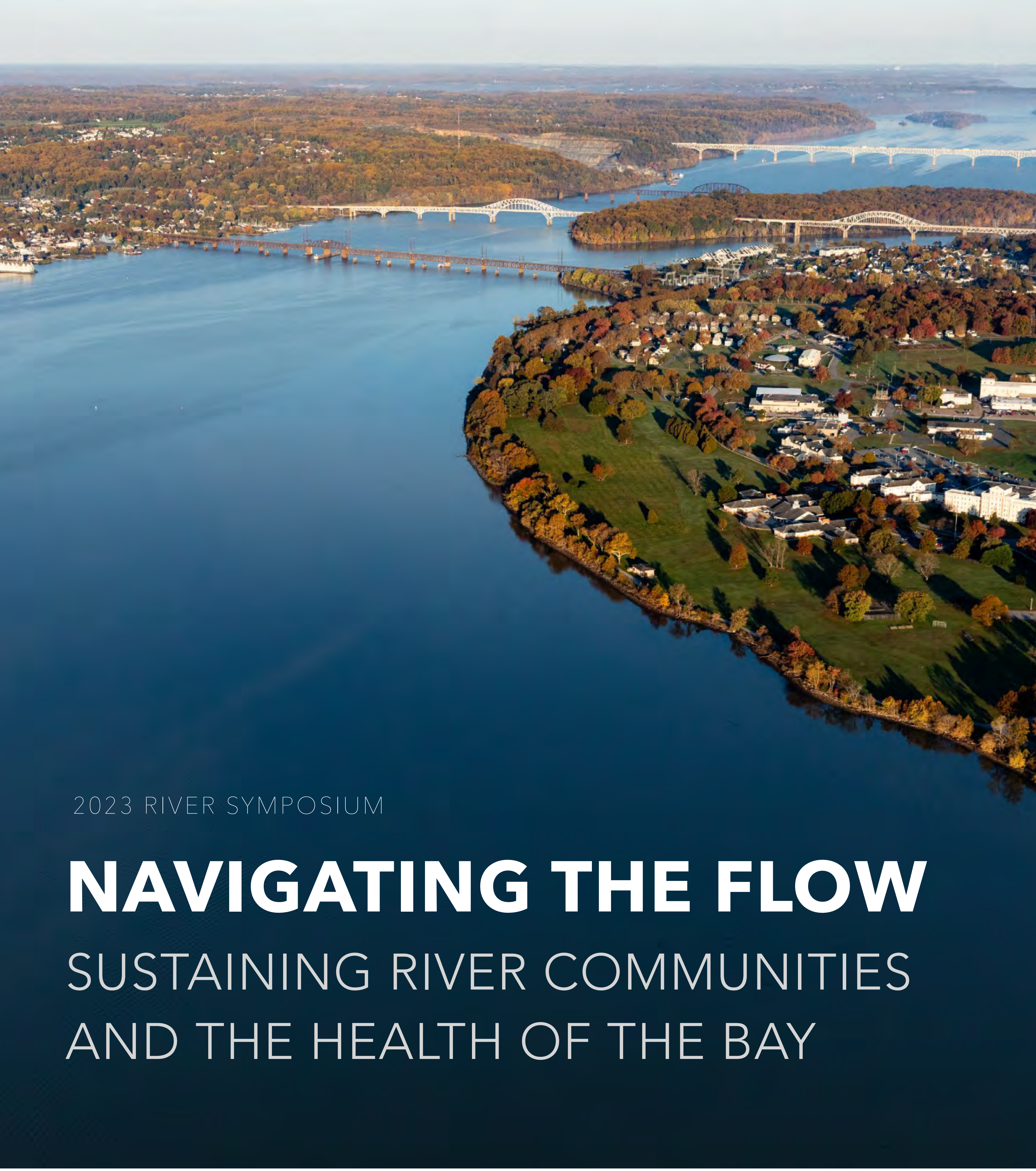

2023 RIVER SYMPOSIUM

NAVIGATING THE FLOW

SUSTAINING RIVER COMMUNITIES AND THE HEALTH OF THE BAY

November 3 & 4, 2023
Bucknell University

Program with Abstracts

www.riversymposium.scholar.bucknell.edu

2023 RIVER SYMPOSIUM

COMMITTEE

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Director, Watershed Sciences and Engineering Program
Bucknell Center for Sustainability and the Environment

Sean Reese
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Bucknell Center for Sustainability and the Environment

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Sid Jamieson
Bucknell Lacrosse Coach (Emeritus)
Cayuga Nation, Haudenosaunee Confederacy

Andrew Warner
Executive Director
Pennsylvania Water Resources Research Center at Penn State University

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

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.

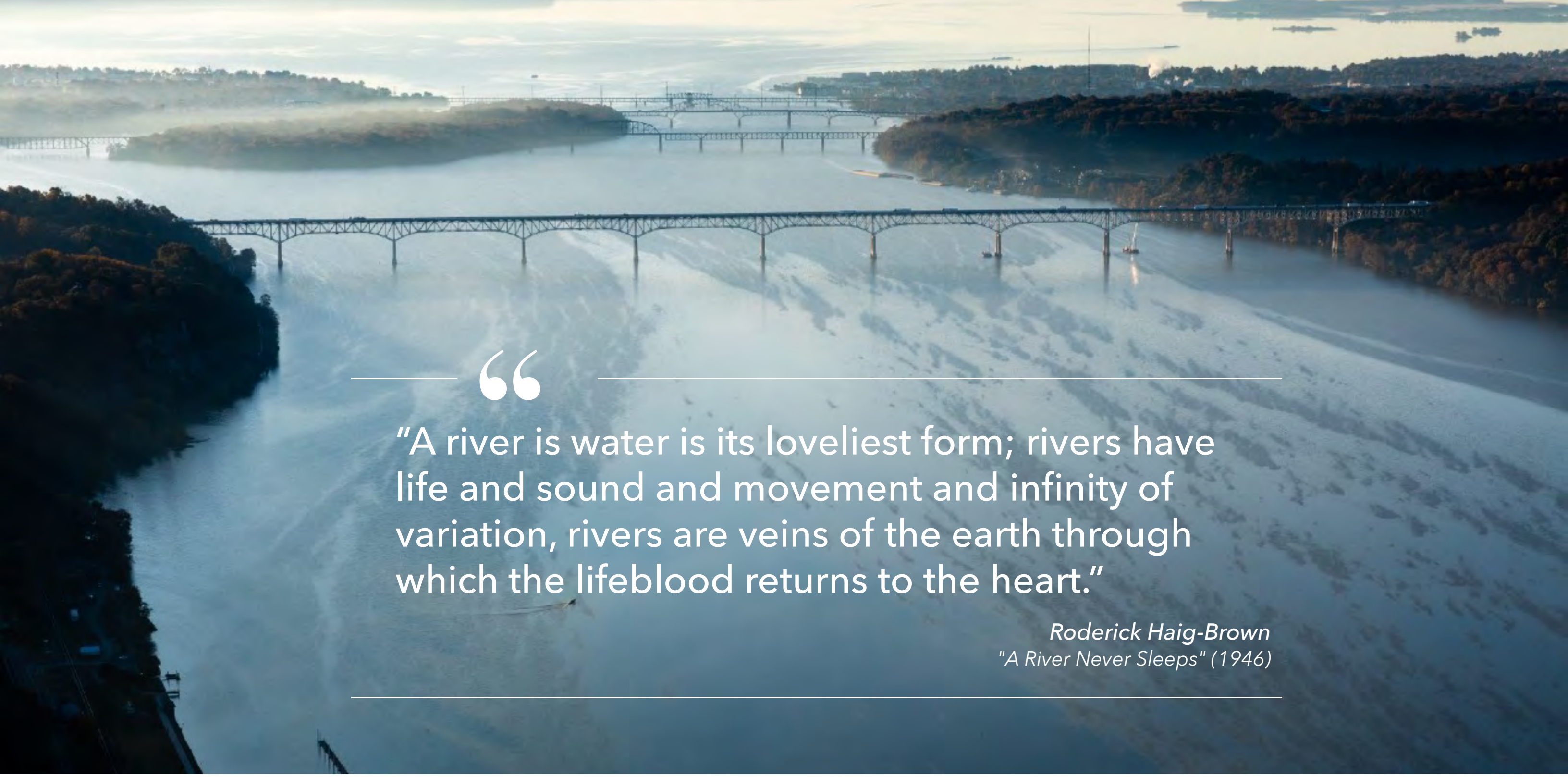
It features keynote and plenary addresses, exhibits, and oral and poster presentations from 151 students, faculty, consultants, agencies, and watershed groups.

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

CONTENTS



FORWARD

NAVIGATING THE FLOW

River flows connect people, places, and other forms of life, inspiring and sustaining diverse cultural beliefs and values. This symposium addresses the need to protect the Susquehanna River and the Chesapeake Bay region as life corridors in a changing climate.

Presentations and breakout discussions will explore a number of socio-ecological topics, including people's spiritual and recreational connections to rivers, water quality and social justice issues, terrestrial and aquatic ecosystems, conservation and restoration principles, and how science can better inform management priorities.

FRIDAY, NOV. 3

INDIGENOUS PERSPECTIVE. On Friday, from 7:10 to 7:30 p.m. in the Forum (Rm. 272), **Oren Lyons**, Chief and Faithkeeper of the Onondaga and Seneca Nations, Haudenosaunee Confederacy, will open the symposium with remarks entitled *"A Faithkeeper's Perspective on the Word "Sustainability."*

KEYNOTE SPEAKER. From 7:30 to 8:00 p.m. in the Forum (Rm. 272), **Denice Heller Wardrop**, Research Professor at Penn State University and Executive Director of the Chesapeake Research Consortium will deliver the keynote address *"Navigating the Complex Waters and Future of 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 18 universities and organizations will present their work. Abstracts for poster presentation are on pages 31-77.

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. 4

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), four half-hour plenary addresses will prompt discussions in the breakout sessions that follow:

- **Oren Lyons**, Chief and Faithkeeper of the Onondaga and Seneca Nations, Haudenosaunee Confederacy, will deliver a plenary address entitled *"What the Ancient Stories Teach Us."*
- **Vanessa Vargas-Nguyen**, Science Integrator for the University of Maryland Center for Environmental Science will deliver a plenary address entitled *"Charting the Course to a Healthy Chesapeake Bay: What Does Our Map Tell Us?"*
- **John Clune**, Research Hydrologist with the U.S. Geological Survey, will deliver a plenary address entitled *"Science to Inform Management Priorities"*
- **Harry Campbell**, Director of Science Policy and Advocacy for the Pennsylvania Office of the Chesapeake Bay Foundation, will deliver a plenary address entitled *"Guardians of the Watershed: Helping Improve the Susquehanna and Chesapeake Bay Ecosystems"*

LUNCH. Lunch will be served from 12:00 to 1:00 p.m. in Walls Lounge (Room 213).

BREAKOUT DISCUSSIONS. Following the plenary addresses, breakout discussions will be held in The Forum (Rm. 272) and the Terrace Room (Rm. 276). Facilitators and note takers will help moderate and synthesize the discussions with the goal of sharing their outcomes to the Scientific and Technical Advisory Committee of the Chesapeake Bay Program.

ORAL PRESENTATIONS. Saturday features 15 oral presentations in five sessions:

- River Ecosystems
- Watershed Hydrology
- Connectivity and Restoration
- Aquatic Habitat and Ecology
- Stream Restoration and Community Engagement

A schedule of oral presentations is provided on pages 7-9. Abstracts for oral presentations are on pages 17 - 30.

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. Andrew Warner, Director.

Special thanks are due the symposium committee: Sean Reese, Janeen Putman, Krista Smith, Matthew Higgins, Jeff Campbell, Jesse Greenawalt, George Lincoln, Sid Jamieson, H. W. "Skip" Weider, and Andrew Warner.

Best wishes for a great symposium!

Sincerely,

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

18TH ANNUAL RIVER SYMPOSIUM

SCHEDULE

FRIDAY, NOVEMBER 3, 2023

THE FORUM (RM. 272)

Zoom link: https://bucknell.zoom.us/j/93315530106?pwd=ZzJpUGg5ZUFJUkZVa3lnaGQxNzhUZz09

7:00 - 7:05 p.m.

Welcome

Andrew Warner
Executive Director
Pennsylvania Water Resources Research Center

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

A Faithkeeper's Perspectives on the Word "Sustainability"

Oren Lyons
Chief and Faithkeeper
Onondaga and Seneca Nations
Haudenosaunee Confederacy

7:30 - 8:00 p.m.

Keynote Address

"Navigating the Complex Waters and Future of the Chesapeake Bay"

Denise Heller Wardrop
Executive Director
Chesapeake Research Consortium

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 from 9 to 10 pm. Student poster awards will be given at 9:45 pm.

**Abstracts for poster presentations are on pages 31-77*

SATURDAY, NOVEMBER 4, 2023

All oral presentations will be held both in-person and virtually via Zoom.
Visit the symposium website for links to individual talks and other details.

8:00 - 8:50 a.m. - Terrace Room (Room 276), Elaine Langone Center

Self-Guided Tour of Posters and Exhibits

8:50 - 9:00 a.m. - The Forum (Room 272), Elaine Langone Center

Welcome and Opening Remarks

Benjamin Hayes

Symposium Chair

Plenary Presentations

Zoom link: https://bucknell.zoom.us/j/93315530106?pwd=ZzJpUGg5ZUFJUkZVa3lnaGQxNzhUZz09

9:00 - 9:30 a.m. - The Forum (Room 272), Elaine Langone Center

What the Ancient Stories Teach Us

Oren Lyons

Chief and Faithkeeper, Onondaga and Seneca Nations, Haudenosaunee Confederacy

9:30 - 10:00 a.m.

Charting the Course to a Healthy Chesapeake Bay: What Does Our Map Tell Us?

Vanessa Vargas-Nguyen

Science Integrator with the Integration and Application Network
University of Maryland Center for Environmental Science

10:00 - 10:11 a.m.

Breakout Discussions

Ancient Stories

The Forum (Room 272)

Zoom link: https://bucknell.zoom.us/j/94228976397?pwd=anVyb1YvNTNtWHIvNkNzYWRrKzREQT09

Charting a Course to a Healthy Chesapeake Bay

The Terrace Room (Room 276)

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

Oral Presentations

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

Session 1 **River Ecosystems** (The Forum, Room 272)

Zoom link: https://bucknell.zoom.us/j/94228976397?pwd=anVyb1YvNTNtWHIvNkNzYWRrKzREQT09

Session 2 **Watershed Hydrology** (Room 241, A and B)

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

Session 3 **Connectivity and Restoration** (Room 241, C and D)

Zoom link: https://bucknell.zoom.us/j/98473027947?pwd=MkpzSEFOOE93THFMVGwyK2RXUjVyZz09

Lunch

12:00 - 1:00 p.m. - Walls Lounge (Room 213)

Plenary Presentations

Zoom link: https://bucknell.zoom.us/j/93315530106?pwd=ZzJpUGg5ZUFJUkZVa3lnaGQxNzhUZz09

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

Science to Inform Management Priorities

John Clune

Research Hydrologist, U.S. Geological Survey

1:30 - 2:00 p.m.

Guardians of the Watershed: Helping Improve the Susquehanna and Chesapeake Bay

Harry Campbell

Director of Science Policy and Advocacy, Pennsylvania Office of the Chesapeake Bay Foundation

2:00 - 3:00 p.m.

Breakout Discussion

Science, Management, and Conservation

The Forum (Room 272)

Zoom link: https://bucknell.zoom.us/j/94228976397?pwd=anVyb1YvNTNtWHIvNkNzYWRrKzREQT09

Oral Presentations

3:00 p.m. - 4:00 p.m.

Session 4

Aquatic Habitat and Ecology

(The Forum, Room 272)

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

Session 5

Stream Restoration and Community Engagement

(Room 241, A and B)

Zoom link: https://bucknell.zoom.us/j/98473027947?pwd=MkpzSEFOOE93THFMVGwyK2RXUjVyZz09

Wrap-Up

3:00 p.m. - 4:00 p.m.

Reflection and Looking Ahead

4:00 - 4:15 p.m.

Discuss the symposium outcomes and ideas for next year's event.

Awards for Best Student Oral Presentations

4:15 - 4:30 p.m.

Closing

4:30 p.m.

2023 RIVER SYMPOSIUM

ORAL SESSION SCHEDULE

Session 1

River Ecosystems

The Forum (Room 272), Saturday, November 4, 11:00 a.m. - 12:00 p.m.

Zoom link: https://bucknell.zoom.us/j/94228976397?pwd=anVyb1YvNTNtWHIvNkNzYWRrKzREQT09

11:00 a.m. **Spatial distribution of benthic diatom communities of Budelkhand rivers with reference to the proposed Ken-Betwa link**
Jyoti Verma*

11:15 a.m. **Initial response of floodplain re-connection and wood addition to the fish community in the Little Arnot Run watershed, Allegheny National Forest**
Lydia Delp, Steve Seiler* and Heather Bechtold

11:30 a.m. **Combining assessments of periphyton community structure and function to detect subtle anthropogenic impacts to headwater streams in the Upper Delaware River Basin**
Steven Rier*, Braedon Gonzales, Hanna Martin, Mariena Hurley, Tanya Dapkey, and Stefanie Kroll.

11:45 a.m. **Panel Discussion/Q & A**

Abstracts for oral presentations are provided on pages 17 - 30.
** denotes presenting author.*

Session 2

Watershed Hydrology

Room 241 A/B, Saturday, November 4, 11:00 a.m. - 12:00 p.m.

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

11:00 a.m. **Critical zone processes shaping stream water temperature in a karstic watershed**
Alexandra Orr*, Elizabeth Boyer, Jonathan Duncan, and Tyler Groh

11:15 a.m. **Levee impact on Susquehanna River Basin flood risks**
Rashid Ansari*, Alfonso Mejia,,and Raj Cibin

11:30 a.m. **Legacy soil compaction and its impacts on stormwater modeling and predictions of flooding**
Shirley Clark*, Zorana E. Mijic, Benjamin E. Iskander, Michael E. Aches, and Jonathan E. Fischer, and Bryan E. Bennett.

11:45 a.m. **Panel Discussion/Q & A**

Session 3

Connectivity and Restoration

Room 241 C/D, Saturday, November 4, 11:00 a.m. - 12:00 p.m.

Zoom link: https://bucknell.zoom.us/j/98473027947?pwd=MkpzSEFOOE93THFMVGwyK2RXUjVyZz09

11:00 a.m. **Reconnecting the Susquehanna River for ecological lift, recreational access and community revitalization**
Lisa Hollingsworth-Segedy*

11:15 a.m. **Pre and post restoration changes in dissolved organic carbon concentration and quality in the groundwater wells of Little Arnot Run, Allegheny National Forest**
Chris Dempsey* and Dylan Schmitzerle

11:30 a.m. **Introduction to guiding principles of aquatic resource restoration**
Dave Goerman*

11:45 a.m. **Panel Discussion/Q & A**

Abstracts for oral presentations are provided on pages 17 - 30.

** denotes presenting author.*

Session 4

Aquatic Habitat and Ecology

Room 241 A/B, Saturday, November 4, 3:00 p.m. - 4:00 p.m.

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

3:00 p.m. **Post-release monitoring of head-started Eastern Hellbender salamanders: A tale of two cohorts**
Part 1: Growth, body condition and survivorship
Michelle Herman* and Peter J. Petokas

3:15 p.m. **Post-release monitoring of head-started Eastern Hellbender salamanders: A tale of two cohorts**
Part 2: Habitat selection, movements, and activity patterns
Peter J. Petokas* and Michelle Herman

3:30 p.m. **Rock Run, an eminent trout stream**
Harvey Katz*

3:45 p.m. **Panel Discussion/Q & A**

Session 5

Stream Restoration and Community Engagement

Room 241 C/D, Saturday, November 4, 3:00 p.m. - 4:00 p.m.

Zoom link: https://bucknell.zoom.us/j/98473027947?pwd=MkpzSEFOOE93THFMVGwyK2RXUjVyZz09

3:00 p.m. **Harnessing nature's engineers: installation of beaver dam analogs for restoration in a flashy, erosive, ephemeral stream**
Siobhan Fathel*, Matthew J. Wilson, and Daniel Ressler

3:15 p.m. **Addressing the health of the Chesapeake Bay by engaging river communities through streamside planting maintenance**
Maggie Ritchey* and Shannon Thomas

3:30 p.m. **Creation of the new Vernal School Partnership and other updates from the Middle Susquehanna River Keeper**
John Zaktanski*

3:45 p.m. **Panel Discussion/Q & A**

Abstracts for oral presentations are provided on pages 17 - 30.

** denotes presenting author.*

INVITED SPEAKERS

Denice Heller Wardrop

Executive Director
Chesapeake Research Consortium

Denice is one of our nation's leading experts at bringing together diverse groups of people to find management alternatives that will improve the health of large, complex ecosystems such as the Everglades and the Chesapeake Bay. A renowned scientist and engineer specializing in wetlands ecology and hydrology, she current serves as Research Professor of Geography at the Pennsylvania State University and is the Executive Director of the Chesapeake Research Consortium, an association of seven research and education institutions in the Chesapeake Bay watershed.

She began her professional life with a B.S. in Systems Engineering from the University of Virginia. She was subsequently attracted to all things water, received a M.S. in Environmental Sciences, and was a practicing consulting engineer for over 10 years. She moved to State College with her husband Rick, a practicing hydrogeologist, and completed a PhD in Ecology. She joined the Penn State faculty and assisted Dr. Robert Brooks in providing leadership to Riparia, a major wetlands research institute in the mid-Atlantic region, and then served as Founding Director of Penn State's Sustainability Institute. She is delighted to now lead the CRC, along with its partners, in bringing the best possible science to the Chesapeake Bay partnership and in developing future environmental leaders.

Denice tries to spend as much time as possible in the wettest portions of the world, assessing the impacts of human activity on the functioning of aquatic systems, primarily freshwater wetlands and streams. She is endlessly fascinated by the behavior of ecosystems, their response to stress, and ways to articulate their functioning and role in human well-being. In her free time, she enjoys hiking in all of the forests and marshes of the watershed and paddling the waters of the Chesapeake near her home in Annapolis, Maryland.

Dr. Heller-Wardrop will deliver the keynote address entitled ***"Navigating the Complex Waters and Future of the Chesapeake Bay"*** from 7:30 to 8:00 p.m. on Friday, Nov. 3 in The Forum (Room 272), Elaine Langone Center.

Oren Lyons

Chief and Faithkeeper
Onondaga and Seneca Nations, Haudenosaunee Confederacy

Oren Lyons Chief and Faithkeeper of the Onondaga and Seneca Nations, Haudenosaunee Confederacy. For more than 14 years he has been a member of the Indigenous Peoples of the Human Rights Commission of the United Nations, and has served in many other leadership roles.

A highly recognized college lacrosse player at Syracuse University during his undergraduate years, Lyons later became increasingly active as an advocate for the rights of Indigenous peoples. He is the founder of the Haudenosaunee lacrosse team.

Lyons has been awarded an honorary Doctor of Law degree from Syracuse University and was a professor of American Studies at the University of Buffalo.   Lyons serves on the board of the Harvard Project on American Indian Economic Development and is board chairman of Honoring Contributions in the Governance of American Indian Nations.

He has received the Ellis Island Medal of Honor, the National Audubon Society's Audubon Medal, the Earth Day International Award of the United Nations, and the Elder and Wiser Award of the Rosa Parks Institute for Human Rights.   In 2022, he received a Lifetime Achievement Award at the Indian Gaming Association's Tradeshow and Convention.

Chief Lyons will deliver opening comments entitled ***"A Faithkeeper's Perspective the Word "Sustainability""*** from 7:10 to 7:30 p.m. on Friday, November 3 in The Forum (Room 272), Elaine Langone Center.   He will also delivery a plenary address entitled ***"What the Ancient Stories Teach Us"*** at 9:00 to 9:30 a.m. on Saturday, Nov. 4 in The Forum (Room 272), Elaine Langone Center.

Vanessa Vargas-Nguyen

Science Integrator
University of Maryland Center for Environmental Science

Dr. Vanessa Vargas-Nguyen is a Science Integrator with the Integration and Application Network and an associate faculty of the Marine Estuarine and Environmental Science Graduate Program. Her current interest is in transdisciplinary approaches, socio-environmental assessments, socio-environmental justice, stakeholder engagement, and adaptive environmental governance.

Vanessa is originally from the Philippines and has extensive experience in molecular biology and marine science, specializing in microbial communities and molecular processes associated with Harmful Algal Blooms and shrimp, corals, and human diseases.

She has since shifted her focus on how science can benefit society and was conferred with the first Ph.D. under the new Environment and Society foundation of the MEES graduate program. Her dissertation used ethnographic approaches to investigate the role of socio-environmental report cards in transdisciplinary collaboration and adaptive governance for a sustainable future. She received academic training from the University of the Philippines (BSc; MSc) and the University of Maryland (MSc; PhD). She is involved in developing holistic socio-environmental assessments for complex systems such as the Mississippi River and Chesapeake Bay watersheds and is coordinating a multi-year international transdisciplinary research consortium involving the US, Norway, Philippines, Japan, and India.

Dr. Vargas-Nguyen will deliver a plenary address entitled *"Charting the Course to a Healthy Chesapeake Bay: What Does Our Map Tell Us?"* from 9:30 to 10:00 a.m. on Saturday, Nov. 4 in The Forum (Room 272), Elaine Langone Center.

John Clune

Research Hydrologist
U.S. Geological Survey

John Clune is a Research Hydrologist who has worked with USGS since 2007. His research focuses primarily on understanding the environmental drivers and responses of nutrients and sediment in streams with an emphasis on the effectiveness of conservation practices, and the geochemistry of groundwater focusing on the quality of drinking water for the protection of public health.

John co-leads the USGS SIMPLE and FACTORs team that provides science support to address priority stakeholder questions and foster collaborative research to better explains trends in water quality in the Chesapeake Bay watershed.

Before USGS, John has also worked for the National Park Service (Grand Teton), US Army Corps of Engineers, University of Pittsburgh, Queens University Belfast, UTC Pratt and Whitney, and Lackawanna Conservation District. He received his Ph.D. Forest Resources in 2021 from Penn State University and B.S. Civil Engineering in 2000 from the University of Pittsburgh.

Dr. Clune will deliver a plenary address entitled *"Science to Inform Management Principles"* at 1:00 to 1:30 p.m. on Saturday, Nov. 4 in The Forum (Room 272), Elaine Langone Center.

Harry Campbell

Director of Science Policy and Advocacy
Pennsylvania Office of the Chesapeake Bay Foundation (CBF)

H.L. (Harry) Campbell is the Director of Science Policy &; Advocacy in the Pennsylvania office of the Chesapeake Bay Foundation (CBF). He has nearly thirty years of experience in watershed assessment, restoration and protection science, policy, and advocacy in academic, governmental, private, and nonprofit sectors. Prior to being named to his current position, he spent nearly eight years as the Executive Director of CBF's Pennsylvania office.

A recognized innovator, he fostered efforts to successfully designate the eastern hellbender the Pennsylvania state amphibian, create of the Keystone Tree Fund, conceive the Keystone 10 Million Trees Partnership/Ten Million Tress for PA, and devise the successful the first statewide, state-based conservation cost-share program in Pennsylvania, the Agricultural Conservation Assistance Program.

He launched CBF's initiative to transform watershed planning in the state, an effort which was recently awarded over $3 million implementation funds in the 2022 federal omnibus budget. He is a frequent guest lecturer, panelist, and interviewee in traditional and nontraditional media. Harry holds a bachelor's degree in environmental resource management and a master's in environmental pollution control from The Pennsylvania State University. He grew up in northern Luzerne County where he spent countless hours fishing and wandering forest and fields. Currently, he resides in the Harrisburg area with his spouse, two teenagers, and an innumerable number of transient sentient beings.

Mr. Campbell will deliver a plenary address entitled *"Guardians of the Watershed: Helping Improve the Susquehanna and Chesapeake Bay"* at 1:30 to 2:00 p.m. on Saturday, Nov. 4 in The Forum (Room 272), Elaine Langone Center.

EXHIBITORS & SPONSORS

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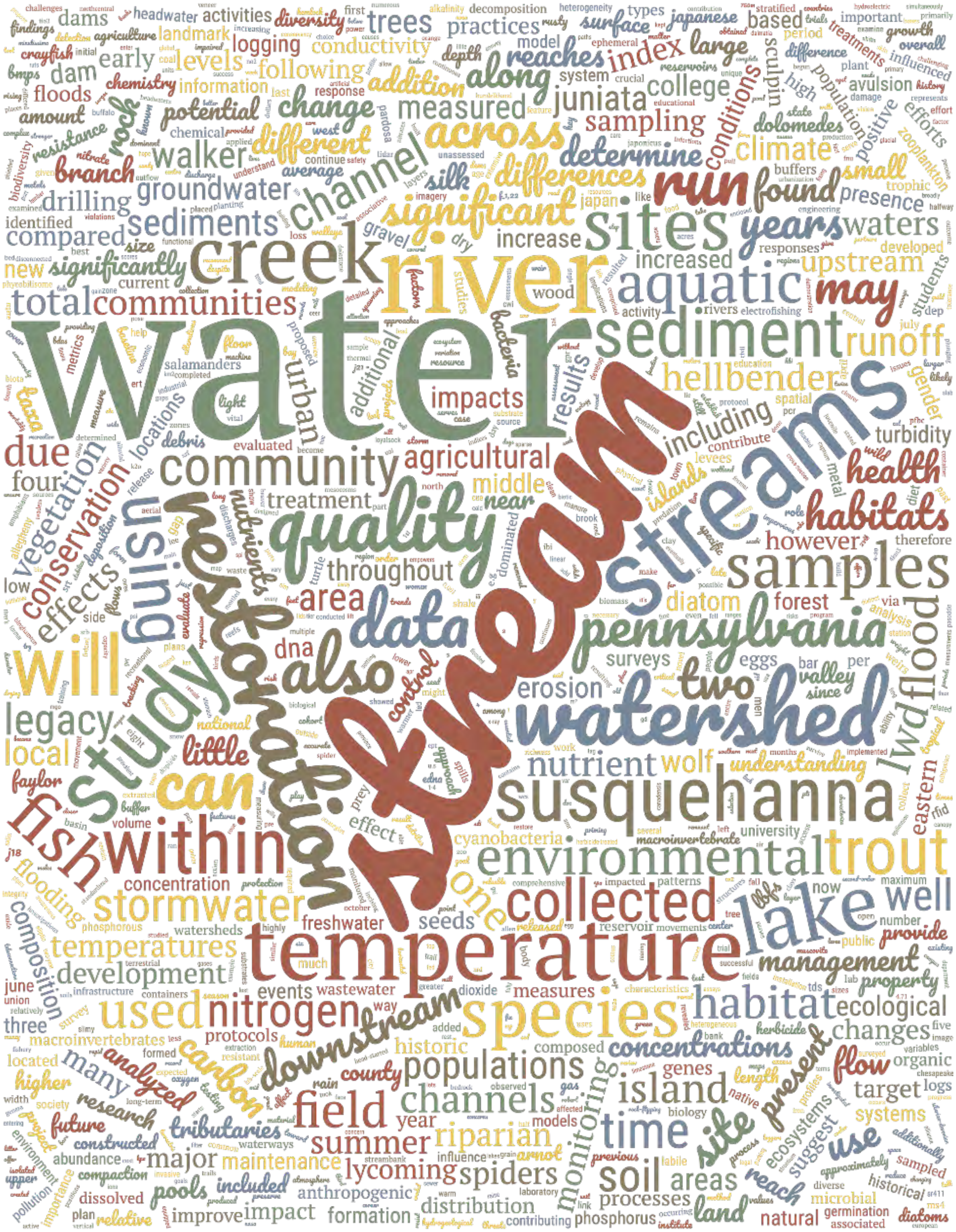


A “word cloud” visualization of the oral and poster abstracts contributed to this symposium (pages 17-78). Their relative size denotes greater prominence to the words that appear most frequently.
A total of 17, 538 words were analyzed.

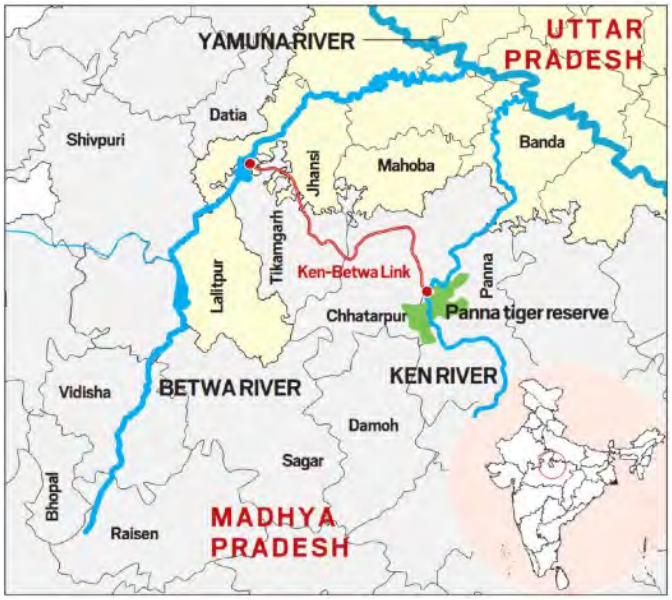
ORAL PRESENTATIONS

SPATIAL DISTRIBUTION OF BENTHIC DIATOM COMMUNITIES OF BUNDELKHAND RIVERS WITH REFERENCE TO THE PROPOSED KEN-BETWA LINK

Verma, Jyoti, University of Allahabad, Prayagraj, Senate House, University Road, Old Katra, Prayagraj, Uttar Pradesh 211002, India, diatombuster@gmail.com.

Freshwater habitats are relatively discontinuous, and species do not disperse easily across the land barriers that separate river drainages into discrete units. In tropical developing countries like India, species extinction, and genetic loss may become severe in the future due to loss of habitat, blockage of waterways, interbasin transfers, and water withdrawal from rivers have negative as well as positive impacts on freshwater ecosystem. The rivers Chambal, Betwa, and Ken, etc. form the lifeline of the Bundelkhand region. Ambitious plans are afoot to link these rivers. Execution of the Ken-Betwa link has already begun.

A preliminary pre-linkage survey was done with respect to diatom communities in these two Rivers. Only 39% of the flora was common to these locations, while many species were specific to both the Ken and the Betwa. *A. m. var gracillima, G. parvulum, P. lanceolatum* were dominant diatom taxa in river Ken while *N. virudula, A. minutissima v. minutissima, C. exicisa, C. turgidula M. granulata* diatom taxa in river Betwa. All these points towards the diverse nature of these Vindhayan rivers and linkages could destroy the biodiversity paving the way for bio invasion, which is common in disturbed habitats as waters will be regulated as per the needs of the populace.



Diatom , Ken-Betwa Link , Bundelkhand, India

INITIAL RESPONSE OF FLOODPLAIN RE-CONNECTION AND WOOD ADDITION TO THE FISH COMMUNITY IN THE LITTLE ARNOT RUN WATERSHED, ALLEGHENY NATIONAL FOREST.

Delp, Lydia, Commonwealth University of Pennsylvania - Lock Haven, 401 N Fairview St, Lock Haven, PA 17745, lgd7371@lockhaven.edu, **Seiler**, Steve, Commonwealth University of Pennsylvania - Lock Haven, 401 N Fairview St, Lock Haven, PA 17745, sseiler@commonwealthu.edu, **Bechtold**, Heather, Commonwealth University of Pennsylvania - Lock Haven, 401 N Fairview St, Lock Haven, PA 17745, hab206@commonwealthu.edu.

The Allegheny National Forest occupies over 500,000 square miles in northwestern PA and has been extensively influenced by human activity including timber harvest, resource extraction, and other impacts. Road building activities to support resource extraction has often left streams that are constrained by berms and disconnected from their floodplain (channelized). Historic timber practices in some watersheds have left even-aged trees along the riparian corridor that have not contributed wood to the stream channel and toward instream fish habitat. Since 2019, multiple partners from Federal and State Agencies have been cooperating to reconnect the channelized portion of Little Arnot Run to its floodplain and to increase the amount of wood in the stream channel by careful 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 four years spanning pre-restoration efforts (= 2 years pre-restoration and 2 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 find strong 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 may be trending upward when compared to reference sites in Cherry Run. Continued monitoring is planned to verify any longer-term influences of this restoration work on the fish community.

watershed restoration, fish community, wood addition

COMBINING ASSESSMENTS OF PERIPHYTON COMMUNITY STRUCTURE AND FUNCTION TO DETECT SUBTLE ANTHROPOGENIC IMPACTS TO HEADWATER STREAMS IN THE UPPER DELAWARE BASIN

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Headwater streams are vital to the health and resiliency of entire watersheds. Despite their collective importance to watershed health, headwater streams are vulnerable to degradation due to their small size and lack of adequate legal protections. Therefore, understanding how human activities impair both the structure and function of these vulnerable ecosystems is essential. We combined structural and functional measures of stream periphyton (microbial growth on surfaces) in 50 headwater streams throughout the upper Delaware River Basin to determine which measures were most helpful in detecting subtle anthropogenic impacts. Structural characteristics included algal biomass, microbial N:P, diatom species composition and diversity, and the relative abundance of diatom ecological guilds. Functional measures included photosynthetic potential, measured by pulse amplitude modulated fluorimetry, and the activities of seven microbial extracellular enzymes.

Environmental variables that strongly influenced both structural and functional measures were local light availability, total phosphorus, and temperature. Dissolved organic matter quantity and composition also influenced patterns in extracellular enzymes. Diatom community metrics, based on ecological traits, generally outperformed metrics based on species composition alone. Overall, combining structural and functional measures of stream periphyton gave a more complete picture of ecological conditions within each stream and how human activities have influenced the health of these systems.

algae , periphyton , function , assessment

CRITICAL ZONE PROCESSES SHAPING STREAM WATER TEMPERATURE IN A KARSTIC WATERSHED

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Water temperature is an important physical property of stream and river networks, influencing in-stream biochemical processes, water quality, and aquatic life. The critical zone is the earth's outer skin from bedrock to treetop. Critical zone processes in the atmosphere, lithosphere, and hydrosphere all influence a stream's thermal regime, and anthropogenic effects such as changes in land-use or natural flow patterns, can greatly impact stream temperature and ecosystem processes.

The Spring Creek Watershed in Centre County, Pennsylvania is a karstic, mixed land use watershed that has undergone steady development over the last century. We analyzed 20 years of stream temperature and flow data to examine natural and anthropogenic factors contributing to the variability in stream temperature in sub-basins of varying geology and land use.

Results suggest that streams with less groundwater contribution and higher levels of impervious cover exhibit the highest average and maximum summer temperatures respectively. Further, impervious cover can cause thermal surges following summer storm events that can increase stream temperatures rapidly to temperatures unsuitable for certain aquatic species. Quantifying stream reaches that may experience temperatures outside critical ecological habitat ranges can help to prioritize planning for streambank restoration, stormwater management and other innovative strategies.

temperature, karst geology

LEVEE IMPACT ON SUSQUEHANNA RIVER BASIN FLOOD RISKS

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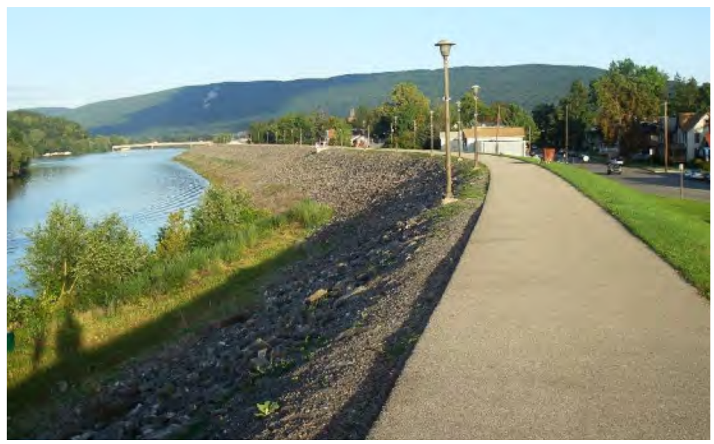
Levees play a pivotal role in safeguarding countless lives and assets across the U.S. Yet, national evaluations by the American Society of Civil Engineers reveal alarming concerns about their state, with a staggering 80% failing to meet crucial safety criteria. The Susquehanna River Basin (SRB), encompassing over 140 levees across 180 miles, mirrors this issue. A significant portion of these levees, about 65%, do not satisfy FEMA's accreditation criteria, and many have exceeded their design life. While levees offer localized flood protection, they inadvertently transfer flood risks elsewhere within the river network. This not only shifts but can also amplify flood risks to communities both adjacent and distant from these structures, which are not fortified by levees. Such regional flood teleconnections can modify flood inundation across varying distances, potentially escalating flood threats in neighboring and remote areas.



To delve deeper into the implications of these flood teleconnections, especially in the SRB, we developed a comprehensive risk model that synergizes data analytics, hydrodynamic assessments, and economic evaluations. Drawing from information across 118 USGS sites, our model scrutinizes potential flood patterns, gauges economic consequences, and pinpoints societal vulnerabilities. Our investigations underscore that the presence of levees can augment the extent of a 100-year flood by approximately 25% of the total area shielded by levees. Disturbingly, specific locales might witness flood depths surging by up to 2 meters. These findings not only highlight the often-overlooked ramifications of levee systems but also demonstrate the expansive spatial effects, unaccounted costs, and potential impacts on vulnerable communities. Given the rising concerns related to climate change and its repercussions on flooding patterns, our insights emphasize the pressing need for a re-evaluation of current levee systems. Addressing these challenges is imperative for enhancing flood resilience and ensuring climate adaptation not just within the U.S., but globally.

Flood Infrastructure, Flood Risk, Adaptation, Equity

LEGACY SOIL COMPACTION AND ITS IMPACTS ON STORMWATER MODELING AND PREDICTIONS OF FLOODING

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Urban development compacted soil, which reduced the ability of water to infiltrate. Land development practices historically compacted the soil over the entire property, rather than restricting compaction to areas where structural support was required for buildings and roads. Estimating the amount of runoff entering stormwater pipes requires models that can adequately capture the amount of rainfall that becomes runoff, after losses such as infiltration. This research study combines field measures of compaction, long-term soil moisture sensing, and stormwater runoff modeling in a demonstration watershed to improve understanding of the impacts of a compaction layer (soil resistance > 2,000 kPa or 300 psi) on the amount of water that will infiltrate. The compaction layer delays the movement of water into the lower layers of a soil profile. The modeling highlights the impacts of limited soil infiltration. For a flooding storm (120 mm [4.71 in] in 87 minutes), increasing the depth to the compaction layer from 3 cm to 8 cm reduces the amount of time the node is flooded by 50% and the maximum flood depth from 0.61 m to 0.15 m. This research highlights the vital importance of soil compaction layers in understanding the movement of stormwater in the urban environment. It also highlights the importance of not compacting areas where structural soil strengths are not required, as well as the importance of soil restoration in reducing urban flooding in these times of climate change.

soil compaction, urban runoff, land development

RECONNECTING THE SUSQUEHANNA RIVER FOR ECOLOGICAL LIFT, RECREATIONAL ACCESS, AND COMMUNITY REVITALIZATION

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The Susquehanna River has a long history of habitat fragmentation via large dams. In addition to the ecological damage, dams are now limiting recreation access in a time when the river's use is transitioning away from industrial uses in favor of expanded recreational uses. With the designation of the North Branch, West Branch, and mainstem Susquehanna River as Pennsylvania Water Trails, dams on the river are now recreational limitations as well as a public safety threats and barriers for aquatic wildlife movement. American Rivers recently completed the removal of Oakland Dam at Mile 350 of the North Branch Susquehanna River Water Trail to eliminate a severe safety hazard and to reconnect 250 miles of headwaters aquatic habitat for river resident fish, migratory fish species, and freshwater mussels. This technical session will provide a case study of the Oakland Dam removal and examine additional opportunities for reconnecting additional miles of Susquehanna River water trails and aquatic habitat for ecological and community benefits.

Dam removal, aquatic habitat connectivity, river recreation, public safety

PRE AND POST RESTORATION CHANGES IN DISSOLVED ORGANIC CARBON CONCENTRATION AND QUALITY IN THE GROUNDWATER WELLS OF LITTLE ARNOT RUN, ALLEGHENY NATIONAL FOREST

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Due to human activity, many headwater streams in Pennsylvania have become incised, resulting in a myriad of issues including stream bank erosion and increased discharge during storm events. Small streams serve as a critical link between terrestrial and downstream ecosystems in transporting organic material. In the Allegheny National Forest, the primary cause of moderate vertical incision of streams can be traced back to timber harvesting practices of the late 1800's to early 1900's that removed trees from along and within stream corridors. To improve floodplain connectivity, we implemented large woody debris strategies by placing whole trees (with canopy and rootwad) and cut logs in the stream channel and its floodplain of Little Arnot Run. One of the project goals was to increase carbon storage within the watershed. We collected water samples from September 2019 through the present from 13 groundwater wells to monitor changes in DOC concentration and DOC quality. Here, we highlight pre and post restoration changes to dissolved organic carbon concentration and quality in the monitoring wells. Restoration work in the watershed occurred between August 2021 and May 2022.

restoration , carbon , groundwater , organic matter

INTRODUCTION TO GUIDING PRINCIPLES OF AQUATIC RESOURCE RESTORATION

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The PA DEP Bureau of Waterway Engineering and Wetlands has developed comprehensive characteristics that guide restoration principles with a systematic approach to restoration efforts. This presentation will introduce the audience to the use of these guiding principles of restoration by highlighting key watershed processes, existence of historical and legacy alterations, effects of such alterations on watershed processes, development of a paleo frame of reference, and the use of an evidence-based approach for developing comprehensive restoration.

The presentation will cover several important aspects of the guiding principles that are important to the execution of highly successful restoration projects. Over the past 15 years this approach has been applied to restore numerous aquatic ecosystems buried by legacy sediment as well as the development of a dedicated restoration industry in PA including mitigation banking. The mitigation banking industry has successfully applied these principles to legacy sediments and other causes of resource degradation successfully to restore 225,000 feet of dynamic valleys including 130 acres of wetlands. This approach has wide applicability to understanding and responding to a variety of watershed alterations, not just legacy sediment.

restoration, legacy sediment, alterations, aquatic resources

POST-RELEASE MONITORING OF HEAD-STARTED EASTERN HELLBENDER SALAMANDERS: A TALE OF TWO COHORTS

PART I: GROWTH, BODY CONDITION, AND SURVIVORSHIP

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The Eastern Hellbender (*Cryptobranchus a. alleganiensis)*, a giant and long-lived aquatic salamander, had virtually disappeared from the upper Susquehanna River watershed by the early 1990's. In an effort to restore a functionally extirpated hellbender population, we collected eggs and larvae from PA and NY and brought them to the WCS Bronx Zoo for rearing until 3-1/2 years of age. We released 99 juveniles in 2018 (J18 cohort) and 124 in 2021 (J21 cohort), into a historical hellbender stream in the southern tier of NY. We released 99 juveniles in 2018 (J18 cohort) and 124 in 2021 (J21 cohort). Prior to release individuals were tagged with a unique RFID microchip and subsequently relocated about twice per month from June through October each summer season using hand-held RFID tag readers. When possible, we recaptured juveniles at the site once a year for health assessment. Individuals that remained at the release site (and did not migrate away) have exhibited significant annual growth and maintained a healthy body condition (based on body-mass index) while feeding on invasive Rusty Crayfish (*Faxonius rusticus*). Juvenile survivorship also appears to stabilize and remain high after about one year in the wild. We hope these initial positive results will ultimately shift the trajectory toward a self-sustaining population, as the juveniles released in 2018 are now approaching sexual maturity and may engage in reproductive activities in the next few years.

hellbender , survivorship , headstarting

POST-RELEASE MONITORING OF HEAD-STARTED EASTERN HELLBENDER SALAMANDERS: A TALE OF TWO COHORTS

PART II: HABITAT SELECTION, MOVEMENTS, AND ACTIVITY PATTERNS

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The Eastern Hellbender (*Cryptobranchus a. alleganiensis*), a giant and long-lived aquatic salamander, had virtually disappeared from the upper Susquehanna River watershed by the early 1990's. In an effort to restore a functionally-extirpated hellbender population, we collected eggs and larvae from PA and NY and brought them to the WCS Bronx Zoo for rearing until 3-1/2 years of age. We released 99 juveniles in 2018 (J18 cohort) and 124 in 2021 (J21 cohort), into a historical hellbender stream in the southern tier of NY. Individuals were tagged with a unique RFID microchip and subsequently relocated about twice per month from June through October each summer season using hand-held RFID tag readers and fixed RFID tracking systems secured to the stream pavement in late spring 2023. We added additional refugia to the release sites, including slab rock and artificial shelters. Habitat selection by the head-started salamanders included natural slab rock, rock clusters, placed rock, artificial shelters, and the complex streambank root systems of large, mature Willow trees (*Salix sp.).* Local movements were typically short with an average linear range of 51.71m for maximum upstream and downstream movements. Most individuals in the J18 cohort eventually moved downstream following initial release, while the J21 individuals remained in the vicinity of the initial release site. The fixed-antenna RFID tracking records revealed that most movements were nocturnal, taking place between sunset and sunrise. However, the J18 cohort showed significant diurnal movements between August 26 and September 3, the period during which most nesting occurs in the southern tier. While no evidence was found for reproduction by the J18 cohort, we are hopeful that some will engage in reproductive activities in the next few years, thus putting this reintroduction project on a trajectory toward a self-sustaining population.

Hellbender, RFID, Habitat, Activity

ROCK RUN, AN EMINENT TROUT STREAM

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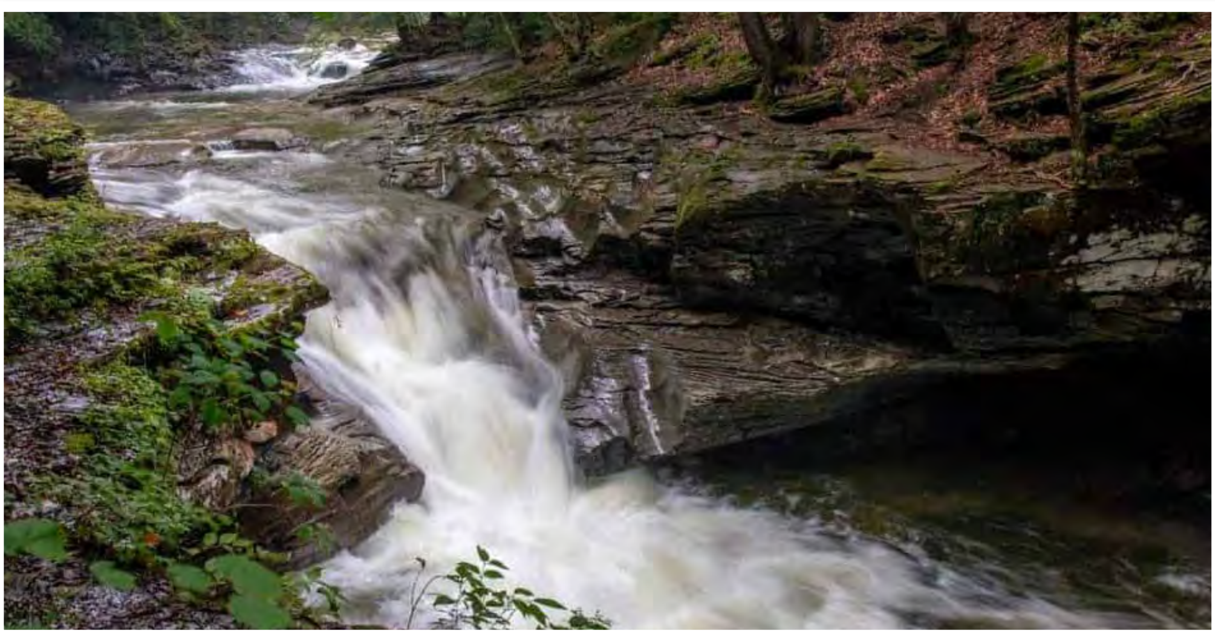
Rock Run is one of the most popular trout streams in Pennsylvania and helps, along with other trout waters to bring just under a half billion dollars to the state annually. While PA has more than one stream named Rock Run, this Rock Run starts in the southwest corner of Sullivan County and its waters flow into Lycoming Creek at Ralston, PA. The run flows for about 20 river miles, initially through private property and then through the public lands of Loyalsock State Forest.

Starting around 2012 indications of warmer temperatures in PA were becoming evident, but subtile. As a result, water temperatures at 13 locations along Rock Run and its tributaries were measured in 2021 and 2022 from April through November. The results of these water temperature measurements were then matched to upper temperatures limits for Rainbow, Brook and Brown Trout.

In addition, Rock Run water temperatures were matched to the National Aeronautics and Space Administration (NASA) Annual Global Surface Temperature (AGST) data in order to determine if Rock Run water temperatures, in the summer, will become too warm for these trout to survive. Some attention to the rate of temperature change in the AGST was determined through the use of an exponential regression. This predictive regression is then used to determine which year Rock Run water temperatures, in the summer, will likely prohibit trout survival. Attention to the fact that over 100 bogs are present within the drainage, and that these bogs contribute warmer waters then otherwise would be expected is included. Opposed to these warm waters are cooler ground waters that enter the length of the Run. This complex water temperature system tends to influence how trout use the Run.



HARNESSING NATURE'S ENGINEERS: INSTALLATION OF BEAVER DAM ANALOGS FOR RESTORATION IN A FLASHY, EROSIVE, EPHEMERAL STREAM

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Ephemeral streams face ecological and hydrological challenges, especially in areas where they become conduits for stormwater runoff from urban and agricultural landscapes. This study focuses on the installation of beaver dam analogs (BDAs) as a restoration technique for an ephemeral, gravel-bed stream located at Susquehanna University's Center for Environmental Education and Research (CEER), which experiences erosion and infrastructure damage due to stormwater runoff from a nearby housing development and an unbuffered agricultural field. This fall, a series of eight BDAs were installed along a 200-meter stretch to mimic the natural structures built by beavers, and thereby reduce the impact of flood damage during heavy rain events wherein BDAs slow, divert, and temporarily store stormwater that would otherwise contribute to erosion and flooding downstream. To characterize initial stream conditions a longitudinal profile, cross-section profiles at each dam location, and bed substrate characterization were performed. Erosion and deposition of substrate will be monitored and quantified seasonally using time series imagery, subsequent cross-section surveys, and measurements from in-situ instruments. This study marks the first PA-DEP permitted application of BDAs as a restoration technique in Pennsylvania and has the potential to transition this ephemeral stream into a perennial one. This study presents significant environmental implications for stream restoration efforts in regions affected by stormwater runoff, while also offering a potentially cost-effective, ecological engineering solution.

stream restoration , beaver dam analog , stormwater management.

(A) Construction of beaver dam analog (BDA) support posts, (B) Weaving of small logs and branches into the support posts, (C) Same BDA during a rain event holding water in a pool on the upstream side (right side of photo)

ADDRESSING THE HEALTH OF THE BAY BY ENGAGING RIVER COMMUNITIES THROUGH STREAMSIDE PLANTING MAINTENANCE

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Planting trees along streams is a great way to improve stream health, but the success of a tree planting–or buffer–depends on much more than getting trees in the ground. A commitment to follow-up maintenance is necessary to ensure the buffer can reach its full potential of stream health benefits. Our goal at Chesapeake Conservancy (CC) is to address unhealthy streams, and buffer maintenance is one key step of this. We employ three maintenance strategies, catering to varying levels of capacity, with the goal of engaging the community within the watershed. The first is contracted maintenance, CC raises funds to include maintenance practices in tree planting contracts that we oversee. This ensures that maintenance can be paid for before the trees even go into the ground. The second is our volunteer program, Riparian Rangers, which performs maintenance on local Union county buffers. The success of this program was documented into a scalable format for communities to utilize to conduct crucial streamside maintenance. The third is our internship program that partners with Susquehanna University to give students real-world conservation experience, including the training and certification necessary to maintain buffers throughout the central PA area. In order to address the lack of buffer maintenance capacity throughout the Bay watershed, local communities can adopt one or more of these maintenance approaches to make a difference.

Buffer Maintenance, Volunteer, Partnership, Chesapeake Bay

CREATION OF THE NEW VERNAL SCHOOL PARTNERSHIP AND OTHER UPDATES FROM THE MIDDLE SUSQUEHANNA RIVER KEEPER

John Zaktansky, Middle Susquehanna RiverKeeper Association, 112 Market Street, Sunbury, PA 17801, midsusriver@gmail.com.

Middle Susquehanna Riverkeeper John Zaktansky will offer a short overview about the importance of translating complex river topics in a way that best engages, educates and empowers everyday people to make realistic changes. This talk will include an overview of educational activities that took place since the last River Symposium as well as programming planned for the upcoming year.

[Photo: Chesapeake Bay Foundation; used with permission

MONITORING ZOOPLANKTON POPULATION, WATER CHEMISTRY, AND WETLAND VEGETATION COMMUNITIES AT ROBERT PORTER ALLEN NATURAL AREA

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The Robert Porter Allen Natural Area is a 260-acre nature preserve in the Sylvan Dell area of Central Pennsylvania. A former farm, this area has been seeded with native plants over the past several years in hopes of restoring terrestrial habitats. Wetlands on the property are extensive and largely intact, but their condition remains uninvestigated. We measured chemical water quality parameters; collected, identified, and quantified zooplankton; and mapped wetland plant communities at several wetland sites throughout the property to establish a baseline from which to continue monitoring. Chemical water quality differed little between sites, though conductivity and nutrients (nitrogen and phosphorus) showed some notable fluctuations. The most prevalent zooplankton species was *Brachionidae brachionus* and the most dominant wetland vegetation was *Phalaris arundinacea*. This valuable baseline data will serve long-term monitoring efforts as managers continue to improve the land at Robert Porter Allen Natural Area.

Wetland restoration, Zooplankton, Nutrient enrichment, Wetland vegetation

URBAN STREAM WATER CHEMISTRY AND COLIFORMS

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The Lycoming College Clean Water Institute has been tracking urban stream water quality in eight streams in the greater Williamsport region over the past eight years. All these urban waters receive discharges from Municipal Separate Storm Sewer Systems (MS4), which convey stormwater runoff to streams and must be managed by governing municipalities to ensure excess sediment and nutrient input is minimized. Stormwater is an important contributor of sediment, nutrients, and bacteria, making it a focal target in improving water quality. All five of the public entities charged with managing stormwater discharges within our study area must reduce nitrogen, phosphorus, and sediments by 10% by 2024/2025.

Here, we examined the levels of total coliforms, *E. coli*, and chemical water quality in the eight streams receiving MS4 discharges in the Williamsport region and compared values obtained from water collected upstream of the urban area to those downstream of all MS4 discharge points to related contamination to urban influences vs. agricultural or industrial influences.

Phosphorus was highest at an intensely modified site downstream of MS4 discharges and lowest at the site upstream of all urban influence in an area of intact, undeveloped forest. Similar results were observed for nitrate. However, there were no significant differences in nitrate, phosphorus, conductivity, fecal coliform concentrations at sites upstream vs. downstream of MS4 influence. We suggest that the land use and cover upstream of urban influence may play a large role in chemical water quality parameters, particularly nutrients in the case of upstream agricultural land use. This study continues to contribute to a growing body of knowledge regarding the influence of stormwater infrastructure on rivertown streams.

Stormwater , Urban streams , Water Quality , Nutrient management

WATER QUALITY MONITORING NETWORK ON HALFMOON CREEK IN CENTRE COUNTY, PA

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Halfmoon Creek in Center County, PA is designated as a high-quality, cold-water fishery by the US EPA, but no part of the creek currently meets its use designation, as 100% of its length is impaired by sediment. As a major contributor to water quality issues in Pennsylvania surface waters, sediment loading in streams is the target of water quality best management practices (BMPs) aimed at reducing phosphorus (P) and nitrogen (N) loads in surface waters.

A 319 Watershed Management Plan, developed collaboratively by the Chesapeake Bay Foundation with other partners, will be implemented to reduce sediment loading in the watershed; however, currently there is no available baseline against which to gauge the effectiveness of the BMPs outlined in the Plan. The Water Quality Monitoring Network on Halfmoon Creek study is intended to provide baseline data on streambank erosion, sediment movement, P loading, nitrate concentrations, and both dissolved and stream-surface emitted NO2 in the watershed against which Watershed Management Plan progress can be measured.

streambank erosion, sediment loading, riparian buffers, greenhouse gases

RESPONSE OF THE NORTH BRANCH OF MIDDLE CREEK TO A CHANGE IN THE SOURCE OF OUTFLOW FROM WALKER LAKE DURING SUMMER 2023

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The impact of Walker Lake on the north branch of Middle Creek (Snyder County) was a focus of study during the summer months of June and July from 2021 to 2023. Walker Lake is large, about $46km^3$ and deep with a maximum depth >9m. Given its morphometry, the lake begins to stratify in early to mid-June and remains stratified through the rest of the summer. Throughout this period of stratification, the hypolimnion becomes hypoxic. Through the years of 2021 and 2022, the outflow of the hypolimnion from Walker Lake released hydrogen sulfide and generated a buildup of iron (III) oxide-hydroxide on downstream stones during 2021 and 2022. In mid-June of 2023, however, the outflow of Walker Lake was adjusted from hypolimnetic water to that of the lower epilimnion. As a result, the temperature and oxygen concentration rose to that of the epilimnion, and the hydrogen sulfide odor disappeared, as well as the iron (III) oxide-hydroxide that had begun to build up on the downstream stones. Each year of the three-year study, diatom biofilms were sampled three times through June and July as surrogates for the state of the streams above and below the impoundment, the first week of June, the last week of June, and the last week of July. In 2021 and 2022, the Walker system showed an average difference of 10°C between the epilimnion and hypolimnion and cooled the stream system by 3°C relative to the average upstream difference from above and below the lake. Measures of alkalinity and conductivity followed the same trends as temperature. Other metrics included Taxa Richness (TR), %Agricultural Guild (%AG), Sedimentation Index (Sed. Index), Total Phosphorus (TP) and Total Nitrogen (TN) Indices. How the reservoir impacted the stream was determined by the change in the metric from above to below the lake. The results in 2023 were mixed relative to the previous two years. Some of the metrics indicated increased impairment of the downstream site following the change in outflow. For example, the Shannon Diversity (SDI) metric, a measure of the complexity of the diatom community, fell indicating that the downstream site became simplified. Also, the %Agricultural Guild rose significantly relative to the first two samples taken in 2023 and relative to the samples taken in the earlier years. Total Nitrogen and Total Phosphorus indices showed no change. Metrics that respond to organic pollution are the Pollution Tolerance Index (PTI, range 1-4) and Generic Diatom Index (GDI, range 4-20). PTI and GDI values suggested that the Walker system improved downstream. However, Taxa Richness fell and the Trophic Diatom Index, a metric that estimates the trophic condition of a stream, rose. That outcome suggests that the downstream became even more eutrophic than during the previous years.

diatom, reservoir, stratification, diatom-generated metrics

ASSESSING THE STREAM HEALTH OF TWO BRANCHES OF THE JUNIATA RIVER

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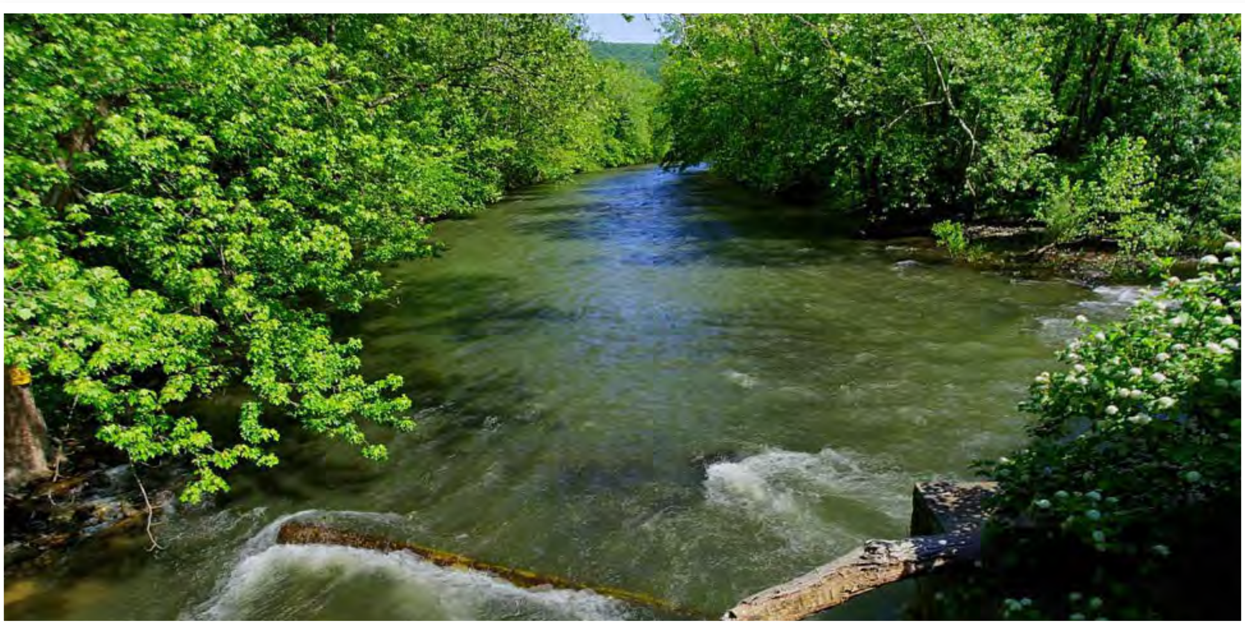
The Little Juniata River is a popular brown trout fishery, originating near Altoona, PA and draining into the larger Juniata River near Petersburg, PA. But many anthropogenic threats, especially those associated with agriculture and urbanization, threaten the health of this river, with previous findings showing the biological integrity of the Little Juniata to be surprisingly low at a number of sites, some samples with IBI scores as low as 16, indicating high degradation. We still understand little as to why these results, which contradict the renowned quality of the river's trout fishery, exist.

To try to explain this, we introduced in-depth water chemistry assessment, in addition to reassessment of the biological integrity of the previous sites. We wanted to test if the levels of aquatic contaminants might correspond with the IBI scores - or, specifically, if the low IBI sites would also show higher levels of contamination. Additionally, 18 sites were added to our assessment on the Frankstown branch of the Juniata river, which originates south of the Little Juniata near Hollidaysburg, PA, to add to our understanding of ecological conditions within the larger watershed.While most of the contaminants we measured did not have concerning concentrations, we found elevated levels of lead at multiple sites along both branches of the Juniata.   Additionally, there was a strong spatial correlation between the contaminated sites, with higher concentrations occurring down-gradient. While this study is still in progress, with current IBI scores still being evaluated, these findings could help inform management practices on the LIttle Juniata River and help us understand where potential issues lie.

Stream Ecology, Water Quality



ROLE OF NUTRIENTS IN MEDIATING THE EFFECTS OF ALGAL-PRODUCED LABILE CARBON EXUDATES ON THE DECOMPOSITION OF LABILE AND RECALCITRANT DETRITAL ORGANIC MATTER IN STREAMS

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Aquatic primary producers release labile carbon exudates into streams that can either increase or decrease the rate of decomposition of terrestrial detritus. The direction and magnitude of this interaction, creating a positive or negative priming effect, on both more recalcitrant or more labile organic matter is not fully understood.

The goal of this study was to better understand the priming effect while considering microbial biomass, enzyme activities, and decomposition rates under different nutrient and light conditions. This experiment investigated the role of priming using cotton and veneer substrates. Modified enclosed rain gutters either allowed or prevented algal growth on the standardized substrates and were submerged in five high nutrient and six low nutrient streams. After incubation, the cotton and veneer were tested on tensile strength, penetrability, fungal sporulation, algal biomass, and enzymatic activities.

We hypothesize there will be a negative priming effect and slower decomposition rates in low nutrient conditions when algal growth is present due to the absorption of labile carbon exudates by decomposers than in low light and high nutrient conditions. Preliminary data analysis indicates there may be priming responses between substrates and across nutrient treatments but additional analysis is required. Further testing of the substrates will include bacterial and fungal biomass, biofilm nitrogen and phosphorus, and percent biomass lost. Additional data analysis will give a clearer understanding of the direction and magnitude of priming occurring in the conditions investigated in this study.

decomposition, priming effect, labile carbon, algae

A TWO-YEAR STUDY OF TWO LOCAL RESERVOIRS ON THE UPPER MIDDLE CREEK DRAINAGE.

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The upper Middle Creek watershed is punctuated by two reservoirs, Walker Lake and Faylor Lake, which differ in their major morphometric measures. Though the discharge of the respective streams is comparable, Walker Lake contains more than 10 times the volume of Faylor Lake (46km3 and 4km3, respectively). Similarly, maximum depth of Walker is 9m while Faylor is 4.5. Thus, Walker Lake becomes thermally stratified in early June and remains stratified into October. Faylor Lake does not become thermally stratified.

This study focuses on the plankton communities, both phytoplankton and zooplankton, of the two reservoirs through the months of June and July during 2022 and 2023. When weighted for biovolume, the phytoplankton of Walker Lake is dominated by filamentous cyanobacteria, but Faylor Lake is dominated by chlorophytes and then by cyanobacteria in July. Taxa richness in both lakes was 24 for both reservoirs in 2023 and for Faylor Lake in 2022. Walker Lake had a taxa richness of 16 in 2022.

Faylor Lake also has a water column occupied mostly by the free-floating vascular plant, *Ceratophyllum demersum*. During the summer months the surface of Walker Lake displays a surface bloom of cyanobacterial filaments and colonies (e.g. *Planktothrix, Anabaena*, and *Aphanizomenon*).

The zooplankton communities of both lakes are dominated by widely distributed taxa. The Faylor Lake community is dominated by *cladocerans* (e.g. *Ceriodaphnia dubia* and *Bosmina longirostris*) but the Walker Lake community generally is dominated by copepods (e.g. *Microcyclops rubellus*) in Walker Lake. Other dominant taxa in Walker Lake include the rotifer *Keratella cochlearis* and the cladoceran *Daphnia magna*. The dominant zooplankters of Faylor Lake are coarse filter feeders, but *M. rubellus* is an omnivore. Both *K. cochlearis* and D. magna filter bacteria and detritus. Average zooplankton taxa richness for both lakes ranged between 10 and 13.

Though both reservoirs are impaired, Walker Lake is decidedly eutrophic. The differences between the two reservoirs cannot be attributed to land use in their watersheds because they both are primarily agricultural. We suspect that differences in the summer ecology of the two reservoirs is due to the differences in their morphometry coupled with the small turnover rate of Walker relative to Faylor.

plankton, reservoir, stratification, morphometry

LAB-SCALE GREEN STORMWATER INFRASTRUCTURES: INTEGRATING RESEARCH AND TEACHING

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A rapid increase of expanding urbanization has led to more impervious surfaces which has increased stormwater runoff and therefore increased peak flows, flooding events, pollution, and sewer overflows. Green Stormwater Infrastructure (GSI) is a management strategy that is most beneficial in developed/urbanized areas where stormwater quantity and quality are an issue. Over the past years, GSI has already been adopted by different cities and communities and there has been continued interest and research in the field. This project aims to build a lab-scale demonstration unit for various GSI techniques to raise awareness among students and community on the design and merits of such approaches. Currently, we are building a rain garden that will be kept in the new engineering laboratory at Juniata. Multiple units of rain gardens will be built with different media types including activated carbon, gravel, silica sand, slag, and zeolite. The project will serve as a learning tool for students and will increase the breadth of the experimental possibilities at Juniata College. This can also be integrated as laboratory modules for courses like Water Quality, Environmental Sustainability, and Water Treatment for Environmental Engineering and Science students at Juniata.

Green Stormwater Infrastructure , rain garden , lab-scale models , integrated teaching

BENEFITS OF RESTORING LARGE WOODY DEBRIS IN STREAMS TO OFF-CHANNEL AQUATIC HABITATS

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Aquatic populations vary amongst valley floor ecosystems due to the presence of multiple aquatic habitats. Populations within off-channel aquatic habitats are valuable as they contribute to biodiversity across valley-floor ecosystems. Groundwater within the valley-floor environment typically connects active stream channels to other aquatic habitats, such as pools and side channels, which form when groundwater intersects with depressions on the valley floor. Groundwater connections benefit biota in off-channel pools by providing a reliable source of water during periods of drought and cool water during warm periods of the summer. As a result, groundwater supplied pools could provide stable habitats for populations of cold-water invertebrates and amphibians as climate warms. Historically, logging affected stream environments by incising stream channels, which concentrated flows and lowered groundwater levels across valley floors resulting in loss of off-channel aquatic habitats and associated biodiversity. Logging has affected groundwater flow to these off-channel habitats within the Allegheny National Forest, but addition of large woody debris (LWD) could restore valley floor hydrology by causing aggradation of bed material in streams and subsequent raising of water table elevation. If this increase in the water table is high enough, groundwater might reconnect to depressions across the valley floor and provide more persistent aquatic habitats. LWD has been added to 750m of Little Arnot Run in Allegheny National Forest as part of a project to restore a stream in a historically logged watershed. Benthic invertebrates have been collected from riffle and pool habitats in Little Arnot Run and from pools and side channels across the valley floor. Water temperature has been monitored in off-channel pools since 22 October 2022 using HOBO pendant temperature loggers mounted at two heights on stakes placed in the center of the pools. Data from these loggers were used to indicate water source (i.e. groundwater or surface runoff). If pools are fed by groundwater, water temperatures should be lower than in pools sustained by rain water, which might allow populations of cold-water species to survive in these pools and resist warming due to climate change. Additionally, temperature patterns will enable us to determine water depth and inundation period, as many of these pools potentially dry up or become extremely shallow seasonally. Size and depth of pools located off of Little Arnot Run were also measured on sample dates to determine potential habitat area. Variability in aquatic invertebrate communities among pools of varying sizes and water sources could illustrate the importance of groundwater connections across the valley floor to biodiversity. Any ecological changes to existing pools in response to LWD restoration might affect regional biodiversity of aquatic biota by altering the number and quality of aquatic habitats present.

EFFECTS OF HETEROGENEOUS LANDSCAPES ON STREAM TEMPERATURE

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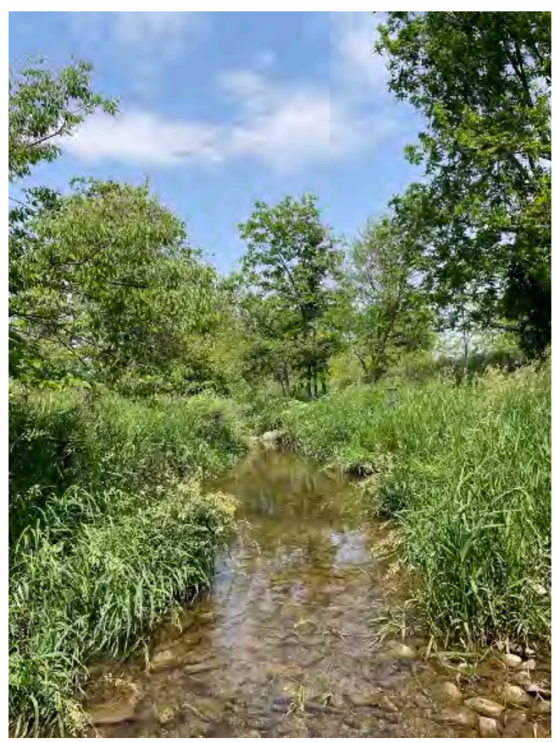
Local to the West Branch of the Susquehanna, Turtle Creek is an agricultural stream that runs through a heterogeneous landscape of open farmlands, riparian buffers, and forested areas. Pennsylvania's Department of Environmental Protection (DEP) has begun restoration projects to reduce nutrient and sediment inputs and to improve Turtle Creek's stream health. DEP's projects along Turtle Creek include bank stabilization and riparian buffers. Riparian vegetation typically serves as a buffer between streams and farmlands, as it can filter and absorb excess nutrients from manure and fertilizer before entering the waterway. Riparian vegetation also shades streams and reduces water temperature, which is critical to stream health. However, due to the "farm-by-farm" approach used in most stream restoration programs, these projects add to the heterogeneity of vegetation along Turtle Creek, as the development of riparian vegetation is primarily up to individual property owners. This study aims to evaluate the influence of riparian vegetation on stream temperature by comparing reaches along this heterogeneous stream system. We monitored 18 sites, 14 on Turtle Creek's main stem and 4 on tributaries to Turtle Creek. The main stem reaches were divided into 5 categories based on riparian land cover (open development, open agriculture, new riparian, old riparian, and remnant forest). HOBO Pendant temperature loggers were set to collect water temperature hourly at each site from June 8th, 2023 to August 1st, 2023. Water samples were collected on a bi-weekly basis to measure concentrations of nutrients and major ions in the streams. Temperature increased as the stream moved from upstream to downstream, with a sharp increase in temperature as the stream flowed from its headwaters into agricultural areas of the valley floor. Long reaches with Remnant Forests produced a cooling effect on the stream between monitoring sites. Stream temperature is influenced by a multitude of factors such as water source, vegetation density, air temperature, and urbanization. While these factors play a pivotal role in regulating water temperature, regional climate is the most important natural factor affecting stream temperature. Therefore, as the climate continues to warm, maintaining riparian buffers and remnant forests could be critical to mitigate rising stream temperature.



Stream Temperature, Riparian Buffers, Heterogeneous Landscape

REVISITING THE MIDDLE CREEK LAKE LEGACY SEDIMENTS (1833-1992): A DETAILED DESCRIPTION OF SEDIMENTS PRODUCED FROM LOGGING AND AGRICULTURE FROM A SMALL WATERSHED IN THE VALLEY AND RIDGE PROVINCE

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Legacy sediments from Middle Creek Lake near Selinsgrove, PA are attributed to upland logging and agriculture and represent a record from 1833 to 1992. During this time interval three dams (1833, 1906, and 1934) formed the mill pond/lake from a multi-thread stream system to generate hydropower. This legacy sediment represents a record of 159 years. The region was mostly forested (hemlock and chestnut) when settlers arrived in the region-1700's. By the mid 1800's, most of the forests had been removed for lumber, making way for the growing communities. By the 1900's, a secondary forest of mixed deciduous and evergreen forests covered headwater areas with farms located in the valley regions. The upstream region of this drainage basin (396 km^2) is geologically diverse and contributes to the composition of the legacy sediment. First order, headwater streams flow through and erode the tightly folded bedrock ranging from the Tuscarora Sandstone (Silurian) to the Catskill Formation (Devonian). Middle Creek is a fourth order stream that flows through the eastward plunging Selinsgrove Anticline, a valley region dominated by Silurian-Devonian Wills Creek, Keyser and Tonoloway Formations (limestone and dolostone), Onondaga and Old Port Formations (cherty limestone) and the Clinton Group and Bloomsburg Formation (sandstone and shales). Where Middle Creek Lake was located near its confluence with Penns Creek, it flows over the Trimmers Rock Formation and Marcellus Shale.

The laminated lake sediments were transformed into soils. In this study, they were analyzed for grain size using a gravitational settling technique. This sediment is predominantly sandy clay loam to loam. Elutriated slides of the legacy sediment were analyzed using X-ray diffraction (XRD) and consist of kaolinite, illite, vermiculite, and muscovite clays. The fine silt and sand size sediment are composed of approximately 95-98 % angular to subrounded quartz, with minor amounts of orthoclase, magnetite, and rock fragments (chert, coal, and siltstone). Mussel shell fragments, charcoal, and reddish orange clay balls (part of the legacy sediment matrix) were also present in the sand size faction. These sediments were analyze using X-ray Fluorescence (XRF) for bulk chemistry and contained 50-65% SIO_2, 12-13 % Al_2O_3, 3-5 % Fe, 2 % K_2O, and trace amounts of other minor elements. Of note were Zr values- ranged from 300-400 ppm. The lake sediments were laminated, contain iron oxide nodules from soil formation, and some organisms like the mussel Eastern elliptio and diatoms. Stumps, leaves, and seeds from the original lowland forest (pre-1833) are preserved in the lake sediments.

This study provides a description of sediments eroded from the Valley and Ridge Province following deforestation and during a time of agricultural expansion. These sediments washed down from the headwater regions and were stored in the mill pond for up to 159 years. The layers are in geomorphic disequilibrium with the multi-thread stream system model that can be applied to the lower part of Middle Creek. Eventually, storms and floods will erode and transport the sediment to the Susquehanna River and Chesapeake Bay.

legacy sediments , Middle Creek , logging , agriculture

WATER QUALITY ASSESSMENT OF MUDDY RUN, PENNSYLVANIA, USA

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Almost a third of Pennsylvania (PA) streams are considered impaired and this is more prevalent in streams passing through urban/developed areas. This study aims to evaluate the overall stream health of Muddy Run, a second-order stream in Central PA, with a primarily urban catchment. The stream passes through distinct developed land uses and offers a unique feature with almost a mile of its length buried underground through a culverted section until it discharges into the Juniata River.

Several physiochemical properties including flow, temperature, pH, dissolved oxygen, hardness, specific conductivity, total dissolved solids, and nutrients were evaluated at four sampling sites over a five-week period to assess both spatial and temporal variations. A two-way ANOVA test along with post hoc t-tests were used to determine statistical differences throughout both sampling weeks and sampling sites.

Significantly higher nutrient concentrations and lower DO levels ($p<.05$) were observed as the stream emerged from underground indicating a point source discharge of nutrients in the creek. TDS and conductivity values were observed to be higher at locations near impervious surfaces with an indication of runoff from streets and parking areas. Differences across sampling weeks were largely driven by storm events. Continuous monitoring and an improved understanding of the water quality will help the local community and authorities to make informed decisions for improving the health of local watersheds and managing urban runoff.

Water quality, Urban runoff, physio-chemical, nutrients

"LEGACY ISLANDS"- UNINTENTIONAL ANTHROPOGENIC ARTIFACTS FORMING IN THE SUSQUEHANNA RIVER (NORTH BRANCH)

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Several islands in the Susquehanna River formed solely from anthropogenic activity and major flood events and are therefore proposed here to be described as "legacy islands". These islands are composed of both glacial and legacy sediments deposited upstream from man-made fish weirs that were produced and used by Native Americans and early European settlers. They are distinct from other alluvial islands due to their low elevation, V-shaped structure, sparse vegetation, length to width ratio, and nearly complete association with anthropogenic activities.

Historical aerial imagery (1939-present) was used to locate fish weir locations and islands that formed from the weirs. This study examined the transformation of an island near Beach Haven, PA in the North Branch of the Susquehanna River. It was surveyed, and 6 cores were drilled to determine the stratigraphy. Samples were analyzed for grain size, mineralogy, and chemistry. Sand to sandy loam was deposited on top of medium to coarse-grained gravel; the gravel represented high-energy flood events. This sediment was periodically rooted between floods. The finest sediment (clay and silt) was composed of vermiculite, chlorite, muscovite, and quartz. Sand size sediments considered glacial consisted of quartz and quartz with magnetite inclusions, andradite, pyrope, chromite, enstatite, zircon, and magnetite. Sand sediments from coal production included anthracite, magnetic glass, metallic industrial waste, shale fragments, ferric oxyhydroxide, hematite, and coke. The distribution of fine grain sizes corresponded to trends observed in some of the major oxides (Fe_2O_3, K_2O, Na_2O, MgO, and TiO_2). Increases in these major oxides may be due to frequent small-scale floods or hydromorphic processes. This zone is represented by mottled and iron-rich layers in the cores. Trees on the island were cored; the oldest tree was 46 years in age.

Based on the aerial imagery and vegetation data, a timeline for the transition from bar to island was established. Since 1939, the gravel bar was impacted by many floods resulting in deposition and erosion. Periodic small-scale vegetation covered parts of the bar. After multiple, major flood events (1972 and 1975), vegetation colonized and stabilized the bar, resulting in the formation of the current island. Trees have been growing since at least 1978, stabilizing the island and causing it to grow in elevation. The major flood of 2011 flowed over the island, deeply scouring the surface, producing parallel-to-flow ruts (~80 cm) in the island soil with a layer of gravel 1.5 m above the river surface. Trees caught debris flowing downstream forming debris dams.

Historical aerial images help resolve how these islands form: 1. gravel bars form upstream from fish weirs, 2. vegetation colonizes gravel and trap sediment, allowing the island to grow and stabilize, and 3. significant floods may reset the process. There may be more "legacy islands" in the Susquehanna, and they may not be restricted to this river. Despite being an unintentional manmade feature comprised of mining waste, these islands provide a valuable habit for many types of organisms. These habits may be threatened by future global climate change due to stronger floods and weather events.

legacy islands, legacy sediments, Susquehanna River, Beach Haven

STORMWATER MANAGEMENT USING LOW IMPACT DEVELOPMENTS (LIDS): CASE STUDY FROM JUNIATA COLLEGE, HUNTINGDON, PA

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The city of Huntingdon is a small town located in Central Pennsylvania. The town is served by a stormwater management system that has aged. This often has led to flooding in parts of the city and sewer overflow into the local creeks. This study aims to assess and manage the urban runoff for the town while the current focus is only on Juniata College. Juniata College is a liberal arts institution situated at the heart of town with a total area of 110 acres and represents a major developed area in the town. Most importantly, a local creek, named Muddy Run passes through Juniata College and carries runoff from residence halls and parking lots. Various places on campus with runoff issues were identified. The places of concern were first selected based on the previous flooding history and those sites were visited after rain events during the year 2022/2023 for a better understanding of the current runoff scenario. Flood Factor and NOAA flood maps were used as additional tools in selecting the sites of concern. An extensive review of the successful cases of Low Impact Developments (LIDs) in similar situations was conducted. EPA Stormwater Calculator was then used to develop multiple scenarios with a suite of LIDs and improvement suggestions for Juniata College. The study also aims to explore ideas and ways for the reuse of captured water and its added benefits to the college on water consumption, cost, and sustainability efforts.

stormwater, low impact development, case study, Juniata college

SEQUESTERING CO_2 USING DIATOMS

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The rising levels of CO_2 are a significant contributing factor to the ongoing climate crisis; methods of carbon capture and sequestration are one of the tools to combat the crisis. The data taken so far would suggest that diatoms can be used to sequester and hold carbon dioxide from the atmosphere. The reasoning behind this is that diatoms, with the silica-based frustule, would be able to hold the carbon dioxide they took in while alive even when they are dead. We used a highly concentrated sample of diatoms to then dry them out and get the mass of this now dry sample. The mass of the sample was then tracked for changes over the course of 6 months, if the mass fell that would suggest the carbon dioxide had left, if the mass was unchanged then it would suggest that the carbon dioxide was kept within the diatom. The findings so far would suggest that the diatoms did keep the carbon dioxide within themselves and did successfully sequester the carbon dioxide. The implications of this would be to find a method to pull the maximal amount of carbon from the atmosphere, and for further study isolating the diatoms to measure the exact amount of carbon dioxide they pull out of the atmosphere.

Carbon Sequestration , Diatoms , Frustule

LARGE WOODY DEBRIS IN STREAMS BASED ON LOGGING HISTORY AND RESTORATION APPROACHES

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Large woody debris (LWD) is an important feature of streams in forested regions, where it structures stream channels and increases habitat variability by influencing water flow. Logging in the 19th and early 20th centuries resulted in dramatic reductions of LWD in streams and correspondingly incised stream channels with simplified habitat. Despite reforestation, these physical changes to stream channels from historical logging remain. Introducing LWD to channels affected by historical logging and allowing natural hydrological processes could reshape channels and restore in-stream habitat. We compared the volume of LWD in streams flowing through old-growth (OG) and mature second-growth (SG, >80 y) forests in northwestern Pennsylvania and between stream reaches where LWD addition projects have been conducted using "chop-and-drop" (CD) or "designed" (D) restoration approaches. We quantified LWD volume for 2 OG, 3 SG, 1 CD, and 1 D stream reaches by measuring diameter and length of wood (>10 cm diameter, >1 m length) that intersected a 100-m long transect down the center of each stream channel. LWD volume was quantified in four vertical zones based on how much was in the water, within stream banks but above water, or intercepting the channel but above or outside banks. OG streams had approximately 8x more LWD than SG streams, likely because logging never occurred to remove LWD and mature trees provided a continuing source of new LWD. Second-growth forests have experienced logging, which resulted in removal of LWD from SG stream channels, and younger trees do not contribute as much new LWD to streams. LWD addition resulted in similar total LWD volumes between D reach and OG streams, but the CD reach had 2x more LWD than OG streams. LWD in the D reach was distributed more evenly across different vertical zones, with over 70% of LWD in the active stream channel where it can interact with stream flow and contribute to channel processes. In contrast, over 99% of LWD in the CD reach was above the channel or outside the stream banks, so it was not actively interacting with the stream. Much of the LWD above and outside the channel will enter the stream eventually and could then modify water flow leading to improved in-stream habitats in CD stream reaches. Despite this delay, chop-and-drop might be a more cost-effective restoration approach due to its relative speed and ease compared to designed installation of LWD, particularly in remote stream reaches.

stream, restoration, logging, large woody debris

ON THE TRAIL OF BLUEBIRDS: WHERE CONSERVATION MEETS EDUCATION

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Conservation goals and practices can best be achieved when they involve multiple stakeholders in projects. We formed an alliance with a local corporation to establish a bluebird trail comprised of four-dozen boxes distributed throughout hundreds of acres of their property. In addition, we have also partnered with the Bluebird Society of Pennsylvania who, in addition to providing us with numerous boxes and excellent advice, will also serve as a larger repository for data collected at these boxes and many others throughout Pennsylvania. This project will directly benefit bluebirds and other native cavity nesting birds in our area while simultaneously training students about conservation practices and alliances, as well as the natural history of birds.

bluebird, conservation, education

DEVELOPMENT OF EDNA DETECTION PROTOCOLS FOR THE EASTERN HELLBENDER IN A TRIBUTARY OF THE WEST BRANCH SUSQUEHANNA RIVER

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The distribution of the Eastern hellbender (*Cryptobranchus alleganiensis*) in the Susquehanna Watershed has been previously studied through traditional rock-flipping assays. This method is beneficial in that hellbenders can be physically observed and potentially tagged, but rock-flipping assays are time consuming, cost ineffective, and pose increased physical risk to animals and researchers. A relatively novel and less invasive method for hellbender detection is through quantitative PCR (qPCR) of environmental DNA (eDNA). The goal of this this study is to develop eDNA collection, isolation, and detection protocols tailored to the resources available at Lycoming College and implement them in a tributary of the West Branch Susquehanna River to detect hellbender populations. Preliminary findings suggest that the protocols used are effective in hellbender eDNA detection studies. Positive controls, negative controls, and designed standards are consistent with duplication. In early testing, hellbender DNA was detected in spiked water samples and samples from known hellbender habitat. Future work includes implementing these protocols on previous rock-flipping survey sites and additional sites to update the knowledge of hellbender distribution within this tributary.

eastern hellbender, eDNA

MONITORING RESPONSES TO AGRICULTURAL BEST MANAGEMENT PRACTICES IN THE WOLF RUN WATERSHED

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Wolf Run is a tributary to Muncy Creek and the West Branch Susquehanna River. In 2013, PA DEP established a Total Maximum Daily Load (TMDL) to address agricultural impacts to the watershed. In 2015, the Lycoming County Conservation District identified four farm sites along Wolf Run to implement agricultural best management practices (BMPs). From 2017 - 2019, 2,300 feet of bank stabilization was added including 240 feet of mudsill, 15 single log vanes, 7 multi-log vanes, and 180 feet of toe logs. Riparian buffer planting and livestock/equipment exclusion was also implemented throughout the impacted sites. Lycoming College Clean Water Institute (CWI) has been monitoring responses to BMPs since 2017. In this study, we present a summary of biological and chemical responses to BMPs along the impacted Wolf Run sites. We used handheld water quality probes to measure water temperature, DO, pH, conductivity, and TDS in the field. Following standardized methods, we measured nitrates and phosphorous using a HACH 6000 spectrophotometer and alkalinity via 0.02 N H_2SO_4 titration in the lab. We sampled fish populations following PFBC protocols, using electrofishing surveys (100 meters per site). Fish were identified and released. We collected macroinvertebrates following PA DEP protocols using a D-frame kick net. We preserved samples in 70% ethanol, identified taxa to family-level, and estimated the Hilsenhoff Biotic Index (HBI). Coliform samples were collected in sterile bags and 100 ml of water was filtered via membrane. Here, we present trends through time for select biological and chemical variables using linear models and generalized linear models. We found significant increase in fish/km ($z= 33.37$, $df = 26$, $p < 0.001$), and trout/km ($z= 21.08$, $df = 22$, $p < 0.001$) over time. We found significant decrease in total phosphorous (adjusted $R^2 = 0.15$, $F_{1,22}= 4.97$, $p = 0.04$) over time. We found no significant differences in nitrate ($F_{1,22}= 3.0$, $p = 0.10$), TDS ($F_{1,22}= 1.34$, $p = 0.26$), HBI ($F_{1,18}= 0.39$, $p = 0.54$), or coliform concentration ($F_{1,25}= 0.15$, $p = 0.70$) over time. This study provided valuable information regarding the effects of agricultural BMPs implemented along four farm sites within the Wolf Run watershed. We demonstrate an increase in both fish and trout abundance over time, suggesting that restoration practices have been successful in improving habitat quality and overall stream productivity. This study also broadly suggests that BMPs have been effective in reducing nutrient concentrations entering the stream. We recommend that future monitoring continue in subsequent years to evaluate effects of restoration practices on water and habitat quality and the sensitive stream biota that occur in Wolf Run.

agricultural BMPs , stream restoration , water quality

EVALUATING VARIATION IN WATER QUALITY AT THE PROPOSED LYCOMING BIOLOGY FIELD STATION RESTORATION SITE

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The Lycoming Biology Field Station (LBFS) is a 116 acre subsidized property owned by Lycoming College adjacent to Loyalsock Creek north of Montoursville, PA. In 2011, Tropical Storm Lee caused historic flooding in Loyalsock Creek resulting in the formation of an avulsion channel that now bisects the LBFS property. Increased bank degradation, nutrient/sediment loading, and damage to local properties led LBFS and USFWS to propose extensive stream restoration efforts to redirect stream flow to the historic channel to improve downstream water quality and prevent future erosion. In this study, we evaluated variation in water quality parameters (temperature, DO, pH, conductivity, TDS, alkalinity, nitrogen, and phosphorous) between the historic and avulsion channel as well as sites upstream of the restoration site to provide control data. Following PA DEP protocols, we measured water quality variables at each site in July and August 2023. We used handheld water quality probes to measure water temperature, DO, pH, conductivity, and TDS in the field. Following standardized methods, we measured nitrates and phosphorous using a HACH 6000 spectrophotometer and alkalinity via 0.02 N H_2SO_4 titration in the lab. We compared focal variables between channel habitats using linear models. We found no significant differences in water temperature ($F_{1,10}=0.33$, $p=0.58$), conductivity ($F_{1,10}=1.11$, $p=0.32$), or TDS ($F_{1,9}=0.2$, $p=0.66$), between the avulsion and historic channels. pH was significantly higher in the avulsion channel ($F_{1,10}=6.04$, $p=0.03$). Nutrient levels were slightly higher on average in the avulsion channel, however there were no significant differences in nitrate ($F_{1,10}=3.72$, $p=0.08$) or phosphorous concentrations ($F_{1,10}=2.4$, $p=0.15$). This study provided valuable baseline water quality data on throughout the proposed LBFS restoration site, broadly showing similarities across channel types. While our study was subjected to small sample sizes, this pilot work highlighted trends in water chemistry across channel types that warrant further monitoring. Higher nitrate and phosphorous concentrations may have resulted from increased erosion in the avulsion channel and could impact downstream water quality. We recommend future monitoring to further evaluate these trends and effects of restoration efforts on downstream water and habitat quality. Monthly grab samples accompanied with continuous water quality probes would allow for future investigation of fine-scale differences in water quality across the LBFS restoration site.

water quality, stream restoration

CONTRIBUTION OF LYCOMING COLLEGE CLEAN WATER INSTITUTE TO THE UNASSESSED WATERS INITIATIVE (2012-2023)

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Pennsylvania has ~83,000 miles of streams (~62,725 streams) that face a variety of anthropogenic stressors when left without legal protection. Native trout populations are at risk of decline and local extirpation due to factors such as land use change, resource extraction, and road construction. Waterways designated as wild trout streams are afforded protections from human-induced impacts. In 2010, the PA Fish and Boat Commission (PFBC) began the Unassessed Waters Initiative (UAI), a collaborative statewide effort to "Proactively identify and properly classify the most at-risk streams which support naturally reproducing trout populations in order to protect, conserve and enhance those waters as wild trout streams." Lycoming College Clean Water Institute (CWI) has been involved with UAI for over a decade, contributing annual surveys of unassessed stream reaches. Here, we provide an update on CWI's contribution to the Unassessed Waters Initiative from 2012-2023. We sampled fish populations following PFBC protocols, consisting of single-pass electrofishing surveys (100-300 meters per reach) using a Smith-Root electrofishing backpack. We identified all captured fish, and measured body length and abundance of trout species. We recorded reach length and width as well as water chemistry variables (temperature, DO, pH, alkalinity, conductivity) at each site. We evaluated effects of DO and reach width on trout abundance using generalized linear models with a Poisson distribution. From 2012-2023, CWI surveyed 657 stream reaches in cooperation with UAI, in which 275 (42%) were occupied by wild trout populations. In 2023, we surveyed 40 stream reaches in Lycoming, Tioga, Clinton, Centre, and Potter counties, documenting 12 new wild trout populations (9 brook trout, 3 brown trout), 2 reaches with no fish present, and 14 dry reaches. We found a significant positive effect of DO on trout abundance ($z = 14.15$, $df = 253$, $p < 0.001$), with highest abundances > 8 mg/L. We found a significant positive effect of stream width on trout abundance ($z = 3.093$, $df = 272$, $p < 0.01$), with highest abundances in streams between 1-5 m wide. Statewide, ~35,000 streams have not yet been assessed, many of which are small 1st – 2nd order streams potentially supporting wild trout populations. CWI will continue its partnership with PFBC contributing to the identification and protection of wild trout waters throughout Pennsylvania. We will also explore the potential for environmental DNA (eDNA) sampling to compliment electrofishing surveys and improve trout detection rates across Pennsylvania.

trout, Unassessed Waters, PA Fish and Boat

QUANTIFYING MACROINVERTEBRATE COMMUNITIES AT THE PROPOSED LYCOMING BIOLOGY FIELD STATION RESTORATION SITE

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The Lycoming Biology Field Station (LBFS) is a 116 acre subsidized property owned by Lycoming College adjacent to Loyalsock Creek north of Montoursville, PA. In 2011, Tropical Storm Lee caused historic flooding in Loyalsock Creek resulting in the formation of an avulsion channel that now bisects the LBFS property. Increased bank degradation, nutrient/sediment loading, and damage to local properties led LBFS and USFWS to propose extensive stream restoration efforts to redirect stream flow to the historic channel to improve downstream water quality and prevent future erosion. In this study, we evaluated variation in macroinvertebrate community composition (macroinvertebrate density, Shannon diversity, Hilsenhoff Biotic Index, and EPT taxa) between the historic and avulsion channel as well as sites upstream of the restoration site to provide control data. We collected macroinvertebrates using three 90-s Surber samples in riffle habitat and three 60-s Kick-nets in run/pool habitats stratified across the stream width at each site. We compared indices across channel types using linear models. We found no significant differences in Shannon diversity index ($F_{1,16}$= 3.66, p = 0.22), Hilsenhoff Biotic Index ($F_{1,22}$= 0.12, p = 0.75), or EPT taxa richness (z= 3.66, df = 22, p = 0.74) between the avulsion and historic channels. We found that macroinvertebrate communities reached higher densities within the historic channel, but this difference was only near-significant ($F_{1,16}$= 3.67, p = 0.07). This study provided valuable baseline information on macroinvertebrate community composition throughout the proposed LBFS restoration site, broadly showing similarities in all community metrics evaluated. Future sampling should continue in subsequent years at sites throughout LBFS to evaluate effects of restoration on stream biota. Benthic macroinvertebrates show seasonal shifts in abundance and assemblage composition, and should therefore be sampled twice per year (late spring and late summer) to collect representative samples. Future sampling should also evaluate fine-scale differences in community composition between the historic and avulsion channels, paying particular attention to changes in sensitive taxa (e.g.; EPT families) in response to channel restoration efforts.

stream restoration, aquatic macroinvertebrates

SEDIMENT MOTION FROM TROPICAL STORM LEE: DO STREAM POWER INDEX AND LIDAR DEMS TELL THE SAME STORY?

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Aircraft-based LIDAR instruments were used in 2006 and 2017 to develop DEMs with horizontal resolution of 1 m. Both DEMS covered the entire Muncy Creek watershed in north-central Pennsylvania. In 2011, Tropical Storm Lee caused record flooding and significant reconfiguration of flow paths. The average difference E (a possible Erosion index) between elevations in 2006 and 2017 along a reach might indicate significant erosion (positive E) or deposition (negative E) in a reach. The stream power index SPI=A*S (where A is the watershed area contributing to flow in the reach and S is the average reach slope) is a well-known index predicting the likelihood and amount of sediment transported in a reach. If SPI increases with downstream distance (s) in a particular reach [that is, d(SPI)/ds>0], erosion might be expected, and vice versa for deposition. The research included all reaches in the watershed with areas greater than 10 hectares. Across the watershed, reaches with d(SPI)/ds>0 have histograms of reach-average E shifted to the right compared to reaches with decreasing SPI, as expected, but d(SPI)/ds and E are nevertheless poor predictors of each other. Small flow paths favored channel erosion (E>0) while large paths favored deposition (E<0). Mapped differences between 2006 and 2017 DEMs showed that stream channels tended to straighten between 2006 and 2017, in line with the observations of Kochel et al. (2015).

Muncy Creek, sediment, erosion, Stream Power Index

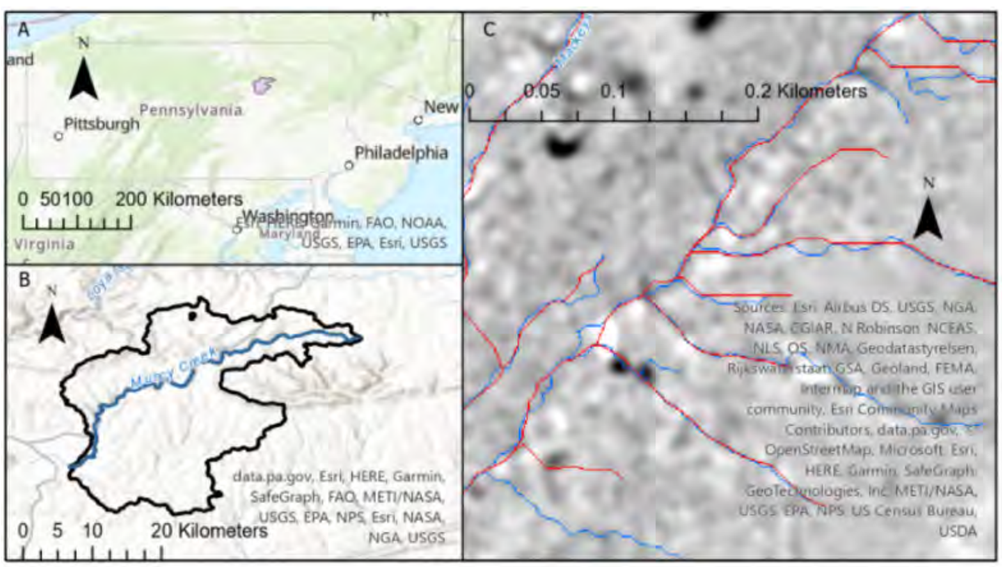

Figure 1. Panel A: location map showing location of Muncy Creek watershed within Pennsylvania, USA (in pink). Panel B: Topographic map showing the watershed area and Muncy Creek. A black dot near the northernmost point in the watershed is the location of panel C. Panel C shows the 2006 flow paths for this site in blue, and the 2017 paths in red. Paths are plotted on top of the E layer, so that pale areas represent erosion and darker areas represent deposition.

RUSTY CRAYFISH (FAXONIUS RUSTICUS) DIURNAL/NOCTURNAL DIET ANALYSIS WITHIN STANDING STONE CREEK

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We examined Rusty Crayfish (*Faxonius rusticus*) within Standing Stone Creek to evaluate nocturnal and diurnal diet during the years 2022 and 2023. We have already dissected and analyzed samples from spring, summer, and fall of 2022 and winter of 2023. Samples from the spring, summer and fall of 2023 are collected and in the process of being dissected and analyzed. Samples were collected during respective 1 PM and 1 AM time periods that correspond with each season of the year within the same day. Rusty crayfish had an increase in stomach contents during the nighttime as compared to the day. This trend was relatively clear across all seasons of the year. Males contained slightly more stomach contents than females during the daytime sampling period. Diets that were analyzed showed small trends which included a large amount of mayflies in the spring and a relatively diverse diet in every season following consisting of plant material, fish scales and bones, and many types of macroinvertebrates. Nighttime samples revealed more macroinvertebrates but there were also more diet samples that were analyzed. Plant material was more common in stomach contents during the summer and fall seasons when aquatic vegetation was the most plentiful. Another component we are adding to the data is how many gastroliths are found and during what season are they the most abundant. The presence of gastroliths is relevant in observing trends in rusty crayfish molting cycles. This study aids in understanding of the impact of invasive crayfish on stream ecosystems.

Rusty Crayfish, Diet Analysis, Stream Ecosystems

ANTIMICROBIAL RESISTANCE IN LOCAL WATERS AND SOILS

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We live in a microbial world. The soils and waters of Pennsylvania are home to an uncountable number of bacteria, the vast majority of which pose no threat to human or animal health. However, some of these bacteria carry genes that make them resistant to the antibiotics we use to treat infections. Antibiotic resistance is naturally occurring in many bacteria but the prevalence of resistant bacteria in the environment can be influenced by human actions (agrochemical runoff, drugs released into waterways because current sewage treatment does not remove them from the water). Horizontal gene transfer makes it possible for noninfectious species to transfer antibiotic resistance genes to bacteria of clinical concern. Antibiotic resistant bacteria caused nearly 3 million infections and 36000 deaths in the US in 2019 (CDC report). The present study sought to determine the diversity of antimicrobial resistance (AMR) genes in streams and soil surrounding the Bucknell University campus, as surveillance of antimicrobial resistance is managed minimally. Additionally, we determined the percentage of the population in each sample resistant to tetracycline and assessed community metabolic diversity. PCR was used to determine if the eDNA from River Run, Miller Run, Buffalo Creek, Limestone Run, and the Susquehanna River contained a range of genes known to regulate antibiotic resistance. Most of the samples contained genes to several of the AMR genes, including resistance to antibiotics that target cell wall synthesis, protein synthesis, and DNA synthesis. Of the five locations, using data from both water and soil samples, the Susquehanna River contained the greatest diversity of genes for antibiotic resistance. River health impacts the well-being of society; therefore, it is important to study the presence of antibiotic resistant genes in the local environment.

Antimicrobial resistance, Susquehanna River, AMR genes, Metabolic diversity

WHAT IS CONTAMINATING STREAMS IN UNION COUNTY?

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Our lab, in collaboration with the Buffalo Creek Watershed Alliance, monitored the water quality in Buffalo Creek, as well as worked to determine the source of bacterial pollution within the watershed. We collected samples from 13 sites, and did so 5 times following PA DEP collection protocols as well as their established limits during analysis. Laboratory work using the water samples collected included nutrient testing, turbidity, total suspended solids, and bacteria plating. We simultaneously extracted DNA from fecal matter belonging to swine, cow, horse, goose, chicken, human, and dog, as well as extracted DNA from the water samples. We then used a Polymerase Chain Reaction (PCR) machine to amplify the extracted fecal DNA, and ran gel electrophoresis on manure samples to establish the specific animal primers match correctly to their own markers. Ultimately there is still work to do in regards to the primers, as our processes likely need to be altered to ensure we are obtaining the most accurate and viable results.

In addition, we obtained Nutrient Management Plans (NMPs) from the Union County Conservation District Office (CCD), which we dissected and organized the offered information into various spreadsheets. From the dissected plans, we were able to track all of the imports and exports of manure within Union County, as well as find the exact parcel PINs of land where the reported amount of manure would be placed. This offers insight into the sources for the bacterial pollution present in the waterways, especially the presence of E. coli due to its typical residence in the gut of animals.We created three spreadsheets for the transactions of chicken, cow, and swine manure. The information was obtained from 46 plans, with poultry holding the largest quantity of manure moved, then swine, then cow. All of the data for the current year was collected using these plans, and are now compacted and thoroughly organized into these spreadsheets. This geographical and quantitative information will be used to map Union County based off of manure locations, and we will be able to determine the proximity of these fields to our sampling sites.

Though there is more work to be completed involving microbial source tracking and PCR testing on the water samples, as well as manure application mapping within the county, our research well establishes the abundance of bacteria present in Buffalo Creek waterways. This work is focused on the improvement of community standards, and by working with the BCWA we will aid in spreading information about areas impaired for recreation and establish goals for repair and continue to contribute to the long-term monitoring of this watershed.

Microbial Source Tracking, Geographical Information Systems

PRELIMINARY DETERMINATION OF METAL CONCENTRATIONS IN WOLF SPIDERS

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The concentration of metals in indicator species, such as wolf spiders, is being studied to determine if metals can be detected to give an indication of the possible bioaccumulation of metals in the food chain. Wolf spiders are common in highly disturbed and degraded habitats as well as riparian zones where they occupy positions within detrital, terrestrial, and aquatic food chains. They also engage in both cannibalism and intraguild predation. These ecological characteristics make them good candidates for tracing food-chain pathways for environmental metal bioaccumulation and biomagnification. Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) was used to determine twenty-one different metal concentrations across several genera of wolf spiders that vary in size and diet. Metal concentrations in spiders collected at sites along the Susquehanna River in Pennsylvania, near a wastewater treatment plant directly downriver from a coal-fired power plant, were compared with metal concentrations in spiders collected from reference sites away from the river or point sources of potential pollution (agricultural fields). The spiders were collected, dried, weighed, digested in acid, diluted and then analyzed by ICP/MS for the concentration of twenty-one different metals including antimony, arsenic, barium, cadmium, chromium, copper, lead, selenium, strontium, and zinc. Preliminary results (in μg/g spider weight) indicate significant differences in some metal concentrations across some sites and significant differences in metal concentration among different wolf spider species within single locations. Due to high variance in metal concentration among wolf spider genera and sites, additional spiders are being analyzed to increase sample sizes and to examine differences across age and sexes of spiders.

bioaccumulation, ICP/MS

SHALE GAS DEVELOPMENT AND WASTEWATER SPILLS AS A DRIVER FOR BIOLOGICAL CHANGES IN SECOND-ORDER STREAMS OF NORTHCENTRAL PENNSYLVANIA

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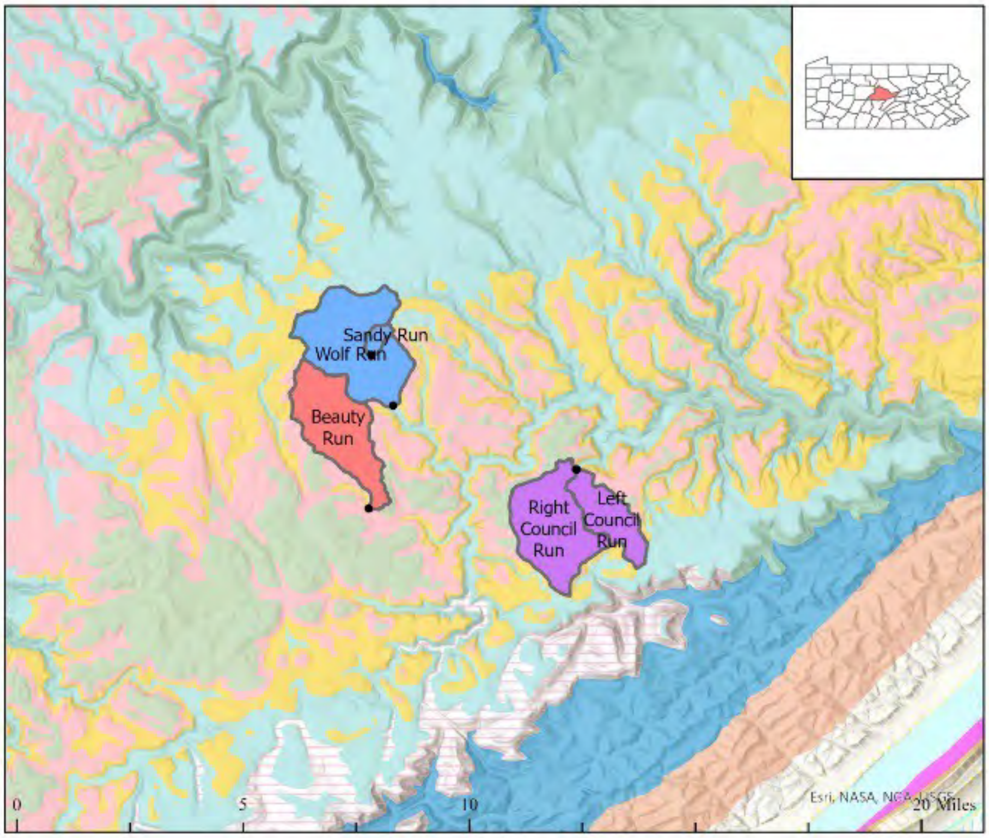
Shale gas development, which targets unconventional formations using horizontal drilling and hydraulic fracturing, has sparked controversy over its environmental impacts. Concerns surrounding water resources have developed over potential releases of saline wastewater or fracking fluids into early order streams via wellpad spills or poorly constructed impoundments. This study seeks to elucidate how spills of shale gas wastewater in addition to shale gas development may alter stream chemistry and biological communities of fish and macroinvertebrates in the northcentral region of Pennsylvania. Northcentral Pennsylvania was selected to isolate effects of drilling since it has minimal confounding land uses like agriculture and major roads. Second-order streams within HUC-12 watersheds were selected for water sampling based on whether upstream conditions contained: i) unconventional drilling including impoundment and spill violations; ii) unconventional drilling with impoundment violations only; iii) unconventional drilling with no documented violations; or iv) no history of drilling or violations. Water samples were analyzed for major cations and anions, including species indicative of shale gas wastewater (Br, Cl, Ba, Sr). Strontium isotopic compositions (87Sr/86Sr) were used to seek evidence for the presence of wastewater brines unique to the Marcellus formation. Current directions involve identifying more recent wastewater spills in the watershed as well as beginning macroinvertebrate and fish sampling protocol. Comparing assessments of biological integrity to ion concentrations and geochemical tracers of potential shale gas-related impacts can inform how shale gas development and shale gas wastewaters may be impacting the ecosystem dynamics of early order streams.

Stream geochemistry, Unconventional drilling and hydraulic fracturing, Wastewater spills , Macroinvertebrates


Sandy Run
Wolf Run
Beauty Run
Right Council Run
Left Council Run
0
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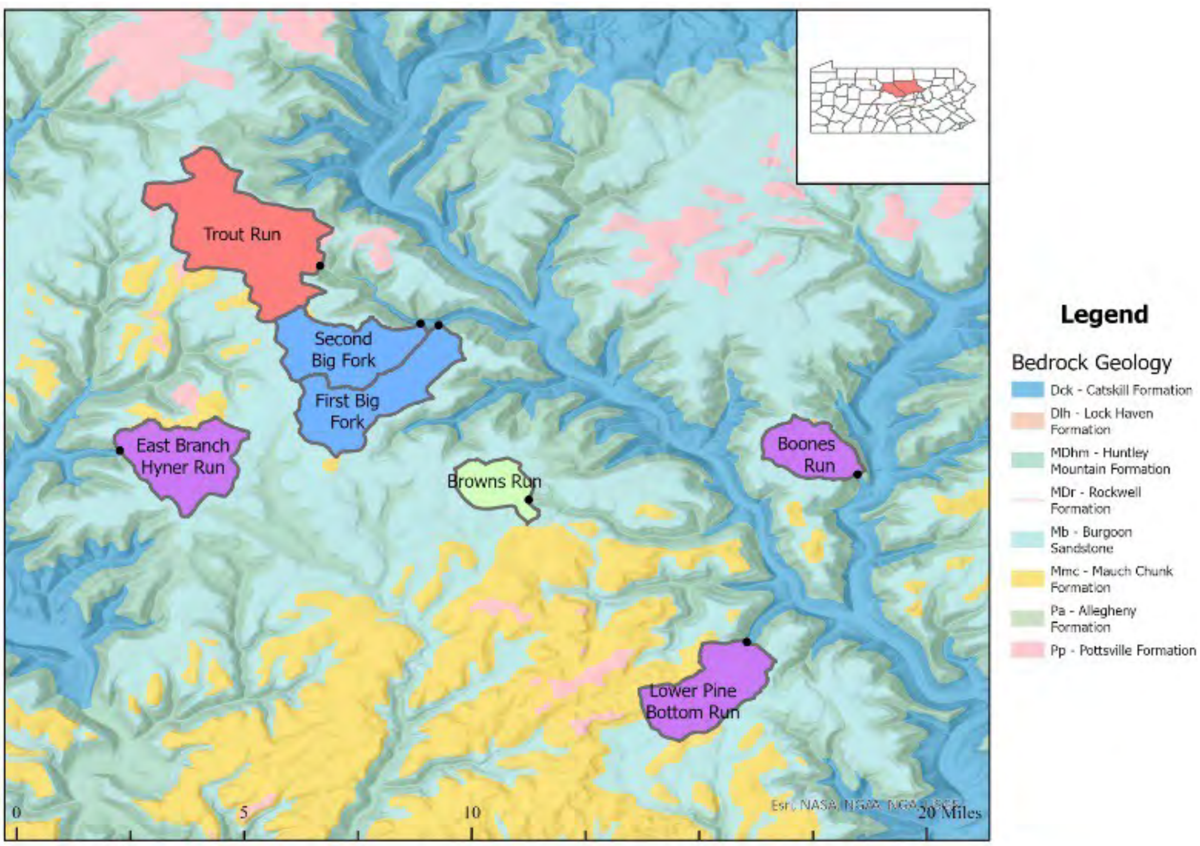
20 Miles


Trout Run
Second Big Fork
First Big Fork
East Branch Hyner Run
Browns Run
Boones Run
Lower Pine Bottom Run
0
5
10
20 Miles
Legend
Bedrock Geology
Dck - Catskill Formation
Dlh - Lock Haven Formation
MDhm - Huntley Mountain Formation
MDr - Rockwell Formation
Mb - Burgoon Sandstone
Mmc - Mauch Chunk Formation
Pa - Allegheny Formation
Pp - Pottsville Formation

GENDER GAP IN CONSERVATION BIOLOGY IN JAPAN

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The Global Gender Gap Index Report evaluates countries based on four attributes; economic participation and opportunity, educational attainment, health and survival, and political involvement. The higher the ranking on each section shows the smaller gender gap of the country in that category. Japan ranked 116th out of 146 countries in 2022 and placed 125th out of 146 countries in 2023, ranking down nine places. While Japan has greater gender gaps in economic participation and political empowerment, there are little smaller gaps in the educational attachment and health and survival category. However, at a glance, OECD Education reports that only 27.6% of women are attending a Bachelor's degree in Science, Computing, and Mathematics, suggesting gender biases within educational fields. Our lab at Bucknell studies conservation of amphibians, and conservation biology is one of the male-dominant fields in Japan. Thus, the aim of this project was to investigate possible factors contributing to the gender gap in the field of wildlife conservation and environmental studies in Japan. We hypothesized that (1) Japanese society and surrounding communities would negatively impact young Japanese women's decision to pursue wildlife conservation as a university major and (2) Japanese women working in the field would perceive more significant challenges associated with their gender than men. To test these hypotheses, we traveled to Japan to collect data during the summer of 2023. We interviewed five women working in wildlife conservation and environmental studies, asking them specific questions about how they got to these positions and the struggles they may have faced along the way. We also visited middle and high schools in Japan and conducted surveys to investigate possible factors contributing to the gender gap in their interests and perceptions about the field among young Japanese people. Our preliminary results tend to reject our hypotheses. Four out of the five interview respondents felt that men were facing greater challenges working in the field and with the society in general. For example, one stated that it is more difficult for men to take days off for family-related purposes (e.g., child care) because "Men are expected to bring money to take care of the family." Another woman stated that it's actually harder to do field work as local people tend to be more suspicious about strange men. Our data also shows that students, especially women students, feel supported by their society, teachers and families to go into their area of interests. Our data overall suggest that Japanese women do not perceive societal and systemic challenging preventing them from pursuing the careers in the field of wildlife conservation and environmental studies. A memorable comment that one of the students stated was that they "don't think it is a good idea to get too close to western gender consciousness." Our results overall suggest that the gender gap in Japan is caused by active choices of women (and men) and those women who made a choice to work in the field are thriving.

Women in STEM, Gender gap

THE EFFECTS OF EASTERN HEMLOCK AND POND DRYING ON POND-BREEDING AMPHIBIANS

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Forest ecosystems are comprised of organisms that occupy different trophic levels, all of which affect one another. In Pennsylvania, the Eastern hemlock tree, *Tsuga canadensis*, is a key player in food webs because it affects soil chemistry, carbon, and nitrogen content, as well as providing shading for species in the understory. Since *T. canadensis* is undergoing a population decline due to the invasive wooly adelgid, understanding how its loss affects other species is crucial. Using outdoor pond mesocosms, we created simple food webs by adding zooplankton, phytoplankton, and two amphibian species, larval wood frogs (*Lithobates sylvaticus*) and spotted salamanders (*Ambystoma maculatum*). Then we manipulated leaf litter composition (majority eastern hemlock detritus or majority mixed detritus) and the rate of pond-drying. We measured treatment impacts on abiotic factors (pH, conductivity, dissolved oxygen, temperature) and quantified mass, developmental stage, and survival of wood frogs and spotted salamanders. Using linear regression and mixed model analyses, we found an interaction between increased drying and the leaf litter treatment, in that wood frog mass decreased with 10, 50 and 60% drying in the mixed leaf litter treatment. Wood frog survival did not differ between treatments, perhaps due to the asynchronous hatching between the two species. Our findings suggest that ponds will dry faster because of the loss of dependable shade coverage from T. canadensis, resulting in decreased amphibian performance due to more rapid pond-drying from increased evaporation.

amphibians, mesocosms, ephemeral ponds, Eastern hemlock

QUICK AND DIRTY FIELD ID: HOW ACCURATE ARE WE AT IDENTIFYING SCULPIN TO SPECIES 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. Sculpin are small-bodied fish, making it 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 field identifications are for the Loyalsock Creek, Pine Creek, and Kettle Creek watersheds. Field identification was compared to a more thorough laboratory examination of vouchered specimens which included additional traits. We are determining which traits overall are the most helpful to accurately identify specimens, how much variation occurs within each species for each drainage, and are developing a field identification protocol based on this information. We also plan to develop a more detailed species distribution map for these drainages.

Freshwater Fish, Lotic, Sampling Methods, Species Distributions

UP AND DOWN: HOW ARE BROOK TROUT POPULATIONS REACTING TO FLUCTUATING TEMPERATURES IN THIS CHANGING CLIMATE?

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Climate change has been a hot topic of discussion over the past decade, and it's taken a toll on our planet in terms of its ecology and environment. Now more than ever, it's critical to understand the relationship between water temperatures rising and the response of aquatic freshwater species. Within Pennsylvania, native Brook Trout (*Salvelinus fontinalis*) populations have been on the decline due to increasing temperatures in cold water streams. Temperature and Brook Trout populations were sampled by Susquehanna University's Freshwater Research Institute from 2011 to 202 0 in the Loyalsock Creek watershed. This data will be analyzed to determine temperature effects on Brook Trout populations within this watershed. We plan to expand this effort to the State of Pennsylvania. Brook Trout are great indicators of a heathy ecosystem in terms of cold water and pristine habitats. However, climate change has already taken its toll in terms of decreasing Brook Trout populations in Pennsylvania. At this rate, we need to manage not just the fish populations but their habitats as well. The overall health of freshwater ecosystems are declining and the alteration of these ecosystems is having an effect on the species within them. Actions are needed for these populations within Pennsylvania because the possibility that they might not be around for much longer is rapidly increasing.

Brook Trout, Climate Change, Freshwater, Temperature

CHARACTERIZING THE DISTRIBUTION OF THE JAPANESE GIANT SALAMANDER IN SMALL, UPPER-REACH TRIBUTARIES DISCONNECTED BY HYDROELECTRIC DAMS USING ENVIRONMENTAL DNA

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The Japanese giant salamander (*Andrias japonicus*) is currently listed as Vulnerable by both the International Union for Conservation of Nature and the Japanese Ministry of the Environment, with its population continuing to decline. One of the major threats is human-made dams, which cause habitat fragmentations within a watershed, making isolated populations even more vulnerable to local extinction. The aim of this study is to characterize the distribution of *A. japonicus* in the upstream tributaries that have been disconnected from the main river stems, the known habitats for this species, for over 40 years by three large hydroelectric dams in Hyogo Prefecture, Japan, using environmental DNA (eDNA). Environmental DNA surveys are non-invasive (do not disturb animals or their habitats) and much more efficient in detecting the presence of the target species than traditional field surveys. During summers 2021, 2022, and 2023, we collected 73 total water samples from 16 different tributaries that feed into the three different dams (Kurokawa Dam: 23 samples from 6 tributaries; Tataragi Dam: 21 samples from 5 tributaries; Ikuno Dam: 29 samples from 5 tributaries). We conducted water filtration and DNA extraction on site and brought the extracted environmental DNA to Bucknell University where we ran quantitative PCR to detect the presence and to estimate the concentrations of A. japonicus eDNA in each site. We obtained A. japonicus liver tissue samples from San Antonio Zoo to make DNA standards (serial dilutions from 10-1 to 10-8 ng/µL). Although we did not see any salamanders during our sampling, our results show that there are 13 out of 23 eDNA positive sites for Kurokawa Dam tributaries, one out of 21 eDNA positive sites for Tataragi Dam tributaries, and 10 out of 29 eDNA positive sites for Ikuno Dam tributaries. We are still analyzing two more tributaries from Ikuno Dam. These results suggest that giant salamanders have persisted in those isolated habitats over several decades. Given the condition of many tributaries, their long-term survivability is questionable, begging for a conservation action plan.

Japanese giant salamander, environmental DNA, hydroelectric dams, habitat fragmentation

PHYSIOLOGICAL ANALYSIS OF NITROGEN METABOLISM IN A NOVEL CYANOBACTERIUM, PSEUDANABAENA STRAIN SR411, ISOLATED FROM THE SUSQUEHANNA RIVER.

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Cyanobacteria are a major contributor to primary productivity and oxygen production within freshwater aquatic ecosystems. Cyanobacteria utilize a light harvesting complex called the phycobilisome (PBS) to expand the wavelengths of light available for photosynthesis. The phycobilisome contains phycobiliproteins; allophycocyanin (AP), phycocyanin (PC) and phycoerythrin (PE) that allow for the absorption and transduction of light in different environmental light conditions.

Nitrogen is an essential nutrient used in amino acid synthesis and biomolecule production. Cyanobacteria can uptake nitrogen through environmental nitrates or ammonia or through the process of nitrogen fixation by which atmospheric nitrogen (N2) is converted to ammonia (NH3). The phycobilisome is a sink for nitrogen and other essential nutrients as it can comprise up to 50% of cellular proteins in cyanobacteria. In the absence of nitrogen, the breakdown of the phycobilisome may occur to conserve nutrients and harvest cellular nitrogen.

The sequenced genome of the SR411 strain of *Pseudanabaena,* isolated from the Susquehanna River, contains nitrogenase synthesis genes (NifHDK) and should therefore have the ability to fix atmospheric nitrogen. The ability of SR411 to survive nitrogen starvation has yet to be studied. In order to investigate the ability of SR411 to fix nitrogen, we compared bacteria starved of and supplemented with nitrogen and measured its growth and phycobiliprotein levels over time. Additionally, we compared the growth and phycobiliprotein levels of WFMT1A and *Fremyella diplosiphon* UTEX 481, two cyanobacteria known to produce nitrogen fixing heterocyst structures, to determine if nitrogen starvation altered the development and survival of other nitrogen fixing cyanobacteria.

Nitrogen Fixation, Microbial Genetics, Cyanobacteria, Susquehanna

THERMAL STRESS ON SCULPIN AND THE TROPHIC SYSTEM IN CONSTRUCTED STREAMS

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Climate change can cause warmer water temperatures, more extreme flows from more frequent and stronger storms, or changes to the amount of snow and timing of snow melt. Because water temperature can result in changes to organism behaviors, changes in water temperature can impact systems on a population and ecosystem level. Understanding the implications of increasing water temperature on a small scale can lead to more direction in conservation objectives. The intention of this study is to identify physical and behavioral measures of thermal stress on slimy sculpin (*Cottus cognatus*). Studies are conducted using novel fully variable stream channels set along a temperature gradient of 10^{C}, 16^{C} and 22^{C} modeling the severity of climate change. We will investigate how slimy sculpin react to changing temperature regimes through changes in body condition in length, weight, and the distribution of individuals at the conclusion of each trial. The study will also explore shifting trophic cascades via macroinvertebrate community composition, leaf decomposition, and algal growth. Through modeling thermal stress in constructed stream channels, we aim to better understand how slimy sculpin are directly impacted and how trophic cascades are modified in response to changing thermal regimes. In addition, we hope these experimental stream channels will act as an innovative model for studying climate change in the laboratory where we can adjust slope, hydrology, and thermal effects.

Constructed Stream Channels, Sculpin, Climate Change, Trophic Cascade

SILK AND PREDATOR SEX MEDIATED ANTIPREDATOR RESPONSES AMONG NEUSTONIC PREY OF THE SEMI-AQUATIC FISHING SPIDER *DOLOMEDES TRITON*

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The semi-aquatic fishing spider, *Dolomedes triton*, deposits hydrophobic silk on the water as well as on emergent rocks and vegetation. Silk cues, although used primarily for intraspecific communication, have the potential to alert prey to their presence and mediate predator-prey interactions. We compared activity level, space use, and predation avoidance of two neuston-dwelling prey species: the water strider *Aquarius conformis* and the wolf spider *Pardosa milvina* in the presence or absence of *Dolomedes* and/or its associated silk. We measured Aquarius (n=152) and *Pardosa* (n=158) behaviors under four conditions: 1) containers with a live predator and its silk, 2) containers with silk cues only from *Dolomedes*, 3) containers with *Dolomedes* and no silk, and 4) control containers without *Dolomedes* or silk. We measured time on the water surface, emergent surfaces, and time climbing artificial vegetation across predator and silk treatments. We also measured time spent moving and attempted and successful predation among treatments containing a live *Dolomedes*. We found significantly lower activity for both *Pardosa* and *Aquarius* when live *Dolomedes* were present and both prey showed significantly stronger responses to female *Dolomedes* than males. Female *Dolomedes* were significantly more dangerous predators for *Pardosa* and *Aquarius*, killing more prey than males. Silk mediated few *Aquarius* behaviors, but predator silk did significantly induce climbing behavior and water avoidance in *Pardosa*. *Dolomedes* strike frequency toward *Pardosa* was significantly lower when silk was present and strike latency for Aquarius was significantly higher in the presence of predator silk. Our results indicate that both species show sex-specific predator avoidance behaviors and silk mediates some behavioral responses in both prey species but in different ways.

neustonic prey, hydrophobic silk, antipredator response, predation

WOLF SPIDERS LEARN TO USE BEACONS AND ASSOCIATIVE CUES TO NAVIGATE TO DRY TARGETS UNDER SIMULATED FLOOD CONDITIONS.

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The wolf spider, *Tigrosa helluo*, burrows at the edges of lotic systems. These spiders range from their burrows during foraging bouts but return daily. They may also be displaced during rain or flood events which may change micro-landscape features around burrow entrances. Previous studies have shown that these spiders use environmental edge or boundary features (reference frame landmarks) to learn the location of a dry target in flooded arenas; however, the relative importance of different types or numbers of landmark cues during spatial navigation remains unknown. We used an open water arena and recorded the ability of adult female spiders to find and enter a dry target cup among flooded cups that varied in one or more landmark features. We measured variation in spatial learning by measuring time to target with no landmark (control), with a beacon (a landmark that is part of the dry target), with an associative cue (a landmark associated with a specific navigational action), and with both a beacon and an associative cue (N=92, n=23 per landmark cue treatment).

For each treatment, we tested spiders for five trials each on four consecutive days, with the last trial on the fourth day having an altered target location, totaling 19 training trials and one reversal trial (1,840 trials). Spiders took significantly less time to find the target over subsequent trials within a day and learned more quickly when landmark cues were present, but we found no difference in the type or number of landmark features in target acquisition time. After learning a target location, moving the landmark (reversal trial) significantly increased target acquisition time among landmark treatments relative to the control. Results indicate that wolf spiders can use visual beacon and associative cue landmarks both alone and when in combination and that performance improves across trials when landmarks are present.

APPLICATION OF MACHINE VISION IN THE MEASUREMENT OF TURBIDITY

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The measurement of turbidity serves as a key indicator of water quality and purity, crucial for informing decisions related to industrial, ecological, and public health applications. As existing processes require both additional expenses and additional steps to be taken during data collection, we seek to generate accurate estimations of turbidity, measured in Formazin Nephelometric Units (FNU), from underwater images. Such a process could give new insight to existing datasets, such as the turbidity levels different plants or animals will tolerate, or provide a cheaper alternative to measuring turbidity when high accuracy is not necessary. This will be achieved through the use of machine vision to create an image classification or regression model trained on image data and their corresponding turbidity values recorded from a turbidimeter using nephelometry measures. Data will be collected in the lab in flowing and standing water mesocosms. Varying amounts of sediment ranging from 0-55 FNU will be used, along with substances that produce visual differences, such as ink, without affecting turbidity. Data will also be collected in the field with different conditions, such as lighting, water depth, substrate, and ambient turbidity. Two categories of image will be collected, one with a Secchi disk in the image, and one without. Early testing has shown promise that the images with Secchi disks can create an accurate model, and this is likely to improve with increased model training. As of now, no testing has been conducted with images not including Secchi disks, but we plan to test the versatility and accuracy of a model trained on native substrate images. Such a process could provide a cost-effective way to measure turbidity without the acquisition of new equipment, and could ideally be applied retroactively to existing data, saving the time required to collect new data.

Turbidity, Machine Vision

ACCESSIBILITY OR ENVIRONMENTAL CONSERVATION? EVALUATING RELATIONSHIP BETWEEN ENVIRONMENTAL PROTECTION AND HIKING TRAILS ACCESSIBILITY VIA LIDAR & UAV

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Binghamton University Nature Preserve spans 190 acres of land, with a notable 20-acre wetland, serving a multifaceted purpose. It is dedicated to preserving the ecological integrity of this landscape, fostering biodiversity, and facilitating research and environmental education. Furthermore, it serves as a recreational space for students, enhancing the bonds between the campus and the neighboring community.

This research focuses on Binghamton University's nature preserve as a case study to explore the intricate balance between two vital objectives: ensuring equal access for all user demographics, including people with disabilities and seniors, while safeguarding the ecosystem services it provides. To achieve these objectives, the study employs a diverse array of public engagement methods, encompassing surveys and community mapping to gather valuable insights from diverse stakeholders. Additionally, the research integrates cutting-edge technology, such as drone flights and remote-controlled vehicles equipped with iPhone LiDAR sensors to acquire comprehensive data on trail conditions and the surrounding environment.

The innovative fusion of community input and high-tech data collection empowers a data-driven approach to environmental management, offering the potential to advance accessibility and sustainability simultaneously. By bridging the gap between these two fundamental considerations, this study not only enhances the Binghamton University nature preserve, but also paves the way for the formulation of novel inclusive and environmentally responsible public policies, and potentially transforming the management of natural preserves nationwide.

HERBICIDE EFFECTS ON EARTHWORM (*LUMBRICUS TERRESTRIS*) SEED SELECTION AND GERMINATION.

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The earthworm, *Lumbricus terrestris*, frequently buries seeds (drawdown) and may predate upon the seed or the radicle as it germinates; however, it is unknown whether herbicides can affect worm seed preference and drawdown behavior or how these interact with germination probabilities. We tested the effect of four herbicide treatments: glufosinate (Surmise Pro®), glyphosate (Hi-Yield Killzall®), both, or neither (control) on mortality, weight gain, and drawdown behavior as well as the effect of herbicide and the presence or absence of a worm on the germination of barley (*Hordeum vulgare*) and einkorn (*Triticum monooccum*) (n=25-26 subjects per treatment; N=255). Each earthworm was given a simultaneous choice between four water-treated seeds (control) and four herbicide-treated seeds (on the herbicide-sprayed half of the container) or eight water-treated seeds in the double control. Germination, the number of radicles or shoots present, was recorded according to treatment side (herbicide-treated or control). In treatment containers with no worm present, only germination was recorded. Drawdown and germination were recorded every four days over a 36-day period, and seeds were removed from the soil surface and new seeds were deposited after every observation period. We found no significant difference in worm mortality across herbicide treatments but found significant treatment side effects for total seeds buried by the end of the experiment. Worms drew down significantly more barley than einkorn, and significantly more seeds were drawn down from the control side of the container than the herbicide-treated side. Fewest seeds were drawn down when seeds were sprayed with both glufosinate and glyphosate. We found significantly reduced weight gain in all herbicide treatments compared to the control. Herbicide application can affect the seed choice of earthworms that aid in bioturbation and burial of seeds, effectively altering the impact of worms on agriculture.

Herbicide, anecic, diet, germination

EFFECTS OF STORMWATER RUNOFF ON DISSOLVED NUTRIENTS CONCENTRATION

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Nutrients within aquatic systems are vital for the overall productivity and diversity of the ecosystem: however, an excess of nutrients in these systems can cause detrimental effects. Runoff from not only urban areas, but also rural agricultural areas has become a point of focus for researchers who wish to find solutions to excess nutrients in waterways. This project was done to determine if rainwater runoff into Fishing Creek, a stream located in Bloomsburg, Pennsylvania, causes a significant influx of nutrient deposition. An increase of nutrient deposition within this fifth order stream may be likely to cause complications further downstream, such as oxygen depletion or reduction of species diversity.

ERT, SRT AND DRILLING LOGS TO INVESTIGATE THE HYDROGEOLOGICAL HETEROGENEITY OF AN AQUIFER IN CEER, SUSQUEHANNA UNIVERSITY.

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The understanding of aquifer hydrogeological heterogeneities facilitates the crucial role they play in how groundwater flows and how solute transport disperses. Geophysics, a non-invasive tool, has become an integral part of hydrogeological investigations for characterizing aquifer heterogeneities. This study provides an overview of the use of multiple geophysics methods, in addition to three drilling logs, in the investigation of the heterogeneity of an unconfined aquifer at the Center for Environmental Education and Research (CEER), Susquehanna University. Both Electrical Resistivity Tomography (ERT) and Seismic Refraction Tomography (SRT) complemented by drilling logs and geological mappings, were used in this study. Eleven ERT profiles and eleven SRT profiles, in addition to three drilling logs, were used to investigate the hydrogeological composition of this site. ERT clearly showed groundwater preferential flow detected in the middle of the surveyed site, while SRT revealed four distinct geological formations between the ground surface and the bedrock. Drilling logs matched the data with layers of silt, clay, and sandy-gravel zones. The integration of both geophysical techniques with the drilling logs provides a more accurate representation of the heterogeneity of the aquifer.

Aquifer Heterogeneity, ERT, SRT

BATHYMETRIC AND SEDIMENT ACCUMULATION OF HALFWAY LAKE, PA USING GROUND-PENETRATING RADAR

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Ground Penetrating Radar (GPR) has emerged as a highly effective method for waterborne subsurface investigations, providing accurate results without causing negative impacts. This study utilized GPR to survey Halfway Like, a manmade reservoir located in Mifflinburg, Pennsylvania. The investigation focused on obtaining detailed bathymetry, sub-bathymetry, and sediment volumes within the lake. A 400 MHz transceiver was employed to perform 71 survey profiles, covering the entirety reservoir. To assess the water volume and the total sediment load, contour maps of bathymetry and sub-bathymetry were generated respectively. For all surveys, a custom-designed GPR apparatus was constructed on a two-person inflatable raft, equipped with a sub-metric GPS and a 400 MHz antenna. The collected data was processed using mapping software, to generate contour maps and 3D models of the site and provide detailed information about the lakebed. In an intense literature review on radar wave velocities through saturated lakebed sediment, like that of Halfway Lake, a value of 0.0762 m/ns was found. The sediment volume was calculated to be 7897.224 m^3, while water volume was calculated to be 19704.963 m^3. The sedimentation rate over the last 100 years has been also estimated to be approximately 87.747 m^3/year. Moreover, the survey profiles reveal the original stream channels of both Rapid Run and Halfway Run. At the point where the two stream channels originally met, the reservoir reaches its greatest depth, measuring 2.5 m. Lastly, the survey profiles display a notable difference in sediment types, with sand accumulation on the beach side and naturally occurring organic sediment in the deeper parts of the reservoir.

GPR, Lake Bathymetry, Lacustrine deposit,

THE FORMATION OF A NEW LEGACY ISLAND IN THE SUSQUEHANNA RIVER NEAR DALMATIA, PA

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A recently produced island in the mainstem of the Susquehanna River near Dalmatia, PA represents a new landform tentatively described as a "legacy island". This island is situated on the Keyser and Tonoloway Formations (Silurian-Devonian) near McKees Half Falls. Historical aerial imagery from the Pennsylvania Spatial Data Access (PASDA) website depicts a series of fish weirs spanning the river near Dalmatia from 1939 until 1970. Between 1970 and 1983, a small, vegetated landform develops over one of the fish weirs. Since 1970, the Susquehanna River has experienced many floods related to tropical storms and nor'easters. The floods from 1972 (TS Agnes) and 1975 (TS Eloise) may have been large contributors to the formation of this island. During these floods, the fish weir may have been located near or at the thalweg of the North Branch flow. The weir was an obstacle that caught bedload gravel and sediments. Later floods added sediment to the growing feature. By 1983, high altitude imagery depicts a tiny bar that is vegetated. This bar grows into the small island that today is 68 m long and 35 m wide; it has an area of 165 m2 with a larger surrounding gravel apron (D50 size of 31 mm).

The island soil is vegetated. The soil was examined by drilling two cores until gravel was reached, approximately 1.2 and 1.17 m depth. Grain size of the soil samples (collected in 10 cm intervals) was analyzed using a gravity settling technique. The soil was predominantly composed of sandy loam to loam. Sediments were also analyzed using X-ray Diffractometry (XRD). Elutriated slides of fine sediment revealed a mineralogy of quartz, magnetite, muscovite, kaolinite and illite. Using microscopy, the composition of the sand was determined to be composed of quartz, magnetite, garnet, muscovite, and small rock fragments. Other grains associated with coal waste included hematite, anthracite coal fragments, magnetic slag, and ferric oxy hydroxide flakes. Plastic was identified in the soil approximately 40 cm below the surface. The vegetation on the island consisted of three species of trees: sycamore (42), silver maple (14), and river birch (9). Many of the trees exhibited scarring at 1 to 1.5 m above the soil. An understory composed of forbs and sedges, including Japanese knotweed, smart weed, and stilt grass was also identified. Recent flooding (2011?) has deposited debris dams in the trees at the head of the island.

This island is different from other typical alluvial bar islands in how it formed. It developed from a fish weir and is composed of legacy sediment composed of coal waste and glacial sediments. Fish weirs were known to have been constructed and used by both Native Americans and early European settlers to catch shad and eel. This island is one of several islands known to have formed this way and represents a new form of alluvial bar island formation. The island resulted from two of the greatest floods to affect the region in recent time.

EVALUATING WALLEYE (SANDER VITREUS) SPAWNING EFFORT ON CONSTRUCTED ROCK RUBBLE REEFS IN RAYSTOWN LAKE

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In this study we evaluated the use of constructed rock rubble for walleyes spawning in 2 locations of Raystown Lake. We created custom mesh-covered traps and deployed these in April 2022 to collect eggs during the spawn in 18 different locations at mile markers (MM) 14 and 15 before construction of the reefs. Our pre-construction sampling accounted for a total area of 403.06 m2 for over 2,800 trap-days from April 1st, 2022 to May 6th, 2022. During this time, we collected 49 walleye eggs. Numbers were highest from Apr 15 to Apr 29, with a total of 40 eggs collected. Average water temperature at this time was 10o C (50o F). Non-target collections were dominated by amphipods (scuds) but we also collected a possible Esocid egg, white perch eggs, and a juvenile green sunfish. In April and May of 2023, after the rock rubble reefs were in place, we sampled the same areas again, over constructed reefs and in control areas, to complete this BACI-designed (before-after-control-impact) study.

Our post-construction sampling accounted for a total area of 579.60 m2 for over 4,100 trap-days from March 29th, 2023 to May 15th, 2023 and 1,212 eggs were collected during this time. The highest number of eggs were caught between March 29th, 2023 to April 5th, 2023 with a total of 831 walleye eggs. During this time the average water temperature was 10.5 C° (51°F). Non-target collections were mostly bluegill, darter eggs, and virile crayfish.

With these findings, we hope future habitat restoration for walleye spawning continues to improve so that the walleye fisheries in the lake could depend less on stocking efforts and save management dollars for other needs.

walleye, spawning habitat, Raystown Lake. egg traps

ASSESSING THE EFFICIENCY OF DIFFERENT MESH SIZES FOR MICROPLASTIC RETRIEVAL FROM THE WATERS OF THE CHESAPEAKE BAY

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This study evaluates the effectiveness and efficiency of different net mesh sizes in removing microplastic surrogates from the Chesapeake Bay watershed, aiming to address two essential research questions. Firstly, it investigates the timing of clogging of various net mesh sizes when filtering microplastic surrogates. The time to clogging will affect the maintenance frequency of the mesh which affects the economics and practicality of sieving microplastics either out of the Bay waters or at the end of pipes to prevent microplastics from entering the tributaries. Secondly, it explores the potential utilization of turbidity as an efficient indicator for the removal of physical marine debris, serving as a surrogate measure for microplastic concentration. The significance of this research is underscored by the growing threat of microplastics to marine ecosystems and the local economy, particularly in the Chesapeake Bay region.

In addition to the primary objectives, this research project incorporates a comparative aspect to provide deeper insights into the filtration process. Specifically, it will compare two distinct filtration durations, namely 30 minutes and 40 minutes, to discern any variations in the performance of different net mesh sizes during this extended period. These comparisons will elucidate the trade-offs between filtration rate and flowrate, highlighting the critical role of mesh size in achieving cleaner water.

Preliminary results suggest that there exists a trade-off between filtration efficiency and time. Finer mesh sizes yield cleaner water but require longer filtration periods. An interesting finding is that a slight increase in mesh opening can sometimes yield comparable filtration results. For instance, Polyester 200 μm mesh achieved the same turbidity levels as Polyester 105 μm mesh after 30 minutes, though the latter reached this point earlier but could not sustain the lower turbidity value during extended filtration. These findings offer valuable insights into crafting effective strategies for microplastic surrogate removal in the Chesapeake Bay, ultimately benefiting marine ecosystems and the interconnected regional economy.

microplastics , filtration , maintenance

AUTHOR INDEX

POSTER AND ORAL PRESENTATION

AUTHOR INDEX (continued)

River Symposia

2006 to 2008

From The Branches to The Confluence

October 18-19, 2006

Pennsylvania Abandoned Mine Drainage Remediation

September 28, 2007

The Susquehanna and Agriculture

September 12-13, 2008

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

6th

River Symposia

2012 to 2014

Wasn't That A Mighty Storm! Flooding In The Susquehanna

October 12-13, 2012

A Fragmented Systems - Dams On The Susquehanna

October 18-19, 2013

Science and the River

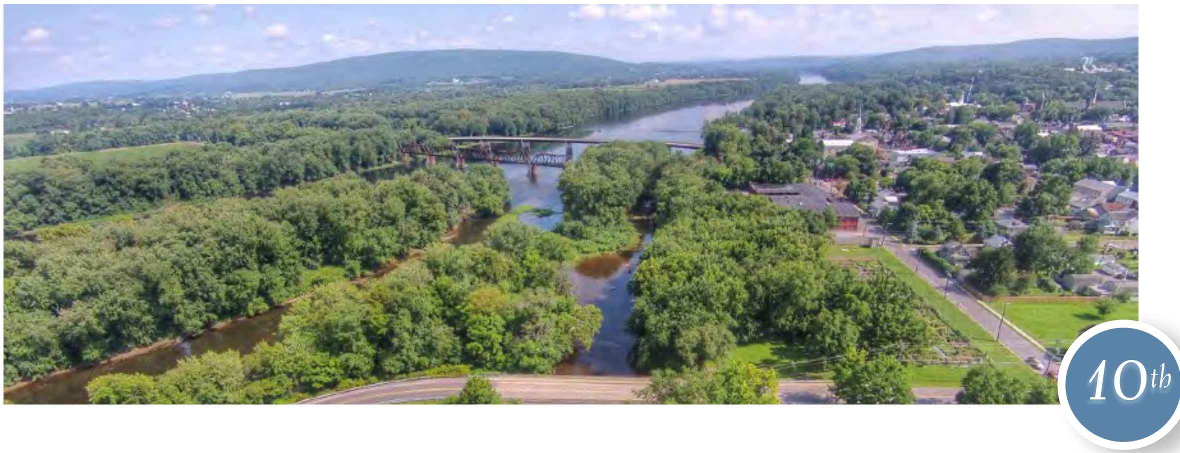
November 21-22, 2014

River Symposia

2015 to 2017

The River, Its Landscape and Our Lives

November 13-14, 2015



A Tale of Two Rivers: The Susquehanna and Delaware

November 11-12, 2016

The Spirit of Two Great Rivers

November 10-11, 2017

River Symposia

2018 to 2020

SCIENCE, CONSERVATION, AND HERITAGE

November 26-27 2018

HEALTHY RIVERS, HEALTHY COMMUNITIES

October 18-19, 2019

WATERSHEDS, ECOSYSTEMS, AND SUSTAINABILITY

November 6-7, 2020

River Symposia

2021 to 2023

Restoration to Resilience: Creating Partnerships

November 5-6, 2021

The River is Everywhere

November 4-5, 2022

Navigating the Flow

November 3-4, 2023

Susquehanna River Heartland Coalition for Environmental Studies

Photo: SRHCES student researchers studying native gastropod communities in the North Branch Susquehanna River at Harding, PA

SRHCES

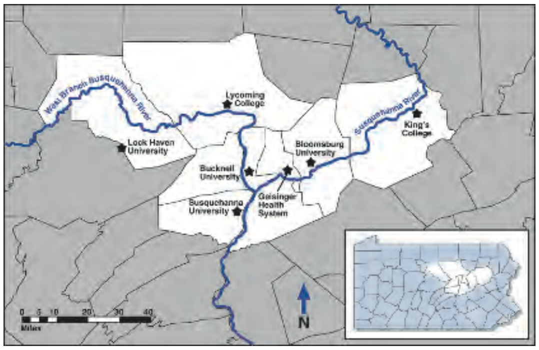
The **Susquehanna River Heartland Coalition for Environmental Studies** has played a major part of the River Symposium since its beginning 18 years ago. Established in 2005, the SRHCES is a unique collaboration of regional universities, environmental agencies, watershed groups, and the Geisinger Health 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
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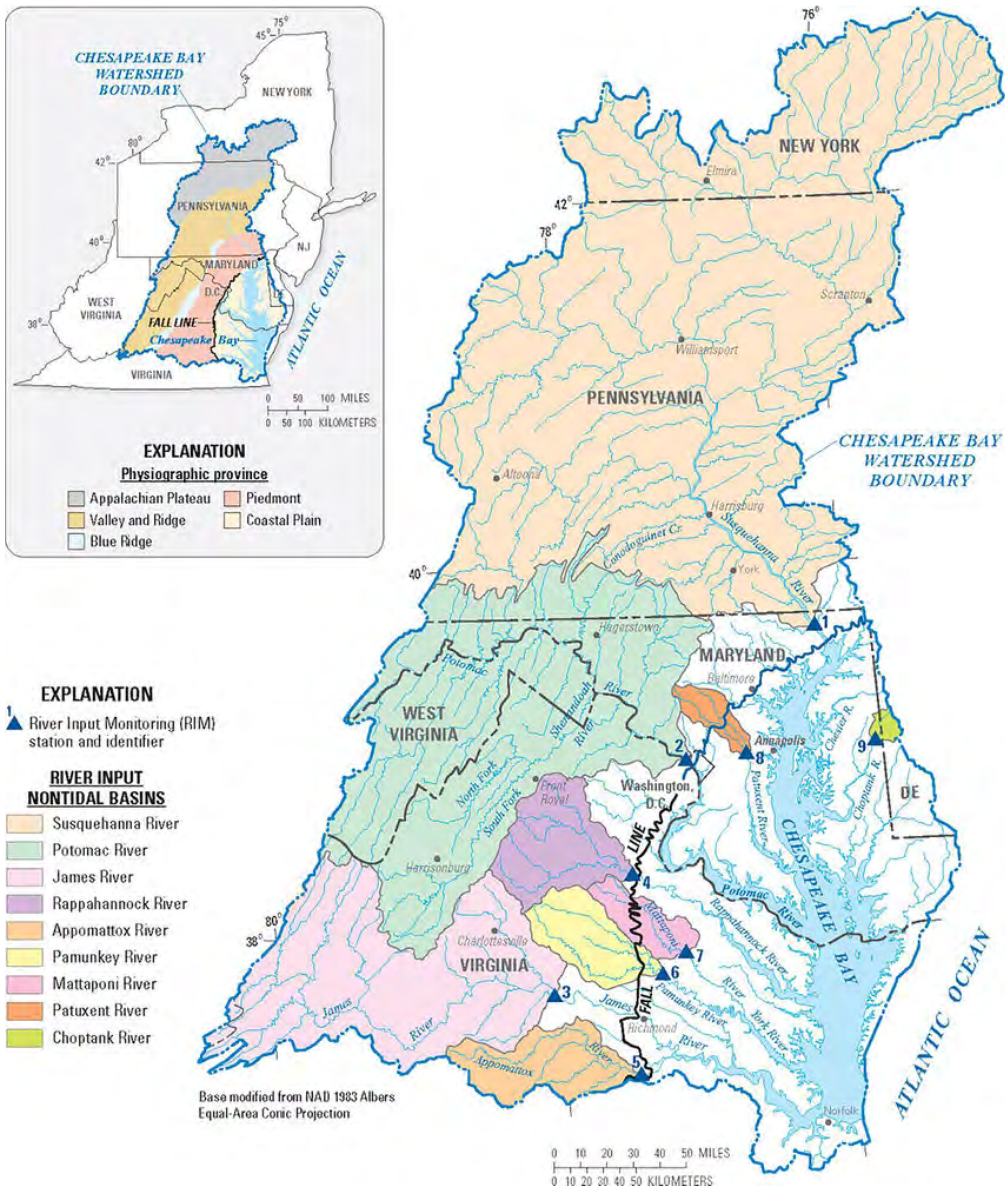
The Chesapeake Bay Watershed



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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18th River Symposium

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