2024 RIVER SYMPOSIUM

ABANDONED MINE DISCHARGE, THE SUSQUEHANNA RIVER, AND THE CHESAPEAKE BAY

November 8 & 9, 2024
Bucknell University

Program with Abstracts

www.riversymposium.scholar.bucknell.edu

COMMITTEE

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Associate Professor, Dept. of Ecosystem Science and Management, The Pennsylvania State University

John Clune
Research Hydrologist, U.S. Geological Survey
Faculty Associate, Bucknell Center for Sustainability & the Environment

H. W. "Skip" Weider
Susquehanna River Heartland Coalition for Environmental Studies

Cover photo: A view downstream of the Lackawanna River near its confluence with the North Branch Susquehanna River near Scranton, Pennsylvania. Even during high flows such as when this photo was taken, iron precipitates from abandoned mine discharges to the river cover the entire bed of the stream and are especially visible in the shallows along the right bank. During base flow conditions most common throughout the year, the dissolved and suspended metal particles turn the water orange and can be seen on satellite images (such as Google Earth) for the lower 3 miles. [Photo: Robert Hughes, Eastern Coalition for Abandoned Mine Reclamation (EPCAMR)].

WELCOME

This symposium brings the public together with faculty, students, scientists, engineers, consultants, watershed groups, and state and federal agencies to share their latest research findings and discuss sustainable restoration and management strategies that will improve the health of watersheds and the ecosystems and communities living therein.

It features keynote and plenary addresses, exhibits, and oral and poster presentations from 156 students, faculty, consultants, agencies, and watershed groups.

Our goal is to cultivate knowledge, and discovery, all the while increasing awareness of the watershed restoration and conservation work under way throughout the Susquehanna and Chesapeake region.

All events are free and open to the public. Oral presentations are both in person and virtually via Zoom. To register and access links to the various sessions, please visit:

riversymposium.scholar.bucknell.edu

PROGRAM WITH ABSTRACTS

CONTENTS

19th Annual River Symposium

ABANDONED MINE DISCHARGE,

THE SUSQUEHANNA RIVER, AND THE CHESAPEAKE BAY

FORWARD

A significant part of this year's symposium will focus on the legacy of coal mines in Pennsylvania, specifically new findings about how discharges from these abandoned mines impact the Susquehanna River and Chesapeake Bay. Pennsylvania has roughly one-third of the nation's abandoned mine lands and millions of residents live in watersheds that are polluted by abandoned mine discharges. Besides water quality and public health issues, there are important environmental justice issues that communities in these areas must cope with.

We will also learn about adaptive management techniques the look to the future and "two-eyed seeing," an approach being used around the world, where traditional science-based knowledge is combined with indigenous wisdom in ways that recognize the interconnectedness between social and ecological processes and improve our abilities to heal damaged ecosystems and live sustainably.

FRIDAY, NOV. 8, 2024

INDIGENOUS PERSPECTIVE. On Friday, from 7:10 to 7:30 p.m. in the Forum (Rm. 272), **Betty Lyons**, Snipe Clan of the Onondaga Nation, Haudenosaunee Confederacy and Executive Director, American Indian Law Alliance, will begin by centering our thoughts on Native American teachings about the interconnectedness of all living beings. Her words will help us focus on values like respect, humility, courage, and community and enrich our sense of being and purpose.

KEYNOTE SPEAKER. From 7:30 to 8:00 p.m. in the Forum (Rm. 272), **Charles A. Cravotta**, Research Hydrologist, US Geological Survey and will deliver the keynote address *"Abandoned Mine Discharges, the Susquehanna River, and the Chesapeake Bay."*

RESEARCH POSTERS. On Friday, from 8:00 to 10:00 p.m. in the Terrace Room (Rm. 276), over 100 students and faculty from 44 universities and organizations will present their work. Abstracts for all poster presentation are provided on pages 46-85.

EXHIBITS. On Friday, from 8:00 to 10:00 p.m. in the Terrace Room (Rm. 276), will be exhibits from watershed groups, agencies, and environmental organizations. Exhibitors will be at their tables from 8 to 9:30 p.m.

EVENING SOCIAL. Also on Friday, an evening social with deserts and refreshments will be held in the Terrace from 9 to 10 p.m. **Awards for Best Student Poster Presentations** will be given at 9:45 p.m.

SATURDAY, NOV. 9, 2024

ON-SITE REGISTRATION AND SELF-GUIDED TOUR OF POSTERS AND EXHIBITS. The welcome desk (located at the entrance to the Terrace Room, Rm. 276) will be open at 8 a.m. on Saturday for on-site registration. Participants can pick up their name badge and symposium folder.

Coffee/tea and light breakfast snacks will be served in the Terrace Room, where you can enjoy a self-guided tour of the posters and exhibits, which will remain on display throughout the day.

PLENARY ADDRESSES. On Saturday, between 9:00 and 10:00 a.m. and 1:00 and 2:00 p.m. in The Forum (Rm. 272). Interactive panel discussions will be held after each session. Abstracts for each keynote and plenary presentation are provided on pages 20-25.

- **Anna Killius**, Executive Director, Chesapeake Bay Commission and **Jill Whitcomb**, Acting Deputy Secretary, Office of Water Programs, Pennsylvania Department of Environmental Protection, will deliver a plenary address entitled *"The Next Generation of Watershed Restoration: Planning for 2025 and Beyond."*
- **Kathy Boomer**, Scientific Program Director, Foundation for Food and Agricultural Research will deliver a plenary address entitled *"Exploring Two-Eyed Seeing to Support Green Sustainability."*
- **Brian Cooper,** Project Manager of the Trout Unlimited's Pennsylvania Abandoned Mine Drainage Program, will deliver a plenary address entitled *"Two Birds, One Stone: AMD Treatment Restores Fisheries While Reducing Chesapeake Bay Sediment."*
- **Robert Hughes**, Executive Director of the Eastern PA Coalition for Abandoned Mine Reclamation, will deliver a plenary address entitled *"Improving communities and restoring watersheds in abandoned mine lands throughout eastern Pennsylvania."*

PANEL DISCUSSIONS. Following each plenary session, panel discussions will be held where the audience can interact with the plenary speakers and ask questions and explore things in greater detail.

LUNCH. Lunch will be served from 12:00 to 12:55 p.m. in Walls Lounge (Room 213).

ORAL PRESENTATIONS. Saturday features 21 oral presentations organized into seven sessions:

- Riparian Plant Communities
- Stream-Floodplain Connectivity and Sedimentation
- Ecosystem services, biogeochemistry, and queer ecology
- Community Resilience, Engagement, and Education
- Hydrology, Climate, and Floodplain Management
- Flow Paths, Riparian Corridors and Stream Temperatures
- Engineering and Sustainable Design

A schedule of each oral presentations is provided on pages 7-10; their abstracts are provided on pages 26-45.

WRAP-UP. From 4:00 to 4:15 pm, everyone is invited to gather in The Forum (Rm 272) to reflect upon the symposium outcomes and ideas for next year. **Awards for Best Student Oral Presentations** will be given at 4:15 p.m.

ACKNOWLEDGEMENTS. This symposium would not be possible without the generous support of the Provost's Office at Bucknell University and the Pennsylvania Water Resources Research Center at Penn State, Dr. Jonathan Duncan, Director.

Special thanks are due the symposium committee: Sean Reese, Janeen Putman, Krista Smith, Matthew Higgins, Shaunna Barnhart John Clune, Jesse Greenawalt, George Lincoln, Sid Jamieson, and H. W. "Skip" Weider.

Best wishes for a great symposium!

Sincerely,

Benjamin R. Hayes, Ph.D., P.G.
Symposium Chair

19TH ANNUAL RIVER SYMPOSIUM

SCHEDULE

FRIDAY, NOVEMBER 8, 2024

THE FORUM (RM. 272)

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

7:00 - 7:05 p.m.

Welcome

Jonathan Duncan
Executive Director
Pennsylvania Water Resources Research Center
Executive Director, Pennsylvania Water Resources Research Center
Associate Professor, Dept. of Ecosystem Science and Management, The Pennsylvania State University

7:05 - 7:10 p.m.

Opening Remarks

Benjamin Hayes
Symposium Chair
Bucknell Center for Sustainability and the Environment

7:10 - 7:30 p.m.

Indigenous perspectives

Betty Lyons
Snipe Clan of the Onondaga Nation
Haudenosaunee Confederacy

President and Executive Director
American Indian Law Alliance

7:30 - 8:00 p.m.

Keynote Address

"Abandoned mine discharge, the Susquehanna River, and the Chesapeake Bay"

Charles A. Cravotta III, Ph.D., P.G.
Research Hydrologist (retired)
U.S. Geological Survey
Consulting Geologist

THE TERRACE ROOM (ROOM 276)

8:00 - 10:00 p.m.

Posters, Exhibits, and Evening Social

Poster presentations* by students and faculty from universities and colleges throughout the Chesapeake region. Students will be at their posters from 8 to 9 pm. Posters will remain on display throughout Saturday for self-guided tours.

Exhibits from state and federal environmental agencies, consulting firms, watershed groups, and other organizations. Exhibitors will be at their tables from 8 to 9:30 pm.

Evening Social with refreshments is from 9 to 10 pm. Student poster awards will be given at 9:45 pm.

SATURDAY, NOVEMBER 9, 2024

All events will take place in the Elaine Langone Center (ELC) and be held both **in-person** and **virtually via Zoom**. Visit the symposium website for more details and Zoom links to plenary presentations and oral sessions.

8:00 a.m. - 12:00 p.m.

Registration and Self-Guided Tour of Posters and Exhibits

Terrace Room (Room 276)

8:50 - 9:00 a.m.

Welcome and Opening Remarks

ELC Forum (Room 272)

Matthew Higgins

Faculty Director, Bucknell Center for Sustainability and the Environment

9:00 - 10:00 a.m.

Plenary Presentations

ELC Forum (Room 272)

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

9:00 - 9:30 a.m.

The Next Generation of Watershed Restoration: Planning for 2025 and Beyond

Anna Killius

Executive Director, Chesapeake Bay Commission

Jill Whitcomb

Deputy Secretary, Office of Water Programs, Pennsylvania Department of Environmental Protection

9:30 - 10:00 a.m.

Exploring Two-Eyed Seeing to Support Green Sustainability

Kathy Boomer

Scientific Program Director, Foundation for Food and Agricultural Research

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10:00 - 10:15 a.m.

Intermission

10:15 - 10:45 a.m.

Panel Discussion

ELC Forum (Room 272)

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

10:45 - 11:00 a.m.

Intermission

Transition to concurrent oral sessions

11:00 a.m. - 12:00 p.m.

Oral Presentations

Session 1 **Riparian Plant Communities**

ELC Forum (Room 272)

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

Session 2 **Stream-Floodplain Connectivity and Sedimentation**

ELC Rooms 241 A and B

Zoom link: https://bucknell.zoom.us/j/91598211028?pwd=MHB3K2hqVGJLbWtiMkg4dmI4NDFIdz09

Session 3 **Ecosystem Services, Biogeochemistry, and Queer Ecology**

ELC Rooms 241 C and D

Zoom link: https://bucknell.zoom.us/j/92099544675?pwd=I7Qu8gyZRbBh7viVerLoRE7TAPjWL8.1

12:00 - 1:00 p.m.

Lunch

Walls Lounge (ELC Room 213)

1:00 - 2:00 p.m.

Plenary Presentations

ELC Forum (Room 272)

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

1:00 - 1:30 p.m. - The Forum (Room 272), Elaine Langone Center

Two Birds, One Stone: AMD Treatment Restores Fisheries While Reducing Chesapeake Bay Sediment

Brian Cooper

Project Manager, Pennsylvania Abandoned Mine Drainage Program, Trout Unlimited

1:30 - 2:00 p.m.

Improving Communities and Restoring Watersheds in Abandoned Mine Lands across Eastern Pennsylvania

Robert Hughes

Executive Director, Eastern PA Coalition for Abandoned Mine Reclamation (EPCAMR)

2:00 - 2:15 p.m.

Intermission

2:15 - 2:45 p.m.

Panel Discussion

ELC Forum (Room 272)

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

2:45 - 3:00 p.m.

Intermission

Transition to concurrent oral sessions

3:00 - 4:00 p.m.

Oral Presentations

Session 4 — **Community Resilience, Engagement, and Education**

ELC Forum (Room 272)

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

Session 5 — **Hydrology, Climate, and Floodplain Management**

ELC Rooms 241 A and B

Zoom link: https://bucknell.zoom.us/j/91598211028?pwd=MHB3K2hqVGJLbWtiMkg4dmI4NDFIdz09

Session 6 — **Flow Paths, Riparian Corridors and Stream Temperatures**

ELC Rooms 241 C and D

Zoom link: https://bucknell.zoom.us/j/92099544675?pwd=I7Qu8gyZRbBh7viVerLoRE7TAPjWL8.1

Session 7 — **Engineering and Sustainable Design**

ELC Gallery Theater (Room 301)

Zoom link: https://bucknell.zoom.us/j/97303438778?pwd=wgzTlKLaJuYFvUlp9facd24ecwHuS5.1

4:00 - 4:30 p.m.

Wrap-Up

ELC Forum (Room 272)

4:00 - 4:15 p.m.

Reflection and Looking Ahead

4:15 - 4:30 p.m.

Awards for Best Student Oral Presentations

4:30 p.m.

End of Symposium

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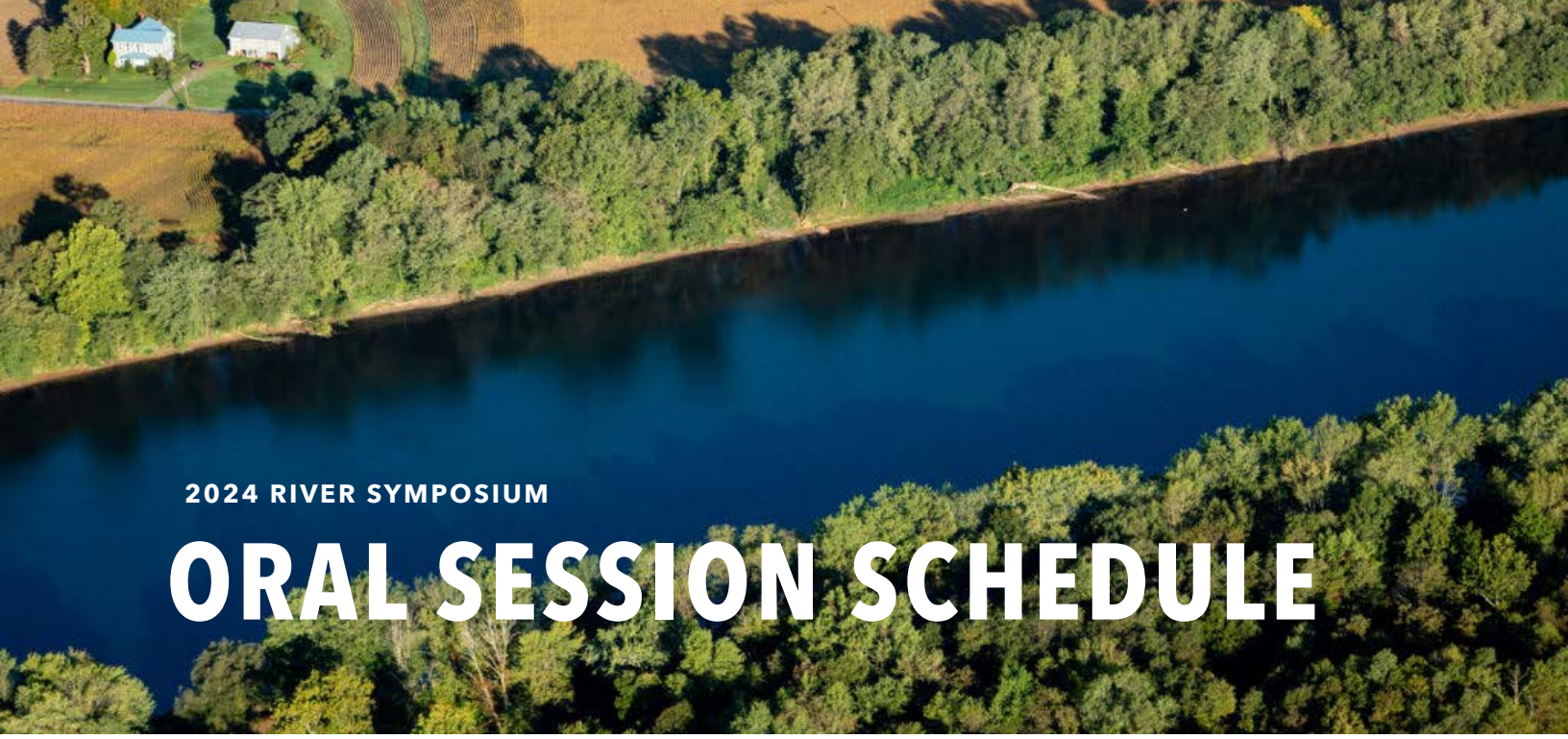


2024 RIVER SYMPOSIUM

ORAL SESSION SCHEDULE

Session 1

Riparian Plant Communities

ELC Forum (Room 272), Saturday, November 9, 11:00 a.m. - 12:00 p.m.

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

11:00 a.m. Garden Loosestrife (*Lysimachia vulgaris*), an emerging invasive plant species of riparian corridors in Pennsylvania
Christopher Martine*, Kaitlin G. Henry, Amy L. Jewitt, Claire Ciafre, Beth H., Williams, P. J. Newhart and Melody P. Sain

11:20 a.m. **A novel approach to collaborative riparian buffer success**
Cline, Zachary*

11:40 a.m. **Elucidating geographical dynamics of invasive knotweeds on Susquehanna River islands via remote sensing**
Michael Penn* and Mark A. Blumler

** denotes presenting author.*

Above photo: A mature riparian forest buffer protects the Susquehanna River in Clinton County, PA. Credit: Will Parson/Chesapeake Bay Program

Session 2

Stream-Floodplain Connectivity and Sedimentation

ELC Rooms 241 A and B, Saturday, November 9, 11:00 a.m. - 12:00 p.m.

Zoom link: https://bucknell.zoom.us/j/91598211028?pwd=MHB3K2hqVGJLbWtiMkg4dmI4NDFIdz09

11:00 a.m. Good Spring floodplain reestablishment remediation project
David Goerman*

11:20 a.m. **Vernal pool hydrology and stream connectivity in the Ridge and Valley of central Pennsylvania**
Taylor Blackman*

11:40 a.m. **Stream bottom changes after beaver dam analogs**
Daniel Ressler,* Matthew Wilson, and Siobhan Fathel

Session 3

Ecosystem Services, Biogeochemistry, and Queer Ecology

ELC Rooms 241 C and D, Saturday, November 9, 11:00 a.m. - 12:00 p.m.

Zoom link: https://bucknell.zoom.us/j/92099544675?pwd=I7Qu8gyZRbBh7viVerLoRE7TAPjWL8.1

11:00 a.m. Queer research experiences: reflections of riparian mercury biogeochemistry and the zoological closet
Austin Wadle*

11:20 a.m. **Soil ad water ecosystem services benefits from cover cropping in the Susquehanna River Basin**
Kalra Marali* and Raj Cibin

11:40 a.m. **Susquehanna River - what does the science say about water quality?**
John Clune,* Natalie Schmer, James Webber, and Alex Soroka

** denotes presenting author.*

Session 4

Community Resilience, Engagement, and Education

ELC Forum (Room 241), Saturday, November 9, 3:00 p.m. - 4:00 p.m.

Zoom link: https://bucknell.zoom.us/j/93595544011?pwd=Fwoy78OqNIPaPTObvIN7XGczZNAb8b.1

3:00 p.m. **Community benefit agreements can lead to more community resilience in abandoned mine communities**
Jordi Comas*

3:20 p.m. **Wildlife Leadership Academy: engaging and empowering the next generation of conservation leaders**
Sara Mueller*

3:40 p.m. **Beaver dam analogs: outcomes for flashiness, aggradation, and collaboration**
Matthew Wilson,* Daniel Ressler, and Siobhan Fathel

Session 5

Hydrology, Climate, and Floodplain Management

ELC Rooms 241 A and B, Saturday, November 9, 3:00 p.m. - 4:00 p.m.

Zoom link: https://bucknell.zoom.us/j/91598211028?pwd=MHB3K2hqVGJLbWtiMkg4dmI4NDFIdz09

3:00 p.m. **Diverging streamflow and precipitation trends in the contiguous US**
Matthew Berzonsky,* Valerie Smykalov, Kayalvizhi Sadayappan, Jan Seibert, and Li Li

3:20 p.m. **Enhancing flood adaptation strategies with nature-based solutions and high-resolution modeling**
Rashid Ansari, Raj Cibin, and Alfonso Mejia

3:40 p.m. **Preliminary results from the Pennsylvania National Flood Insurance Program implementation survey**
Thomas Hughes* and Virginia Silvis

** denotes presenting author.*

Session 6

Flow Paths, Riparian Corridors and Stream Temperatures

ELC Rooms 241 C and D, Saturday, November 9, 3:00 p.m. - 4:00 p.m.

Zoom link: https://bucknell.zoom.us/j/92099544675?pwd=I7Qu8gyZRbBh7viVerLoRE7TAPjWL8.1

3:00 p.m. **Concentrated flow pathways and riparian buffer performance**
Rachel Taylor,* Heather Preisendanz, and Tyler Groh

3:20 p.m. **Predicting the impact of riparian vegetation and land use on stream temperatures in the Chesapeake Bay watershed using deep learning**
Elham Mahmod Por* and Kimberly Van Meter

3:40 p.m. **Complexities in surface and groundwater salinity and conductivity within a mixed land-use karst watershed**
Alexandra Orr* and Elizabeth Boyer

Session 7

Engineering and Sustainable Design

ELC Gallery Theater (Room 301), Saturday, November 9, 3:00 p.m. - 4:00 p.m.

Zoom link: https://bucknell.zoom.us/j/97303438778?pwd=wgzTlKLaJuYFvUlp9facd24ecwHuS5.1

3:00 p.m. **Using 3D printing to test waterwheel efficiency**
Qiwen Wu* and Kushal Adhikari

3:20 p.m. **Repurposing spent lithium-ion batteries for chemical looping in-situ CO_2 capture and conversion**
Frank Onwudinjo* and Jude, A. Okolie

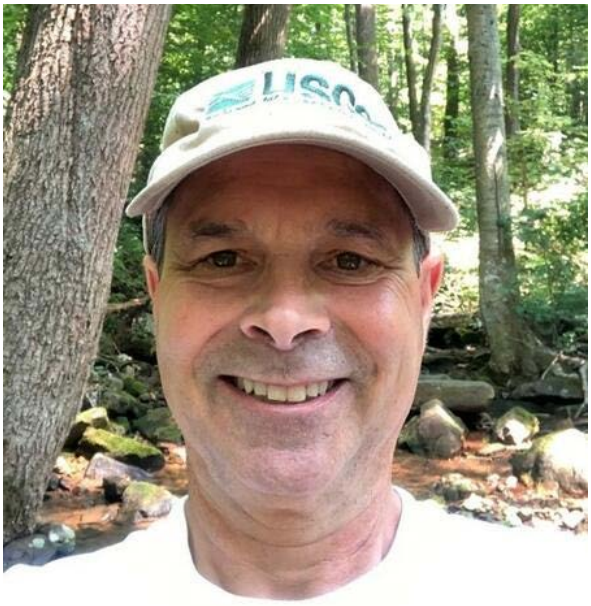
3:40 p.m. **Environmental Journalism: Tips to connect scientific work with the public and questions to dig deeper into hot-button issues**
John Zaktansky*

** denotes presenting author.*

INVITED SPEAKERS

Charles A. Cravotta III

Research Hydrologist (retired)
U.S. Geological Survey



Dr. Cravotta is an internationally recognized scientist with more than 40 years of professional experience, mostly as a research hydrologist for the U.S. Geological Survey, until December 30, 2023. He established Cravotta Geochemical Consulting LLC ("CGC") for continued involvement with colleagues, students, and watershed groups. He received his B.A. in Environmental Sciences from the University of Virginia (1979) and his M.S. and Ph.D. in Geochemistry and Mineralogy from the Pennsylvania State University (1986, 1996).

Dr. Cravotta's research integrates field, laboratory, and computer modeling methods to understand factors affecting water quality, especially that in highly disturbed or engineered environments, such as mine-impacted watersheds and water-treatment systems for remediation of acid mine drainage (AMD). He has provided mentorship and research guidance to more than 45 graduate and undergraduate students as external student adviser, adjunct faculty member, or advisory board member. He has also provided research support and guidance to local watershed groups and regional organizations involved in the restoration of watersheds impacted by AMD.

Dr. Cravotta will deliver the keynote address entitled ***"Abandoned Mine Discharge, the Susquehanna River, and the Chesapeake Bay"*** from 7:30 to 8:00 p.m. on Friday, Nov. 8 in The Forum (Room 272), Elaine Langone Center.

Betty Lyons (Gaeñ hia uh)

Snipe Clan of the Onondaga Nation, Haudenosaunee Confederacy
President and Executive Director, American Indian Law Alliance

Betty Lyons, president and executive director of the American Indian Law Alliance (AILA), is an Indigenous and environmental activist and citizen of the Onondaga Nation. Her native name, Gaen hia uh, meaning 'small sky,' was given to her by her Snipe Clan mother and has developed her love for the earth from her deep connection to her culture.

Growing up, she learned a deep respect for the earth and the responsibility to protect it. Lyons worked together with the NOON organization (Neighbors of the Onondaga Nation) to educate and teach local communities about the culture of the Onondaga Nation to further a better understanding and to bridge the gap between the communities.

Betty is President & Executive Director of the American Indian Law Alliance (AILA), an Indigenous and environmental activist and citizen of the Onondaga Nation. She has worked for the Onondaga Nation for over 20 years. Ms. Lyons serves as a member of the Haudenosaunee External Relations Committee and has been an active participant at the annual United Nations Permanent Forum on Indigenous Issues (UNPFII) since the first session in 2001 as a delegate of the Onondaga Nation. Betty attended Cazenovia College and is a Bryant Stratton College Graduate of the Paralegal Program.

Betty continues to work for the protection of Indigenous peoples who are fighting to protect their traditions, territories, resources, and care for Mother Earth. Out of her concern for Indigenous peoples and Mother Earth, Betty serves on numerous boards like: 4 The Future Foundation, Connie Hogarth Center, Center for Earth Ethics, The MOST, Skä•noñh- Great Law of Peace Center Academic Collaborative, and is Co-Chair of the Center of Earth Ethics Advisory Board.

She is also the hardworking mother of Garett and Sid Jr.

Ms. Lyons will deliver a special opening remarks entitled *"Broken Landscapes"* at 7:10 to 7:30 p.m. on Friday, Nov. 8, 2024 in The Forum (Room 272), Elaine Langone Center.

Anna Killius

Executive Director
Chesapeake Bay Commission

Anna Killius joined the Commission in 2023 as Executive Director. She previously served as Director of Advocacy for the James River Association and legislative counsel for Congressman John Sarbanes of Maryland, where she advanced his leadership as co-chair of the Congressional Chesapeake Bay Watershed Task Force.

Anna has held appointments to the Chesapeake Bay Citizens Advisory Committee and the Virginia Soil and Water Conservation Board. She is a 2021 graduate of the Virginia Natural Resources Leadership Institute. She received a juris doctor degree from William and Mary Law School, where she was a member of the first class of the Virginia Coastal Policy Center, and a bachelor's degree in history from the University of Dallas with a concentration in Applied Mathematics.

Director Killius will co-present a plenary address entitled ***"The Next Generation of Watershed Restoration: Planning for 2025 and Beyond"*** on Saturday, Nov. 9, from 9:00 -9:30 a.m. in the ELC Forum (Room 272).

Jill Whitcomb

Acting Deputy Secretary, Office of Water Programs
Pennsylvania Department of Environmental Protection

Jill Whitcomb is currently serving as the Pennsylvania Department of Environmental Protection (DEP) Acting Deputy Secretary of the Office of Water Programs. She oversees and provides direction for four bureaus and their work in point and nonpoint source management, permitting, and compliance; water quality standards and assessment; water obstructions and encroachments, flood protection, and dam safety; safe drinking water and source water protection; and interstate waters, compacts and commissions, and coastal zones management.

Previously, Jill served in multiple staff and management roles at DEP, most currently as the Director of the Bureau of Watershed Restoration and Nonpoint Source Management, overseeing Pennsylvania's statewide nonpoint source management program, conservation districts, agriculture conservation and compliance assurance, and Chesapeake Bay watershed restoration efforts. Prior to joining DEP, Jill worked for the Lancaster County Conservation District. Jill holds a Master of Environmental Pollution Control from Penn State University and a Bachelor of Science in Biology from Lebanon Valley College.

Deputy Secretary Whitcomb will co-present a plenary address entitled ***"The Next Generation of Watershed Restoration: Planning for 2025 and Beyond"*** on Saturday, Nov. 9, from 9:00 -9:30 a.m. in the ELC Forum (Room 272).

Kathy M.B. Boomer

Scientific Program Director
Foundation for Food & Agriculture Research

Dr. Kathy Boomer joined FFAR as a Scientific Program Director in July 2019 after serving ten years as the Lead Watershed Scientist for The Nature Conservancy's Chesapeake Bay Restoration initiative. She has led numerous research partnerships to engage stakeholders and advance targeted agricultural and urban conservation practices.

Kathy has worked in China as a monitoring consultant for the Food and Agriculture Organization of the United Nations She continues to focus on developing programs to advance crop, soil, and watershed health through innovative water management. Kathy received her bachelor's degree in natural resources, her master's degree in wetland ecology and her doctorate degree in biogeochemistry all from Cornell University.

Earlier in her career, she worked with the Smithsonian Environmental Research Center as a geospatial ecologist. In this capacity, she investigated ecosystems services provided by a range of terrestrial, wetland and coastal habitats. She continues to serve on the Executive Board of the U.S. Environmental Protection Agency's Chesapeake Bay Program's Scientific Technical Advisory Committee.

Kathy has extensive experience in landscape modeling and field research to support technical assistance and a passion for advancing science-based decision-making to provide a pathway to sustainability and resilience of humans and nature. Outside of strengthening partnerships to ensure food security and agroecosystem sustainability, she enjoys watching and attempting a wide range of sports with her family on Maryland's Eastern Shore.

Dr. Boomer will deliver a plenary address entitled *"Exploring Two-Eyed Seeing to Support Green Sustainability"* from 9:30 to 10:00 a.m. on Saturday, Nov. 9 in The Forum (Room 272), Elaine Langone Center.

Brian Cooper

Project Manager, Pennsylvania Abandoned Mine Drainage Program
Trout Unlimited

Brian Cooper is the Pennsylvania Abandoned Mine Drainage (AMD) Project Manager for Trout Unlimited, a national conservation organization dedicated to wild salmonids and their habitat. Brian manages Trout Unlimited's AMD Technical Assistance Program, a free service through which, over the past 20 years, Trout Unlimited has provided technical assistance on more than 240 projects to over 75 watershed organizations, conservation districts, and other groups. He also manages the maintenance of the 10 passive AMD treatment systems that Trout Unlimited has constructed in Clinton and Clearfield counties and assists watershed groups with planning and funding the maintenance of their treatment systems. Brian has been leading a renewed effort to restore Beech Creek in Clinton and Centre Counties, and works to identify and develop new AMD treatment projects in priority waters throughout the Commonwealth.

Prior to joining Trout Unlimited, Brian was a project manager at a Fortune 500 environmental consulting firm, where he worked extensively on energy development projects. Brian's technical expertise includes wildlife biology, endangered species, environmental regulations, aquatic resource assessments, and permitting. Brian held a federal recovery permit for a variety of endangered bat species for over a decade, and some of his most interesting projects included developing risk assessments for bat species in the offshore environment as part of the permitting process for offshore wind development. For one project, Brian used bioacoustic monitors to document bat activity more than 40 miles off the coast of New York!

Brian is a graduate of Bucknell University (2011) where he earned a Bachelor of Science in Biology with a minor in Environmental Studies. He was a member of the very first class of *Bucknell on the Susquehanna* students, and now resides in nearby Williamsport. When he isn't sampling mine drainage or staring at spreadsheets, Brian enjoys hunting, fishing, and exploring the Pennsylvania Wilds region with his wife, two children, and dog.

Mr. Cooper will deliver a plenary address entitled ***"Two Birds, One Stone: AMD Treatment Restores Fisheries While Reducing Chesapeake Bay Sediment"*** from 1:00 to 1:30 p.m. on Saturday, Nov. 9 in The Forum (Room 272), Elaine Langone Center.

Robert Hughes

Executive Director
Eastern Pennsylvania Coalition for Abandoned Mine Programs (EPCAMR)

Robert has 30 years experience in abandoned mine land reclamation, water pollution control technologies, environmental education, and capacity building in coalfield communities throughout Northeastern & Northcentral PA. In his current role as Executive Director of EPCAMR, he is a coalition builder, grant writer, and administrator, and coordinates state-wide conferences on Abandoned Mine Reclamation. Bobby is the author of an activity/coloring book for youth on EPCAMR's work, an e-book on our AMD Environmental Education Programs, and a Cornell University Press publication on Civic Ecology. He is a certified UAS Remote Drone Pilot.

Currently working with EPCAMR Staff to advocate for renewable energy projects on mine lands related to solar and have created a Solar Site Suitability GIS Tool for siting potential solar projects on mine lands across PA geothermal projects utilizing underground mine pool water, rare earth elements recovery, stream restoration to keep clean streams from entering the underground mine workings, conducting watershed assessments and water quality and flow monitoring of dozens of AMD impacted rivers and streams throughout the Northern Anthracite and Bituminous Coal Fields, including Shamokin Creek. He is also working on projects focused on reclaiming abandoned waste culm banks in partnership with the Appalachian Regional Independent Power Producers Association (ARIPPA) in coalfield communities; Agnes Flood Baby and Wyoming Valley Coal Region native of the City of Wilkes-Barre in the heart of the Northern Anthracite Coal Field.

Mr. Hughes will share more about EPCAMR's ongoing efforts to improve communities and restoring watersheds in abandoned mine lands throughout eastern Pennsylvania from 1:30 to 2:00 p.m. on Saturday, Nov. 9 in The Forum (Room 272), Elaine Langone Center.

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A "word cloud" visualization of the oral and poster abstracts contributed to this symposium (pages 20-18).
Their relative size denotes greater prominence to the words that appear most frequently.
A total of 17, 104 words were analyzed.

2024 RIVER SYMPOSIUM

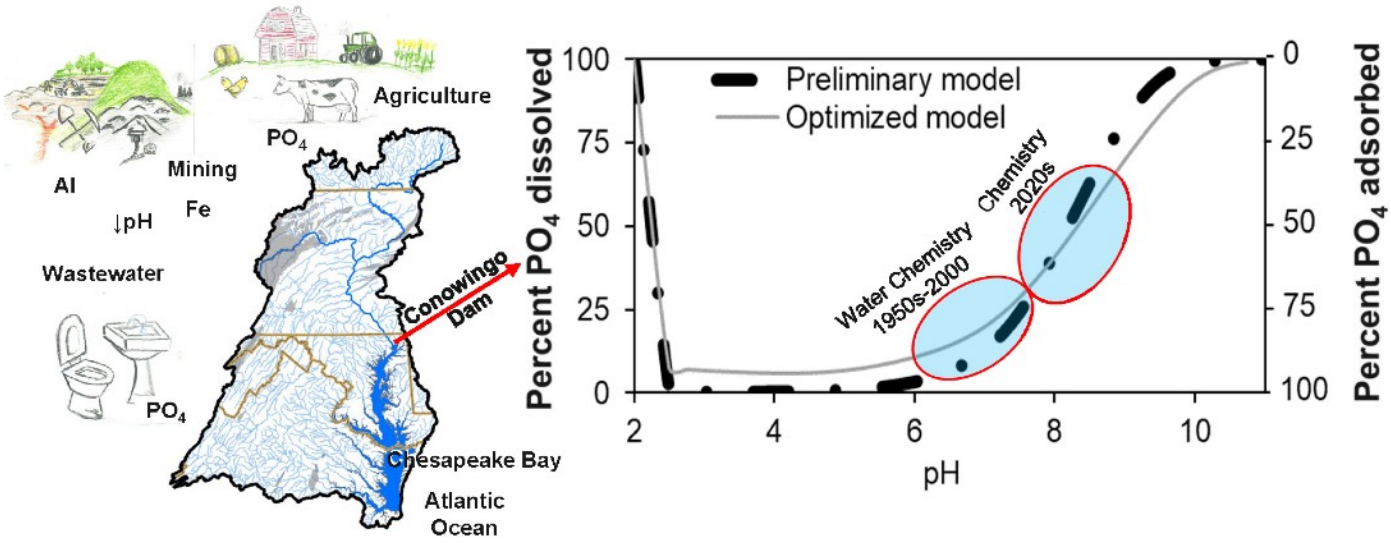
INVITED PRESENTATIONS

KEYNOTE ADDRESS

ABANDONED MINE DISCHARGES, THE SUSQUEHANNA RIVER, AND THE CHESAPEAKE BAY

Cravotta, Charles A., Hydrology/Geochemistry, Cravotta Geochemical Consulting, 859 Bloody Spring Rd, Bethel, PA 19507, cravottageochemical@gmail.com.

Nutrient pollution from agriculture and urban areas plus acid mine drainage (AMD) from legacy coal mines are primary causes of water-quality impairment in the Susquehanna River, which is the predominant source of freshwater and nutrients entering the Chesapeake Bay. Recent increases in the delivery of dissolved orthophosphate (PO_4) from the river to the bay may be linked to long-term increases in pH, decreased acidity of precipitation, and decreased acidity, iron, and aluminum loading from widespread AMD.



Since the 1950s, baseline pH increased from ~6.5 to ~8 in the West Branch and "North Branch" of the Susquehanna River, which drain bituminous and anthracite coalfields of Pennsylvania. A current baseline pH of ~8 and daily maxima exceeding 9 have been documented along the lower Susquehanna River. In response to improved river quality, bioavailable PO_4 now may be released into solution from legacy sediment that has filled major impoundments in lower reaches of the river. At typical pH (5-8) of natural water, aqueous PO_4 species tend to be adsorbed by hydrous iron, aluminum, and manganese oxides that coat soil and sediment particles; however, PO_4 may be substantially desorbed at pH >8.

We created a geochemical model that simulates equilibrium aqueous/solid distributions of PO4 as pH and other solution characteristics change. Considering current conditions in the lower Susquehanna River, the model demonstrates potential for extensive release of adsorbed PO4 at pH >8. Empirical data from laboratory experiments corroborate model results. The transfer of PO4 into the water column may increase algae growth, which removes CO_2 and drives pH to higher values, facilitating additional PO_4 release and exacerbating the potential for harmful algal blooms. Thus, legacy sediment is a currently unquantified source of PO_4 that warrants consideration by resource managers and programs collaborating to reduce phosphorus loads to the bay and similar settings worldwide.

acid mine drainage, phosphate, adsorption, algae blooms

THE NEXT GENERATION OF WATERSHED RESTORATION: PLANNING FOR 2025 AND BEYOND

Killius, Anna, N/A, Chesapeake Bay Commission, 60 West Street Suite 406, Annapolis, MD 21401, akillius@chesbay.us; **Whitcomb**, Jill, Office of Water Programs, Pennsylvania Department of Environmental Protection, Harrisburg, PA 17110.

Like the estuary we treasure, the Chesapeake Bay Program is unique and complex: a regional partnership with a shared vision, working together to achieve the goals of the Chesapeake Bay Watershed Agreement. After forty years of progress through partnership, the Program has reached a critical point of self-reflection as we strategize for a future beyond 2025. As we take stock of what we have achieved, where we have fallen short, and the challenges ahead, how can Pennsylvania lead by example, inspiring the next generation in conservation?

Chesapeake Bay, Beyond 2025

EXPLORING TWO-EYED SEEING TO SUPPORT GREEN SUSTAINABILITY

Boomer, Kathy, Sustainable Water Management, Foundation for Food & Agriculture Research, 401 9th Street NW, Suite 730, Washington, DC, 20004, kboomer@foundationfar.org; **Worthington**, Kay, CSIRO-US, San Mateo, CA 94404, kay.worthington@csiro.au; **Anstee**, Janet, AquaWatch CSIRO, Canberra ACT 2601 Australia, janet.anstee@csiro.au; **Farrell**, Zandria**,** AquaWatch CSIRO, Canberra ACT 2601, Australia, zandria.farrell@csiro.au; **Held**, Alex, AquaWatch CSIRO, Canberra ACT 2601, Australia, alex.held@csiro.au.

Despite decades of investment amounting to billions of dollars in restoring the Chesapeake Bay, risks to our water supplies and water quality have escalated under intensifying pressure from human activities and climate change. Further, it has become evident that shared sustainability goals—including soil health, biodiversity, climate resilience, and food security—depend on innovative approaches to water resource management. Yet, the adoption of advanced technical solutions, including nature-based solutions, precision irrigation, conservation drainage, and advanced crop systems, remains on less than 10% of our lands. A more holistic, systems-based approach to rivers and land management that actively engages the diverse communities connected to these systems is urgently needed to overcome our global challenges. To tackle this challenge, the Foundation for Food & Agriculture Research (FFAR) and Australia's National Science Agency (CSIRO) are honored to promote Two-Eyed Seeing workshops inspired by Albert Marshall and the Mi'kmaq Elders from Unama'ki, Nova Scotia. We welcome experts to explore tractable pathways to meaningfully integrating indigenous and contemporary scientific ways of knowing to advance informed decision-making in water resource management.

Two-Eyed Seeing, water management

TWO BIRDS, ONE STONE: AMD TREATMENT RESTORES FISHERIES WHILE REDUCING CHESAPEAKE BAY SEDIMENT

Cooper, Brian, Northeast Coldwater Habitat Program, Trout Unlimited, 18 East Main Street, #3, Lock Haven, PA 17745, brian.cooper@tu.org; **Rummel**, Shawn, Northeast Coldwater Habitat Program, Trout Unlimited, 18 East Main Street, #3, Lock Haven, PA 17745, shawn.rummel@tu.org; **Lutz**, Allison, Northeast Coldwater Habitat Program Trout Unlimited 18 East Main Street, #3 Lock Haven PA 17745, allison.lutz@tu.org; **Wolfe**, Amy, Northeast Coldwater Habitat Program, Trout Unlimited, 18 East Main Street, #3, Lock Haven, PA 17745, amy.wolfe@tu.org.

Abandoned mine drainage is among the leading sources of stream impairment in Pennsylvania and the top source of impairment in Pennsylvania's coldwater streams. AMD is created when pyritic rock is exposed to air and water during mining operations, forming sulfuric acid and dissolving naturally occurring metals such as iron, aluminum, and manganese. Trout Unlimited, along with many partners, has been active in AMD remediation in Pennsylvania for over 25 years. Successful treatment of AMD results in significant reductions in acidity, dissolved metals, and sulfate, and the return of healthy biological communities.

Results of multi-year monitoring of the effects of treatment on water quality and biological communities demonstrate positive impacts at multiple scales. At the discharge scale, we see effective elimination of acidity and dissolve metals content. At the stream-reach scale, we have documented water quality improvements that restored naturally reproducing trout populations and benthic macroinvertebrate communities below passive systems constructed and maintained by TU and our partners. At the large watershed scale, the cumulative effect of many AMD treatment systems (most of which are located in first and second order watersheds) led to the dramatic reduction of acidity and metals in the West Branch Susquehanna, along with increased diversity and abundance of fish. At the Chesapeake Bay scale, reductions in acidity and metals may be harder to appreciate due to dilution, but AMD treatment still

provides benefit through improved overall water quality and an under-appreciated side benefit: sediment reduction.

Although not accounted for in the Chesapeake Assessment Scenario Tool (CAST), AMD treatment systems remove sediment from the Chesapeake Bay watershed by forcing the precipitation of dissolved metals into solid waste within the treatment system where they can be removed for disposal. These dissolved metals would otherwise precipitate as sediment downstream. Therefore, the observed reduction of metal concentrations in the West Branch Susquehanna has positive implications for the role of AMD treatment systems in achieving sediment reduction goals for the Chesapeake Bay. Further study is needed to quantify the total sediment reduction service being provided by Pennsylvania's many AMD treatment systems, and AMD treatment warrants greater consideration in efforts to restore the Chesapeake Bay.

2024 RIVER SYMPOSIUM

ORAL PRESENTATIONS

GARDEN LOOSESTRIFE (*LYSIMACHIA VULGARIS*), AN EMERGING INVASIVE PLANT SPECIES OF RIPARIAN CORRIDORS IN PENNSYLVANIA

Martine, Christopher, Department of Biology, Bucknell University, 1 Dent Drive, Lewisburg, PA 17837, ctm015@bucknell.edu; **Henry**, Kaitlin, G, Biology, Bucknell University, **Jewitt**, Amy L., iMapInvasives Program, Western Pennsylvania Conservancy, Pennsylvania Natural Heritage Program, Rachel Carson State Office Building, Harrisburg PA 17105; **Ciafre**, Claire, Western Pennsylvania Conservancy, Pennsylvania Natural Heritage Program, Rachel Carson State Office Building, Harrisburg, PA 17105; **Williams**, Beth H.; **Newhart**, PJ; and **Sain**, Melody P., Department of Biology, Bucknell University, 1 Dent Drive, Lewisburg, PA 17837.

Lysimachia vulgaris (garden loosestrife, *Primulaceae*) is a yellow-blooming perennial wildflower native to wetlands of Europe, western Asia, and northern Africa. The species has been listed as ecologically invasive in large portions of the United States and has in many places been banned from sale, but its status in the Mid-Atlantic region has thus far been poorly assessed.

Our recent surveys in the Susquehanna River valley have shown that garden loosestrife is more abundant in this system than previously known, with multiple new records established between the Lewisburg, PA area and the southern border of the state. Incursions in many sites are quite dense, with the plants often dominating the frequently-inundated hydrologic zone between water-willow (*Justicia*

virginiana) and lizard-tail (*Saururus cernuus*) patches at the water's edge and the upper and less-disturbed areas of woody plant recruitment. At times, garden loosestrife co-occurs with the unrelated purple loosestrife (*Lythrum salicaria, Lythraceae)*, but also appears to exploit niches where purple loosestrife is not abundant. When combined with verified observations posted to iNaturalist, iMapInvasives, and EDDMapS the new records for garden loosestrife suggest that this species is a quickly-emerging invasive plant in riparian corridors throughout the state and an increasing threat to native plant diversity and natural community assemblage.

Invasive species, Lysimachia, loosestrife, Susquehanna

A NOVEL APPROACH TO COLLABORATIVE RIPARIAN BUFFER SUCCESS

Cline, Zachary, Chesapeake Conservancy, 1250 W Sassafras St, Selinsgrove, PA 17870, zcline@chesapeakeconservancy.org.

Riparian buffer restoration plays a critical role in improving water quality and stabilizing ecosystems, and innovative methods play a critical role in providing long-term success. This presentation explores two resilient and scalable approaches to buffer planting: the live stake collaborative (LSC), which began in 2019, and new this year, a seed collection/grow-out program. These approaches provide efficient, low-cost solutions for restoring riparian zones, particularly when implemented through collaborative partnerships. Live staking plants sections of branches from native wetland species directly into riparian zones, where they take root and stabilize streambanks. This method is highly accessible, requiring minimal training and is adaptable to varying site conditions. The process promotes rapid re-vegetation of riparian buffers, reduces soil erosion, and enhances habitat for aquatic species. The seed collection and grow-out program confronts the issue of limited availability of native plants in nurseries, supporting the sustainability of restoration efforts by including local, native plant populations. Partnerships with universities, conservation groups, and local communities have been hallmarks of successful project completion in the past. These collaborations allow for the sharing of resources, the sharing of training and educational outreach, and they create involvement across communities that makes successful restoration a shared success. By leveraging these collective efforts, buffer plantings can become more resilient, adaptable, and meaningful.

Riparian, Restoration, Conservation, Collaboration

ELUCIDATING GEOGRAPHICAL DYNAMICS OF INVASIVE KNOTWEEDS ON SUSQUEHANNA RIVER ISLANDS VIA REMOTE SENSING

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Invasive knotweed (*Reynoutria spp.*) is a group of highly invasive plant species in Europe and America. Using remote sensing data of river islands, I found that knotweed patches expand in open ground 48-112 cm/yr. Patches downstream of a large wastewater treatment plant grew faster than those upstream, implicating nutrient pollution as possibly facilitating knotweed invasion. I estimate that knotweed has been in the Upper Susquehanna River Valley since at least 1961 and that it spreads principally during the largest floods. Knotweed's establishment rate is approximately one patch per 3000-4200 m2. Knotweed is excluded from areas of frequent flooding with heights of 0-1 m above typical water level being a preliminary approximation for river islands and 2 m for a floodplain. Such flooding likely excludes knotweed from 13-43% of such riparian areas. I also determined that knotweed causes soil aggradation below its canopy.

I conclude that preserving topographic diversity of riparian areas is likely to lessen knotweed's negative effects on biodiversity. I recommend that rapid-response activities focus efforts on a stream's largest floods and that they be performed after a one growing season delay. Future studies should determine whether knotweed can concurrently cause both soil aggradation as well as bank mass failure, whether stabilization of streams encourages knotweed monocultures, and whether nutrient pollution facilitates knotweed invasion.

invasive knotweed, erosion, geographical spread, flooding

GOOD SPRING FLOODPLAIN REESTABLISHMENT REMEDIATION PROJECT

Goerman, David, Bureau of Waterways Engineering and Wetlands, PA Dept. Environmental Protection, 400 Market St, Harrisburg, PA 17105, dgoerman@pa.gov.

The presentation will provide an overview of the remedial activities done on a large-scale floodplain reestablishment project. The project encompasses approximately 4,600 feet of floodplain valley restoration encompassing approximately 18 acres. The valley was originally buried in coal waste or culm that during events was heavily eroded and transported into the downstream communities along Good Spring Creek (GSC) and the Swatara Creek. The Donaldson Culm Bank eliminated the natural floodplain of GSC adding to the higher peak stream flows and flooding downstream in the Boroughs of Tremont and Pine Grove and Pine Grove Township Schuylkill County. A brief discussion of why intervention (aka the problems) was necessary to ensure the success of the original project objectives. A discussion of the design techniques and decisions that were made to implement this novel approach to reestablishing the 7 square mile drainage area watercourse.

The work included excavation and placement of additional log base level control structures that were buried below the floodplain surface to prevent and control any accelerated erosion and prevent head cutting of channels along the valley. Approximately 25,000 feet of 15–24-inch diameter logs were placed across the entire valley at a horizontal spacing based upon 1.0-1.5-foot vertical elevation increase. The design approach is intended to provide valley grade control so the stream channel(s) that form can move across the valley and maintain the same channel invert elevation and if erosion occurs it is controlled and prevented from propagating beyond the next set of valley grade control logs. No bedrock controls are present throughout the site due to its historic mining. The surface of the floodplain was then covered in woody debris (treetops and logs) to provide habitat, roughness, and to assist in development of an anabranching channel pattern.

Restoration, Floodplain, Stream, Wetland

VERNAL POOL HYDROLOGY AND STREAM CONNECTIVITY IN THE RIDGE AND VALLEY OF CENTRAL PENNSYLVANIA

Blackman, Taylor, Department of Ecosystem Science and Management, The Pennsylvania State University, 1619 Houserville Rd, State College, PA 16801, tnb5149@psu.edu.

Vernal pools are small ephemeral wetlands most well-known for supporting amphibian reproduction, among other unique biota. In the Ridge and Valley of central Pennsylvania, vernal pools occur naturally and artificially by the thousands across different landscape positions and underlying lithologies. The origins of these features stem largely from periglacial soil processes during the Pleistocene, legacy roads, and shallowing surface mining. This presentation will cover the different settings in which pools are found and the landscape conditions that underpin their hydrology. A comparison of two distinctly different settings, forested headwaters versus an urbanized valley floor, will highlight the variety of observed vernal pool hydro-regimes and degrees of stream connectivity: 1) a cluster of 11 pools above the headwaters along a topographic saddle underlain by shale and 2) three created vernal pools at Millbrook Marsh in the middle of State College.

In the first setting, pools were formed over 10 k.y.a. with some containing 36% soil organic matter at 1.25 m, and they reside just above the stream network. High-frequency water level monitoring was conducted within pools and nearby shallow groundwater wells during Water Year 2022. At Millbrook Marsh, pools were built by targeting specific soil strata. The marsh is covered by legacy sediment (post-European arrival) that is 1 to 1.5 m thick, with plastic trash marking the top of the horizon and metal at lower extents. Below this layer is a dense fragipan layer comprised of loamy textures 0.5 m or less thick, which caps a deep mixed gravel layer. For groundwater to reach the created wetlands, it was key to have the lowest extent of the vernal pool within the gravel layer. Vernal pools can be created or enhanced for an array of specific outcomes such as carbon sequestration, amphibian habitat, nutrient management and water quality, and as provisioning resource for terrestrial species. A vernal pool's functions are primarily controlled by hydrology, specifically how it responds to rainfall and dries out seasonally. The lessons learned from natural systems are crucial to guiding creation and restoration efforts.

Vernal Pools, Headwaters, Legacy Sediments, Ephemeral Hydrology

STREAM BOTTOM CHANGES AFTER BEAVER DAM ANALOGS

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Ephemeral streams are often conduits for stormwater runoff from agricultural and urbanized landscapes. These channels are quickly inundated by storm flows, convey large quantities of water at high velocity during short episodes, then drain completely soon after the storm event. Water flows often scour the channel and threaten nearby vegetation and infrastructure by eroding banks and carving a deeply incised channel. Beaver dam analogs (BDAs) are a stream restoration structure that might reduce water velocity, create sediment traps, and store more water in the subsurface to reduce the destructive energy of these high storm flows.

Eight BDAs were installed in October 2023 in an ephemeral stream on Susquehanna University's field station where storm flows have been incising a channel and threaten mature trees, railroad culverts, and roadway ballast by undercutting the channel banks. The channel bottom was sampled prior to BDA installation, then 6 months after installation. Channel surveys show significant sediment retention in the upstream "beaver ponds". We are evaluating whether the retained sediment is finer than the initial sediment, which would suggest slower velocity water and less energy to move coarse gravel during bed-load transfer events. Stormwater delivery to the channel has significant exposure to railroad ballast (diabase and industrial slag), parking stormwater infrastructure (No. 2 limestone gravel), and agricultural fields (sandstone cobbles). By recording the mineralogy of the cobbles and gravel during examination, we hope to also demonstrate changes in transport of each material along the ephemeral channel.

Beaver Dam Analog, Stream Restoration, Sediments, Gravel size distribution

QUEER RESEARCH EXPERIENCES: REFLECTIONS OF RIPARIAN MERCURY BIOGEOCHEMISTRY AND THE ZOOLOGICAL CLOSET

Wadle, Austin, Department of Civil and Environmental Engineering, Bucknell University, 750 Fraternity Road, Lewisburg, PA 17837, ajw030@bucknell.edu.

Mercury (Hg) is an element well known for its neurotoxic effects, but has also gained attention for its potential to disrupt human endocrine systems. Understanding how Hg behaves in our environments, ie its fate and transport, and its potential for harm requires multidisciplinary expertise. Insights from Hg monitoring in the Cedar River in Eastern Iowa and a nearby freshwater wetland completed in the late 2010s and readings of queer and feminist science studies provide a transformative example to advance the science and engineering that are needed to remediate the harms of Hg exposure. From 2016 to 2018, total mercury concentrations in the Cedar River ranged from 1.6 to 14.6 ng/L, with 80% being bound to suspended sediment particles. Concentrations of monomethylmercury (MeHg), a highly bioaccumulative species of mercury, ranged between 0.05 to 0.82 ng/L. MeHg is produced by bacteria in the wetlands that feed the Cedar River. From these concentrations and hydrological data we can estimate the export of total mercury and MeHg from the watershed. For 2017, 2.6 μg m^{-2} year-1 of total Hg is exported from this watershed, representing 25% of Hg deposited to this watershed via rainfall. For this same time period, 0.09 μg MeHg m^{-2} year-1 is exported downstream, representing 3.4% of total Hg exported from the watershed in 2017. Low concentrations of MeHg and percentages of total Hg are worth attention given the tendency of MeHg to increase in concentration as one moves up the food chain, a process termed biomagnification. Single digit percentages are familiar to queer and trans people, where we are told that our low population level occurrence means that we are not worthy of attention at the same time we are blamed for divine retribution through hurricanes and earthquakes. However, one does not need to work only in metaphor to see intersections between Hg biogeochemistry and queerness. One investigation found increased rates of homosexuality among Florida ibises as a symptom of increased MeHg exposure as it sought to explain lowered ibis populations in the 1990s. While there is value in having research of this type performed not only by dominant genders and sexualities, it is not simply enough to have queer scientific and engineering workers performing this research. This presentation will take into account lessons from queer ecologies and environmental engineering to advance a critical stance toward Hg biogeochemistry in riparian environments.

Mercury, Biogeochemistry, Queer ecologies

SOIL AND WATER ECOSYSTEM SERVICES BENEFITS FROM COVER CROPPING IN THE SUSQUEHANNA RIVER BASIN

Marali, Kalra, Department of Civil & Environmental Engineering, Penn State University, 235 Agricultural Engineering Building, University Park, PA 16802, mmk5750@psu.edu; **Cibin**, Raj, Department of Civil & Environmental Engineering, Penn State University, 247 Agricultural Engineering Building, University Park, PA 16802, czr58@psu.edu.

The Susquehanna River is one of the main contributors to the ongoing water quality problem in the Chesapeake Bay, making agricultural nutrient pollution a major concern in the Susquehanna River Basin (SRB). Agricultural best management practices such as cover cropping are instrumental in reducing nutrient loads to the Bay. However, cover crop implementation remains low in the SRB. Farmers may not be motivated to bear the cost of downstream water quality improvements if the recommended best management practices seem to have no benefits for their farms and communities. We used the Soil and Water Assessment Tool to model seven scenarios of improved or expanded cover cropping practices in the SRB, evaluating each scenario's impact on six ecosystem services: water quality, crop yield, hay yield, soil erosion regulation, nutrient cycling, and water cycling. We found that increasing the area under cover crops led to small increases in crop yield, thanks to a "green manure" effect where cover crop biomass decomposed into plant-available nutrients. Increases in cover cropping reduced sediment and nutrient loads at the SRB watershed outlet, but without corrected fertilizer application rates, summertime water quality actually worsened. Leguminous cover crops were more successful at preventing soil loss, while grain cover crops were more effective at reducing nitrogen loss. Harvesting cover crops, known as commodity cover cropping, allowed for the production of a small hay crop in the same year as a cash crop, but neutralized the green manure effect. Extending the cover crop season with early planting and late termination increased the soil and water ecosystem service benefits of cover cropping, but reduced cash crop yield. These results show that expanded cover cropping in the Susquehanna River Basin can improve downstream water quality while reducing soil loss and improving soil fertility in the fields where it is implemented.

cover crop, ecosystem services, Susquehanna River, hydrological modeling

SUSQUEHANNA RIVER -- WHAT DOES THE SCIENCE SAY ABOUT WATER QUALITY?

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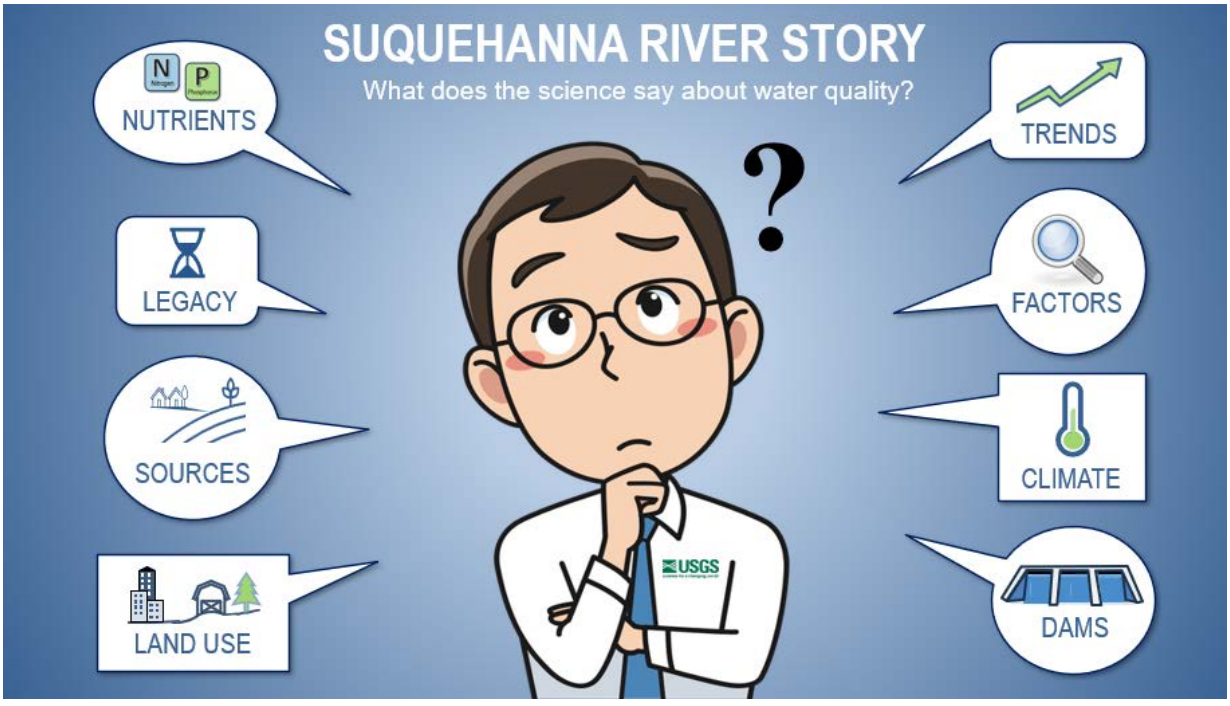
The wide and majestic Susquehanna River is one of the oldest rivers in the world. Despite its beauty, the Susquehanna River and the Chesapeake Bay downstream has been facing the detrimental effects of excess nutrients. This communication product provides a unique synthesis of the story of nutrient water quality in the Susquehanna watershed. With few exceptions, trends in stream nutrient loads at long-term (1985-2020) monitoring sites have been improving, but a considerable percent of the short-term (2011-2020) monitoring sites show degrading trends. Resource managers have varying control over the intricate blend of factors that affect nutrient delivery to the river. Resource managers have less control over physical factors (geology, climate, and hydrology) and more control over source inputs (atmospheric and land use) such as surplus nutrients from manure and fertilizer use. Regulation and technological advances in wastewater treatment and atmospheric deposition have improved water quality, and recent focus is towards management of urban nonpoint sources. Lastly, legacy storage of nutrients (dams and groundwater) remains a challenge for resource managers toward meeting water quality goals.

Susquehanna River, Chesapeake Bay, Nutrients, Eutrophication



COMMUNITY BENEFIT AGREEMENTS CAN LEAD TO MORE COMMUNITY RESILIENCE IN ABANDONED MINE COMMUNITIES

Comas, Jordi, Office of Environmental Justice, Pennsylvania Department of Environmental Protection, 208 W 3rd St., Williamsport, PA 17701, jcomas@pa.gov.

Abandoned Mines and their discharges (AMD) in Pennsylvania have well-known and documented natural, economic, aesthetic, and social negative impacts. Since the inception of the mining industry, community and labor groups have both lost and won a variety of struggles to mitigate the negative impacts of mining and especially AMLs. In the last twenty years, activists and advocates starting in California forged a new implementation tool, a community benefit agreement, which uses a legal contract to bind a developer to a process of defining and delivering community benefits. Those benefits can range from wage floor guarantees to cash infusions for municipal or civic efforts to design considerations for facilities. Since the historic federal investments in IIJA and BILL, the Department of Energy has reinforced the visibility and use of Community Benefit Agreements or Plans as a bonus or requirement for certain grants and investments. In this presentation, the core elements of a community benefit agreement will be reviewed. It will focus on both what is positive as well as what are loopholes or pitfalls from Community Benefit Plans or Agreements, starting with the slippery slope of using non-binding forms of community benefit tools that are not legal agreements to do a kind of shallow community engagement.

policy, community benefits, abandoned mines, innovation

WILDLIFE LEADERSHIP ACADEMY: ENGAGING AND EMPOWERING THE NEXT GENERATION OF CONSERVATION LEADERS

Mueller, Sara, Executive Director, Wildlife Leadership Academy, 7 East Water Street, Lock Haven, PA 17745, smueller@wildlifeleadershipacademy.org.

The mission of the Wildlife Leadership Academy is to engage and empower high school age youth to become Conservation Ambassadors to ensure a sustained wildlife, fisheries and natural resource legacy for future generations. A year-round program, the Academy begins with residential programming that focuses on wildlife/fisheries biology, conservation, and recreation as well as leadership skills development. Graduates then continue with outreach projects through education, service, media engagement, creative arts, and outdoor mentorship in their home communities. The Academy has found a unique formula for success in providing youth conservation education to over 1,100 alumni across the state of Pennsylvania and in 14 other states. In addition, Academy programming is expanding and evolving to ensure that conservation education is accessible to diverse audiences by building belonging throughout all of its programs. Finally, the Academy has been fortunate enough to follow-up with 10% of our alumni to see what they are doing now (and where they are doing it!). Learn about how you can engage with the Wildlife Leadership Academy to support the next generation of conservation leaders.

youth, conservation, education, partnerships

BEAVER DAM ANALOGS: OUTCOMES FOR FLASHINESS, AGGRADATION, AND COLLABORATION

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Ephemeral streams are critical conduits connecting watersheds to their receiving waters, yet these systems are typically not prioritized in stream restoration. In addition, these systems provide a great opportunity for testing restoration methods with low risk to aquatic life. In Fall 2023, we installed eight beaver dam analogs (BDAs) along a 200-meter stretch of a deeply incised ephemeral and stormwater-driven stream at Susquehanna University's field station with the goal of aggrading the channel and reconnecting the stream to its floodplain. To quantify the effectiveness of these structures we completed pre- and post-installation survey transects across the stream and floodplain above and below each dam, along the length of the thalweg, and installed pressure transducers (water depth) and temperature loggers above each dam. Transects 8 months-post install show aggradation above dams up to 50% of the incised area, with decreasing aggradation further downstream. Storm events increased in intensity between January and May 2024, yet the rate of increase in water depth (i.e., flashiness) decreased during this same period. In addition, flashiness decreased by a greater magnitude at further downstream BDAs indicating cumulative benefits of these structures when installed in series. To our knowledge, this experiment marks the first use of BDAs as a stormwater management technique in an ephemeral system and the first BDAs installed in Pennsylvania. This has prompted the creation of a state-wide working group for more broad application of process-based restoration and opportunities for collaboration will also be discussed.

process-based restoration, geomorphology, stormwater management

DIVERGING STREAMFLOW AND PRECIPITATION TRENDS IN THE CONTIGUOUS UNITED STATES

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Climate change has caused varied long-term changes in river discharge. Although precipitation is often considered as primarily driving discharge, some rivers have shown dwindling discharge despite increasing precipitation, whereas others have shown increasing discharge albeit declining precipitation. It is however not clear how widespread such diverging trends are, and what are the primary drivers for diverging trends. Here we quantify the temporal trends of precipitation and river discharge over 1980 – 2014 in 671 sites, and identify the drivers of the trends in the continental US using the CAMELS-US dataset. The relative fractions of surface flow, shallow subsurface flow and deep subsurface flow based on their depth of generation to total stream discharge were also estimated using the HBV (Hydrologiska Byråns Vattenbalansavdelning) hydrology model. Long-term trends in total discharge and its flow fractions were calculated with a Theil-Sen regression. Results show that many sites have different trend directions in discharge and precipitation, with diverging trends observed in 28% of the 671 sites. Surface, shallow subsurface and deep subsurface flow fractions are increasing at 48%, 56% and 39% of sites and decreasing at 37%, 43% and 61% of sites respectively. Catchment attributes that best explained these trends were identified using a random forest model. Evapotranspiration emerged as the primary driver for trends of discharge and deep subsurface flow. However, precipitation is the primary control over surface and shallow subsurface flow. These results indicate that the discrepancies between discharge and precipitation trends are largely driven by simultaneously changing evapotranspiration and precipitation.

Hydrological Modeling, Machine Learning

ENHANCING FLOOD ADAPTATION STRATEGIES WITH NATURE-BASED SOLUTIONS AND HIGH-RESOLUTION MODELING

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As climate change intensifies and land development expands, managing flood risks and nutrient pollution in agricultural watersheds is increasingly critical. Nature-based climate solutions offer a promising avenue to integrate into current flood management strategies, addressing both flooding and water quality improvement through nutrient reduction and denitrification. However, the impact of these solutions is scale-dependent, with regional applications offering the most significant benefits. Recognizing the co-benefits of nature-based flood adaptation enhances their economic justification and stakeholder support. To quantify these benefits, we developed an integrative modeling framework combining the Soil Water Assessment Tool (SWAT) and the LISFLOOD-FP hydrodynamic model. SWAT's streamflow and nutrient outputs drive floodplain delineation and water quality assessments, refined at high resolution using the NHDPlus dataset and an external routing module. This framework was applied in the Susquehanna River Basin, reducing computation time significantly for climate and land use scenario evaluations. Our approach offers a robust tool for regional-scale flood adaptation planning, supporting more effective decision-making for flood risk management and nutrient mitigation.

Adaptation, Flood risk, Nutrient pollution, nature-based solution

PRELIMINARY RESULTS FROM THE PENNSYLVANIA NATIONAL FLOOD INSURANCE PROGRAM IMPLEMENTATION SURVEY

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The Northeastern U.S. has experienced an increase in extreme precipitation events in recent decades due to climate change; a trend forecasted to continue through the end of the century. Consequently floodplain management, both for the present and the future, is more important than ever. The National Flood Insurance Program (NFIP) is the main federal instrument deployed in the U.S. to guide floodplain management across the country and encourage best practices. Most NFIP research has focused on insurance affordability issues related to the flood insurance part of the program. The floodplain management component has
been little studied, despite its potential for improving community flood resilience and climate adaptation. This research focuses on the resources and support for floodplain management in Pennsylvania. Pennsylvania requires that each of the 2,560 municipalities in the commonwealth participate in the NFIP, resulting in over 2,000 floodplain managers and other municipal authorities working in the floodplain management space. I conducted a survey from July to December 2023 targeting those municipal officials, both floodplain manager and other, that are required to implement the NFIP floodplain regulations, resulting in 295 completed responses. At least one completed survey was obtained from each of the 67 counties in the commonwealth. Respondents indicated there were issues with both training and resources available to local-level floodplain managers, with 50% signaling that their floodplain management staff did not have sufficient technical resources or training to implement NFIP requirements. Floodplain managers also identified disconnects between floodplain management and flood insurance at the local level.

The findings of this survey point to a need to reexamine the current local-level floodplain management requirements of the NFIP in order to better support floodplain managers in their work towards making their communities more resilient for the impacts of climate change now and future.

Validation, Disheartening, Challenging, Optimistic

CONCENTRATED FLOW PATHWAYS AND RIPARIAN BUFFER PERFORMANCE

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Riparian buffers are a commonly utilized agricultural conservation practice. They are intended to treat water leaving fields before entering streams. However the amount of surface runoff actually intercepted and treated by riparian buffers may be undermined by concentrated flow pathways that form over time. In this research we created a new technique using GIS to determine Riparian areas in a central PA watershed susceptible to concentrated flow paths.

BMPs, Buffers

PREDICTING THE IMPACT OF RIPARIAN VEGETATION AND LAND USE ON STREAM TEMPERATURE IN THE CHESAPEAKE BAY WATERSHED USING DEEP LEARNING

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Stream temperature is a fundamental driver of river ecosystem health, with profound implications for biodiversity, water quality, and the resilience of aquatic habitats. Understanding the intricate interplay between environmental factors—such as riparian vegetation, land use, and climatic forces—has never been more critical, as urbanization and climate change pose escalating threats to watershed integrity. This study presents a novel application of Long Short-Term Memory (LSTM) deep-learning models to investigate how both local riparian buffers and upstream land use patterns influence stream temperature across the expansive Chesapeake Bay Watershed (CBW). Harnessing high-resolution (1-m) land cover data in conjunction with 30-m National Land Cover Database inputs, we demonstrate the power of deep learning to capture spatial and temporal complexities in stream temperature regulation. Our results reveal key stream reaches where riparian deforestation and land-use changes intensify thermal stress, contributing to ecosystem degradation. By identifying these critical areas, our study not only enhances our understanding of watershed-scale environmental processes but also provides actionable insights for conservation and restoration priorities. This research underscores the role of advanced modeling techniques in shaping sustainable watershed management strategies, offering a scientific foundation for adaptive responses to ongoing climate and land-use pressures. The implications extend beyond ecological preservation, providing a framework to safeguard both river health and the well-being of communities reliant on the Chesapeake Bay and its tributaries. Our findings serve as a call to action for integrated, science-driven management aimed at fostering resilient ecosystems and sustainable river networks in the face of an uncertain environmental future.

Stream Temperature, Chesapeake Bay Watershed, Deep Learning, Climate Change

COMPLEXITIES IN SURFACE AND GROUNDWATER SALINITY AND CONDUCTIVITY WITHIN A MIXED LAND-USE KARST WATERSHED

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Increasing salinity in surface and groundwaters has become an emerging problem for ecosystem health. The critical zone, which spans from bedrock to treetop, plays a key role in regulating water chemistry through interactions in the atmosphere, lithosphere, and hydrosphere. Anthropogenic inputs, primarily from road salt and wastewater effluent, are a key source of chlorides and salinity, which are key contributors to conductivity. This study explores the sources and variability of chloride, sodium and conductivity in a mixed land-use, karstic watershed of central Pennsylvania. We analyzed annual and seasonal concentrations of these parameters in streams and springs across urban, agricultural, forested, and mixed-land use sub-basins. Initial results have indicated increasing chloride and sodium concentrations in both surface and groundwaters in urban and mixed land-use locations. Continuous conductivity data from selected locations, including periods of baseflow and storm events, indicates a more complex story where conductivity may be diluted or enriched based upon the season. The results of this study can form the basis for identification of stream reaches that may experience chronic or acute chloride pollution concentrations, which can inform watershed management strategies, including road salt application, stormwater management, and restoration efforts to mitigate water quality degradation.

USING 3D PRINTING TO TEST WATERWHEEL EFFICIENCY

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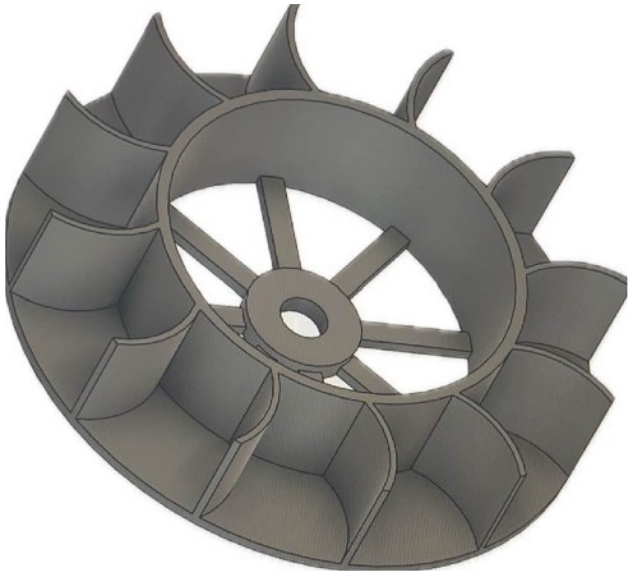
Waterwheels are simple yet effective mechanisms that convert energy from flowing water into rotational energy. This study proposes an optimal waterwheel configuration designed to maximize efficiency when integrated with an alternator to generate electricity. Using Autodesk Fusion for design and Prusa 3D printing for fabrication, five waterwheel models were tested under varying flow rates to measure rotational energy and efficiency. The efficiency was calculated by comparing the rotational energy produced to the gravitational energy of the water. Results showed that solid waterwheels with curvy paddles were the most efficient, while hollow designs were the least.



This project will culminate in the construction of a demonstration waterwheel system for Juniata College's engineering lab, serving as both a practical teaching tool for energy conversion and electricity generation concepts, and as a way to inspire high school students' interest in STEM during outreach events. Additionally, it serves as a preliminary investigation into scalable waterwheel systems for addressing energy needs in impoverished areas, with the next step being the installation of a pilot system in the river at Sparks Farm, a Juniata College property.

REPURPOSING SPENT LITHIUM-ION BATTERIES FOR CHEMICAL LOOPING IN-SITU CO2 CAPTURE AND CONVERSION

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This paper comprises a detailed review of existing techniques for the chemical looping CO_2 capture and its in-situ conversion into valuable products such as green fuels and chemicals. CO_2 emissions from industrial activities have a detrimental impact on life and are a major contributor to global warming, which has been steadily increasing each year. To mitigate these high levels of CO_2 emissions, this study reviewed the potential for value addition using CO_2 as a precursor via chemical looping CO_2 capture and in-situ conversion (CL-ICCC). The products formed are green fuels and chemicals. Rather than just carbon capture and storage (CCS), it provides insights into a novel cost-saving and more efficient approach aimed at integrating the capture and conversion phases, known as carbon capture and utilization (CCU). The bifunctional materials are prepared using an electronic waste (Li-ion batteries) enabling the simultaneous synthesis of new products from the recovered CO_2 form the core of the chemical looping mechanism. These substances allow for the cyclic recovery and concurrent conversion of CO_2. Instead of having two standalone procedures, a unified approach is proposed such that sorption and catalysis are integrated with the design and preparation of a novel bifunctional material. This work provides an overview of the chemical looping CO_2 capture and in-situ conversion (CL-ICCC). Methods discussed include dry reforming of methane, reverse water gas shift reaction (RWGS), methanation, and oxidative dehydrogenation reaction. The composition of bifunctional material for chemical looping CO_2 capture and in-situ conversion was x-rayed comprising sorbent-catalysts (SC) and sorbent oxygen carriers (SOC). Also, bifunctional preparation techniques and advances in these areas are outlined. Findings from this review highlight the significance of computational and experimental tools demonstrating the robustness of the chemical looping process. Challenges and prospects of the chemical looping CO_2 capture and in-situ conversion were identified. Finally, this would be a valuable tool for researchers and sustainability assessment practitioners seeking insights in this novel area.

Bifunctional materials, Catalysis, Adsorption, Chemical looping

ENVIRONMENTAL JOURNALISM: TIPS TO CONNECT SCIENTIFIC WORK WITH THE PUBLIC AND QUESTIONS TO DIG DEEPER INTO HOT-BUTTON ISSUES

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After two decades as a local award-winning journalist, John Zaktansky switched careers to run the Middle Susquehanna Riverkeeper Association in early 2020. The transition allowed him to better see the local research and other environmental resources that were not receiving proper public awareness and has devoted the past four-plus years to shining a light on those elements. In this session, he will share tips for students and faculty on what they can do to better market their research to local media sources, discuss alternative ways to bring awareness to this important work and look at some of the bigger environmental issues of the region and the types of questions we should be asking to have a deeper understanding and be in a better place to creatively and collaboratively find a solution.

environmental justice , communication , media , research

2024 RIVER SYMPOSIUM

POSTER PRESENTATIONS

[Photo: Chesapeake Bay Foundation; used with permission

AN ENVIRONMENTAL ARCHIVE: USING HISTORICAL MAPS FOR RIVER RESEARCH

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This project demonstrates the value of using historic maps to measure environmental change and anthropogenic impact on freshwater in the central Susquehanna River valley, as part of the upper Chesapeake watershed.

Christopher Magoc has observed that "the topography of the Mid-Atlantic is wrinkled by historic waterways" that tell us much about the environmental choices and costs of making modern America (2015). Though at first glance historic maps might seem appealing curiosities more than a source of usable environmental data, this poster will illustrate (literally) the rich archive of information contained in different genres of cartographic records.

Much of the information we have about riverine environments sits in the natural sciences, but an historical lens is essential to understanding how we arrived here. Maps record not only changing knowledge about the natural world, but also plans to transform it. They are unusual as sources because they depict a chronology of past, present, and future: they mark older interventions, documenting who was there and what was built; they record current occupants and practices; but they also declare – and try to legitimate – claims and agendas for future use. Maps show nature being made and remade. As Andrew Hurley has argued, historical research is a necessary partner to environmental remediation, by showing that the landscape is "the product of human decisions that could be undone" (2010).

This poster will sample different cartographic records from the seventeenth century onward to demonstrate the array of sources available for researchers from all disciplinary backgrounds. These include manuscript maps, land surveys, insurance maps, bird's eye maps, flood and topographical maps, aerial and satellite photography, as well as 'narrative maps' in travelogues

and other written descriptions. With each we need to consider not only what (or where) the map is showing us, but how it does so, and the choices of scale, perspective, composition, and purpose. This research thus highlights the importance of cartographic literacy as part of both a liberal arts and environmental education.

These maps help us understand why our region looks the way it does. They identify sites of industrial activity and settlement (mill races, river dams, canal beds, railway routes, factory use, park corridors) and the effects on waterways (encroachment, diversion, channelization, pollution, rehabilitation). They mirror the changing energy regimes of the Anthropocene, from organic to mineral, and the mandates of what those in the eighteenth and nineteenth centuries called "improvement" – what those in the twenty-first might simply call "development." Put another way, these historical clues allow us to trace what historian Donald

Worster has called the "chains of environmental consequence" (2009).

Maps and cartography, Cartography, Environmental History, Humanities

OCCURRENCE AND CONCENTRATIONS OF PER- AND POLYFLUOROALKYL SUBSTANCES IN INVASIVE *CHANNA ARGUS* POPULATIONS: A TRANSCRIPTOMICS APPROACH FOR DETECTING CONTAMINANT EXPOSURE

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After widespread use in consumer products, firefighting foams, and industry, per- and polyfluoroalkyl substances (PFAS) contamination of aquatic ecosystems is a global problem and the consumption of contaminated fish is an important exposure pathway for humans. The northern snakehead (*Channa argus*) is a recent invader to the eastern United States and is growing in popularity as a sport and food fish. However, there is limited information about PFAS contamination in invasive northern snakehead populations. The goal of this research is to (1) quantify PFAS in northern snakehead populations and (2) use a landscape transcriptomics approach to identify molecular markers of sublethal PFAS exposure. By collecting information about PFAS, we can build the knowledge base about the effects of PFAS on fish while facilitating informed health decisions by fish consumers.

Emerging Contaminants, PFAS, Northern Snakehead, Transcriptomics

FOOD WEB ALTERATIONS IN SUSQUEHANNA RIVER BY NON-NATIVE FLATHEAD CATFISH (*PYLODICTUS OLIVARIS*).

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Flathead catfish *(Pylodictus olivaris*), one of the world's worst invasive species, were first detected in Pennsylvania's Susquehanna River in 2002. Since then, they have established a growing population, expanding throughout the river system. While their predatory effects on native fish are known, their impact on river food webs is less understood. This study aimed to assess how flathead catfish invasion affects the trophic position and isotopic niche of the Susquehanna River food web by comparing invaded and non-invaded sites. Key species examined included crayfish, minnows, smallmouth bass (*Micropterus dolomieu*), and channel catfish (*Ictalurus punctatus*). Flathead catfish occupied the highest trophic position, with evidence showing a shift in the trophic position of resident species, especially channel catfish. Isotopic niche expansion and overlap were also observed, supporting the "trophic disruption hypothesis," where native species change diets to avoid competition. Our results indicate that flathead catfish invasion is altering food web structure and energy flow in a large riverine ecosystem and contributes to the breadth of knowledge regarding how diverse ecosystems may respond to the introduction of a large, predatory fish species.

flathead catfish, channel catfish, apex predator, food web

THE CENTER FOR AGRICULTURAL CONSERVATION ASSISTANCE TRAINING

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The Center for Agricultural Conservation Assistance Training (CACAT) in Penn State Extension was formed in January 2023 with the mission to help farmers, agricultural landowners, and conservation professionals implement best management practices (BMPs), ensure the health of land and water in our communities, and leverage funding and partnerships. The vision for the Center began to take form in 2016 when a group of partners convened at a conference called "PA in the Balance," in which they discussed barriers and innovative solutions for promoting both environmental goals and profitable agriculture in Pennsylvania. A major barrier that surfaced repeatedly was the lack of technical assistance available to implement agricultural BMP projects. Through legislative action of state funding called the 2022 Clean Streams Fund, the Agriculture Conservation Assistance Program (ACAP) formed and allowed for a portion of its funds to be delegated to Penn State to create the Center.

To accomplish its mission, the Center provides professional development opportunities for ag conservation professionals, additional coursework and on-farm training experiences for undergraduate students, and technical assistance for ag conservation. The Center has provided outreach to counties in the form of both office and field visits to assist conservation professionals in coordinating ACAP projects. The Center has worked with partners to develop and offer trainings across the Commonwealth. In June 2024, the Center hosted its first annual Ag Conservation Convention, focusing on strengthening connections with farmers and agricultural producers, building conservation skills, and improving knowledge of resource concerns and best management practices to mitigate them. The monthly newsletter "Conservation Currents" has a higher than industry average open rate for electronic newsletters. The Center aims to grow its impact and be a part of the solution to achieving water quality goals and profitable Pennsylvania agriculture.

Agricultural conservation, Applied work

PHYTOPLANKTON IN RAYSTOWN LAKE

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Phytoplankton are crucial organisms of aquatic ecosystems. They are primary producers and form the foundation of aquatic food webs. They produce oxygen through photosynthesis and support a wide range of heterotrophic marine and freshwater organisms. With this project, I expect phytoplankton assemblages will differ between areas of Raystown Lake that are either eutrophic or oligotrophic. The purpose of this research is to document and quantify those differences. If this difference is strong, then I hypothesize that there will be particular phytoplankton taxa within the assemblage that, if present in a water sample, will indicate or be diagnostic of eutrophic or oligotrophic conditions. Understanding the relationship between phytoplankton and trophic status in Raystown Lake will aid tracking and understanding changes in nutrient status and water quality, and therefore will provide an ecological tool for water quality management. By assessing phosphorus and isotope (c:n) ratios in raystown lake, I can use phytoplankton groups to categorize these water quality parameters and estimate the trophic status's in Raystown Lake.

Phytoplankton, Trophic Status, Isotope Analysis, Phosphorus

A LANDSCAPE TRANSCRIPTOMICS APPROACH FOR EVALUATING THE EFFECTIVENESS OF RIPARIAN BUFFERS TO REDUCE THERMAL STRESS IN BROWN TROUT (SALMO TRUTTA)

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Riparian buffers are a best management practice (BMP) consisting of vegetated areas planted along the banks of streams, rivers, and other water bodies. Riparian buffers are used as part of watershed management plans for improving stream habitat for cold-water species of fish, including recreationally important brown trout (*Salmo trutta*). The planting of riparian buffers has been encouraged to improve water quality by mitigating adverse environmental effects of urbanization and agricultural activities. Water quality goals often include the reduction of nonpoint pollution and stream water temperatures. Although various aspects of the effectiveness of riparian buffers to improve water quality have been studied, the impact of riparian buffers on the thermal physiology of coldwater fishes is understudied. To address this research gap, we are examining brown trout gene expression (gill transcriptomics) to assess the efficacy of riparian buffers to reduce thermal stress. To accomplish this, we are conducting a space-for-time substitution study, in which we are monitoring eleven riparian stream buffer sites of varying age classes (three young [5-10 years], four intermediate [5-20 years], and four mature sites [15+ years]) to understand how buffer development (age) influences thermal tress in naturally reproducing brown trout. Brown trout sampling will occur during three seasons (fall 2024, spring 2024, and summer 2025) to assess population density and for non-lethal gill biopsies used for gene expression. Three HOBO temperature monitors are deployed at each site, two instream loggers and one air logger, to monitor temperature variation at 30-minute intervals. Physical stream and riparian buffer assessments will be conducted. Gill tissues will be used to assess individual brown trout thermal stress through analysis of transcriptomes. Increased riparian buffer development (e.g., leading to increased percent canopy cover) is expected to be associated with a decrease in thermally stressed brown trout as indicated by heat shock protein expression. We also expect genes that are responsive to stress generally (e.g., immune response) to be upregulated in both summer fish due to thermal stress and fall fish due to preparing for reproduction, but for this stress to be reduced in summer fish in more developed riparian buffer sites. This research will address a critical gap in our understanding of how riparian buffers influence brown trout, an ecologically important species in Pennsylvania streams.

Riparian buffers, Pennsylvania, Thermal stress, Transcriptomics

INCREASING OYSTER RECRUITMENT ON ARTIFICIAL REEFS

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A living shoreline is a structure for coastal restoration composed of natural and man-made materials to protect shorelines while promoting ecological enhancement through the recruitment of key foundation species such as shellfish or native vegetation. Eastern oysters (*Crassostrea virginia*) are a common target species because they form reefs that provide ecosystem services such as increased water filtration, habitat development, and coastal defense. This study examined three ways to optimize recruitment of Crassostrea virginica on low carbon concrete (LCC) used for living shorelines. First, recruitment to LCC modules was compared to traditional materials (shell and rock). Second, the effects of three post-manufacturing surface texturing treatments on recruitment were compared. Third, the effect of a poly-catechol styrene primer applied via three different solvents was compared against an untreated control. Results indicated that LCC reef units perform as well or better than traditional materials. Somewhat surprisingly, surface texturing methods performed significantly worse than the untreated control indicating that the texture from the manufacturing process was more than adequate. Additionally, there was no clear effect on LCC treated with a SeaTakTM Poly-catechol styrene primer regardless of the solvent used, however, tests of attachment strength remain to be completed. This research contributes to ongoing efforts to develop resilient coastal protection strategies via the US Defense Advanced Research Projects Agency (DARPA) Reefense Program. The outcomes of this study will help inform the design and implementation of future oyster restoration and shoreline protection projects, leading to increased protection of vulnerable coastal areas.

Living Shoreline, Coastal Resillence, Eastern Oyster

MONITORING PLANT COMMUNITY COMPOSITION, MACROINVERTEBRATES, AND WATER CHEMISTRY IN A WETLAND UNDERGOING RESTORATION

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The Robert Porter Allen Natural Area (RPANA) is a 227-acre nature preserve in South Williamsport, Pennsylvania. RPANA includes one of the largest floodplain wetlands remaining on the West Branch of the Susquehanna River. The wetland is currently undergoing a restoration project to expand open water and saturated areas, remove non-native vegetation, and plant native vegetation. Wetlands on the property are largely intact, but there is a lack of fine-scale information regarding current wetland plant distribution, the extent of non-native plant species encroachment, aquatic macroinvertebrate richness and composition, and chemical water quality.

This study aims to provide background (pre-restoration) data regarding the biotic and abiotic status of the wetland. During June to September 2024, a total of 99 1m2 plots were constructed on eight transects throughout the wetland. All plants within each plot were identified to species, and their percent cover was estimated. Following PA DEP protocols, aquatic macroinvertebrates were collected from all eight transects using a D-frame kick net. Samples were preserved in 70% ethanol, and taxa were identified to family-level. A handheld water quality meter was used to take field measurements of pH, dissolved oxygen, conductivity, total dissolved solids, and temperature at all transects. A total of 96 vascular plant species were documented, 72 native species (75%) and 24 introduced species (25%). *Peltandra virginica* (Green Arrow Arum) was the most abundant species, observed in 43 plots on all eight transects with an average cover of 50%, followed by *Leersia oryzoides* (Rice Cutgrass) recorded in 23 plots on five transects with an average cover of 25%. Lythrum salicaria (Purple Loosestrife) was the most abundant non-native species, observed in 15 plots across six transects at low density (<20% cover).

Thirty-seven aquatic macroinvertebrate taxa were documented. Transect 1 had the highest macroinvertebrate species richness with 26 taxa and Transect 8 had the lowest with 11 taxa. *Asellidae*, a moderately pollution sensitive isopod, was the most abundant family with 2,779 individuals counted across all 8 transects. *Physidae* (Bladder snails) was the second most abundant taxon with 324 individuals recorded in seven transects, and they are a pollution tolerant group. Water quality parameters (pH 6.14-7.58; Dissolved oxygen 1.15-4.06 mg/L-1 ; Conductivity 53-479 uS/cm-1; TDS 26-708 ppm) were mostly within normal ranges for a freshwater marsh. Dissolved oxygen was notably low, averaging 1.7 mg/l. This hypoxic condition may be due to multiple variables including the low flow and lack of connectivity through the wetland as well as the lack of rainfall and hot summer months when measurements were taken.

The dominant vegetation are native species that provide wildlife habitat, food sources, and sediment control. The proximity of native wetland plants to the newly restored wetland areas is a promising sign that colonization of desired vegetation will be successful. This survey will inform invasive plant management plans to eradicate noxious weeds like Purple Loosestrife. The high species richness of macroinvertebrates and good water quality are also encouraging signs that restoration efforts will be successful.

Wetland restoration, Wetland vegetation, Macroinvertebrates, Water quality

EVALUATING IMPACTS OF BRIDGE REPLACEMENT PROJECTS ON EASTERN HELLBENDER POPULATION PERSISTENCE

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The Eastern Hellbender (*Cryptobranchus a. alleganiensis*) represents an ancient lineage of giant (≤ 2.5 ft.), long-lived (> 25 years) stream-obligate salamanders. Land use change has resulted in range-wide population declines in the past 50 years. However, stream systems in northwestern Pennsylvania contain high quality hellbender habitat and are thus considered to be one of the last remaining strongholds for the species. Beginning in 2025, PennDOT has scheduled multiple bridge replacement projects in an Allegheny River tributary that harbors a high biodiversity of sensitive stream taxa, including regionally significant hellbender populations. Such construction activity may result in elevated sediment loads and impaired water quality as well as direct mortality within local hellbender populations. In summer 2024, we conducted multiple mark-recapture surveys to provide baseline data regarding hellbender demography and habitat quality at three stream reaches within the proposed bridge replacement project area. We used traditional rock-lifting survey techniques (2 surveys per reach) to assess hellbender population size/structure and shelter rock habitat quality. We estimated population size at each reach using an intercept-only POPAN model using program RMark in program R and provide descriptive statistics for population density, sex ratio, and age/size class structure. We recorded 107 capture events (n = 84 unique individuals) across six survey occasions. Population density ranged from 0.17 – 0.95 hellbenders per 100m2 habitat and sex ratios were relatively balanced across all three reaches. Old adults made up the majority of populations at sites A (0.71) and B (0.68), compared to site C, which was comprised mainly of young adults (0.42) and sub-adults (0.17). Shelter rock availability was relatively high across study sites (0.61 - 0.83), and shelter occupancy ranged from 0.07 - 0.15. Post-construction surveys will be conducted to evaluate bridge replacement effects on hellbender demography and habitat use/availability. We will deploy continuous water quality probes to evaluate changes in water quality and sedimentation rates. Artificial nest boxes may be installed to augment habitat loss resulting from construction activity. These data will also be integrated with long-term (10+ years) datasets for future population modeling and estimation of population persistence within the watershed.

amphibian decline, land use, construction, hellbender

LONG TERM MONITORING OF A HISTORIC EASTERN HELLBENDER POPULATION IN NORTHWESTERN PENNSYLVANIA

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The Eastern Hellbender (*Cryptobranchus a. alleganiensis*) represents an ancient lineage of giant (≤ 2.5 ft.), long-lived (> 25 years) stream-obligate salamanders endemic to the eastern United States. While considered indicators of stream habitat quality, hellbender populations have experienced rapid, range-wide declines driven by suppressed recruitment. Northwestern Pennsylvania has a long history of hellbender research, and stream systems in the region represent some of the highest quality habitat remaining throughout the hellbender's range. Hillis and Bellis (1971) conducted demographic surveys in an Allegheny River tributary in 1968, providing one of the earliest assessments of *Cryptobranchid* ecology. Kaunert (2011) replicated these survey methods in 2010 and noted a decline in abundance within this historic population. In this study, we conducted mark-recapture surveys at the Hillis and Bellis (1971) site to evaluate long-term demographic trends for one of the longest monitored hellbender populations in existence. We conducted two traditional rock-lifting surveys in June – August 2024. We hand-captured individuals and measured total length (TL), snout-vent length (SVL), mass, and sex before permanently marking individuals with 12.5mm PIT-tags. We provide descriptive statistics to assess temporal trends in population size, density, sex ratio, and age/size class structure from 1968 – 2024. Overall, we recorded 27 capture events (n = 19 unique individuals) across two survey occasions in 2024. Population estimates declined from 1968 (152) to 2010 (89.60 ± 25.52) and 2024 (20.0 ± 2.5). While the proportion of old and young adults were comparable in 2010 and 2024, we failed to detect any sub-adults or juveniles within the population during this study. Male-skewed sex ratios were present in 1968 (1.58:1) and 2010 (2.47:1), but were even in 2024 (1:1). Temporal decreases in abundance and presence of young age classes are common signs of hellbender decline. However, given differences in sampling effort between historic and current monitoring efforts (9 vs. 2 surveys/year), more sampling is needed to compare population estimates. We will conduct additional mark-recapture surveys to improve sampling effort, increase accuracy of population estimates, and monitor demographic trends in this historic population in the coming years. Data from this project will be also be used to evaluate impacts of PennDOT bridge replacements within the watershed and estimate population persistence across Pennsylvania.

long term monitoring, hellbender, conservation

CONSTRUCTION AND INSTALLATION OF HELLBENDER ARTIFICIAL NEST BOXES IN A TRIBUTARY OF THE WEST BRANCH SUSQUEHANNA RIVER

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The Eastern Hellbender (*Cryptobranchus a. alleganiensis*) represents an ancient lineage of giant (≤ 2.5 ft.), long-lived (> 25 years) stream-obligate salamanders endemic to the eastern United States. While considered indicators of stream habitat quality, hellbenders have experienced rapid range-wide population declines due to chronic nest failure. Habitat specialization on submerged rock slabs has imposed difficulties in monitoring efforts, resulting in historical information gaps in *Cryptobranchid* reproductive ecology. However, artificial nest boxes are an emerging conservation tool that provide a minimally-invasive technique for monitoring population trends and evaluating understudied aspects of hellbender reproduction. In this study, we constructed, installed, and monitored artificial nest boxes in a major tributary of the West Branch Susquehanna River. We constructed nest boxes using a 1:1 mixture of Portland cement and masonry sand using custom polyurethane rubber molds (910 Castings, Chardon, OH). In July – August 2024, we deployed nest boxes (n = 30) across two sites (15 nest boxes per reach) at high density (0.6 nest boxes/100m2 of wetted habitat). From August – September, we monitored rates of nest box occupancy, availability, and stability. We used underwater cameras to document occupancy and a BioMark HPR Plus PIT scanner to identify hellbenders occupying shelters. Within 30 days of installation, we detected shelter occupancy, several unique animals (n = 5), and high shelter availability (0.69). We also documented 100% shelter stability and an active hellbender nest established in September 2024. We will install additional nest boxes (n = 45) along a gradient of riparian forest cover in 2025. Future nest box monitoring efforts will evaluate factors influencing shelter performance, population trends, paternal care behaviors, and nest success within the watershed. This work will expand the scope of an existing artificial nest box monitoring framework in western Pennsylvania, allowing for broader evaluation of factors limiting hellbender recruitment and population persistence across the state.

hellbender, habitat augmentation, reproduction, population monitoring

SOME CONTROLS ON THE DEVELOPMENT OF LEGACY ISLANDS IN THE SUSQUEHANNA RIVER

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Some islands in the Susquehanna River have recently formed and developed from human activities. A small island cluster located downstream from the Selinsgrove Railroad Bridge (circa 1871) formed due to 1) an obstacle- the bridge, 2) coal and industrial legacy sediments, and 3) the removal of vegetation by locals. Aerial photographs and personal accounts reveal how the island cluster transitioned from a series of bars to vegetated landforms up to 0.5 acres in area and 2.2 m in elevation. We consider these fluvial islands to be "legacy islands".

In this research we modeled the processes and formation of legacy islands. The island cluster initiated from an accumulation of gravel. The gravel formed a bar that was colonized by a pioneer species (American water-willow community). The willow caused finer sediment to fall out of suspension, and the substrate to aggrade. This promoted the growth of successive woody vegetation (riverine scour community) which colonized and stabilized the bar. Finally, a permanent silver maple-sycamore forest grew, transforming the bar into an island. One key factor in island growth was the capture of flood debris by multi-trunk trees which produced debris dams. Debris dams deflect high energy flood water, causing finer sediments to be deposited. The occasional loss of vegetation due to man resulted in the island transforming back to a bar.

The base of the island was composed of cobbles to gravel that decreased downstream (30 to 19 mm); sand occurred on the island's tail end. Bituminous coal, quartzite, quartz/wacke sandstone, siltstone, brick, glass, and other human-caused debris formed some of the sediment. Much of this sand was composed of quartz, coal, and industrial waste. Minor amounts of the sand contained garnet, quartz with magnetite and muscovite (Pleistocene source). X-ray Fluorescence (XRF) of the cored sediments indicated that slight increases in silt corresponded to increases in certain oxides and metals (Fe_2O_3, Al_2O_3, K2O, MgO, Pb, Zn, Zr, and Ni). CaO increases were attributed to Corbicula and Pleurocera found between 100 and 150 cm in the core. Initial values of Pb (20 to 74 ppm) measured higher than local background levels.

Anthropogenic activities like construction, mining and deforestation have resulted in the formation and destruction of islands. Many of these island clusters have formed within the last 30 years and support a wide range of wildlife (mammals, migrating birds and waterfowl, amphibians, and reptiles). We need to understand how legacy islands form because they represent new fragments of the riparian ecosystem that may require future conservation and restoration. Additionally, the erosion of these floodplain sediments has consequences downstream. They add to the naturally produced sediments that accumulate behind dams, and they may be transported by major floods to lowland ecosystems like the Chesapeake Bay.

Fluvial Island, Legacy sediments, riverine scour, debris dams

EXPLORING OSMOTIC REGULATION GENES IN A NOVEL *PARACOCCUS* SPECIES WITH HIGH SALT TOLERANCE

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The microbial community of a particular environment is essential for the maintenance of the biogeochemical cycles within that environment. Microbes can also help the maintain the health of the environment by breaking down pollutants (bioremediation). In 2021, while characterizing the microbial community of the pond at the Bucknell Natural area, we isolated an orange-pigmented bacteria called ME4. After sequencing the genome, we conducted 16S rRNA, ANI, and pangenome analysis to determine the taxonomy and genomic composition of ME4. We used BIOLOG GenIII plates to determine the carbon metabolism and growth characteristics of ME4. While ME4 has greater than 95% 16S rRNA gene identity with *Paracoccus marcusii*, further analysis revealed an ANI value <88% compared to all sequenced *P. marcusii* strains. This finding suggests ME4 is a unique species of *Paracoccus*. Results from the GENIII plate also indicate that ME4 can tolerate up to 4% NaCl. Salt tolerance in other bacteria is often regulated by the SigF osmolarity regulation pathway, which may also be connected to pigment production and oxidative stress resistance. To characterize the response of ME4 to stress, we used qPCR to assess transcriptional changes in SigF regulated genes (pknD, sigF, nrsF, crtY, TreY) after exposure to 4% NaCl solution and 10mmol/L peroxide solutions. These findings emphasize not only the breadth of unidentified microbes in our ecosystems, but the value of using whole-genome taxonomic analyses like ANI rather than 16S rRNA analyses to identify them. Additionally, as salt tolerant Paracoccus species have potential use in whey bioremediation, understanding the response of ME4 to osmotic stress will help us determine if ME4 could have similar applications.

microbial ecology, osmotic stress, bacteria, bioremediation

AMERICAN EEL EDNA MONITORING IN THE PINE CREEK WATERSHED

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The American Eel (*Anguilla rostrata*) is an important species of freshwater fish native to North America. As critical hosts of the glochidia of several threatened and/or endangered freshwater mussel species, American Eel population health and persistence is of increasing interest in the Susquehanna River basin. Barriers along streams (dams, culverts, etc.) can impede eel migration, preventing natural spawning behavior, though additional impacts on population persistence are unknown, though likely of interest to conservation efforts. The Susquehanna River Basin Commission (SRBC) has stocked approximately 60,000 eels in the Pine Creek Watershed in north-central PA since 2010. There is a paucity of information on where those eels have moved and whether they have traversed barriers in the area to spread throughout the drainage system. eDNA saves time in detecting elusive species, minimizes damage to individuals (vs. electrofishing), and may be more accurate than electroshocking, particularly when used for species that frequently burrow. A species-specific marker to test for eel DNA in qPCR analysis was developed a few years ago with very high accuracy. Here, we used this method at five sites in Pine Creek and its tributaries in Tioga County, PA to assess the current distribution of American Eel near where stocking activities had previously occurred. Two sites were immediately at SRBC stocking locations, while three were upstream or downstream of the stocking locations, separated by barriers inventoried in the North Atlantic Aquatic Connectivity Collaborative (NAACC)'s stream barrier database. Most of these barriers had been surveyed and evaluations had determined that they were not likely to be a hindrance to aquatic organism passage, while some barriers remain unsurveyed. We used a Smith-Root eDNA backpack and previously developed qPCR procedures, along with the recently developed American Eel qPCR markers, to extract and quantify the American Eel eDNA in our samples. In short, we filtered 1 L of stream water using a 0.45 µm self-preserving filter, extracted DNA from filters using the DNEasy Blood and Tissue Kit, then used 15 µL qPCR reactions using a CFX Opus 96 Real-Time PCR System. We designed a gBlock to use as a positive control and for developing a standard curve to quantify eel DNA in field samples. Following successful in-lab sampling to ensure the protocol worked, we sampled five field sites adjacent to stocking locations in the Pine Creek valley. We found eel eDNA at only one site downstream of the stocking site on the main branch of Pine Creek. In the future, electrofishing or other surveying should take place to confirm continued eel presence in the area. Incorporating more data from the NAACC database and surveying the unsurveyed crossings may be relevant in understanding how stocked eels move throughout a drainage basic. Expanding sampling sites to include areas of active eel stocking by SRBC may also help identify major influences on eel movement and success, including water quality, prey abundance, and other potential predictors. Eventually, these data could help develop models to predict where eels might be most successfully stocked in the future.

eDNA, American Eel, Barriers

STORM CHASING: MAPPING AND INVESTIGATING THE CITY OF WILLIAMSPORT'S STORM SEWER SYSTEM

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The City of Williamsport owns a municipal separate storm sewer system (MS4) and has recently reached an agreement with the Williamsport Municipal Water Authority (WMWA) to have the WMWA assume responsibility for the inspection and maintenance of the MS4 system as required by United States Environmental Protection Agency (US EPA) regulations. The MS4 empties water into seven urbanized streams within city limits as well as directly into the Susquehanna River. As part of US EPA regulations, the WMWA must inspect and document the location and condition of stormwater outfalls. These stormwater outfalls penetrate the road to allow surface water to infiltrate streams, making them a possible entry point for illicit discharges (unauthorized dumping of materials into the MS4). Initial documentation of Williamsport's MS4 recognized 32 outfalls. Further surveying discovered at least 360 outfalls, which now need to be documented and inspected. Throughout the summer of 2024 we inspected the stormwater outfalls within the Williamsport MS4 area with the goals of mapping the MS4, tracing and stopping illicit discharges and other pollution sources, producing an annual MS4 report, and developing a Standard Operating Procedure (SOP) for future work. Outfalls were characterized by their type, material, shape, size, and location, and inspected during low-flow (at least 48 hours after precipitation). Outfalls were photographed and inspection reports were electronically and physically filed. If outfalls had flow during dry weather, investigators attempted to find the source of the flow, whether that flow was illicit, and the nature of the flow. During summer 2024, 257 outfalls were inspected, with seven outfalls being newly discovered so added to the inventory and three outfalls containing dry-weather flow, so further investigated. The outfalls were added to the MS4 report and a SOP was developed for future work. 95% of outfalls within the MS4 area have now been inspected and documented, creating an accurate map of stormwater outfalls. This allows for efficient monitoring, effective remediation, and an enhanced ability to trace pollutants. Future work should focus on annual re-inspections to maintain the quality of the outfalls and to identify and ensure the termination of any illicit discharges.

MS4, Stormwater, Urban Streams, Infrastructure

UNASSESSED WATERS INITIATIVE: SURVEYING NATIVE PA BROOK TROUT POPULATIONS

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Pennsylvania has approximately 80,000 miles of streams, many of which are coldwater streams with native brook trout (*Salvelinus fontinalis)* populations that are important to recreation and serve as an excellent bioindicator. Unfortunately, many of these streams are threatened by resource extraction, declining water quality, and changes in land use. The Pennsylvania Fish and Boat Commission is tasked with surveying state streams and protecting streams containing naturally reproducing brook trout populations. The Unassessed Waters Initiative (UWI) began in 2010 as a joint effort between PFBC and partners (e.g., institutions of higher education, non-profit organizations) to identify high priority watersheds through standardized electroshocking and water quality surveys. Lycoming College's Clean Water Institute (CWI) joined the program in 2010 and has participated every year since. Between 2012 and 2024, CWI surveyed 638 streams, documenting wild brook trout populations in Lycoming, Tioga, Clinton, Clearfield, and Centre counties. Here, we centralized and organized CWI's UWI dataset and used it to investigate physical and geological indicators (predictors) of wild trout presence. All data were entered into Microsoft Excel then edited to remove errors and standardize the units and formatting of all variables. We then used the data on the 365 streams from that dataset for which all data was complete. Of those 365 streams, 139 (40.8%) contained no brook trout. Using the predictors of stream wetted width (m), dissolved oxygen (mg L-1), temperature (°C), pH, and conductivity (µS cm-1), we completed a principal components analysis in JMP 18 on the log-transformed predictors, retaining principal components (PCs) with eigenvalues > 1. Using these two retained PCs as predictors, we used AICc-based model selection in R 4.4.1 to investigate 12 possible models (all possible combinations of PCs 1 and 2), all using a zero-inflated negative binomial general linear model. We considered models well supported when ΔAICc < 2. PC1 explained 37.4% of the variation in predictor variables and was negatively associated with dissolved oxygen and positively associated with temperature, alkalinity, and conductivity. PC2 explained 18% of the variation in predictor variables and was positively associated with stream wetted width and negatively associated with pH. Four models had ΔAICc < 2, none including a significant predictor PC for the count portion (i.e., explaining trends in streams in which brook trout were present) of the zero-inflated negative binomial model. PC1 (related negatively to DO and positively to temperature, alkalinity, and conductivity) was significant, with a positive coefficient, in all four best-supported models, while PC2 was not significant in any best-supported model. These results suggest that dissolved oxygen and temperature may be the primary determinants of trout abundance when trout are already present, but that other factors may influence their absence from an area (e.g., barriers, low flow). Future work should expand the dataset to include more of the statewide UWI dataset and add a wider array of variables, including landscape factors (e.g., barriers, hydrology).

Brook Trout, Unassessed Waters, Modeling

ASSESSING PROTOCOLS FOR ERADICATION OF *LYSIMACHIA VULGARIS* (GARDEN LOOSESTRIFE) IN THE SUSQUEHANNA RIVER VALLEY

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The newly problematic species *Lysimachia vulgaris* (Garden Loosestrife, *Primulaceae*) is plaguing the waterways of central Pennsylvania. Garden loosestrife is native predominantly to Europe but can be found in eastern Asia and northern Africa. The plant is rhizomatous and will aggressively colonize river environments. In particular, it is threatening important river brash environments, which are semi-aquatic conglomerates of *Justicia* plants that form important environments for fish spawning. In order to protect these fragile conditions, it is imperative to understand how to best control and mitigate invasive *L. vulgaris* populations. To achieve this, I have devised a set of conditions to test on plots of *L. vulgaris* on an island in the West Branch of the Susquehanna River near Bucknell University. I have observed and recorded the features of the habitat, organismal interactions with plants, and where on the island they are growing (as of Oct. 2024). Once this was determined, I sought to assess the efficacy of various types of mechanical removal and the introduction of physical barriers. For all of the treatments, roughly a 0.5m plot was marked with dowel rods and tape and labeled according to their corresponding treatment with a number representative of treatment. 2 replicates were completed in 2 separate plots of the island. To determine what mechanical removal technique may be best, I dug a roughly 0.5m deep hole and transplanted soil from an unafflicted area of the island into it, as well as cutting the plants at the base, pulling the plants as best I could, and 'tilled' the soil by breaking it up at the surface with a shovel. To test physical barriers, a similar 0.5m deep hole was dug and was replaced with soil from the same aforementioned location, then plots were either lined with weed mat/geotextile fabric, landscape edging, or were placed in a flowerpot. In the latter treatment, the flowerpot was punctured with holes every 2cm of its 30cm depth in the hopes that I could determine how deep the roots would attempt to spread. These plots will be monitored weekly until the plants die, and the results will be gathered concretely come spring

when I can observe best how well the plants overwinter. With the information gathered from this project, I hope to be able to find an ideal method to control the spread of *L. vulgaris* to protect vital river environments, as well as gain important knowledge of the plant in general to determine which areas are most at risk for its spreading. At this current time, the environment has been examined and associated data has been collected and the plots have been set up to observe.

Invasive species, River scour, Eradication, Lysimachia

FROM FIELD TO LAB: OPTIMIZING IDENTIFICATION TECHNIQUES FOR FRESHWATER SCULPIN IN THE WEST BRANCH SUSQUEHANNA RIVER?

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Freshwater sculpin are a small-bodied, benthic species found in cool- to cold- water rocky streams. They can be a useful environmental indicator due to their partial tolerance to turbidity and siltation and intolerance to warmer temperatures, chemical pollution, and acidification. Mottled Sculpin *Cottus bairdii* (Girard, 1850) and Slimy Sculpin *Cottus cognatus* (Richardson, 1836) are two species overlapping in distribution within West Branch Susquehanna River watersheds. The suggested identification protocol for these species is to examine distribution maps, use a dichotomous key to make an initial identification, then review additional characteristics to confirm. This can be a time-consuming process in the field and can make accurate identification challenging. In addition, due to its size, it can be difficult to determine morphological differences in a field setting, along with among-species variation and between-species overlap in characteristics. We developed a protocol and collected vouchers in the field to determine how accurate our sculpin identifications are for the Loyalsock Creek, Pine Creek, and Kettle Creek watersheds along with smaller West Branch Susquehanna River tributaries. Our field identification was compared to a more thorough laboratory examination of vouchered specimens which included additional traits. We fine-tuned traits based on year 1 data and completed a second season using our new protocol. Year 2 protocol was helpful in accurately identifying specimens by analyzing the field and lab traits that we will finalize for year 3 field season identification. Our next steps are completing caliper measurements to target variation in morphology and investigating species distribution for these drainages with our finalized protocol targeting established gaps.

Freshwater, Sculpin, Sampling Methods, Species Distribution

HOW PRECIPITATION EVENTS AFFECT MICROPLASTIC TRANSPORTATION IN SMALL STREAM SYSTEMS

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Microplastics are small pieces of plastic typically between 1-1000 µm. Microplastics can come from larger pieces of plastic degraded down to fragments, from clothing in the form of fibers, or as a byproduct of production in the form of beads. Microplastics have varying ecological impacts depending on size and form, and can travel at different heights in the water column based on the type of plastic. Therefore, precipitation and runoff may have an impact on how these plastics travel through smaller stream systems. I investigated Selinsgrove Creek will be taken 3 different sites, with 2 sample locations at each site. Samples are taken at 3 heights in the water column, and then homogenized. These samples will be gravity filtered through 228.6 µm and 23 µm filters separated by 30 inches of 1.5 inch PVC. Microplastics will be categorized by type for each sample. To account for precipitation changes I will be taking discharge measurements and collecting precipitation data from the Pennsylvania State Climatologist website. I hypothesize that after major precipitation events we will see more microplastics in the water column compared to normal flow.

Microplastic, Discharge

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LITTLE ARNOT RUN RESTORATION UPDATE: TRENDS IN THE FISH COMMUNITY 3 YEARS POST-RESTORATION

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The Allegheny National Forest has been extensively influenced by human activity including timber harvest and resource extraction. Road building activities to support resource extraction has often left streams that are channelized and disconnected from their floodplain. Historic timber practices often left even-aged trees along the riparian corridor that have not contributed wood to the stream channel and toward instream fish habitat. Multiple agencies and university have been cooperating since 2019 to reconnect the channelized portion of Little Arnot Run to its floodplain and to increase the amount of wood in the stream channel by installation of tree bundles in lower portions of the watershed and widescale, directional felling of riparian trees throughout the rest of the watershed. Floodplain reconnection in lower sites on Little Arnot Run was completed in August 2021 and directional felling of trees throughout the watershed was completed in early 2022. Here, we present fish community data from Little Arnot Run sites across five years spanning pre-restoration efforts (= 2 years pre-restoration and 3 years of post-restoration) and compare these data with the fish community from Cherry Run, a nearby watershed without restoration activity that serves as a control watershed. We conducted triple pass electrofishing surveys in late July-early August of each year to estimate the composition and biomass of the fish community at two locations in each watershed, one location near the downstream confluence and one location closer to the headwaters. We did not predict, nor did we find, trends in species richness or fish community diversity following restoration. Variation in the number and biomass of brook trout (*Salvelinus fontinalis*), and in the whole fish community, appears to be highly influenced by baseflow conditions. After correcting for the area sampled, fish biomass at locations in Little Arnot Run appear to be trending higher when compared to reference sites in Cherry Run; however, continued fish community monitoring is planned to verify long-term influences of this restoration work.

Stream restoration, In-stream habitat, Fish communities

FISHING OUT INVASIVES: HOW ARE NATIVE TESSELLATED DARTERS REACTING TO THE PRESENCE OR ABSENCE OF INVASIVE BANDED DARTERS?

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Invasive species have caused multiple large scale ecological issues, including the extinction of many species. These invasive organisms directly affect native species by ways of outcompeting them or forcing them outside of their ecological niche. Understanding these relationships can be key in attempting to slow the spread of these invasive species. In the Susquehanna River Basin, native tessellated darters and invasive banded darters have similar substrate preferences as they both tend to prefer larger substrate sizes. It is believed that banded darters entered the Susquehanna in the late 1960s from the Ohio River Basin via a bait bucket transfer and since then have become the most abundant darter species in the Susquehanna (Gray and Stauffer, 2001). Banded darters are larger and much more aggressive than their tessellated counterparts, which is likely affecting the natural behaviours. To investigate this, I will use a mock stream channel system at Susquehanna University's Freshwater Research Institute. This system has four independent 10 ft. x 2 ft x 2 ft. channels that are split into three sections. Each section will have two fish in three pair combinations: tessellated and tessellated, banded and banded, and tessellated and banded, and have four substrate sizes available, with preference of substrate size observed over a two hour trial. I hypothesize that both tessellated and banded darters will each prefer the larger substrate sizes when they are separated, however when placed together the aggressive behavior of the banded darters will force the tessellated darters away from the substrate that they prefer and to the smaller substrate sizes.

Invasive Species, Tessellated Darter, Banded Darter, Substrate

OPTIMIZING METHODOLOGY FOR HEAVY METAL BIOACCUMULATION ANALYSIS IN FRESHWATER MUSSELS

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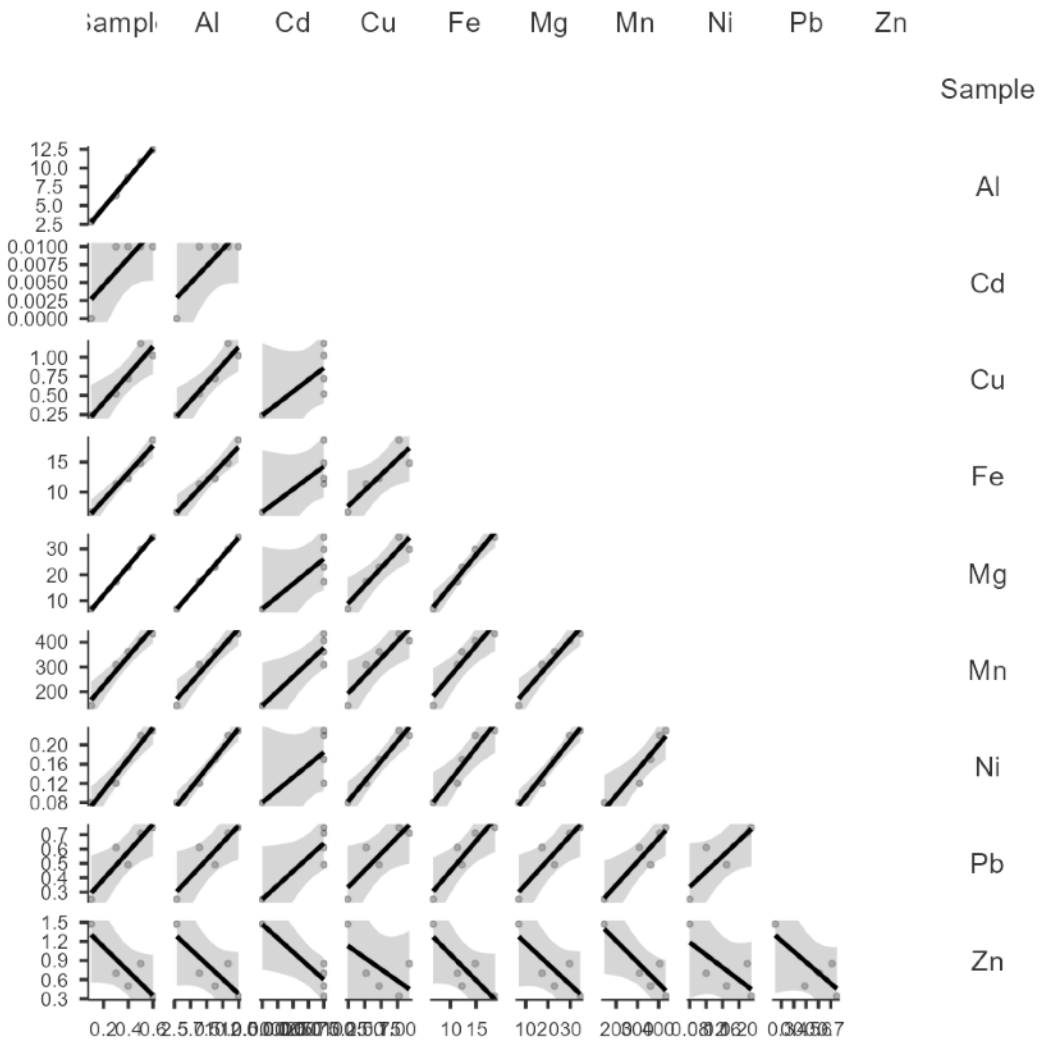
In this study, we developed and refined a methodology for assessing heavy metal bioaccumulation in freshwater mussel shells. Our goal was to refine sample preparation and digestion methods to achieve accurate, consistent measurements across multiple study sites. Given the role of mussels in aquatic ecosystems, it is critical to establish reliable techniques to ensure precise measurement of heavy metals across various study sites.



Our method involved testing incremental sample masses (0.1–0.6 grams) to identify an optimal mass for consistent concentrations of metals. Following standardized acid digestion protocols, samples were analyzed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), with calibration curves enabling the precise quantification of metal content.

Preliminary results suggest that a sample mass of 0.2–0.3 grams provides the best consistency across metals, with strong reproducibility. These findings establish a solid foundation for bioaccumulation analysis and are essential for accurately assessing the impacts of anthropogenic activities on freshwater mussel health.

This optimized methodology offers a reliable approach for future studies on bioaccumulation in mussels, supporting broader conservation and environmental monitoring efforts.

Bioaccumulation, Freshwater Mussels, Heavy Metals, ICP-OES Analysis

CHANGES IN SUMMER ZOOPLANKTON COMMUNITY STRUCTURE FOLLOWING THE LOSS OF *CERATOPHYLLUM DERMERSUM* IN FAYLOR LAKE, A SMALL RESERVOIR IN SNYDER COUNTY, PA

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Faylor Lake is a reservoir of the west branch of the upper Middle Creek watershed. The volume of Faylor Lake is $0.7x10^6$ m^3 with a mean depth of 1.24m. This study focuses on the zooplankton communities of Faylor Lake through the months of June and July during 2023 and 2024. Until 2024, the common free-floating vascular plant, *Ceratophyllum dermersum*, was found throughout the lake. During the summer of 2024, however, *Ceratophyllum* had all but disappeared and found only in small clumps on the shore of the reservoir. The zooplankton community of Faylor Lake in 2023 was dominated by widely distributed cladoceran taxa, such as *Ceriodaphnia dubia* and *Bosmina longirostris*. The zooplankton community of 2024 was generally dominated by rotifers (e.g. *Asplanchna pirodonta*) throughout most of the study. The dominant zooplankters of Faylor Lake are coarse filter feeders. Average zooplankton taxa richness for 2023 was 10 and 13 in 2024. We suspect that differences in the zooplankton ecology of the reservoir is connected to the loss of *Ceratophyllum dermersum*. The zooplankton community changed over the course of two summers with the loss of *Ceratophyllum dermersum*.

Zooplankton, Ceratophyllum dermersum, Aquatic, Lake

MUNCY CREEK SEDIMENT TRANSPORT: DETECTING SIGNIFICANT SEDIMENT MOTION PATTERNS

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Tropical Storm Lee in 2011 resulted in extreme flooding and sediment transport in Muncy Creek, a tributary to the West Branch of the Susquehanna River. Fortunately, high-resolution (one meter horizontal), aircraft-based LiDAR elevation maps (i.e., DEMs) were collected in 2006 and 2017 shortly before and after Lee. Large elevation changes due to sediment deposition or erosion should be detectable by taking the difference between elevation for a given 1-m cell in 2006 and in 2017. Thus, the variable Ediff = z2006-z2017 is a measure of erosion and negative values of Ediff correspond to deposition. Looking at reaches of all sizes and throughout the watershed, previous work at Bucknell showed that the standard deviation of Ediff measured underneath reaches was correlated with the sediment capacity index Tc=ln(A*S), where A is the watershed area feeding into the reach and S is the slope of the bed in the reach. This implies that high sediment motion (from high values of Tc) results in sediment redistribution within a reach, and variations in Ediff underneath the reach.

Muncy Creek was also studied in considerable detail by Kochel et al. (Geomorphic response to catastrophic flooding in north-central Pennsylvania from Tropical Storm Lee (September, 2011): Intersection of fluvial disequilibrium and the legacy of logging, Geosphere, 12(1), 2015) with aerial photography and field observations. Their work resulted in color-coded maps of the channel and floodplain, providing a picture of sediment motion at spatial scales far smaller than the reach scale. With their permission, their map for Muncy Creek was "rubber-sheeted" in ArcGIS Pro so that the Ediff prediction of sediment erosion or deposition could be compared to their observations. This combination of data helps to illustrate the sediment transport patterns. For example, when a channel was straightened by Ivan, the Ediff map shows deposition on the outside of the bend and erosion in the inside, pushing the channel so as to reduce its length.

A conclusion from this study is that reach-level measures such as Tc might correlate with actual sediment transport and re-distribution within a reach, but the physical processes that actually move the sediment act at much smaller spatial scales. Future work will extend this study further downstream.

Sediment transport, Muncy Creek, Sedimentation, Erosion

ENVIRO JUSTICE VIEWS: PENNENVIROSCREEN IS A TOOL FOR ASSESSING DISPROPORTIONATE RISK

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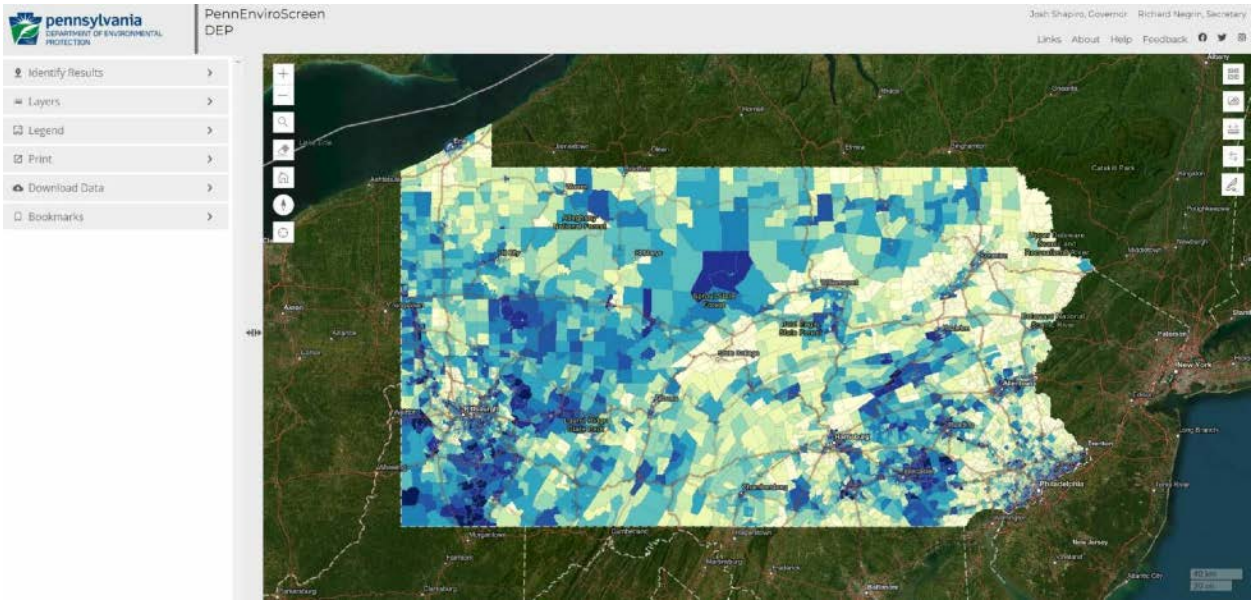
PennEnviroScreen is the official GIS tool built by PA DEP and put into service September 16, 2023. Like any such GIS tool, it has a distinct purpose which shapes its methodology, data, and functionality. In this case, PES was built both for permitting regulation and for community engagement. It relies on a definition of disproportionate impact. This poster will provide an overview fo the design logic, the method, the data, and the uses of PES. The poster will also include a live demonstration so that any visitors to poster can see how it works.

Environmental Justice, Policy, Regulation, GIS



SPARCNET AND RAMP: UTILIZING A LARGE COLLABORATIVE NETWORK TO TRAIN THE NEXT GENERATION OF CLIMATE SCIENTISTS

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Formidable challenges in STEM include how to diversify our workforce and how to train the next generation of scientists to mitigate the impacts of large-scale global change. The Salamander Population and Adaptation Research Collaboration Network (SPARCnet) is an inclusive collaboration of scientists from over 30 institutions founded in 2013. We study range-wide population dynamics of *Plethodon cinereus*, the red-backed salamander, with students of all levels, from elementary to undergraduate and graduate students. In summer 2023, SPARCnet received a 4-year NSF-Research and Mentoring of Postbaccalaureate (RaMP) program grant. Here, we describe the research methods used by SPARCnet collaborators and the objectives of our RaMP program. We also highlight the achievements of our program over the last 15 months.

Researchers utilize the same cover-board plot study design and sampling methods across the range of P. cinereus in eastern and north-central North America. In spring and fall months, researchers sample the plots for salamanders, recording a variety of morphometric data and uniquely marking each individual. Our RaMP program connects our research with mentoring of recent post baccalaureates across our multi-disciplinary network. Our goals are to recruit and mentor a diverse cohort of mentees each year, provide professional development training, and advance our research. New mentors received formal training on best practices and new mentees attended a salamander bootcamp to

learn research methods and build community. Mentees take part in a collaborative cohort project utilizing the 10-year dataset and individual tailored projects that differ based on mentor expertise and mentee interests. Our achievements over the last 15 months highlight the necessities of remaining flexible and continuously adapting to improve our program to meet both our mentoring and research goals. Our successes have also illustrated the distinct power of coordinated population studies across the range of a species. We are excited to witness the impacts of our efforts in the upcoming years and to disseminate our results to interested audiences, including other mentoring programs as well as the scientific and wildlife management communities.

red-backed salamander, climate warming, NSF RaMP, demographic study

THE EFFECTS OF LEAF LITTER SPECIES AND SHADING ON AMPHIBIAN PERFORMANCE

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The hemlock woolly adelgid (*Adelges tsugae*; HWA) is a small, invasive, aphid-like insect that feeds on the sap of hemlock trees. In the northeastern United States, the primary tree impacted by the HWA is the eastern hemlock (*Tsuga canadensis*), which lose their needles and eventually die due to infestation. This results in a thinning of the canopy, and therefore, more light on the forest floor, as well as a change in leaf litter composition on the ground. Both factors could impact the surrounding ecosystem, including ephemeral pool species such as spotted salamanders (*Ambystoma maculatum*) and wood frogs (*Lithobates sylvaticus*). We randomly assigned 20 cattle tanks, designed to mimic ephemeral pools, to different treatments, either a 35% or 70% shade cloth treatment and either mixed leaf litter or eastern hemlock dominated leaf litter. We added 40 tadpoles and five salamander larvae to each tank. After five weeks, we determined the mass (mg), total length (mm), and developmental stage of each individual. The salamander larvae showed no differences in mass or length between treatment groups, while tadpole mass was higher in the mixed leaf litter treatment but showed no difference between shade treatments. We found no difference in survival rates for tadpoles or salamander larvae between treatments. The increase in tadpole mass in mixed leaf litter was likely due to the improved variety of nutrients available compared to hemlock dominated leaf litter. While eastern hemlock did not appear to have a direct impact on the organisms, other indirect effects of its potential loss to northeastern forest ecosystems are yet to be determined.

Eastern Hemlock, Spotted Salamander, Wood Frog, Ephemeral Pools

ASSESSING JUNIATA RIVER TRIBUTARIES FOR 6PPD- QUINONE PRESENCE AND CONCENTRATION IN AQUATIC LIFE

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Stormwater runoff from urban areas is a threat to aquatic ecosystems. Anthropogenic chemicals contained in this runoff negatively impacts sensitive organisms. For example, 6PPD-quinone (N-(1,3-Dimethylbutyl)-N′-phenyl-p-phenylenediamine-quinone), a common tire antidegradant, is responsible for Urban Runoff Mortality Syndrome (URMS), and is known to cause high spawn mortality in salmonids, such as Brook Trout (*Salvelinus fontinalis*) and less so for others such as Brown Trout (*Salmo trutta*). This recent breakthrough on the dangers of 6PPD-quinone has created opportunities to address the nuances of this dangerous chemical within aquatic ecosystems and may add information explaining the dominance of brown trout over brook trout in native brook trout catchments. Therefore, this project proposes an initial study to investigate how 6PPD-q could play a role in brown trout being competitively dominant over brook trout, and thus explain some of the distribution patterns typically seen in these salmonids. We will sample water, benthic macroinvertebrates, and trout in streams in the Little Juniata River watershed upstream and downstream of road/urban runoff. Upstream locations will serve as controls and downstream locations will have sources of immediate road runoff and a putative source of 6PPD-Q. Lab analysis will test the concentration of 6PPD-q on water samples and tissues to measure the bioaccumulation of 6PPD-quinone in freshwater stream food chains. We expect impact sites to have high 6PPD-q in organisms with brook trout absent because of their sensitivity. Seeing as this research has interdisciplinary knowledge gaps, studies should be encouraged to explore the presence of 6PPD-quinone in local watersheds to identify areas of concern and species at risk. This is the first study to explore the influence of 6PPD-quinone on the distribution and abundance of brook and brown trout as well as to measure its bioaccumulation in freshwater stream food chains in the Little Juniata River.

Brook Trout, Brown Trout, 6PPD-quinone, bioaccumulation

THE DISAPPEARANCE OF *CERATOPHYLLUM DEMERSUM* AND THE IMPACTS ON PHYTOPLANKTON COMMUNITIES IN FAYLOR LAKE, SNYDER COUNTY, PA

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Faylor Lake, a reservoir within the west branch of the upper Middle Creek watershed, has a total volume of 0.7×10^6 m^3 and a mean depth of 1.24 m. This study examines the phytoplankton communities during the months of June and July in 2023 and 2024. In 2023, phytoplankton was dominated by Chlorophyta when weighted by biovolume, indicating a stable and uniform assemblage. The average importance of Cyanobacteria increased from .02% in 2023 to 27.68% in 2024. The observed shifts in phytoplankton communities correspond with the near disappearance of *Ceratophyllum demersum*, a common free-floating vascular plant that had been abundant throughout the lake in 2023 but was found only in small clumps along the shoreline in 2024. This loss of *Ceratophyllum demersum* likely impacted nutrient cycling, habitat availability, and light penetration in the water column, contributing to the shift toward an increase in Cyanobacteria and an overall increase in phytoplankton biovolume in 2024.

Phytoplankton, Reservoir, Cyanobacteria, Ceratophyllum

COMMUNITY ENGAGED LEARNING IN ENVIRONMENTAL ENGINEERING

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For over a decade, waterways in Union County have been classified as impaired for recreation based on pollution with fecal bacteria. We created a learning module on local water quality with a focus on bacterial pollution in collaboration with the Buffalo Creek Watershed Alliance (BCWA). We have been administering the module in CEEG 340: Introduction to Environmental Engineering. CEEG 340 is part of both the civil engineering and environmental engineering curricula, but students from other STEM majors also take this course.

Members of the BCWA visit our classroom and talk about their specific concerns, as well as their work and roles in working with the community and helping to restore and protect local waterways. Students then learn about standard water quality parameters by going out into the field, sampling, conducting laboratory measurements, and analyzing data. Students also research water quality regulations to contextualize their data. Students communicate their results to the public using memos, letters to the editor, Instagram posts, and websites– which go through multiple drafts with feedback from the instructor. In addition, before creating their communication artifact, students participate in an analysis of audience exercise. After completing the project students submit a reflection on their experiences—what they learned and their interests in community engagement. We hope that the continued use of this module will ensure a long-term collaborative program with the BCWA community partner and draw from the organization's current concerns and needs. We thank The Center for Community Engaged Leadership, Learning & Research; and The Department of Civil and Environmental Engineering (Bucknell University) for funding.

community engaged, learning, water quality

FEELING GROOVY? SALAMANDER USE OF ARTIFICIAL COVER OBJECTS IN A RIPARIAN FOREST

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Artificial cover objects (ACOs) are a common method used in the study of terrestrial salamanders in forested habitats. In this study, we designed and deployed an experiment to investigate use of ACOs by Red-backed Salamanders *(Plethodon cinereus*) that were given the choice of either smooth or grooved ventral surfaces. Our preliminary data show greater numbers of salamanders beneath grooved boards during the majority of the weekly samples. However, because our study plots are also home to the lead-back phase of this salamander, we have an opportunity to investigate possible differences between these morphs, and here our results diverge. Teasing apart these salamander phases indicated that during most weeks the red-phase salamanders beneath smooth ACOs outnumbered those beneath channeled boards, but that the opposite was true for the lead-back phase. Our study continues to determine if these results are maintained.

Plethodon cinereus, Red-backed Salamander, artificial cover objects

USING IBI SCORES TO PREDICT POTENTIAL STREAM RESTORATION SUCCESS IN PENNSYLVANIA

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The U.S Environmental Protection Agency set goals in the Chesapeake Bay Watershed Agreement that Pennsylvania must cut 69% of nitrogen outputs but this target has not yet been met. The Susquehanna River basin that flows to the Chesapeake is largely agricultural communities. Of the 69% of nitrogen production that Pennsylvania is responsible for, 80% is the byproducts of agriculture. Pennsylvania's delisting stream initiatives are efforts to reduce the number of streams that are considered in poor health and thus impact the bay. For a stream to become listed as impaired, its Index of Biological Integrity score must be less than 50. This score indicates the stream has a high level of disturbance with a predominance of benthic macroinvertebrate species that are tolerant to pollution. We plan to use recently released IBI scores and Land Use/Land Cover datasets to predict which streams will likely improve with restoration. Using PA Department of Environmental Protection IBI scores from 1991 to the present. We plan to use the state-wide DEP data to develop trends in subwatershed stream quality based on IBI scores, as well as conduct case studies of specific stream reaches where Freshwater Research Institute projects have given us a complete history of stream restoration efforts and timing. Using these case study results, we anticipate a process in which we can make predictions about other watersheds that might be good candidates for new stream restoration projects. We hope to provide some insight into trends associated with water quality and restoration in streams, contribute to efforts to delist streams in Pennsylvania, and accelerate the restoration of the Chesapeake Bay.

Benthic Macroinvertebrate, Stream Restoration, Delisting Strategy, Index of Biological Integrity

DIURNAL VARIATIONS IN WATER TEMPERATURE IN A SECTION OF THE WEST BRANCH SUSQUEHANNA RIVER NEAR LEWISBURG, PA

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To assess the spatial and temporal variability in water temperatures in the West Branch of the Susquehanna River, a network of nine buoys were deployed at three cross-section locations near Milton, Lewisburg, and Chillisquaque. The buoys were equipped with data loggers and sensors to record relative humidity, air temperature (°C), solar radiation (W m-2), and water temperature (°C) at 0.15-meter depth as well as 0.61-meter depth. Readings were collected every 15 minutes from May to August. The buoys were anchored to the bed of the river with cinder blocks with sensors to record water temperature (°C) at bed of the river and total water depth.

Longitudinally, water temperatures consistently increased by 0.2 to 0.5 °C km-1 as a result of shortwave radiation from the sun and latent heat transfer from warmer air immediately above the water. Lateral variations in temperatures were considerably more complex due to changes in water depth, riparian shading, and mixing of water currents. Vertically, temperatures in the deepest section of the channel typically increase 1-2 °C from the water surface to the riverbed, reflecting long-wave radiation conduction that penetrates the water column and warms the low albedo and dark, iron and magnesium-stained cobbles that cover the bed of the river. Generally, water temperatures are a subdued reflection of air temperatures, with atmospheric conditions and solar radiation exerting significant influence over the diurnal fluctuations in river temperatures. Typically, peak diurnal water temperatures occur several hours later than peak solar radiation each day. Data from buoys positioned approximately fifteen meters from the channel banks indicate that shading from the riparian corridor is the primary factor affecting temperature variability along the river's edges. For example, for the network of three buoys deployed at the Milton cross-section, solar radiation reached a maximum of 913 W/m² at the right bank, compared to a minimum of 856 W/m² at the left bank on June 13, 2024. Water temperatures decreased by as much as 5.4 °C after the sun descended below the shaded areas of the channel.

river temperature, solar radiation, heat transfer

CLIMATE CHANGE AND DECLINING BODY CONDITION OF JAPANESE GIANT SALAMANDERS (*ANDRIAS JAPONICUS*) IN HYOGO, JAPAN

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Climate change and extreme climate events pose significant threats to biodiversity. Amphibians are particularly susceptible to climate shifts due to their permeable skin and sensitivity to environmental conditions. Japanese giant salamanders (*Andrias japonicus*) are currently listed as Vulnerable by the International Union for Conservation of Nature and the Japanese Ministry of the Environment. Understanding the impacts of changing temperatures on physiological health is critical for their conservation efforts. To understand the implications, this study aims to investigate whether the body condition of an *A. japonicus* population has changed over 14 years in relationship to temperature-related parameters. We assessed body condition, a measurement of overall health, using long-term biometric data collected from 2008 to 2022 in Hyogo Prefecture, Japan. Body condition was calculated using the scaled mass index (SMI). Local air temperature parameters from 2008-2022, collected by the Japan Meteorological Agency, were used to measure changes in the local climate. Preliminary analyses using generalized linear mixed models indicate a decline in body condition in the *A. japonicus* population from 2008 to 2022. We aim to examine whether these observed declines in body condition correlate with increasing air temperatures. Increasing air temperatures can increase water temperatures, which reduces dissolved oxygen levels. Lower oxygen availability impacts *A. japonicus*, as they partially rely on cutaneous respiration, making it particularly challenging for them to survive in warmer waters. This study will provide insight into climate change effects on *A. japonicus,* informing future conservation strategies.

HETEROCYST FORMATION CHARACTERIZATION OF A FILAMENTOUS CYANOBACTERIUM FROM WHITEFISH MOUNTAIN

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Cyanobacteria are photosynthetic microorganisms that are of interest for their potential as a biofuel source but also in their role in diagnosing the environmental conditions of a given waterway. WFMT 1a is a filamentous cyanobacterium that was collected from a waterfall on Whitefish Mountain in Montana. Many filamentous cyanobacteria, such as the isolate discussed herein, can form specialized non-photosynthesizing cells within a filament called heterocysts, whose primary function is to engage in atmospheric nitrogen fixation for the benefit of the whole filament. As other bioavailable nitrogen sources become scarce within an aquatic environment, heterocysts are formed at higher frequencies along a filament up to a minimal distance between heterocysts as determined by intracellular signaling and gene regulation. To better characterize WFMT 1a, we grew cultures from this isolate in an altered media made to be nitrogen-free. We then compared the ratio of heterocysts to vegetative cells and counted the minimal number of vegetative cells between heterocysts.

ASSESSING SEASONAL VARIATION OF IRON OXIDES AND TURBIDITY: A CASE STUDY OF SHAMOKIN CREEK IN PENNSYLVANIA

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As groundwater interacts with rocks and minerals exposed by coal mining, it gradually generates acid mine drainage (AMD) and increases iron oxide concentrations. This process renders water unsuitable for domestic use, eliminates aquatic life, and contributes to broader environmental degradation. Creeks and other water resources surrounded by several areas of land used for coal mining are, thus, impacted by the effects of AMD. Previous studies on coal mining and AMD have focused on understanding their ecological impacts, economic implications, and effects on water quality. However, the current study assessed seasonal changes in iron oxides and turbidity using Shamokin Creek in Pennsylvania as a case study watershed. This study hypothesized that there are no significant differences in iron oxides and turbidity values in the early spring and late summer seasons. Geospatial, laboratory, and statistical analyses were utilized to analyze data collected from Shamokin Creek remote sensing and water sampling. The geospatial, laboratory, and statistical analyses all revealed a significant decrease in turbidity from spring to summer seasons and a significant increase in iron oxides. The results of this study can be used to better understand the changes in concentrations of iron oxides and turbidity levels through seasons, further aiding water treatment efforts.

Acid Mine Drainage , Remote Sensing , GIS , Water Quality

SUSQUEHANNA RIVER TRIBUTARY SEDIMENT RESPONSE TO BEAVER DAM ANALOGS

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The American Beaver (*Castor canadensis*) is a known ecosystem engineer that influences the geomorphology, hydrology, water quality and terrestrial and aquatic vegetation in streams. Historically beavers have been extirpated, thus creating incised streams and bank erosion. Beaver dam analogs (BDA) are anthropogenic structures constructed to mimic the effects that beaver dams have on the ecosystem by using local, natural materials such as, sediment and gravel, wooden stakes, and tree branches. The goal with these artificial structures is for incised streams to become aggregated, by decreasing erosion and increasing deposition rates. This study aims to assess the geomorphometric changes of 8 BDAs in one of the tributaries of the Susquehanna River approximately one year after implementation. Researchers also installed erosion scour chains and bank erosion chains to monitor changes in erosion and deposition, along with pressure transducers, temperature loggers and water level loggers to measure various environmental factors. Profile transects were also taken pre and post installation to monitor changes in the stream profile and thalweg.

Beaver dam analogs, aggradation, erosion, sediment

RELATIONSHIPS BETWEEN TREE SIZE, STRUCTURE, AND FRUIT PRODUCTION IN PAWPAWS (*ASIMINA TRILOBA*) AND THEIR ROLE IN RIPARIAN BUFFERS

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The pawpaw (*Asimina triloba*) is a temperate fruit bearing tree with other related genera in the tropics. Pawpaws can grow in deciduous forests and are most successful in moist soils with a pH between 5.4-7.0. With this species being native to eastern North America and most successful in USDA Zone 5, pawpaws could be effective to integrate into riparian buffers in the Chesapeake Bay watershed. This tree also acts as a food source for people and animals like racoons, squirrels, and opossums across its native range. There has been extensive research on fruit production in cultivated orchards, however there is little research of fruit production in wild type pawpaws. To learn more about wild type pawpaws we investigated two pawpaw sites and collected the diameter at breast height (DBH), height, clustering of fruit production, fruit quantity, and dimensions of the ripe fruit. We found a relationship between the DBH and tree height with fruit quantity. While our data showed a relationship between fruit yield and height, previous research found no relationship. Other research has also shown wide variability in other orchard-based fruits, such as apples, in tree height and fruit quantity. Our research could help identify best practices for planting pawpaws in riparian buffers for both restoration and fruit production.

multifunctional buffer, ecosystem services, natural capital

RECOVERY OF IRON AND TRACE ELEMENTS (CO, NI, ZN) FROM ABANDONED MINE DRAINAGE USING OXIDATION AND PH ADJUSTMENT

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The objective of this research was to precipitate and recover Fe and Al and trace metals (Co, Ni, Zn) from abandoned mine drainage (AMD) through pH adjustment. AMD samples were collected from 'Site 15' near Ranshaw, PA with pH values in the range of 3-5. Jar tests were used to evaluate metal removals at defined pH endpoints of approximately 5, 6, 7, 8, 9, and 10. NaOH was used to raise the pH in all experiments. The jar testing procedure included 10 minutes of rapid aeration, 30 minutes of mixing and flocculation, and 30 minutes of settling time. Metal concentrations were measured by ICP-MS. The results showed that the minimum pH value for greater than 90% removal of the metals was 7 for Fe, 6 for Al, 9 for Ni, 9 for Co, and 7 for Zn. A second set of experiments was conducted in which all the metals were precipitated simultaneously using a target pH of 9.0. The goal of this testing was to create a metal solution that could be used to supplement anaerobic digestion of food waste which typically requires addition of trace metals such as Co and Ni.

The final AMD precipitate supplemented anaerobic digestion (AD) of food waste, where methanogens require trace amounts of Fe and other metals to survive. AD reactors supplemented with AMD precipitate produced greater methane content than a control with no trace metal addition, but did not perform as well as a vendor supplied solution of trace metals designed for anaerobic digestion. Using AMD precipitate for AD of food waste potentially gives economic incentive to treating AMD, benefiting humans and the environment, but additional research is needed to fully develop this concept.

abandoned mine drainage, resource recovery, trace metals

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River Symposia

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September 28, 2007

2nd

The Susquehanna and Agriculture

September 12-13, 2008

3rd

River Symposia

2009 to 2011

Cultures At The Confluence - Native Americans

September 26, 2009

4th

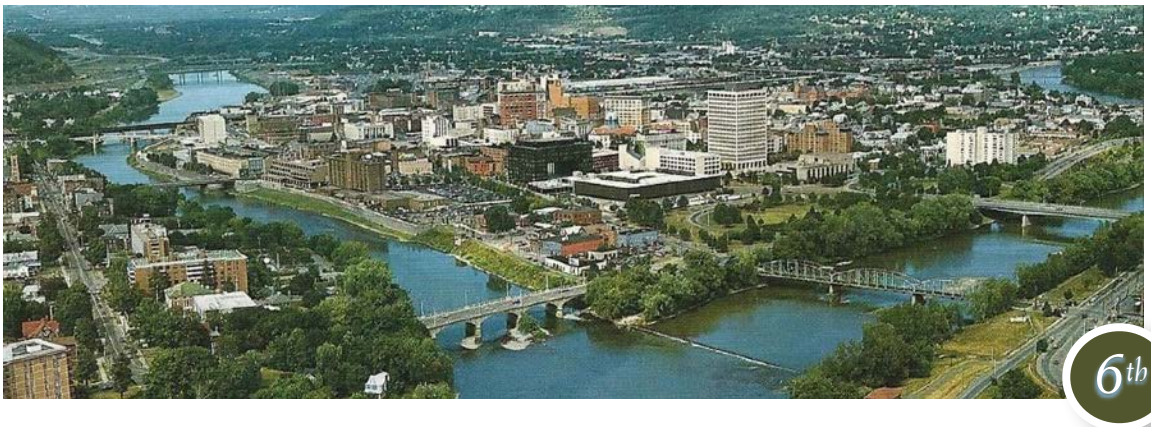
River Health and The Chesapeake Bay

October 22-23, 2010

5th

River Towns in the 21st Century

October 18-19, 2011



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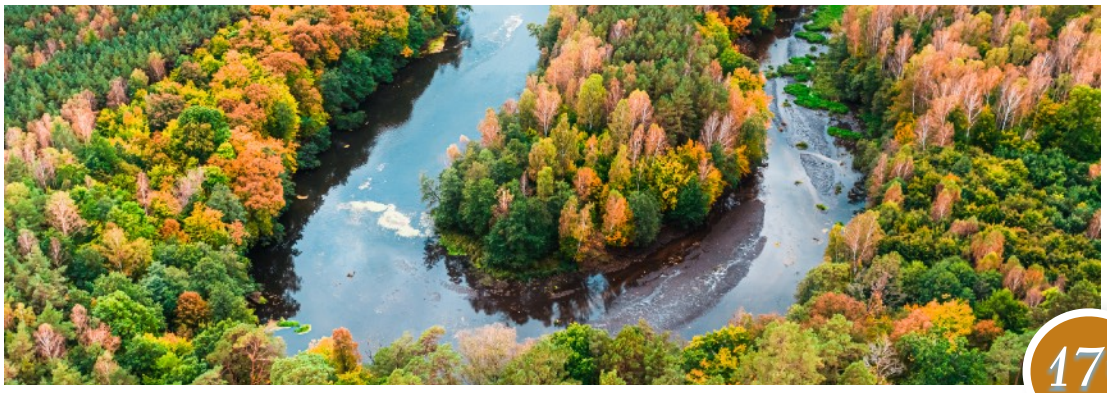
November 4-5, 2022



17th

Navigating the Flow

November 3-4, 2023

18th

Photo: SRHCES student researchers collecting water samples on Fishing Creek near Bloomsburg, PA under the supervision of Dr. Steven Rier, Professor of Biology.

SRHCES

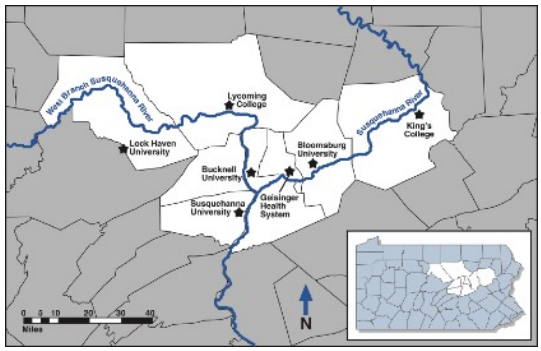
The **Susquehanna River Heartland Coalition for Environmental Studies** has played a major part of the River Symposium since its beginning 19 years ago. Established in 2005, the SRHCES is a unique collaboration of regional universities, environmental agencies, watershed groups, and the Geisinger Health System, all working together on interdisciplinary research projects in the "heartland" of the Susquehanna River waters.

Its members meet quarterly to discuss ongoing research projects, opportunities for collaboration, and emerging issues in the watershed.

The Coalition creates educational opportunities that promote student interest and involvement in the natural resources of the Susquehanna watershed.

It creates a unique collaboration that connects post secondary students attending institutions in the Susquehanna heartland region with local communities and environmental organizations.

Members present their findings at the Susquehanna River Symposium and other public events throughout the year.



www.srhces.org

PENNSYLVANIA WATER RESOURCES RESEARCH CENTER

The **Pennsylvania Water Resources Research Center (PAWRRC)**, founded in 1964, is authorized by Congress as one of the nation's 54 water resources research centers and institutes comprising the National Institutes of Water Resources. The program is administered by the U.S. Department of the Interior through the U.S. Geological Survey, in a unique Federal-State-University partnership. The institutes emphasize the role of University research, education, and outreach in advancing problems related to water quality and quantity. The PAWRRC is located at Penn State University, the primary land-grant University within Pennsylvania. At Penn State, PAWRRC is resides within and is administered by the Institutes of Energy and the Environment (IEE), organized under the Office of the Vice President for Research.

The Pennsylvania Water Resources Research Center cooperates with the National institutes of Water Resources, the U.S. Geological Survey, and Penn State Institutes of Energy and the Environment to support, coordinate and facilitate research through several programs:

Annual State Base Grants via USGS 104b. The PA-WRRC receives USGS 104B federal base funding from the USGS 104B program that is distributed via a small grants competition to researchers at academic institutions across Pennsylvania. Each federal dollar received through the program is matched with two non-federal dollars, and federal funds are not to used to pay indirect costs. PAWRRC uses the base grants to facilitate research on water resources issues, to help train new scientists, disseminate research results, and to cooperate with other colleges and universities and with other NIWR institutes to promote regional coordination. The FY 2019 USGS draft 104b and final 104b request for proposals describe the nationwide program and the role of PAWRRC. For applications from colleges and Universities in Pennsylvania, see the PA-WRRC 104b request for proposals.

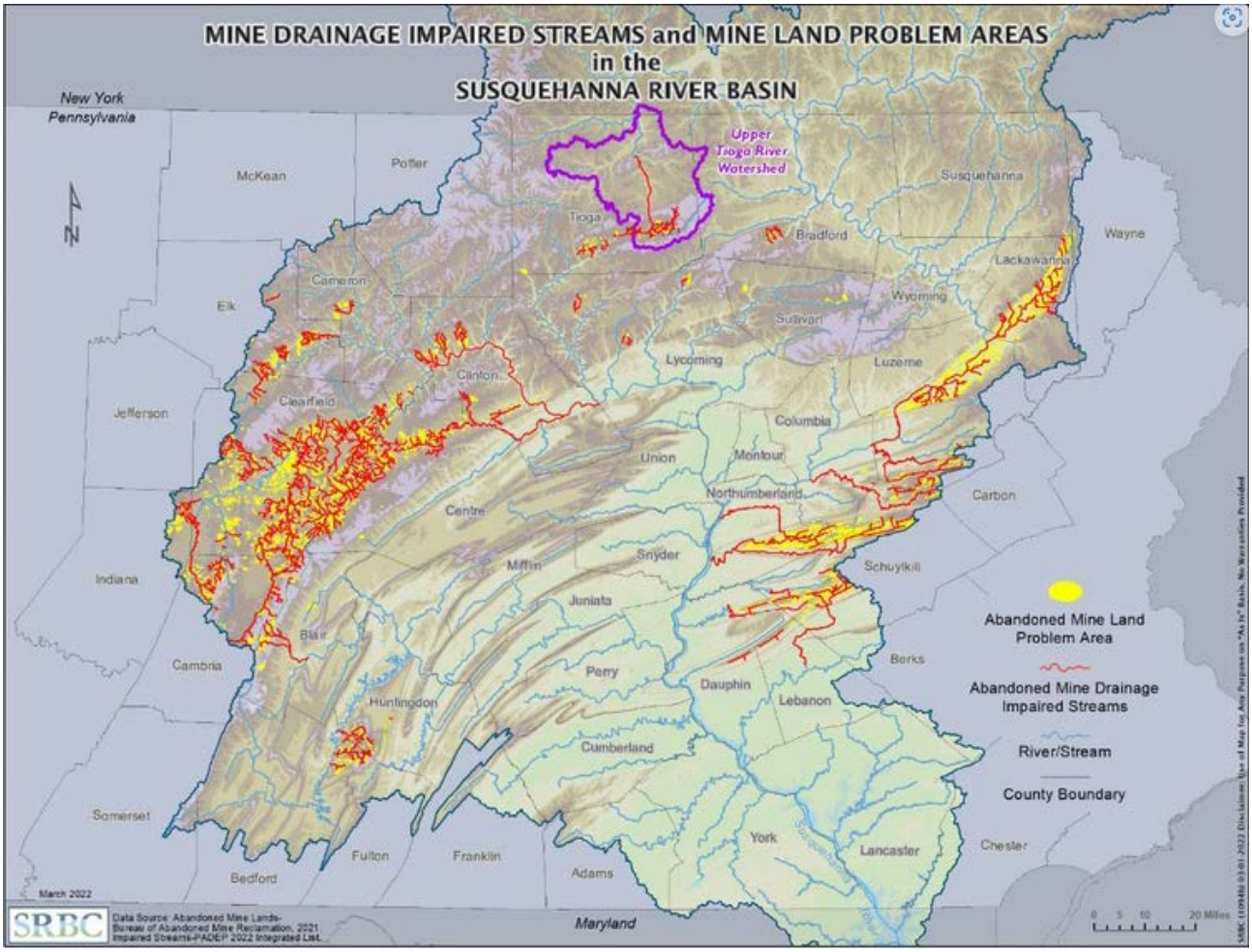
Annual National Competitive Grants via USGS 104g. The U.S. Geological Survey in cooperation with the National Institutes for Water Resources supports an annual call for proposals to focus on water problems and issues that are of a regional or interstate nature or relate to a specific program priority identified by the Secretary of the Interior and the Institutes. The goals are to promote collaboration between the USGS and university scientists in research on significant national and regional water resources issues, promote the dissemination and results of the research funded under this program, and to assist in the training of scientists in water resources. See the FY 2019 104g request for proposals.

The PWRRC is a proud sponsor of this year's River Symposium.

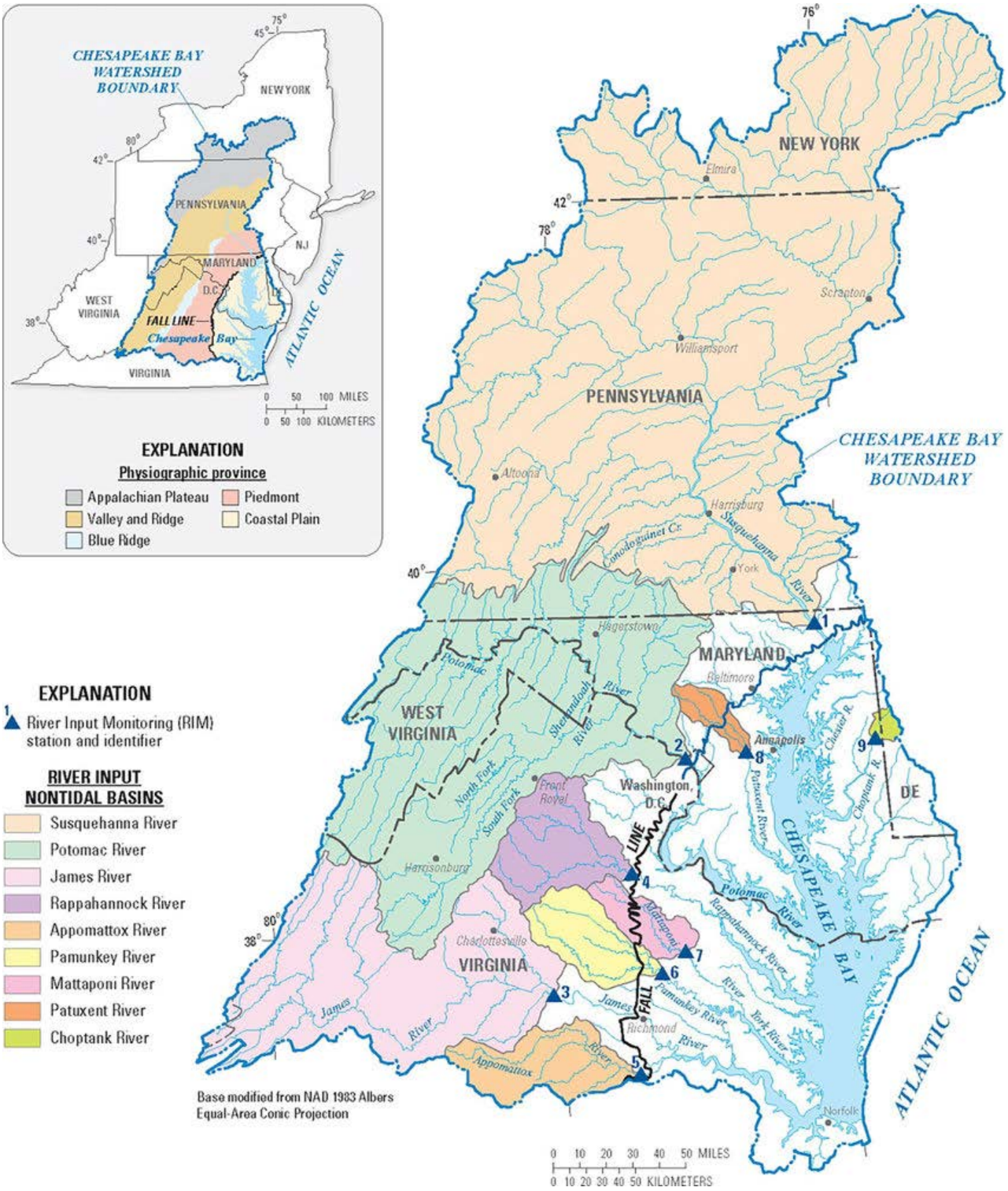
PENNSYLVANIA WATER RESOURCES RESEARCH CENTER

Abandoned Mine Discharge (AMD)

- Abandoned mine drainage is the second highest cause of water pollution in Pennsylvania.
- AMD discharges can be acidic or alkaline. Both types of discharges can cause minerals in the rock to dissolve into the water.
- Acid mine drainage can be 10,000 times more acidic than neutral water. and is toxic to aquatic life
- Common ways to treat acid mine drainage include:
  1. **Active treatment**, such as treatment plants that add lime or other neutralizing material to reduce the acidity, causing the metals to settle out of the water (precipitate) before reaching the stream.
  2. **Passive treatment,** such as wetlands that help sequester contaminated materials and promote microbial action, which can also help treat mine drainage by precipitating metals.



The Chesapeake Bay Watershed



From: Zhang, Qian & Blomquist, Joel. (2018). Watershed export of fine sediment, organic carbon, and chlorophyll-a to Chesapeake Bay: Spatial and temporal patterns in 1984-2016. *Science of The Total Environment*. 619-620. 1066-1078. 10.1016/j.scitotenv.2017.10.279. [Used with permission]

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19th River Symposium

ABANDONED MINE DISCHARGE

THE SUSQUEHANNA RIVER, AND THE CHESAPEAKE BAY

November 8-9, 2024

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