Greg's position is to promote ways to enhance water quality and ecological uplift in the State's aquatic ecosystems while providing additional benefits to the citizens of Maryland through environmental restoration.

ADVANCES AND APPLICATIONS OF EDNA METHODS

Bane Schill; wschill@usgs.gov; USGS-Leetown Science Center

Session: Aquatic Invasive Species: Then and Now; Classroom 2, 1:30-3:00

The analysis of environmental DNA (eDNA) has become a widely used approach to problem solving in species management. The detection of cryptic species including invasives and (or) species at risk is the goal, typically accomplished by testing water and (or) sediment for the presence of the target species' characteristic DNA signatures. Studies may focus on a single species of interest using a specific PCR assay (active sampling), or many species may be detected simultaneously using metabarcoding and massively parallel sequencing. Many improvements in sample collection, processing, and data analysis have been made over eDNA studies' two decades or so lifetime. Recently for example, we have introduced a new approach to eDNA capture based on flocculation, a process that has been used for centuries to clarify liquids including, water, beer, and wine. Only a small amount of added concentrated flocculating agent is required, and sample volumes of millilitres to gallons can be accommodated. Bacteria and virus are collected simultaneously allowing for pathogen testing and (or) additional ecological studies from one water sample. While eDNA analysis is a valuable tool, proper study design and interpretation of results is critical to obtaining useful information. The evolution of eDNA analysis, its promise, limitations, and future directions are discussed.

Bane Schill is a Research Chemist specializing in molecular biology at the USGS-Leetown Science Center where he has been employed since 1979, first under the U.S. Fish and Wildlife Service and subsequently under the U.S. Geological Survey. His areas of focus have been population genetics pertaining to striped bass restoration in the 1980s and the endangered species listing of Atlantic salmon in the late '90s. Current focus areas include development of aquatic animal disease diagnostics, fecal source tracking, research into the causes and mitigation of harmful algal blooms (HABs), and environmental DNA methodology and applications.

HOW'S MY WATERWAY: TELLING THE WATER STORY

Kiki Schneider; schneider.kiki@epa.gov; EPA Office of Water/ Office of Wetlands, Oceans, and Watersheds

Coauthor: Dwane Young, EPA Office of Water, Office of Wetlands, Oceans, and Watersheds

Session: The Life Cycle of Big Environmental Data; Room A-111/113, 1:30–3:00

How's My Waterway is a web-based application designed to communicate water quality data to the public. It tells the water quality story at the community, state, and national levels. The community page guides users by providing information to answer three questions: "How's the drinking water?", "Can I swim here?", and "Can I fish here?" How's My Waterway answers these questions by pulling data from five different systems and combining that data together into one cohesive, public-friendly story. How's My Waterway goes beyond just showing data on a map, it also provides meaningful metrics and lists of information to users to help them better understand the water quality within their watershed. To provide context for this community-level data, How's My Waterway also provides summary data at the state and national scale using various EPA and state data sources to communicate this context to the public. With its initial release, How's My Waterway provides information on water quality assessments, drinking water providers, permitted facilities, water quality monitoring locations, non-point source projects, non-point source success stories, TMDLs and other restoration plans, and state and national probabilistic surveys. How's My Waterway is also architected in an innovative way that makes it easy to add new data sets to provide additional context as these data sets become available. Because How's My Waterway is built upon a services-based architecture, it also stays up-to-date with the most current data available. This services-based approach also enables other users or application developers to build their own applications based on these underlying datasets. How's My Waterway is a truly innovative application that really demonstrates the power of open water data.

Kiki Schneider is an IT Specialist in the Office of Water at the US Environmental Protection Agency. She has a background in environmental policy and user centered design. She's worked at the EPA for 9 years mainly working to make applications user friendly and understandable and is the project lead for How's My Waterway. In her free time she enjoys spending time with her 2 kids, Cyrus and Zoey.

FORMING A BALTIMORE URBAN WATERS FLOOD TEAM

Robert J. Shedlock; rjs1157@gmail.com; U.S. Geological Survey

Coauthors: J. Morgan Grove, U.S. Forest Service USDA

Session: Climate Resiliency; Bridge Room, 10:30–12:00

The Actionable Science Team of the Baltimore Urban Waters Partnership (BUWP) formed a flood team in 2019 in response to requests by local partners for a flood forum to improve communication and coordination on flooding in the Greater Baltimore region. The team has met several times to discuss the goals, potential activities, and benefits of such a forum. These meetings have shown how a complete treatment of flooding in the Baltimore region would involve a diverse set of topics. In addition, flooding often occurs in multiple jurisdictions requiring coordination and information-sharing across political boundaries. The flood team plans to organize an initial workshop (in early 2020) to identify and discuss the flood issues that are most important to the Baltimore Urban Waters partners. We would like to connect agencies responsible for flooding issues with each other and with academic and government scientists conducting flood-related research and data collection programs. The flood team would also like to explore ways of educating policy makers and the public on the importance of understanding threats from flooding and how to manage them. The BUWP flood team also plans to coordinate its activities with the work in Baltimore of the UREx-SRN (Urban Resilience to Extreme Events Sustainability Research Network) project team, which is funded by the National Science Foundation.

Bob Shedlock is a scientist emeritus with the U.S. Geological Survey. Since retiring in 2015, he has worked mainly on urban environmental issues with the Baltimore Urban Water Partnership and the Baltimore Ecosystem Study, helping to organize interagency workshops on environmental monitoring and flooding. His technical experience has been in groundwater hydrology, geochemistry, wetland hydrology, water supply assessments, and urban hydrology. Bob was on the first MWMC Board of Directors and served as the Vice Chairman for three years in the late 1990's. He has geology degrees from the University of Notre Dame and the University of Michigan and currently resides in Towson with his wife Linda.

UPDATES ON MDE'S MS4 MONITORING AND ANALYSIS EFFORTS: 2019 SUMMARY AND 2020 PROJECTS

Wencheng Katherine Slater; katherine.slater@maryland.gov; Maryland Department of the Environment

Coauthor: Jeff White, Maryland Department of the Environment

Session: Stormy Weather! What's New with Stormwater Management? Room 111/113, 10:30-12:00

MDE consulted with academics, DNR, USGS and drafted MS4 Monitoring Guidelines for the next Phase I MS4 permit. In the Guidelines, we emphasized the importance of developing and implementing a QAPP and promoted a flow-weighted composite method of calculating storm event concentrations. MDE values counties' first-hand experience and has revised the Guidelines according to their feedback. MDE hosted a biological monitoring workshop in March to build consensus and promote inter-county communication, and a turbidity monitoring workshop is planned with USGS in 2020. MDE is also analyzing monitoring data with ICPRB. We built a database to host more than 97,500 records of water quality, benthic, and habitat data collected under the MS4 permit since 1990s. We performed in depth research and analysis for three of the MS4 monitoring watersheds. In 2020, we plan to initiate a Network of Control by organizing current state-wide long-term monitoring efforts to enhance the usefulness of monitoring data and increase analytic power. We are working with DNR to compare habitat assessment in different seasons, the effects of varying map scales on benthic monitoring, and assist county's stormwater monitoring needs. Our ultimate goal is to improve monitoring consistency, enhance data quality, increase using county data in the state-level assessment, and eventually promote data-driven decisions.

Katherine Slater works on Integrated Water Planning Program at the MDE since November 2017. Her work focus on bridging science and policy with the latest literature and defensible analysis. She just defended her Ph.D. dissertation on Oceanography at University of Maryland Center for Environmental Science. Her doctorate research is about hypoxia in the Chesapeake Bay. Before coming to the MDE, She worked on ecosystem-based fishery management at NOAA as a Knauss Sea Grant Fellow and later as a research associate during 2016 - 2017, and prior to NOAA she interned at the EPA in 2015.

SEASONAL AND SITE DIFFERENCES IN SMALLMOUTH BASS IMMUNE FUNCTION

Cheyenne Smith; crsimpson@usgs.gov; West Virginia University

Coauthors: Christopher Ottinger, USGS; Vicki Blazer, USGS

Session: Fish Disease - Lesions and Tumors and Popeye, Oh My! Room A-300, 10:30–12:00

Four hundred thirty-two smallmouth bass (*Micropterus dolomieu*), age 2 and older, were collected from four sites with differing land use – South Branch of the Potomac (n = 94), Potomac mainstem at Antietam Creek mouth (n = 100), West Branch Mahantango (n = 120) and Pine Creek (n = 118) – in spring and fall over three years (2016-2018). Fish were euthanized, weighed, measured, and any visible abnormalities were recorded. Anterior kidney was aseptically removed and homogenized. A necropsy was performed and tissues were preserved for histopathological and gene transcript analyses (liver, anterior kidney). Water samples were collected and analyzed for chemicals bimonthly April to June and monthly during the rest of the year. Storm samples were also collected. Immune function assays were performed with leukocytes isolated from anterior kidney homogenates. Leukocytes were tested for: bactericidal activity of macrophages against *Aeromonas veronni bv. sobria* and *Yersinia ruckeri*; respiratory burst activity in phagocytes; and mitogenesis activity of lymphocytes. The analysis revealed significant seasonal and site differences in all immune function tests. Factors that may relate to seasonal and site differences including temperature and other environmental factors, land use and water chemical concentrations, as well as parasites or other signs of infectious disease, will be discussed.

Cheyenne Smith is a PhD student at West Virginia University working under Dr. Vicki Blazer at the Leetown Science Center in Kearneysville, WV. She is interested in fish health and is studying immune function in smallmouth bass.

ILLUSTRATING NUTRIENT INPUTS IN THE CHESAPEAKE BAY WATERSHED OVER TIME

Breck Sullivan; bsullivan@chesapeakebay.net; Chesapeake Research Consortium

Coauthors: Cuiyin Wu, Chesapeake Research Consortium; Robert Sabo, U.S. Environmental Protection Agency; Qian Zhang, University of Maryland Center for Environmental Science; Emily Trentacoste, U.S. Environmental Protection Agency

Session: Nutrients and Their Unintended Consequences; Room A-300, 1:30–3:00

Understanding inputs to local watersheds is the first step for managers and planners to implement targeted restoration practices. The Chesapeake Bay Program Phase 6 Watershed Model provides the nitrogen and phosphorous input data for counties within the Chesapeake Bay Watershed. There are currently national nutrient inventories to identify nutrient inputs but having this information at a county level is potentially useful to local managers. Inputs to the Phase 6 model was utilized to create a detailed nutrient inventory for all the counties in the watershed with critical nutrient sources from 1985 – 2018. To visually show local managers and planners nutrient inputs, county-level factsheets were designed for nitrogen and phosphorus using the nutrient inventory which will be made available for all counties in the watershed. Graphics on the factsheet include atmospheric deposition, primary nutrient inputs, and agricultural efficiency. Initial trends from the factsheets identified areas of significant decreases in inputs such as municipal wastewater and nitrate while some areas showed significant increases in urban fertilizer. The inventory and factsheets will help local mangers and planners identify the specific sources they need to control to improve local water quality and serve as a communication tool to illustrate how specific county's nutrient inputs have changed over time.

Breck Sullivan is an Environmental Management Staffer for the Scientific, Technical Assessment and Reporting staffer at the Chesapeake Bay Program. She worked on the following project with her colleagues Cuiyin Wu (Chesapeake Research Consortium), Robert Sabo (U.S. EPA), Qian Zhang (University of Maryland Center for Environmental Science), and Emily Trentacoste (U.S. EPA).

EARLY DETECTION AND ERADICATION PROGRAM NEEDED FOR *TRAPA BISPINOSA*, A NEW SPECIES OF WATER CHESTNUT IN THE POTOMAC RIVER WATERSHED

Jil Swearingen; jilswearingen@gmail.com; In The Weeds

Coauthor: Nancy Rybicki, PhD., USGS

Session: Aquatic Invasive Species: Then and Now; Classroom 2, 1:30-3:00

Eurasian water chestnut (*Trapa natans*) has been present in the United States since the 1880s and is a well-known invasive species. A new introduction of a relative of *T. natans* was discovered in Virginia. It was recognized as new by fruits that have 2 horns in contrast to the 4-horned fruits associated with *T. natans*. This new species was verified in 33 Northern Virginia locations by 2018. To determine its distribution scientists verified the species of any Trapa reported to local herbaria, extension agents, pond managers, and online invasive species databases. . All the recent reports (2000 to 2018) are in Fairfax and Prince William counties in Virginia. Herbaria specimens showed it was reported in Westmoreland and Stafford counties in Virginia in 1995. Scientists conducting research on this 2-horned type of Trapa have not found this type of Water Chestnut in other states in the NE US. It has only been reported in Virginia and in the Potomac River watershed. By 2019 a study of populations around the world revealed that its name is *T. bispinosa* Roxb. var. iinumai Nakano, and its DNA and morphology matched samples of this morphotype in Taiwan.

Jil is a biologist and invasive species consultant for her company In The Weeds, with 30 years experience. She started the Exotic Plant Working Group and Weed Busters Volunteers for Montgomery County (MD) (1990-1993), Weed Busters Training and Certification program for the National Park Service (1997), and WeedUS: Database of Invasive Plants of Natural Areas (1998). Jil brought governmental and non-governmental entities together to found the Mid-Atlantic Invasive Plant Council (1999), is lead author of 'Plant Invaders of Mid-Atlantic Natural Areas' (2002); co-developer of Invasive Plant Atlas of the U.S. and Mid-Atlantic Early Detection Network (2010), and Mid-Atlantic Invaders Tool (2019).

MANAGEMENT RESPONSE: HOW CAN LOCAL AND STATE GOVERNMENTS RESPOND TO INDICATIONS OF WATERSHED HEALTH DEGRADATION

Renee Thompson; rthompson@chesapeakebay.net; USGS Chesapeake Bay Program

Coauthors: Nancy Roth, Tetra Tech, Peter Claggett, USGS, Kelly Maloney, USGS

Session: Vital Signs of Watershed Health; Room A-307, 10:30–12:00

Chesapeake Bay Watershed states have adopted different approaches toward defining and identifying healthy watersheds. However, States have limited resources and varied approaches to assess and monitor these watersheds over time. In addition, local communities have the potential to play a vital role in identifying and protecting highly valued waterways and watersheds. Understanding how to effectively convey information about the signals of change of stream and watershed health across the Chesapeake Bay region, as well as identifying the various tools that may be used, primarily by local and state governments, to protect these watersheds is essential. The amount, type and way that land use change occurs are key factors affecting healthy watersheds. Decisions to protect healthy watersheds can be informed by regional population growth, development, and land use change. Tracking the vital signs of stream and watershed health will provide managers with information valuable for preemptively responding to potential threats. This session will present some of the policy options, incentives, and conservation and planning tools that can be implemented to reduce stressors and protect valued ecosystems.

Renee Thompson is a Geographer with USGS, Lower Mississippi Gulf Water Science Center and based at the Chesapeake Bay Program where she serves as the Coordinator for the Maintain Healthy Watersheds Goal team. She has a background in Environmental Science, management and policy and holds a Master's degree in Community Planning with a focus on Land Use and the Environment from the University of Maryland. Renee worked as a policy analyst for Coastal States Organization prior to joining USGS in 2008.

DECLINING STATUS OF ANADROMOUS FISH SPAWNING HABITAT IN PATUXENT RIVER

Jim Uphoff; jim.uphoff@maryland.gov; MD DNR, Fishing and Boating Services

Session: From Alewife to Brook Trout: The Importance of Healthy Fish Communities; Classroom 1, 1:30–3:00

Year-class success of blueback herring, alewife, and American shad (anadromous herring) in Patuxent River has become very low in the past decade, a trend not shared by these species in other major spawning systems. This decline coincides with development in the portion of the watershed draining spawning and nursery areas breaching 10% impervious surface. Impervious surface reflects cumulative ecological deterioration of a watershed from multiple biological, chemical, and physical changes that are not necessarily linked to the Bay pollution diet. Habitat changes for herring spawning in Patuxent River fit a general schedule indicated by impervious surface reference points for estuarine fish habitat. There has been a strong increase in salt levels (an indicator of runoff water quality) since 1978 at five freshwater stations in the spawning and nursery region used extensively by anadromous herring (from Laurel to below Wayson's Corner), and to a lesser extent by yellow perch, white perch, and striped bass. Extensive stocking and fishery closures in the Patuxent River have not restored anadromous herring. Yellow perch, white perch, and striped bass spawning and nursery habitats are downstream of anadromous herring and herring may serve as an early warning for these other anadromous species that are still supporting fisheries in the river.

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

FROM SPACE TO SOCIETY: EXPLORING HYPERSPECTRAL REMOTE SENSING TO AID CHESAPEAKE BAY RESOURCE MANAGERS IN THE DETECTION OF POOR WATER QUALITY

Stephanie Uz; stephanie.uz@nasa.gov; NASA

Coauthors: John McKay, Maryland Department of Environment, Shellfish Monitoring Division; Jennifer Wolny, Maryland Department of Natural Resources; Shannon McDonnell, University of Maryland

Session: Remote Sensing and the Bay; Classroom 3, 1:30-3:00

A recent shift at NASA to consider science and applications together during the design of Earth observing missions expands the focus of research and development. For the water quality community, this means exploring how current and future sensors together with other efforts can enable new basic and applied research that will ultimately benefit society. New space-based instruments currently being studied, designed, and built by NASA will change the way we monitor water quality with increased spectral, temporal, and spatial resolution. While each of these new sensors will improve our ability distinguish indicators of poor water quality, practical solutions will require fusing data from multiple platforms, accounting for uncertainties and other limitations. Now is the time to think about how everything will come together while there is still some flexibility in planning data collection, management, and product generation. To prepare the science and applications communities for these new observations, we have been meeting regularly with interagency stakeholders from around the Chesapeake Bay since April, 2018 and held a one-day workshop in August to improve the integration satellite-derived indicators of water quality variables with modeling efforts. Together with NOAA, we also offer training opportunities to build capacity among end users and increase awareness of potential uses of satellite data as well as uncertainties and limitations. The community is collaborating to advance water clarity and harmful algal bloom (HAB) monitoring and modeling capabilities. Group recommendations include supplementing satellite data with high-spectral resolution in situ radiometry data focused on the tributaries, coasts and shorelines where current coarse satellite data are masked out – areas most important for aquaculture and recreation. We are also exploring collaborations with citizen science observing networks, as has proved useful in less turbid water bodies. Modelers endeavor to integrate satellite radiance measurements into models and merge well-validated satellite products, get feedback on output, and make them operational to advance toward forecasting. Developing a HAB forecasting system requires improving empirical relationships in the Chesapeake. Recommendations from discussions like these help to define the basic and applied research gaps that program managers can use to guide future solicitations.

Dr. Stephanie Schollaert Uz is the Applied Sciences Manager at NASA Goddard Space Flight Center where she leads efforts to increase the use of NASA Earth observations and science for societal benefit. She leads an interagency Chesapeake Bay group that has been meeting monthly since April, 2018 to connect remote sensing efforts with resource manager to advance local applications of satellite data products related to water quality and other indicators of ecosystem health. She also advises new NASA missions on end-user needs, including the Surface Biology Geology study recommended in NASA's recent Decadal Survey. Her research background in atmospheric and oceanic science includes investigating the response of ocean biology to physical forcing using satellite data, measurements collected at sea, and computer model output. She previously worked on the NASA Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) Project – a next generation hyperspectral ocean-color satellite planned for launch in 2022. Before becoming a research scientist, she served as a Meteorology and Oceanography Officer in the U.S. Navy. She has a Ph.D. in Atmospheric and Oceanic Science from the University of Maryland, an M.S. in Physical Oceanography from the Graduate School of Oceanography at the University of Rhode Island, and a B.S. in Oceanography from the U.S. Naval Academy.

CHANGES IN GROUNDWATER AND SURFACE WATER IN THE MARYLAND PIEDMONT AS A RESULT OF ROAD-DEICING SALT APPLICATION

Tiffany VanDerwerker; tiffany.vanderwerker@maryland.gov; Maryland Geological Survey

Session: Groundwater; Room A-300, 3:30–4:30

Road-deicing salt has been applied to roads during winter storm events since the 1940's. As a result, chloride concentrations in Maryland streams and groundwater have increased over time. In the Maryland Piedmont, unconfined aquifers are the primary water source for people on private water wells, and these aquifers are very susceptible to surface-based contamination. Water with elevated chloride concentrations can damage plumbing fixtures, appliances, and pipes. Chloride is unreactive and therefore it does not degrade in the environment and is easily mobilized in groundwater and surface water. Chloride transport between surface water and groundwater in Maryland has not been adequately evaluated. To investigate this relationship, the Maryland Geological Survey (MGS) performed a review of the literature for road-deicing salt impacts to both groundwater and surface water. As part of a multi-year study (conducted by MGS) to evaluate road-deicing salt contamination in groundwater, chloride data were compiled from various sources. These data were mapped in ArcGIS to evaluate spatial distribution of available data and changes in chloride concentrations over time.

Tiffany VanDerwerker is a Hydrogeologist with the Maryland Geological Survey (MGS) and a licensed Professional Geologist (NC) with a focus on groundwater quality and chemistry. Some of her work at MGS includes an evaluation of baseline groundwater quality in the Appalachian Plateau, brackish water intrusion along the Mayo Peninsula (Anne Arundel County), and road salt contamination in groundwater in the Piedmont. She attended Virginia Tech where she received both her Bachelor's and Master's Degrees in Geosciences.

HISTOPATHOLOGICAL ASSESSMENTS OF SMALLMOUTH BASS FROM LONG-TERM MONITORING SITES ON THE MONOCACY AND POTOMAC RIVERS

Heather Walsh; hwalsh@usgs.gov; USGS Fish Health Research Laboratory

Coauthors: Vicki Blazer, USGS; Brandon Keplinger, WV DNR; Michael Kashiwagi, MD DNR

Session: Fish Disease - Lesions and Tumors and Popeye, Oh My! Room A-300, 10:30–12:00

The use of histology in fish health assessments provides researchers with the capability to identify disease and abnormalities in fish. In routine assessments of smallmouth bass, histology has become an essential tool for the identification of intersex, parasites, and preneoplastic and neoplastic abnormalities. In adult and juvenile smallmouth bass sampled multiple years from the Monocacy River near Frederick, Maryland and the Potomac River/Antietam Creek near Sharpsburg, Maryland, parasites such as trematodes, cestodes, and myxozoans have been identified in numerous tissues. In most cases, co-infections of these parasites have been observed and may weaken their host's immune response. Additionally, the prevalence of intersex is high in male smallmouth bass sampled at these sites. Intersex prevalence and severity can vary by season, oftentimes being greater in the spring. In previous studies of smallmouth bass, intersex has been shown to be correlated with atrazine, which is typically applied in the spring when bass spawn. The purpose of the current study will be to identify correlations between chemicals sampled at these sites with the observed histopathology. Temporal variation will be analyzed between years and season to provide a better understanding of how intersex and parasite infections change over time and potential risk factors associated with these changes.

Heather Walsh is a Post-Doc Researcher at the USGS Fish Health Laboratory where she has been working on projects involving smallmouth bass disease in the Chesapeake Bay region for over a decade. She enjoys working on any types of fish studies which include histopathology and molecular pathology.

UTILIZING REMOTE SENSING DATA TO ASSESS SEAGRASS HABITAT CRITERIA IN MARYLAND'S COASTAL BAYS

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

Coauthors: Rebecca Marks, MD DNR; Rebecca Golden, MD DNR

Session: Remote Sensing and the Bay; Classroom 3, 1:30-3:00

Seagrasses in Maryland's Coastal Bays have been experiencing a decline over the past 20 years, due to excessive nutrients causing poor water clarity, and rising water temperatures. Remote sensing data is increasingly being utilized to monitor and forecast a variety of ecological changes and concerns. This project evaluated the use of remote sensing data to determine seagrass habitat conditions and attainment in Maryland's Coastal Bays. Level 2 images for chlorophyll a, water clarity (KD490) and sea surface temperature were acquired from the NOAA CoastWatch and NASA Ocean Color websites. These variables were derived from daily remote sensing imagery collected by the MODIS Aqua sensor at a 1 kilometer spatial resolution. Images were converted into a format supported by ArcGIS where mean and median values were calculated per pixel and compared to seagrass habitat thresholds. Remote sensing results were compared to known seagrass distributions and fixed water quality monitoring data. Lessons learned on imagery acquisition, pre and post-processing and required software platforms will be discussed. The processing steps and Python script developed for this project could be expanded to include the Chesapeake Bay, as well as applied to sensitivity analysis to refine seagrass habitat criteria thresholds and identify suitable areas for seagrass restoration.

Mrs Wazniak is an Environmental Program Manager- MD Department of Natural Resources. She is the head of the Integrated Assessment program in the Division of Tidewater Ecosystem Assessment. Her responsibilities include coordinating phytoplankton and Harmful Algal Bloom monitoring as well as Coastal Bays monitoring and assessment.

INTEGRATED STRATEGIES FOR ADDRESSING ALGAE AND RELATED IMPACTS ON WATER SUPPLIES

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

Coauthor: Benjamin Wright, Hazen and Sawyer

Session: Harmful Algal Blooms; Classroom 1, 10:30–12:00

Harmful algal blooms (HABs) are overgrowths of algae in water, and those caused by certain types of algae (particularly cyanobacteria, also known as blue-green algae) are a concern for water utilities worldwide. HABs are a source of taste and odor compounds in reservoirs, and in some cases can lead to the release of harmful cyanotoxins, which can be challenging to remove through conventional drinking water treatment processes. Many water utilities in the mid-Atlantic and Northeastern United States that have not traditionally experienced algae-related issues are now experiencing HABs, and even utilities well-versed in algae issues are experiencing new seasonal and magnitude event patterns. The seemingly ubiquitous and expanding nature of HABs, coupled with increased attention from the national media, is making algal mitigation critical for many water utilities. In this presentation, we will draw upon recent case studies to explore how recent trends in HAB occurrence demand changes to how we monitor source water quality. In particular, we will draw attention to the need for an integrated monitoring and management approach for source waters that covers multiple spatial and temporal scales and relies on data analytics for improved understanding of long-term trends and responses.

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. He works with water utility operations staff and managers to integrate the latest data and tools into their decision-making toolboxes.

QUANTIFYING EFFECTS OF STREAM RESTORATION ON NITRATE LOADS IN AN URBAN WATERSHED USING A HIGH-FREQUENCY SENSOR NETWORK

Claire Welty; weltyc@umbc.edu; UMBC

Coauthors: Andrew J. Miller, UMBC; Jonathan M. Duncan, Pennsylvania State University; Edward J. Doheny, US Geological Survey

Session: Stream Restoration Monitoring; Auditorium, 10:30–12:00

In fall 2017 - winter 2018, stream restoration construction was implemented by Baltimore County in the upper reaches of Dead Run watershed with the goal of reconnecting the stream with its floodplain to reduce stormflow velocities and streambank erosion. In addition, a wet pond was installed for the purpose of obtaining water quality credits for N, P, and sediment mass flux reductions to the stream network. In a project funded by Chesapeake Bay Trust, beginning in August 2018 we installed high-frequency nitrate, depth, and velocity sensors to track nitrate mass fluxes into and out of the restoration site and water quality pond over time. Data collected to date over four seasons have identified some surprising results. These include: (1) downstream concentrations of nitrate at the restoration outlet frequently being higher than upstream concentrations entering from the unrestored stream reach, which may be attributable to a tributary entering between the upper and lower reaches that is a hotspot of base-flow nitrate bleeding in from a legacy groundwater source; and (2) loss of discharge and hence nitrate mass flux along a stream reach downstream of the restoration site during hot, dry periods. We will discuss these and other data trends as well as challenges in obtaining high-quality, high-frequency data sets in a small stream in a highly urbanized system.

Dr. Claire Welty is Director of the Center for Urban Environmental Research and Education and Professor of Chemical, Biochemical, and Environmental Engineering at University of Maryland, Baltimore County (UMBC). Her research focuses on quantifying the urban water cycle at multiple scales, using a combination of mathematical modeling and field observations. At UMBC, she also hosts the field headquarters of the Baltimore Ecosystem Study Long-Term Ecological Research project. Dr. Welty has served as Chair of Water Science and Technology Board of the National Research Council. Dr. Welty holds a PhD in Civil and Environmental Engineering from MIT.

ADDRESSING AND PREVENTING LITTER IN MARYLAND

Ashley Van Stone; ashley@trashfreemaryland.org; Executive Director, Trash Free Maryland

Coauthor: Shari Wilson, Trash Free Maryland Board Chair

Session: Be Part of The Solution: Litter Outreach and Education; Room 307, 3:30-4:30

Trash Free Maryland is the leading advocate for public policies and initiatives to reduce trash pollution in the state. We work toward a state of Maryland that is free of trash, debris, and litter, where communities, public spaces, and waterways are safe, healthy, and support economic viability. In this presentation, you will learn more about the organization’s approach to litter reduction and mitigation, it's past and current advocacy, outreach and programmatic efforts, critical successes and next steps, and ways to support litter prevention in Maryland. Research on microplastics in the Chesapeake Bay will shared, alongside more background and context on our community based initiatives – Less Litter, B-More and Cheers to Clean Water. Historical, ongoing and forthcoming policy campaigns will be discussed with opportunity for group discussion on priorities for Maryland and the Chesapeake Bay Watershed.

No bio submitted

NEW GUIDANCE ON USING SITE-LEVEL DATA TO IMPROVE THE STREAM RESTORATION PROTOCOLS

David Wood; wood.csn@outlook.com; Chesapeake Stormwater Network

Coauthor: Tom Schueler, Chesapeake Stormwater Network

Session: Stream Restoration Monitoring; Auditorium, 10:30–12:00

Stream restoration is increasingly relied upon by states and local communities to meet the pollutant load reductions in the Chesapeake Bay TMDL. In 2013, an expert panel recommended three protocols to calculate nutrient and sediment removal rates for stream restoration practices. However, the past several years of implementation have revealed concerns about how to properly apply the protocols. At the center of those concerns was a desire to shift toward more site-specific data collection and post restoration monitoring to better capture the extreme variability across reaches. Over the past year and a half, a team of 65 stream restoration researchers and practitioners have developed recommended guidance for how to collect site-specific data to improve consistency in how the protocols are calculated, as well as monitor and verify the continued performance of the restoration, years after it is completed. This talk will summarize the key recommendations that will affect the stream restoration community going forward and provide an update on the progress made in getting them approved by Chesapeake Bay partnership.

David is the Stormwater Coordinator for the Chesapeake Stormwater Network, a small nonprofit focused on providing training and capacity building for a network of over 11,000 stormwater professionals from around the country. David manages CSN's annual webcast and workshop series, and facilitates the development of a variety of technical resources, including BMP expert panel reports, fact sheets and guidance documents.

REVISITING CHESAPEAKE BAY RESOURCE LIMITATION: A RE-ANALYSIS OF BIOASSAY AND TIDAL MONITORING DATA AND IMPLICATIONS FOR WATER-QUALITY MANAGEMENT

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

Coauthors: Emily Trentacoste, USEPA Chesapeake Bay Program; Cuiyin Wu, USEPA Chesapeake Bay Program/Chesapeake Research Consortium; Claire Buchanan, Interstate Commission on the Potomac River Basin; Anne Gustafson, University of Maryland Center for Environmental Science; Tom Fisher, University of Maryland Center for Environmental Science

Session: It's All About the Models; Classroom 1, 3:30-4:30

Understanding the temporal and spatial roles of nutrients and light in limiting phytoplankton primary production is necessary for developing successful nutrient management strategies. Chesapeake Bay has well-documented seasonal and spatial variations in nutrient and light limitation, which demonstrate the necessity of dual nutrient management strategies, and which are used to model tidal water quality (WQ) response to watershed nutrient loads. However, there is a lack of understanding on whether these resource limitation patterns have changed over time in response to nutrient load changes in the last three decades. Toward that end, we compiled tidal WQ monitoring data and bioassay data for the period of 1992-2002 and developed classification and regression tree models to predict bioassay-based limitation classes. The best model can correctly classify limitation classes for 61 of the 72 station-month pairs (i.e., classification rate = 85%). This model was applied to monitoring data for the period of 2007-2017 to predict limitation in the mainstem Bay. In addition, this approach was adapted to assess the status of and change in nutrient limitation in three tributaries. Overall, these new understandings in resource limitation can improve the interpretation, prediction, and modeling of tidal WQ changes in the context of nutrient management mandated by the Chesapeake Bay TMDL.

Dr. Zhang is an Assistant Research Scientist (Watershed Effectiveness Data Analyst) with the University of Maryland Center for Environmental Science (UMCES) at the USEPA Chesapeake Bay Program (CBP). His main role is to work with managers and scientists in the Chesapeake Bay partnership to explore causes behind the observed current status and long-term trends in the water quality of Chesapeake Bay and its tributaries, which is critical to defining the success of Chesapeake Bay and watershed restoration efforts to date and to making science-based management decisions in the foreseeable future. In 2016, he obtained his Ph.D degree in Environmental Engineering from the Johns Hopkins University.

Poster Abstracts

<STUDENT POSTER> DO DIFFERENT EXPOSURE PATTERNS OF MARCELLUS SHALE PETROLEUM PRODUCTION WATER EXERT STRESS ON A COMMON NORTH AMERICAN AMPHIBIAN (*LITHOBATES CLAMITANS*)?

Carlos Barragan; cbarra2@students.towson.edu; Towson University

Coauthors: Frank Green, Towson University; Christopher J. Salice, Towson University; Paula F.P. Henry, USGS

Hydraulic fracturing is a process used to extract petroleum products from shale formations by using high-pressure injections of fracking fluid. Due to the toxic nature of this fluid, and resultant wastewater, there is a growing concern for surface water contamination. There are several petroleum operations in the Susquehanna River watershed, which comprised around 50% of the freshwater delivered to the Chesapeake Bay. This study used L. clamitans (Green frog) larvae to gauge their sensitivity to fracking fluid exposure (1.5mL/L) in 3 different pulse treatments. Each regimen was given an exposure schedule; the control group had no exposure, a group with an 8hr exposure 3/week, a group with an 8hr exposure once/week, and a group with 24hr exposure once/week. Animals were exposed to these patterns for 30 days. Our results indicate that larvae exposed for 8hr 3/week had significant increased hazard (57.8 times that of control animals). To assess the effect of produced water on larval amphibian metabolism we used respiration chamber (Sensor Dish®) to obtain a rate of O2 Consumption per milligram. Using ANOVA with post-hoc Tukey's HSD, we found a significant increased O2 consumption in the treatment with a one 24hr/week pulse. Ongoing analysis is needed to better understand how effects observed here may improve our understanding of the potential ecological effects of produced water.

URBAN STREAM RESTORATION: CONVEYANCE AND MATERIAL PROCESSING CHANNELS

Maddie Berg; Madeline.Berg@stantec.com; Stantec

Due to the recent interest in stream restoration to help the Chesapeake Bay, this study was undertaken to evaluate the in-stream effectiveness of two restoration practices: conveyance channels and material processing channels. Ten streams, five of each restoration practice, were evaluated in terms of organic retention and macroinvertebrates. The upper and lower reaches of each stream were sampled with transects to measure organic retention percent cover and sampled with two methods for macroinvertebrates. Despite each site being evaluated only once during the summer of 2018, which was the highest rainfall on record in Maryland, trends were still apparent. Material processing channels had significantly higher organic retention compared to conveyance, as they had a larger average hydraulic radius and a greater presence of woody debris. Focusing on macroinvertebrate sampling methods, traditional kick-net sampling compared to novel habitube sampling collected similar species richness. Abundance varied greatly, though habitubes collected higher average abundance compared to traditional sampling. Results from this study suggest that urban stream restoration practices can impact organic retention within streams as well as the ability to provide the best habitat for in-stream biota. When designing streams to reduce downstream impacts, material processing channels should be considered as they retain organic matter and work to provide habitat potential. Due to similar species richness collections across all reaches, habitubes have the potential to be a valid future sampling technique. This, or a similar study, such as one with beavers and Beaver Dam Analogs (BDAs), should be continued over multiple years through different seasons to see if the trends persist or get stronger as the site ages. Stream restoration projects with a more natural approach have the potential to increase the function and durability of streams in the Mid – Atlantic Region, especially if they are further evaluated.

FROM COLORING BOOKS TO FIELD JOURNALS: THE EVOLUTION OF OUTREACH MATERIALS

Dionna Bucci; dionna.bucci@fairfaxcounty.gov; Fairfax County, VA Stormwater Management

Fairfax County seeks to inspire students to become environmental stewards by connecting them to their local watershed and the Chesapeake Bay. To this end, the Watershed Education and Outreach Section (WEO) offers several free programs and specialized tools to Fairfax County Public Schools (FCPS). In 2009, WEO developed their first outreach material: a coloring book. While this tool was great for public education, it didn't meet teachers' needs for materials that connected directly to school curricula. To tackle this problem, in collaboration with FCPS curriculum writers and stewardship groups, WEO created a Fairfax County Field Guide and then a Field Journal for use in 4th and 9th grade classrooms. The Journal allows WEO messages to reach over fifteen thousand students and provides a tool to connect students to nature while also addressing state-mandated standards of learning. This evolution of pre-existing education materials allows students across grade levels to: learn about their watershed and the importance of stormwater management, learn about and apply science curriculum skills and concepts, and get outside to connect with, explore, and protect their natural world. The Field Journal is also not only applicable locally, but easily transferable to other jurisdictions across the country to assist with environmental awareness and foster environmental stewards.

CLIMATE CHANGE: PLANNING FOR COASTAL RESILIENCY IN THE NORTHERN CHESAPEAKE BAY

Sanita Corum; scorum@eaest.com; EA Engineering, Science, and Technology, Inc., PBC

Coauthors: Alyssa Calomeni, Mark Dhruv, Christopher Overcash, and Eric Yan; EA Engineering, Science, and Technology, Inc., PBC

As part of efforts by Harford County, Aberdeen Proving Ground (APG), the Chesapeake Science and Security Corridor Joint Land Use Study (JLUS) Committee, and EA Engineering, Science, and Technology, Inc., PBC., a planning level study was prepared to develop a regional strategy needed to address concerns related to sea level rise and shoreline stabilization surrounding the Susquehanna River Flats and Upper Chesapeake Bay region. Sea level rise from climate change and other factors in the Upper Chesapeake Bay region, is predicted to increase water levels up to 2.3 ft by 2050 and 6.9 ft by 2100. Additional impacts from storm events including storm surge and wave action will increase water levels further resulting in both periodic and prolonged flooding of areas within Harford, Cecil and Kent counties which encompass the Upper Chesapeake Bay region. Based on recommendations in the JLUS, a regional adaptation strategy was developed by first evaluating critical coastal vulnerabilities and then developing an adaptation plan which will inform the selection of coastal adaptation strategies. Coastal adaptation strategies primarily focus on ensuring that mission critical elements at APG were supported through the use of a regionally based approach that was also protective of civilian needs.

NITROGEN AND PHOSPHORUS CONTENT IN SHELLS AND TISSUE OF A WIDESPREAD FRESHWATER MUSSEL, EASTERN ELLIPTIO

Megan Davis; medavis16@crimson.ua.edu; University of Alabama

Coauthor: Matthew Ashton, Maryland Department of Natural Resources

Oyster restoration has been recognized as a pathway to improve Chesapeake Bay water quality. The restoration of freshwater mussels has received less attention, but has the potential to offer similar ecological benefits. Mussels occupy a variety of freshwater habitats, are long lived, and capable of filtering large quantities of water. Their activities have the potential to sequester and cycle nutrients and suspended particles prior to reaching the Bay. The role mussels might play in Bay restoration was first identified in Executive Order 13508 and more recently by a Chesapeake Bay Program STAC workshop proposal. We suggest that restoration of freshwater mussels could provide another tool to achieve several of the Chesapeake Bay's water quality outcomes, although technical questions remain that require further attention. We used standard shellfish biochemistry and particulate nutrient sampling methods to quantify the nitrogen and phosphorus content in Eastern Elliptio (N=34) from two streams. From this, we determined percent and per individual N and P content for mussel tissue and shell. Nutrient content was strongly correlated with dry tissue and shell weight along with shell length. The later suggests that determining nutrient content can be estimated from a simple, non-lethal measurement. More sampling is needed to examine variability across species and landscapes.

MICROBIAL SOURCE TRACKING IN MONTGOMERY AND PRINCE GEORGE'S COUNTIES

Michael Durbano; ksermon@eaest.com; EA Engineering, Science, and Technology, Inc., PBC

Coauthors: Kandice Sermon, EA Engineering; Michael W. Powell, EA Engineering; Martin Chandler, WSSC Water; Rachel Noble, UNC; Matthew Price, UNC.

Since 2007, EA Engineering, Science, and Technology, Inc., PBC (EA) has been managing a long-term microbial source tracking (MST) study in the 26 sewer basins located in Montgomery and Prince George's Counties. The purpose is to determine the impact on surface water quality and to characterize long-term water quality trends in pathogen indicators from human versus non-human sources associated with improvements made to the WSSC's sewer collection system. The monitoring data from 34 rounds of MST monitoring at 46 regional stream locations was evaluated to characterize the sources of bacterial contamination and evaluated to identify surface water locations that had the highest probability of being adversely impacted. Surface water samples are analyzed for Enterococcus spp., the human-specific Bacteroides HF183 genetic marker, and other source specific markers of fecal contamination. Recently, the monitoring program transitioned from a culture-based Enterococcus method (Method 1600) to a qualitative Polymerase Chain Reaction (qPCR) based method (Method 1609.1), as well as a transition to digital droplet DCR for MST marker quantification. An overview of the results from the multi-year study will be presented.

SAMPLING CYANOBACTERIA AT A D.C.LAKE

Catherine Gaudlip; gaudlip@hood.edu; Hood College Center for Coastal and Watershed Studies

Coauthor: Nathan Purser

The Constitution Gardens Lake in Washington, D.C. experience summer algal and cyanobacteria blooms, which are likely the result of the combination of summer heat, stagnant water, and nearby nutrient runoff. Samples were taken monthly at 6 locations around the lake. Sampling techniques include grab samples for nutrient concentrations and photosynthetic pigments. Additionally, temperature, dissolved oxygen, and pH were taken for water quality parameters. The average pH and temperature (°C) for each sampling event was 9.58 and 28.68, respectively. The average dissolved oxygen for all sampling events was on average 9.62mg/L. Average chlorophyll fluorescence ranged from 36.09 in June to 257.49 in late September. Average phycocyanin fluorescence ranged from 15.51 in June to 56.75 in late September, with a peak fluorescence of 786.95 in late August. Average ammonia concentrations ranged from 0.046mg/L in June to 0.184mg/L in September, with a peak concentration of 0.260mg/L in late July. Average nitrate levels in June were 0.242mg/L; whereas, in September they were 0.310mg/L, which peaked in July at 0.3775mg/L. Average orthophosphate levels decreased from 0.209mg/L in June to 0.0095mg/L in September. Peroxide application would eliminate cyanobacteria as well as increase oxygen levels.

<STUDENT POSTER> EFFECTS OF PRODUCED WATER FROM HYDRAULIC FRACTURING ON METABOLIC RATE OF *LITHOBATES CLAMITANS*

Matt Godbey; mgodbe1@students.towson.edu; Towson University

Coauthors: Paulo Ribeiro, Towson University; Carlos Barragan, Towson University; Frank Green, Towson University; Andrew East, Towson University; Paula Henry, USGS Patuxent River; Christopher J. Salice, Towson University

Yields from hydraulic fracking wells of The Marcellus Shale formation in Pennsylvania has grown 36% from 2012-2015. This growth of hydraulic fracking takes place predominantly in The Susquehanna watershed; which contributes 50% of all fresh water to the Chesapeake Bay. This suggests a potential for contaminants from Pennsylvania's fracking industry to affect amphibians in Maryland. A series of studies were conducted to determine the toxicity of produced water (PW) from a fracking facility on *Lithobates clamitans*. Starting with an acute toxicity study on *L. clamitans*, data were then used to design exposure levels for a 30-day chronic toxicity study. The chronic study was conducted with three PW treatment levels: low (0.75mL PW/L), medium (1.5mLPW/L), and high (3.0mLPW/L). The endpoint of the 30-day chronic was to measure oxygen consumption rate of individual tadpoles under three conditions; no recovery time, 5-day recovery time, and 14-day recovery time. Metabolic rates increased with higher exposure levels of PW with the effects diminishing with longer recovery time. These results indicate components of PW influence energetic costs in a native amphibian. These costs could translate to ecologically meaningful effects in local amphibians exposed to PW. More research is needed to better understand the potential effects of PW on native amphibian species.

<STUDENT POSTER> THE EFFECT OF WHITE-TAILED DEER ON THE GWYNNS FALLS WATERSHED: IMPLICATIONS FOR WATER QUALITY

Kristen Gossage; kgossage@stevenson.edu; Stevenson University

Coauthor: Joseph Matanoski, Stevenson University

White-tailed deer (*Odocoileus virginianus*) populations in central Maryland have increased markedly with the expansion of suburban communities. High densities of ungulate browsers, such as white-tailed deer, have been shown to have significant deleterious effects on vital characteristics of forest ecosystems, including vegetative cover, forest recruitment, soil compaction, species assemblages, and soil nutrient profiles. Gwynns Falls is a tributary of the Chesapeake Bay comprising 168 km-2 including forested, suburban, and urban land cover types. We examined the impact of the white-tailed deer population on the forest ecosystem in the watershed. Deer populations were estimated at 79 km-2 or about 10 times the predicted carrying capacity. Vegetative cover was markedly reduced from typical forest systems. In addition, there was a notable absence of seedling trees, and >95% of newly germinated woody vegetation exhibited signs of damage due to deer browsing. Management of white-tailed deer populations in the bay watershed should remain a top priority because of the potential negative effect on water quality due to these browsers.

USING STREAM INVERTEBRATES TO ASSESS THE MERCURY CONDITION OF MARYLAND STREAMS

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Coauthors: Jacob Oster, University of Maryland Center for Environmental Science; Laura Lapham, University of Maryland Center for Environmental Science; William Lamp University of Maryland College Park; Cynthia Gilmour, Smithsonian Environmental Research Center

Elevated mercury (Hg) deposition to Maryland watersheds has been ongoing for decades. Maryland has a diversity of watersheds making any assessment of the impact of Hg deposition both difficult and expensive. Stream assessments are typically done by measuring contaminant concentrations in water which, at the very least, requires multiple measures over different seasons and flow conditions. Of particular interest is the production of methylmercury (MeHg), as this is the form of mercury which bioaccumulates through the food web. Fish are the organism typically used for Hg assessment purposes but many first order streams do not contain fish. We tested the idea of using amphipods and isopods as sentinels of stream “Hg condition” by measuring Hg and MeHg concentrations in the organisms over time in two watersheds showing different Hg “condition”; assessed by Hg and MeHg water fluxes. Both amphipods and isopods reflected the differing “Hg condition”, with the fully forested watershed stream more impacted than the riparian buffered agricultural stream. The amphipods were a better indicator of the Hg “condition”; however, neither organism temporally tracked water born MeHg export suggesting a different pathway of MeHg exposure. Regardless, invertebrates might be a cost effective means of assessing headwater stream Hg “condition” across space.

<STUDENT POSTER> STRESSED TO DEATH? MULTIPLE STRESSORS AND THE EFFECTS ON *DAPHNIA MAGNA* SURVIVAL, REPRODUCTION, GROWTH, AND BIOENERGETICS

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Though often toxicity tests evaluate a single chemical and its effects on a single species, aquatic systems are obviously much more complex. In order to better understand the impacts of anthropogenic chemicals on actual populations, it is first important to establish how other, naturally occurring stressors, such as predation, temperature, and changes in food quality and quantity, also impact populations. The interactions of these combined stresses, both natural and anthropogenic, provide a more informed perspective on the impacts of anthropogenic ecological changes. A full-factorial 21-day chronic study exposed *Daphnia magna* to three stressors; predator kairomones delivered as two concentrations (100% and 50%), obtained from controlled *Pimephales promelas* cultures; a common fungicide for corn and soybeans, pyraclostrobin; and sodium chloride, commonly found in road salts. Sodium chloride was shown to significantly decrease reproduction, whereas predator kairomones significantly increased growth; however this depended on predator kairomone exposure level. Alternatively, pyraclostrobin significantly decreased growth. Understanding these complex interactions will be important data to collect moving forward in protecting Maryland freshwater systems.

RESTORATION MONITORING IN WHEEL CREEK WATERSHED

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Harford County received a Chesapeake and Atlantic Coastal Bays 2010 Trust Fund grant to address impacts to the Wheel Creek watershed, near Bel Air, Maryland by implementing stream restoration and stormwater BMP retrofits, conducting public outreach, monitoring the physical, biological, and water chemistry conditions. Restoration activities in the watershed were completed between 2012-2017. Since 2010, Harford County, Versar, Maryland Department of Natural Resources and USGS have collaborated to conduct comprehensive storm runoff, biological, and geomorphological assessments in the watershed to assess the effectiveness of the restoration efforts in reducing erosion, improving water quality, and improving the biological community. The monitoring conforms to the recommended Before After Control Impact study design. Results of the monitoring, which has recently concluded its first year of the fully post-restoration effort, are presented.

STATE LAKES PROTECTION AND RESTORATION FUND

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Coauthors: Mike Naylor, Maryland Department of Natural Resources; Mark Lewandowski, Maryland Department of Natural Resources; Cathy Wazniak, Maryland Department of Natural Resources

In May 2018, Governor Larry Hogan approved $1,000,000 annually for three years for the State Lakes Protection and Restoration Fund which is intended to protect and restore 16 state-owned or state-managed lakes, a task undertaken by the Maryland Department of Natural Resources. The Fund can be used for removing sediment, treating contaminated sediment, preventing the spread of invasive species, improving ecological and recreational value, and any other action the department deems necessary. The department held five open houses around the state in November and December of 2018 to solicit public input, and subsequently drafted a work plan and working budget for a range of projects that were selected to begin in July 2019. These projects range from scientific assessments of water quality, harmful algal blooms, and aquatic invasive species to shoreline stabilization, sediment removal, and habitat restoration. The department is currently seeking public input regarding the development of a work plan for the second phase of the Fund for projects to begin or continue in 2020-2021. We hereby report on projects underway in 2019-2020, highlight lake monitoring as a cost-effective way to maximize ecological and recreational value, and accept input toward developing a budget for best use of the Fund in coordination with local governments, organizations, and citizens.

<STUDENT POSTER> USING HIGH-FREQUENCY DATA AND CONCENTRATION-DISCHARGE RELATIONSHIPS TO DESCRIBE SOLUTE MOBILIZATION AND TRANSPORT IN SUBURBAN AND URBAN WATERSHEDS

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Coauthor: Joel Moore, Towson University

Elevated specific conductance (SC) and major ion concentrations can negatively impact stream ecosystem health and water quality. Concentration-discharge (C-Q) relationships reflect the distribution of solute sources in watersheds and offer insight into solute transport by highlighting the relative contributions of flow pathways. We used discrete samples and high-frequency (5-15 min) SC data to examine storm event C-Q relationships for 3 watersheds (<6.5 km2) in Maryland: 1 primarily forested suburban with septic systems (1.1% ISC) and 2 urban with sanitary sewers (~25% ISC). C-Q behaviors for SC, dissolved silica, and major ions were characterized using the rotational direction of hysteresis loops and a flushing index (FI) that indicates if concentration or dilution occurs on the rising limb. In the primarily forested watershed, SC data showed predominantly counterclockwise flushing patterns (FI >0) in winter and clockwise dilution patterns (FI <0) during non-winter months. Flushing patterns were common for SC during winter in the urban watersheds, and first-flush pulses of ions often were observed even when dilution was the overall trend, a phenomenon not observed in the suburban watershed. In summer, chemostatic patterns for SC were observed occasionally in the suburban watershed and more frequently in urban watersheds, even when discharge increased by 3 orders of magnitude.

MOLECULAR CHARACTERIZATION OF LANDFILL LEACHATES

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Landfill leachate can contain extreme concentrations of metals, contaminants of emerging concern (CECs), dissolved organic carbon, and ammonia in comparison to domestic wastewaters. Historically, inorganic contaminants in landfill leachates have been more studied, partly because of the complexity of dissolved organic matter and analytical demands of measuring individual organic chemicals. While more recent targeted quantification of CECs has greatly contributed to the understanding of landfill leachates, nontargeted approaches to landfill leachate analysis are still rare. We addressed this need by molecularly characterizing landfill leachates by FT-ICR-MS. We also measured other chemical properties in leachate samples and a suite of CECs.

IRON PRESENCE IN STREAM RESTORATION PROJECTS AND POTENTIAL IMPACTS TO THE AQUATIC BIOLOGICAL COMMUNITY

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Coauthors: Christopher J. Salice, Towson University; Jamie Suski, EA Engineering, Science, and Technology, Inc., PBC

Restoration stream sites in Maryland utilizing the Regenerative Streamwater Conveyance (RSC) design have been observed with iron flocculate, which may be from dissolved iron in groundwater that is introduced to the system following restoration. Aquatic faunal communities including invertebrates and amphibians may be sensitive to iron flocculate that results from abiotic and biotic factors. Study objectives seek to identify RSC design aspects that are associated with increased iron in the restored stream and the resulting impacts on the aquatic community. Field site monitoring for water quality, iron (dissolved & flocculate), macroinvertebrates, and fish will be used to characterize iron presence and potential effects in restored and unrestored streams. Data from the field studies will inform mesocosm designs to identify direct and indirect effects of iron on the benthic macroinvertebrate community. This will be complemented by field experiments, which include the identification of temporal shifts in stream chemistry and iron presence as well as performing caged field studies on representative aquatic species. The caged study will deploy sensitive taxa from reference streams into iron flocculate stream locations. Results from this research will improve our understanding of the relationship between RSC system and iron and the potential impacts to ecological receptors.

EXAMINING CONNECTIONS BETWEEN ROAD SALT APPLICATION AND STREAM HEALTH IN BALTIMORE COUNTY STREAMS

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Coauthors: Dillon Mahmoudi, UMBC ; Ginny Rogers, Versar Inc.

Maryland's benthic communities have long been impacted by development and urbanization around the Baltimore area. Road salt has recently been identified as another factor contributing to stream health. The Maryland Biological Stream Survey (MBSS) is conducted annually at streams across the state to assess the quality and health of benthic communities. Specifically, in Baltimore County, there are many "Poor" and "Fair" rated streams, showing an overall decline of stream health in many areas of the County. Road salt application is particularly high during the winter months when there is heavy snowfall and the roads are susceptible to freezing. These winter months, especially February and March, are the peak season for benthic community development and propagation. High amounts of road salt application can change the water chemistry, increase chloride concentration, and potentially cause fatal consequences to the benthic community. This poster seeks to examine the possible relationship between road salt application and stream health across streams in Baltimore County by using basic correlation analyses and GIS applications.

EXPORT OF NITROGEN AND SEDIMENT FOLLOWING LEGACY SEDIMENT REMOVAL AND FLOODPLAIN RECONNECTION RESTORATION PROJECTS

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The Mid-Atlantic Piedmont region was altered through deforestation, conversion to agricultural lands, and mill dam construction during European settlement. By the 1840s, mill dams were ubiquitous throughout the Piedmont and led to the deposition of fine-grained (legacy) sediments that buried pre-settlement wetlands. Following failure of mill dams in the 19th and 20th centuries, streams incised through the legacy sediments leaving steep banks that are easily erodible. In addition to contributing to elevated sediment export, the location of the stream within steep banks substantially limits interaction with the surrounding floodplain and groundwater underlying the floodplain. Lack of hydrologic connection with groundwater affects infiltration, recharge, nutrient cycling, and water temperatures. Legacy sediment removal and floodplain reconnection (LSR-FR) restoration techniques were developed to address the unique conditions caused by historic mill dams. However, little is known about the effectiveness of this new approach. We compared baseflow and stormflow nitrogen (N) and total suspended solids (TSS) loads between upstream (control) and downstream (restored) conditions of six different LSR-FR projects in the Maryland Piedmont. Restoration projects varied in length, age, and impervious surface coverage (ISC). Sites with higher ISC have lower NO3- concentrations than agricultural and suburban sites with lower ISC. Initial results indicate N load reductions are not significant during baseflow, except at the sites with ISC > 20%, which show a decrease in N ranging from 0.29 to 1.75 mg/d/km2. The reduction may be a result of low loading from the surrounding more urbanized landscape. Restored streams exhibit non-significant changes in TSS transport relative to their control with the exception of one newly restored agricultural stream showing an increase in TSS transport (8.19 mg/d/km2 ± 18, $p < 0.05$). Preliminary results on stormflow indicate that retention of sediments may occur during high stage events when water exceeds bank height. Further research on stormflow N and TSS export is in progress.

THE EFFECT OF WETLAND RETROFIT PROJECTS ON PHOSPHATE LEVELS IN THE ESTUARINE AND COASTAL WATERS OF HAMPTON, VIRGINIA

Zachary Messegee; zachary.messegee@hamptonu.edu; Hampton University

The over-enrichment of nutrients like phosphorus to the bay area can largely be attributed to rock weathering, sewage effluent and fertilizer run off. In an attempt to decrease the outflow of total phosphates (TP) into the Hampton River, which flows out to the bay, the city developed a retrofit project to convert an existing out flow area into a wetland. The site was monitored for 10 months and compared to data from 2012 to 2015. EPA method 355.3 was utilized for the determination of TP via UV-vis colorimetric analysis. The study of these local waters considers factors such as salinity, the dissolved oxygen content and pH of the water in addition to TP. Since March 2019, phosphate levels have followed similar trends to previous years, with increased TP concentration peaking during the summer months around 1 ppm when water levels were at their lowest and 0.05 ppm when it is most dilute. In comparison of 2019 to 2012-2015, the concentration of TP has shown lower concentrations when it comes to low tidal events. Compared to 2012-2015, dissolved oxygen content has seen a decrease in the lake area as well as a slight increase to the lake acidity and salinity, indicating that mixing areas of the river may be moving into the lake.

THE ROLE OF PLACE ATTACHMENT IN VOLUNTEER MONITORING: A TRANSNATIONAL PILOT STUDY OF ENGAGING AND RETAINING VOLUNTEERS

Rachel Pierson; Rachel.Pierson@uvm.edu; University of Vermont

Engaging the public in scientific research through water monitoring (a form of citizen science) has potential to expand knowledge of conditions and to improve collaborative decision-making. Place attachment has also been demonstrated to lead people to adopt more environmentally responsible behaviors. However, few studies have considered if motivations to participate in citizen science programs differ across cultures, the role that place attachment may play as a potential driver of initial or sustained participation, and what actions or behaviors to protect the environment may result from participation. This study applied a mixed-method approach to assess and compare motivations and outcomes of participation of new and experienced volunteers in stream-based water monitoring programs in three countries: the United States, Canada, and New Zealand via: 1) surveys of 24 stream-based volunteer monitoring groups, and 2) follow-up semi-structured interviews with a subset of survey participants. Stream monitoring groups in the US monitor streams in the New York and Pennsylvania regions of the Chesapeake Bay watershed. This research aims to determine the extent to which place attachment influences participants' decision to volunteer over time, as advocacy for protection of local natural areas is a potential benefit of volunteer monitoring related to place-based connections. These findings may also help program directors understand why people participate, providing insight to increase recruitment and retention of volunteers for citizen science programs.

<STUDENT POSTER> EFFECT OF URBAN SEDIMENTATION ON EASTERN BLACKNOSE DACE ESCAPE PERFORMANCE

Olivia Saliger; osalig1@students.towson.edu; Towson University

Coauthors: Cassidy Hartke, Towson University; Dr. Jay Nelson, Towson University; Dr. Christopher Oufiero, Towson University

The Eastern blacknose dace (BND) *Rhinichthys atratulus*, is one of the most urban-tolerant fish species and lives in even the most degraded streams in Baltimore, Maryland. Increased sedimentation in urban streams could necessitate compensation by fish to successfully evade predators in turbid waters. Ten adult BND were collected via seine from each of 2 streams within the Patapsco basin, one rural and the other very urbanized in order to determine how increased turbidity associated with urbanization affects escape performance in BND. Escape response of each fish was tested under turbid and non-turbid conditions. Turbidity was created through addition of suspended diatomaceous earth in the water and was standardized by measuring optical density with a spectrophotometer. An escape reflex was captured at 500 FPS using a high-speed camera after stimulating the fish remotely with a simulated predation attempt. Data are currently being analyzed, however, there appears to be a visible difference between rural and urban BND, with urban BND more responsive to stimuli in both turbid and non-turbid waters. This research contributes towards understanding of what adaptive characteristics are necessary for fish to successfully evade predators and survive in the urban stream environment.

STREAM RESTORATION EFFECT ON WATER QUALITY IN STREAMS OF THE LOWER SUSQUEHANNA SUBBASIN

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Coauthors: Jennifer Sliko, Penn State Harrisburg, Shirley Clark, Penn State Harrisburg, Elizabeth Bell, Penn State University, Alan Strayer, Penn State Harrisburg

Many stream restorations in the US are not monitored frequently or effectively after being restored to determine the effect of the mitigation. Of those that are monitored, many fail to meet their goals of improving water quality and stream habitat (with some projects actually worsening stream conditions for biotic life). Variation in stream restoration efficacy in reducing nutrient content of stream water requires further investigation of the success of stream restoration projects. This preliminary study of four Lancaster County, PA floodplain restorations on tributaries of the Lower Susquehanna Subbasin investigates downstream change in aquatic total nitrogen (TN), total phosphorus (TP), and dissolved oxygen (DO) concentrations as well as trends in TN over time after construction. Streams are restored with the objective of reducing TN and TP and increasing DO yet a consistent downstream decrease in TN and TP concentrations was not found in all streams monitored in this study. Dissolved oxygen was found to increase downstream in all streams during normal flow but was not found to increase downstream in all restorations during storm flow. Yearly TN concentration decreases were not observed to grow greater each year after construction. Further study is called for with emphasis on more extensive monitoring of groundwater.

COLLABORATIVE DEVELOPMENT OF A VOLUNTEER MONITORING PROGRAM FOR CHESAPEAKE BAY SUBMERGED AQUATIC VEGETATION

Suzi Spitzer; sspitzer@umces.edu; University of Maryland Center for Environmental Science

Coauthors: Brooke Landry, Maryland Department of Natural Resources; Sky Swanson, University of Maryland Center for Environmental Science; Katie May Laumann, University of Maryland Center for Environmental Science; and Bill Dennison, University of Maryland Center for Environmental Science

Research on submerged aquatic vegetation (SAV) informs policy and management decisions in the Chesapeake Bay; however, limitations to scientists' data collection capabilities have hindered scientific research and management efforts. We worked with SAV experts, volunteer monitoring coordinators, and citizen scientists, to design a volunteer monitoring program that generates useful, scientifically-rigorous data for professional scientists, while also providing an engaging and educational experience for volunteers with varying interests and abilities. This poster will describe the collaborative process of developing a multi-tiered monitoring protocol and training program, highlight several resources that were developed for this program, and share key insights learned throughout the process.

COPING COMMUNITY RAISES RESILIENCY: THE DEAL ISLAND SHORELINE PROJECT

Rebecca Swerida; rebecca.swerida@maryland.gov; MD DNR- CBNERR

Coauthor: Nicole Carlozo, MD DNR

Deal Island, Maryland is a small, environmentally and socially vulnerable rural community in Somerset County. Roads, property and vital community infrastructure are regularly impacted by flooding. The Deal Island Community Shoreline Restoration and Enhancement Project site has lost an extensive dune system and 234 feet of shoreline since the 1970s. Should the shoreline breach, a marsh complex would wash out and directly expose a locally important road to erosion. A 1,200 linear feet dune restoration project with offshore breakwaters will demonstrate how nature-based practices can help address flooding and erosion to protect people, infrastructure, and ecosystems. The goals of the project were identified 1) erosion control 2) enhancement of marsh integrity 3) wildlife habitat. In order to understand how well the project supports those goals, a BACI monitoring design will be used to observe following metrics: marsh, shoreline and stone structure elevation, vegetation diversity and density, rates of accretion and changes in sediment characteristics. A similar, adjacent shoreline area, not to be impacted by construction, will also be observed as a control site. The monitoring data will be used to understand how the project impacts specific habitat parameters and achieve resiliency goals. The results will be used to improve restoration methodologies.

COLLABORATIVE DEVELOPMENT OF A VOLUNTEER MONITORING PROGRAM FOR CHESAPEAKE BAY SUBMERGED AQUATIC VEGETATION

Renee Thompson; rthompson@chesapeakebay.net; USGS - Chesapeake Bay Program

Coauthor: Nancy Roth, Tetra Tech

The CBP has a goal of sustaining watersheds identified as healthy by its seven partner jurisdictions. Quantitative indicators are important to assess current watershed condition, track future condition, and assess vulnerability of these watersheds to future degradation. Building upon EPA's Preliminary Healthy Watershed Assessment (PHWA) framework, we assembled and evaluated a set of Chesapeake-specific metrics characterizing multiple aspects of landscape condition, hydrology, geomorphology, habitat, biological condition, and water quality, for integration into an overall watershed health index. Geospatial analyses were structured, where possible, to leverage data from EPA StreamCat, the National Fish Habitat Partnership, the Chesapeake Bay model for nutrient loads, and other regional sources. Vulnerability metrics were derived including future developed land use, forest loss, protected land status, and brook trout susceptibility to climate change. Metric values were compiled for nearly 84,000 NHDPlus catchments Bay-wide. Understanding threats to healthy watersheds across the Chesapeake region can inform multiple CBP goals and outcomes including: Stream Health, Fish Habitat, Protected Lands, Climate and Diversity. The indicators will be available to federal, state, and local managers as a geospatial tool that provides critical information for maintaining watershed health.

ASSESSING HARMFUL ALGAL BLOOMS IN STATE OWNED LAKES

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

Session: Harmful Algal Blooms; Classroom 3, 10:30-12:00

During the summer of 2019, eight State owned lakes were sampled for harmful algae blooms. Lakes sampled included Smithville, Tuckahoe, Unicorn, Urieville, Wye Mills, Clopper, Hunting Creek and Greenbriar. No harmful algae were detected in Tuckahoe or Greenbriar. Potentially toxic cyanobacteria were found in 6 lakes and low levels of microcystin were found in the water at three lakes (Smithville, Wye Mills and Clopper Lakes). Microcystin ranged from .81 to 2.67 ppb. Anatoxin was below detection limits at Unicorn, Clopper and Hunting Creek Lakes. Additionally, filamentous algae mats were shown to produce toxins in Unicorn, Smithville and Wye Mills (Lyngbya, Microseria wollei). Microcystin ranged from 3.2 to 5 ppb in the filaments. Urieville had potentially toxic filamentous algae (pending saxitoxin results).

While the toxin levels observed were well below the 10 ppb threshold for a recreational, no-contact advisory; three 'Animal Safety Alerts' were issued. Animal safety alerts were determine based on bloom levels of potentially toxic cyanobacteria species or low levels of toxin. Pets, especially dogs, and other animals are more likely to be exposed to toxins by drinking the lake water directly and/or licking their coats after swimming in bloom water. When in doubt, keep pets out.

MONITORING SUBMERGED AQUATIC VEGETATION IN THE CHESAPEAKE BAY

Briana Yancy; briana.yancy@maryland.gov; Maryland Department of Natural Resources

Coauthor: Brooke Landry, Maryland Department of Natural Resources

Submerged aquatic vegetation (SAV) is an important resource in the Chesapeake Bay. SAV provides food and habitat, stores carbon and takes up nutrients, anchors and oxidizes sediments, protects shorelines from erosion, and increases water clarity. Due to its ecological importance, the Chesapeake Bay Program (CBP) has set a 185,000-acre Bay-wide SAV restoration goal. To track progress towards this goal and assess ecosystem health, the CBP is working towards a three-tiered hierarchical SAV monitoring program. The first tier is the Bay-wide aerial survey that maps SAV throughout the Bay and its tributaries and has been ongoing since 1984. The second tier, the Chesapeake Bay SAV Watchers program, is the CBP's first official SAV monitoring program for volunteers. This program was designed to provide volunteers with an engaging and educational experience while also generating useful SAV data for scientists and managers The third tier, the Chesapeake Bay Sentinel Site Monitoring Program for SAV, includes more intense data collection at a limited number of long-term SAV sentinel sites throughout the Bay. Each tier is specifically designed to help scientists and managers develop a more comprehensive understanding of SAV resilience and recovery and inform management decisions and strategies.

Annual Standing Committee Reports

Maryland Water Monitoring Council

2018-2019 Annual Report

This report summarizes MWMC activities from November, 2018 through December 6, 2019.

2019 marked the 25th year for the Council and it was an exciting one. The Board of Directors continued to guide the Council toward its goals and new members provided fresh ideas that helped move the Council forward. The 2018 Annual Conference drew a record 625 attendees. Included were a host of exciting talks and posters and the fifth post-conference social was held at Checkerspot Brewing in Baltimore. Committee work continued in earnest, including some worthy projects and workshops. The Council entered 2019 with a renewed commitment to pursue the three Cs – Communication, Coordination and Cooperation - among water monitoring agencies and organizations throughout the State.

Board of Directors

The MWMC Board of Directors continued its work under the leadership of Sandy Hertz (MDOT) and Mat Pajerowski (USGS) serving as Chair and Vice-Chair, respectively. Although not a Board member, the Board welcomed Najma Khokar in April. Najma has agreed to Chair the Information Management Committee. All members in 2018 continued in their Board service into 2019. Andy Becker (KCI) was officially approved as a Board member in March. MWMC Board of Directors information can be found at http://dnr.maryland.gov/streams/Pages/MWMC/BoardofDirectors.aspx .

2018 Annual Conference

The 24th Annual Conference was once again held at the Maritime Institute on December 7 and the gathering was bigger and better than ever. With a record 625 in attendance, the event's theme was Science, Stewardship and Citizen Involvement – Working Together for Clean Water. An informative plenary session started with a talk by Dominique Luekenhoff (US EPA) who discussed green corridors and EPA's efforts to enhance vibrant communities. Will Baker (Chesapeake Bay Foundation) presented past and current CBF work with an emphasis on citizen science. Cathy Wiss (Audubon Naturalists Society) received the 12th Annual Carl Weber Award for her decades of work training volunteers to monitor streams. And Joe Davis and Matt Budinger (Baltimore County Schools) were the recipients of the third annual Above and Beyond Award for their excellent environmental education programs. Session topics included environmental reporting, urban ecology, watershed stewardship, trash, fish passage, and stormwater. Eighty talks, 42 posters (including 14 student posters), 21 vendors or sponsors, and 12 "special interest" exhibits all contributed to a diverse and well-rounded agenda.

Workshops

Stream Monitoring Roundtable

The 12th Annual Stream Monitoring Roundtable was held at the Hein Public Service Building in Glen Burnie on February 22, 2019. About 54 people attended and there were 23 presentations by staff from agencies, consulting firms, academic institutions and NGOs. Katherine Slater (MDE) gave a lunchtime presentation titled, Reaching Across the Aisle: Collaboration in MS4 Biological Monitoring. Andy Becker (KCI) and Shirley Kirby (MDE) collaborated to produce an online map of all submitted point data for 2018 monitoring. This map was used to locate areas of overlap and identify potential opportunities for collaboration. The map will be updated annually. For more information about the Roundtable, contact Andy Becker at andy.becker@kci.com.

What's in store for 2019?

2019 will be the 25th 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 Dec. 6 conference in April and the event will feature plenary talks by Ben Grumbles (MDE Secretary) and Nick DiPasquale (retired Chesapeake Bay Program Chair).

The Monitoring and Assessment Committee plans to hold another Stream Monitoring Roundtable in early spring and the newly-Chaired Information Management Committee may hold an event to celebrate the renewal of this long-dormant committee.

Full committee reports can be found elsewhere in this program.

Submitted by Dan Boward
MWMC Executive Secretary (for seven more months)
December 6, 2019

Maryland Water Monitoring Council Groundwater Committee

2019 Annual Committee Report

Chair

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No report submitted.

Maryland Water Monitoring Council Monitoring and Assessment Committee

2019 Annual Committee Report

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No report submitted.

Maryland Water Monitoring Council Citizen Science and Community Stewardship Committee

2019 Annual Committee Report

Committee members and affiliations
Jeff Reagan, Biohabitats Inc., Board Member, Chair
Diana Muller, Board Member, Co-Chair
Karen Wiggen, Charles County Dept. of Planning and Growth Management, Board Member
Marla Duley, Community Member

No report submitted.

Maryland Water Monitoring Council Student Committee

2019 Annual Committee Report

Committee members and affiliations

Joel Moore, Towson University, Chair, Board Member
Dan Boward, MDNR, Board Member
Karin Olsen, Anchor Qea, Inc., Community Member
Tami Imbierowicz, Harford Community College, Community Member
John Munro, UMUC, Community Member
Dot Lundberg, Rowan University, Community Member (through 2017 MWMC meeting)

No report submitted.

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