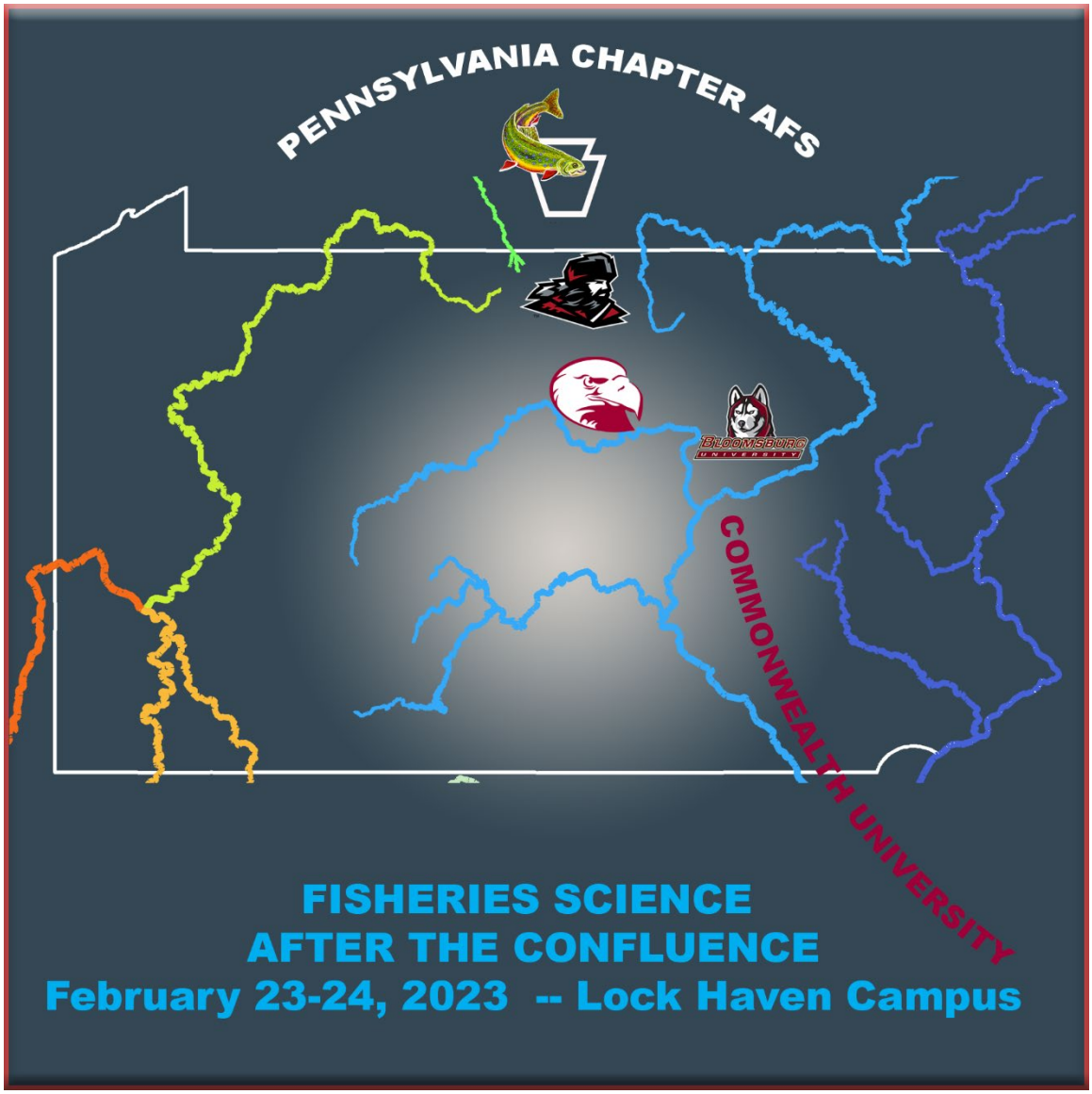

2023 Spring Technical Meeting Compendium

February 23-24, 2023

Commonwealth University of PA – Lock Haven

Durrwachter Alumni Conference Center

Lock Haven, PA

Contents

Day 1 Meeting Schedule

Time	Thursday February 23rd, 2023 Durrwachter Conference Center - 10 Susquehanna Ave, Lock Haven, PA 17745
7:00 – 8:30	**Technical set up: Check-in and registration**
8:30	Welcome and introductions: President Matt Shank
8:40	Opening remarks - Commonwealth University: Provost Diana Rogers-Adkinson; Professor Steve Seiler
9:00	**PLENARY: Dr. Casey Bradshaw Wilson,** Allegheny College - Collaborations and Conservation: What we know about Invasive Round Gobies in the Upper Allegheny Watershed
	MORNING TECHNICAL SESSION (*STUDENT PRESENTER)
	Fisheries science and education
9:30	**Stark et al.** – Diet Analysis of Invasive Flathead Catfish in the Susquehanna River Basin
9:50	**Snyder et al.** – Population Assessment of a Threatened Sculpin Species Using Remotely Operated Vehicle Technology
10:10	**Henning** – Eels in the Classroom: Developing an Environmental Education Outreach Program to Promote Migratory Fish Awareness
10:30	*Networking and Kahoot Break*
	Impacts to watersheds
11:00	**Shank** – Using water chemistry and biological data to identify atmospheric deposition impairments in PA headwater streams
11:20	**Steffy** – A Case Study on Impacts of Unconventional Natural Gas Development in Two Small Watersheds in Northcentral Pennsylvania
11:40	**Clark et al.** – Freshwater Unionid Mussels Threatened by Predation of Round Goby (*Neogobius melanostomus*)
12:00	*Lunch (Kahoots last 15 minutes)*
	AFTERNOON TECHNICAL SESSION
	Watershed ecology and restoration
1:00	***Nauman et al.** – Linking in-stream and landscape-level conditions to macroinvertebrate assemblages in the Little Juniata River watershed
1:20	**Rummel et al. (Lutz presenting)**– Scaling Up Restoration: Recovery of Native and Wild Trout Populations and Other Downstream Responses Due to Abandoned Mine Drainage Remediation in a Large River System

1:40	**Sebastian et al.** – Instream habitat improvement, monitoring, and future plans in the French Creek watershed
2:00	*Break*
2:20	**Kirk et al.** – Evaluating the thermal integrity of streams in Northwest Pennsylvania based on water temperature and fish community data
2:40	**Mueller et al.** – Color and Pattern Variation of Populations of *Salvelinus* across Pennsylvania: An Angler Science Project
3:00	***Wilson** - Buffalo Creek Watershed (Tributary to Allegheny River) Fish Monitoring and Water Quality Analysis
3:20	**Cooper Award Presentation**
3:30	**PA AFS CHAPTER BUSINESS MEETING**
4:30	Dinner on your own

Plenary Speaker Bio

Casey Bradshaw-Wilson, PhD.
Associate Professor of Environmental Science & Sustainability
Co-Director of Watershed Conservation Research Center
Allegheny College

Dr. Bradshaw-Wilson is an Associate Professor of Environmental Science & Sustainability at Allegheny College in Meadville, PA. She also serves as a director for Allegheny's newly established Watershed Conservation Research Center. Her research currently focuses on a variety of fisheries and herpetofauna work with a long-term focus on determining the range and impacts that Round Gobies have on native species in the upper Allegheny Watershed.

Evening Poster Session and Social

6:30 – 9:00	***STUDENT PRESENTER** **Durrwachter Conference Center - 10 Susquehanna Ave, Lock Haven, PA 17745**
	***Spitz, Argent, and Kimmel** – Aquatic macroinvertebrate colonization and decomposition rates of the invasive Japanese knotweed (*Fallopia japonica*) and a native control, American sycamore (*Patanus occidentalis*)
	***Nauman and Merovich**– Linking in-stream and landscape-level conditions to macroinvertebrate assemblages in the Little Juniata River watershed
	***Holdsworth, Garman*, Nauman*, and Merovich** – Evaluating walleye (Sander vitreus) spawning effort on constructed rock rubble reefs in Raystown Lake
	***Stum, Marshall, Tzilkowski, Buderman, and Wagner** – Documenting Spatiotemporal Trends in Fish Communities of the National Park Service Eastern Rivers and Mountains Network
	***Kozlowski, Marchakitus*, Bechtold, and Seiler .** – Restoration measures on stream biofilm and fish abundance in the Little Arnot watershed, PA
	Rummel, Tomlinson, Lutz, Lavelle, and Wolfe – Evaluation of Aquatic Organism Passage at Road-Stream Crossing Improvement Projects in Pennsylvania
	***Thomas, Schall, Smith, Stark, and Wagner –** Piloting the use of stable isotope analysis to understand trophic dynamics of invasive Flathead Catfish *Pylodictis olivaris*
	***Reheard and Ferreri –** Exploring relationships between periphyton biomass, substrate disturbance, and benthic macroinvertebrate diversity related to the McCoy Dam removal in Spring Creek of Centre County, Pennsylvania
	***Frantz and Moyer –** Significant differences in average pH and alkalinity found among streams with differing bedrock geologies
	***Rider, McTammany, and Seiler –** Evaluation of the reach and catchment level effects of riparian buffers on fish communities
	Raab, Lech, Allison, Clark, Sallack, and Welte – PFBC Freshwater Mussel Surveys in 2022
	Foster, Lutz, and Rummel – Trout response to multiple habitat restoration techniques in the Kettle Creek watershed

Day 2: Workshop Descriptions and Facilitator Bios

Time	Friday February 24th, 2023 - Lock Haven East Campus Science Center – 301 W Church St, Lock Haven, PA 17745
7:00 – 8:00	**Technical set up: Check-in and registration**
	CONCURRENT WORKSHOPS
8:00 – 12:00	R for fisheries professionals: Facilitator Jason Doll (Francis Marion University). *** 2 PDPQs for CFP (4 hours)
8:00 – 12:00	Freshwater mussels of Pennsylvania's Susquehanna River basin. Facilitators: Rick Spear (PADEP), Nevin Welte (WPC, PFBC), Dakota Raab (PFBC). *** 2 PDPQs for CFP
8:00 – 12:00	An Introduction to the Mayfly larvae of Pennsylvania. Facilitators: Dave Rebuck (PADEP – retired) and Mike Bilger. *** 2 PDPQs for CFP
12:00	**Adjourn**

*** Workshops will be held at the East Campus Science Center on Friday, February 24th from 8:00-noon.**

All 4 hour workshops qualify for 2 PDPQs for AFS Professional Certification

R for fisheries professionals

Facilitator: Jason Doll, Francis Marion University (jason.doll@fmarion.edu)

Topics covered include FSA and simple fisheries stock assessment, R basics, condition and weight-length relationships, catch curve and mortality, LVB models, and stock-recruitment.

Jason Doll, PhD is a quantitative fisheries ecologist. Jason received his PhD from Ball State University in 2015 and was a post-doctoral research associate at the Quantitative Fisheries Center at Michigan State University. He is currently an Assistant Professor of Fisheries at Francis Marion University where his research focuses on population and community dynamics of freshwater fish. Jason is on the FishR Core Team and one of the maintainers/developers of FSA, FSAdata, and RFishBC.

Freshwater mussels of Pennsylvania's Susquehanna River basin

Facilitators: Rick Spear (PADEP), Nevin Welte (WPC, PFBC), Dakota Raab (PFBC).
(rspear@pa.gov), (c-nwelte@pa.gov), (draab@pa.gov)

Topics covered include the ecology and identification of mussels of the Susquehanna drainage. The first portion of the workshop will include a presentation and the second will include hands-on identification.

Dakota Raab is a fisheries biologist with the Fish and Boat Commission. He earned an undergraduate degree at SUNY Cobleskill and a Master's at Kentucky State University. Originally interested in non-game fish management, he shifted interests to freshwater mussels after spending a summer surveying federally listed species with the Georgia DNR. As a member of the PFBC Division of Environmental Services, Dakota has surveyed mussels in each of Pennsylvania's major river basins.

Nevin Welte is a mussel biologist for the Pennsylvania Fish and Boat Commission. He earned his degrees at Mercyhurst and Tennessee Tech University and had his first mind blowing experiences with mussels while snorkeling 123 miles of the upper Delaware River with the U.S. Geological Survey. Nevin began working with PFBC in 2006 and currently helps guide agency mussel conservation actions. He is a member of the Pennsylvania Biological Survey Mollusk Committee and is a member of the Freshwater Mollusk Conservation Society.

Rick Spear is an Aquatic Biologist Supervisor for the PA DEP Pittsburgh Office. He earned a B.S. degree in Marine Biology from Stockton University. He has been working with mussels for 21 years and he is DEP's expert on freshwater mussels. He is the President of PA Biological Survey Mollusk Technical committee and is a member of the Freshwater Mollusk Conservation Society. He thinks mussel are fascinating animals and enjoys collecting, teaching, and learning about freshwater mussels.

An Introduction to the Mayfly larvae of Pennsylvania.

Facilitators: Dave Rebuck (PADEP – retired) and Mike Bilger (USGS – retired).
(rebuckdave@gmail.com), (michaelbilger9@gmail.com)

Topics covered include morphology, life history, pollution tolerance, habitat preference, and taxonomy of Ephemeroptera. The first portion of the workshop will include a presentation and the second will include hands-on identification. Microscopes will be provided for workshop participants.

Dave and Mike have nearly a century of combined experience in macroinvertebrate taxonomy, ecology, and environmental investigations for academic, governmental, and private institutions. Their experience and expertise are a huge asset and we thank them for their willingness to share with workshop participants.

Dave Rebuck holds a B.S. degree in Entomology from Penn State University and recently retired after a long 43-year career as an Aquatic Biologist, Taxonomist, and Water Program Specialist. During his career, he worked for the Academy of Natural Sciences of Philadelphia at the Stroud Water Research Center and for the Pennsylvania Department of Environmental Protection. Dave has sampled streams, rivers, and lakes across eastern North America and has identified many macroinvertebrate samples from those diverse habitats, in addition to areas of Central America.

Mike Bilger earned BS in 1972 from the University of Maryland, Fish and Wildlife; 1977 MS University of Maryland, Invertebrate Zoology; 1974-1980 Massachusetts Division of Water Pollution Control, Aquatic Biologist; 1980-1991; U.S. Environmental Protection Agency Region 1 New England Regional Laboratory, Aquatic Biologist; 1991-2006 U.S. Geological Survey PA District Office, Aquatic Biologist; 2006-2014 EcoAnalysts, Inc., Aquatic Biologist; 2014-2018, Susquehanna University, Freshwater Research Institute, Adjunct Professor; 2018-present, JB Ecological Services, Aquatic Biologist.

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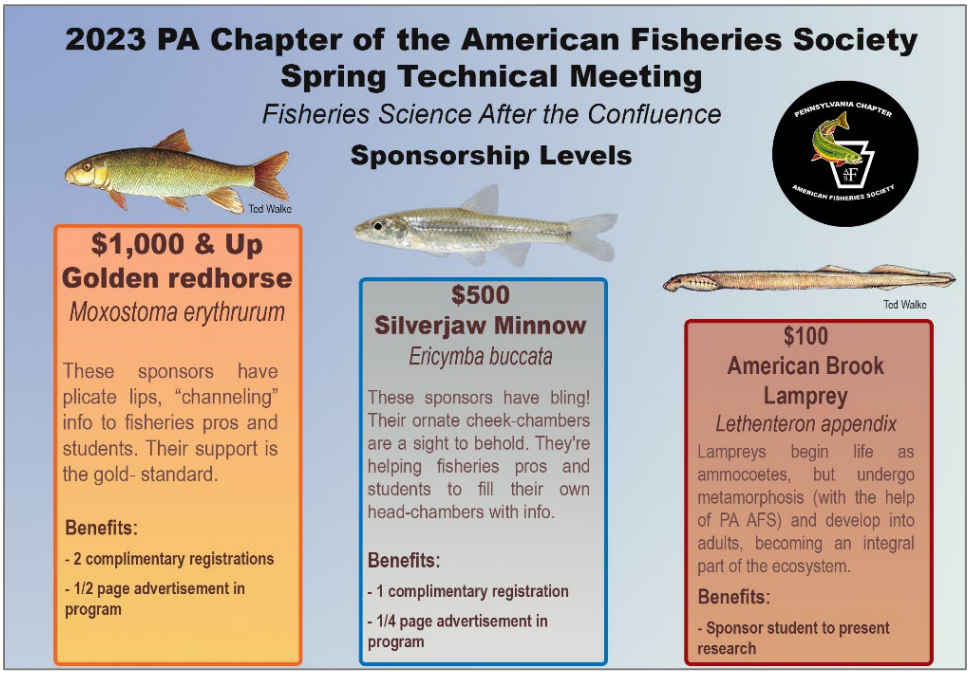

Local Restaurants

We recommend checking out the following restaurants during your stay in Lock Haven:

1. Broken Axe Brew House 1 E Bald Eagle St (*over 21 only*)
2. The Main Street Grill 127 E Main St
3. Stella A's Bar and Grill 219 E Main St
4. Odd Fellas 101 E Main St
5. Dutch Haven Restaurant 201 E Bald Eagle St
6. Old Corner Grill & Bottle Shop 205 N Grove St
7. Avenue 209 Coffeehouse 209 Bellefonte Avenue
8. OIP – Original Italian Pizza, 136 East Main Street
9. Hanger 9, 208 Bellefonte Avenue

Summer Social Info

The Pennsylvania Chapter
American Fisheries Society

2023 Summer Social

Juniata College
PENNSYLVANIA
• 1876 •

Raystown Field Station

RAYSTOWN FIELD STATION

Saturday July 22, 2023

Lunch at Noon**:** Please bring a covered dish or dessert

Business Meeting at 3 PM

With introduction of new officers

14322 Field Station Lane, Entriken PA 16638
GPS Coordinates: 40.367336, -78.144544

Fun for the whole family by the lake!

Come early . S t ay late. Hiking, canoeing, kayaking, fishing, fish sampling, swimming, sightseeing, and conversation.

For more information about the event contact: **George Merovich** at MEROVICH@Juniata.edu To learn more about the Juniata College Field Station visit: www.Juniata.edu/offices/field-station

Podium Presentation Abstracts

* INDICATES A STUDENT PRESENTER TO BE JUDGED

Diet Analysis of Invasive Flathead Catfish in the Susquehanna River Basin

Sydney Stark[1], Megan Schall[2], Geoff Smith[3], Julian Avery[1], Ty Wagner[4]

[1] Department of Ecosystem Science and Management, Pennsylvania State University, State College, PA

[2]Department of Biology, Pennsylvania State University, Hazelton, PA

[3]Pennsylvania Fish and Boat Commission, Division of Fisheries Management, Bellefonte, PA

[4] U.S. Geological Survey, Pennsylvania Cooperative Fish and Wildlife Research Unit, Pennsylvania State University, Forest Resources Building, University Park, PA

Aquatic Invasive Species (AIS) are a growing concern due to their ability to alter ecosystem function and reduce native biodiversity. In Pennsylvania, a prominent AIS is the Flathead Catfish, *Pylodictis olivaris*, a large-bodied piscivore introduced to the Susquehanna River Basin. Flathead Catfish can quickly become established and populations can attain rapid population growth rates. Importantly, these invasive populations can reduce the biomass and abundance of sportfish and species of conservation need directly through predation. However, in the Susquehanna River Basin, little is known about the potential predatory impact of Flathead Catfish on other species. To address this uncertainty, a diet study was completed using DNA barcoding to identify prey items from the stomach contents of Flathead Catfish. Fish collection occurred during May to October 2020 and 2021. A total of 576 fish were collected from 38 locations. Of the 576 fish collected, 40.8% (n = 235) had diets containing prey items. A total of 45 different species were detected with a mix of fish and crayfish prey items. Margined Madtom (*Noturus insignis,* n= 31 diets) and Rusty Crayfish (*Faxonius rusticus*, n= 87 diets*)* were the most common fish and crayfish species, respectively. Size-related differences in Flathead Catfish diet composition was documented for some prey species. For example, some fishes of the family Centrarchidae occurred more frequently in larger Flathead Catfish (> 600mm) and Cyprinidae occurred more frequently in smaller Flathead Catfish (< 301mm). Diets only containing crayfish were most common in fish less than 300mm, with mixed diets more commonly occurring in larger fish. The frequency that Rusty Crayfish occurred in diets was similar across size classes. This study represents the first comprehensive analysis of the diet of the invasive Flathead Catfish in the Susquehanna River Basin and some of the first information on which prey species may be most affected by the establishment of the voracious predator.

Presenter: Sydney Stark; sps6558@psu.edu

Population Assessment of a Threatened Sculpin Species Using Remotely Operated Vehicle Technology

Blaine Snyder, Bob Murphy, Chris Wharton, Jon Aglio, and Mark Fernandez

The entire range of the Pygmy Sculpin (*Cottus paulus*), a federally threatened fish species, is confined to a single 6,000,000-gallon spring pond and its 500-foot outflow in northeastern Alabama. It's because of this limited distribution and associated vulnerabilities that regulatory and natural resource agencies identified the need to protect the Pygmy Sculpin population. Anniston Army Depot and the U.S. Army Corps of Engineers supported the need to develop innovative solutions to help protect the species. One challenge was the development of an approach to estimate and monitor the population density of a federally-protected, cryptic, benthic fish -- one that's less than two inches in length at maturity -- without disturbance or harm. Underwater drone or Remotely Operated Vehicle (ROV) technology, digital imaging, and videography allowed population estimation without disturbing substrates or sculpins. A statistical approach was developed to capture ROV video of substrates and sculpins at 50 randomly-selected locations in Coldwater Spring Pond. Digital imagery saved for each pond sampling location was scaled to quantify the viewing area, and sculpins were counted in the defined field of view to allow density calculations. ROV imagery was collected on a seasonal basis over multiple years to compare Pygmy Sculpin densities both seasonally and annually. Statistical modeling techniques were used to generate sculpin population density maps and provide population estimates in each of four seasons over two and a half years. Surveys showed that sculpins are distributed throughout the spring pond and the entire reach of the spring run, and densities were highest in cobble/gravel substrates, followed by *Nostoc*/sand habitats and submerged/emergent aquatic vegetation in both the spring pond and spring run. This assessment is providing essential abundance and distribution information for Pygmy Sculpin protection efforts and a baseline for any future evaluations of population dynamics.

Presenter: Blaine Snyder, Tetra Tech, blaine.snyder@tetrtech.com, (717)495-2168

Eels in the Classroom: Developing an Environmental Education Outreach Program to Promote Migratory Fish Awareness

Aaron Henning

Susquehanna River Basin Commission, Harrisburg, Pennsylvania

Restoration of migratory fish species to the Susquehanna River Basin is a stated goal of the Susquehanna River Basin Commission (SRBC) as well as the overall objective of the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC). Prior to the 20th century the Susquehanna River supported a robust diadromous fish community including American shad, river herring, sturgeon and American eel. Construction of hydroelectric dams across the lower river ended volitional migratory fish runs and eventually necessitated restoration efforts through various fish passage mechanisms. In 2016 via FERC re-licensing, a long-term plan to trap & transport American eel around the dams was implemented and through 2022 has moved more than 2 million eels upriver. In addition to the physical transporting of fish, a novel environmental education program was developed in-house by SRBC to accompany the American eel restoration effort. In cooperation with fellow resources agencies and the project licensee a nominal proportion of the annual elver capture is distributed to in-basin schools for in classroom rearing and ultimately, re-release back into the watershed. Expanding from 2 schools to 26 in four years this program has proven effective in raising awareness of American eel and provide K-12 students with a unique hands-on opportunity to participate in migratory fish restoration.

Presenter: Aaron Henning; ahenning@srbc.net

Using water chemistry and biological data to identify atmospheric deposition impairments in PA headwater streams

Matthew Shank

PA Department of Environmental Protection

Forested, mountainous, headwater streams with few anthropogenic stressors are disproportionately affected by atmospheric deposition of acids and acidifying compounds. Although emissions of SO_4, NO_3, and other pollutants have decreased as a result of the US Clean Air Act, atmospheric deposition is currently responsible for over 587 miles of aquatic life use impaired streams in Pennsylvania. Watersheds underlain by base-cation poor geology with few anthropogenic sources of alkalinity are at highest risk of adverse effects, including chronically low pH and alkalinity, and elevated spikes of dissolved aluminum during high flow events. Increased road density in riparian buffers, especially unpaved roads with crushed limestone aggregate, can mitigate atmospheric deposition by increasing alkalinity in receiving streams. Three macroinvertebrate metrics were created that effectively discriminate streams with and without atmospheric deposition stressors. One metric, the Acid Tolerance Index (ATI) utilizes individual Acid Tolerance Values (ATVs) that were developed for 112 macroinvertebrate taxa. These ATVs represent a useful addition to currently available organic pollution tolerance values that are currently utilized for Indices of Biological Integrity, but do not fully capture organism tolerance to non-nutrient stressors. Macroinvertebrate communities affected by abandoned mine drainage (AMD) often appear similar to those affected by atmospheric deposition. However, by leveraging water quality data, these stressors can be effectively disentangled. This research will allow accurate and precise determination of aquatic life use impairment when atmospheric deposition is the source of ecosystem stress. This will allow accurate reporting for Clean Water Act purposes, as well as identification of streams that may represent excellent targets for restoration, as increases in alkalinity and pH will result in water chemistry conditions similar to reference streams.

Presenter: Matthew Shank; mattheshan@pa.gov

A Case Study on Impacts of Unconventional Natural Gas Development in Two Small Watersheds in Northcentral Pennsylvania

Luanne Steffy

Susquehanna River Basin Commission

The Susquehanna River Basin Commission has been monitoring water chemistry, biological communities and physical habitat in small watersheds in the heart of the unconventional natural gas (UNG) drilling region in Pennsylvania for the last decade. A case study analysis between two very similar high quality, cold water (HQ-CWF) watersheds, one with drilling and one without, was completed in an attempt to understand any long-term impacts of UNG on multiple metrics of stream health and biological integrity. Grays Run is located in Lycoming County, PA and has experienced UNG development over the last 10 years while Hunts Run in Cameron County, PA has been free of any UNG development within the watershed. Routinely since 2011, water chemistry samples, macroinvertebrate samples, fish assemblage surveys and variety of physical habitat assessments have been completed by Commission staff. A comparison of 10 years of water quality, macroinvertebrate community, fish assemblage and physical habitat data reveal a high degree of similarity between years and sites across most assessed metrics. Additionally, a comparable level of annual and seasonal variation was seen across both sites. While ten years of data is substantial and multiple lines of evidence are currently pointing to minimal aquatic ecosystem impacts in Grays Run, sustained monitoring is essential as the UNG industry continues to operate, particularly within special protection watersheds.

Presenter: Luanne Steffy; lsteffy@srbc.net

Freshwater Unionid Mussels Threatened by Predation of Round Goby (*Neogobius melanostomus*)

Kyle H. Clark[1,3], Deborah D. Iwanowicz[2], Luke R. Iwanowicz[2], Sara J. Mueller[1], Joshua M. Wisor[1,3], Casey Bradshaw-Wilson[4], William B. Schill[2], J. R. Stauffer, Jr.[1], and Elizabeth W. Boyer[1]

[1] Penn State University, Department of Ecosystem Science & Management, University Park, PA

[2] U.S. Geological Survey, Eastern Ecological Science Center, Kearneysville, WV

[3] Pennsylvania Fish & Boat Commission, Bellefonte, PA

[4] Allegheny College, Department of Environmental Science, Meadville, PA

Indigenous freshwater mussels (Unionidae) are integral to riverine ecosystems, playing a pivotal role in aquatic food webs and providing ecological services. With populations on the decline worldwide, freshwater mussels are of conservation concern. In this study, we explore the propensity of the invasive Round Goby fish to prey upon indigenous freshwater mussels. First, we conducted lab experiments where Round Gobies were given the opportunity to feed on juvenile unionid mussels and macroinvertebrates, revealing rates and preferences of consumption. Several Round Gobies consumed whole freshwater mussels during these experiments, as confirmed by mussel counts and x-ray images of the fishes. Next, we investigated Round Gobies collected from stream habitats of the French Creek watershed, which is renowned for its unique and rich aquatic biodiversity. We developed a novel DNA metabarcoding method to identify the specific species of mussels consumed by Round Goby and provide a new database of DNA gene sequences for 25 indigenous unionid mussel species. Several of the fishes sampled had consumed indigenous mussels, including the Elktoe (non-endangered), Creeper (non-endangered), Long Solid (state endangered), and Rayed Bean (federally endangered) species. The invasive Round Goby poses a growing threat to unionid mussels, including species of conservation concern. The introduction of the invasive Round Goby to freshwaters of North America is shaping ecosystem transitions within the aquatic critical zone having widespread implications for conservation and management.

Presenter: Kyle H. Clark; kyleclark@pa.gov

Linking in-stream and landscape-level conditions to macroinvertebrate assemblages in the Little Juniata River watershed

* Brenden Nauman, George Merovich

Juniata College, Department of Environmental Science, Fisheries and Aquatic Science Program

The Little Juniata River is a renowned wild brown trout fishery that drains central Pennsylvania to the Susquehanna River at Duncannon. Despite numerous anthropocentric factors that continue to threaten watersheds world-wide, little is known about the conditions in the Little Juniata River watershed that supports its popular cold-water fishery. Consequently, we conducted a watershed-wide study to classify current ecosystem conditions. We surveyed basic water chemistry and benthic macroinvertebrate assemblages, and we also measured in-stream physical habitat conditions and examined land use land cover data for 47 different sites throughout the watershed. Macroinvertebrate IBI scores varied widely from pristine (94.1) to highly degraded (16). Using NMDS and principal component analysis, we found IBI scores and macroinvertebrate assemblages varied with water chemistry and with various measures of in-stream and watershed-scale land use that represented an environmental disturbance gradient. Land use relationships will allow us to model in-stream conditions across the watershed in un-samples tributaries. Our findings will provide insight for prioritizing restoration areas and efforts in the watershed.

Presenter: Brenden Nauman; NAUMABJ19@juniata.edu

Scaling Up Restoration: Recovery of Native and Wild Trout Populations and Other Downstream Responses Due to Abandoned Mine Drainage Remediation in a Large River System

S. M. Rummel, A. Lutz, K. Lavelle, A. Wolfe

Northeast Coldwater Habitat Program, Trout Unlimited

Impaired by abandoned mine drainage (AMD), the West Branch Susquehanna River was once devoid of life, and recovery was considered impossible. Through multiple partnerships, numerous remediation projects have been completed over the last 30 years. The objective of this study was to document current water quality and biological conditions and identify changes in response to the efforts to restore the watershed. Pollution-sensitive fish species have increased over time and brook trout (*Salvelinus fontinalis*) were documented in the main stem of the river for the first time in 2019. In addition, sections of tributaries and the main stem of the river have been documented to support natural trout reproduction (~320 kilometers) with several supporting Class A trout fisheries (~90 kilometers) since 2009. Nearly 42 kilometers of the main stem now support natural trout reproduction, demonstrating the improved conditions of the watershed. Some tributaries sampled only contained young of the year trout, indicating that adult trout use the main stem of the river. Increased pH and alkalinity and decreased metal concentrations, conductivity, and acidity have occurred since 2009 due to AMD treatment. Macroinvertebrate communities have also shifted towards reference conditions. The presence of a wild trout fishery is attributed to the cumulative improvements in water quality from active and passive AMD treatment systems and abandoned mine land (AML) reclamation. Treatment of AMD in the West Branch watershed has increased the amount of available habitat, coldwater refugia, and spawning areas; increasing resiliency of trout populations to current and future stressors such as climate change. The results of this project demonstrate the cumulative impact of numerous, strategic restoration projects in headwater areas and tributaries of large rivers.

Presenter: Allison Lutz; allison.lutz@tu.org

Instream habitat improvement, monitoring, and future plans in the French Creek watershed

Briana Sebastian, Casey Bradshaw-Wilson, Mark A. Kirk, Kelly Pearce

Watershed Conservation Research Center, Allegheny College

Streambank and instream habitat restoration is an important practice to reduce erosion and sediment loading and mitigate property damage. The Watershed Conservation Research Center (WCRC) and community partners are working to improve streambanks and instream habitat at two sites (Craig Road and Telliho) on Woodcock Creek, a main tributary to French Creek, in Crawford County, PA. Our objectives were to monitor these sites and the surrounding watershed area before and after restoration. Two pre-restoration surveys were conducted at each site on fish assemblages, macroinvertebrates, substrate, water velocity, basic water quality parameters, and riparian habitat in summer 2022. Water samples were collected bi-weekly from June to October 2022 at eleven locations in the French Creek watershed upstream and downstream of the sites. Craig Road was restored in August 2022, where habitat improvement structures were implemented along the streambanks, and two surveys were completed post-restoration (August and October 2022). Thirty one species were collected in pre-instream habitat improvement, and twenty eight species were found after restoration. Pre-restoration surveys will continue for the Telliho site until habitat improvement occurs, which is planned for summer of 2023. Post-restoration monitoring will continue for at least 5 years. This is a key component in determining the effectiveness of these habitat improvement projects and usefulness of them as a tool for both conservation and restoration in lotic systems.

Presenter: Briana Sebastian; bsebastian@allegheny.edu

Evaluating the thermal integrity of streams in Northwest Pennsylvania based on water temperature and fish community data

Mark A. Kirk, Casey R. Bradshaw-Wilson, Kelly J. Pearce, Megan A. Hazlett, Chris L. Shaffer, and Scott A. Wissinger

Watershed Conservation Research Center, Allegheny College

Stream temperatures are projected to increase globally given the threats associated with climate change. Whereas cold-water fisheries are projected to decline, warm-water fisheries are projected to increase. Hence, being able to quantify the thermal characteristics of stream ecosystems is crucial for management and conservation in the face of climate change. Our objective was to use water temperature data and fish community data from large-scale research efforts to quantify the current and future thermal integrity of streams in Northwest Pennsylvania. We defined the thermal integrity of streams based on water temperature data and a thermal multi-metric index (T-MMI) that described fish communities based on their thermal compositions. We found that T-MMI scores decreased with water temperatures, indicating that that our community-based assessments of thermal composition accurately reflect instream temperatures. T-MMI scores also increased with watershed-level forest cover, indicating that agricultural impairment is associated with warm-water fish communities. Finally, we projected changes in T-MMI scores under future climate change scenarios and found that most cold-water streams will have their thermal integrity compromised if climate change continues. Our results indicate that management and conservation actions are required for protecting stream thermal integrity, which can include reforestation practices and the protection of groundwater inputs.

Presenter: Mark A. Kirk; mkirk@allegheny.edu

Color and Pattern Variation of Populations of Salvelinus across Pennsylvania: An Angler Science Project

Sara J. Mueller[1], Eamonn Powers[1], Jay R. Stauffer, Jr.[1]

[1] Department of Ecosystem Science and Management, Pennsylvania State University, University Park, PA

Little is formally known or understood about the color patterning of Brook Trout (*Salvelinus fontinalis*). Often, anglers and fish enthusiasts anecdotally remark on the beauty of fish they have caught and often recall unique markings or coloration. The purpose of this study is to attempt to quantify the patterning and coloration of *Salvelinus* (*Baione*) from across the state of Pennsylvania by collecting photographs through an angler science project. Anglers who wished to participate requested a custom grey card, which was sent to them along with instructions for how to submit data to a custom survey using the ArcGIS Survey123 platform. Photographs were color corrected using Photoshop and length was calculated using the Steromorph R package. Red spots and parr marks were manually counted and plotted against length. A weak relationship between size and number of marking indicates that other factors influence these markings. We also make suggestions for implementation so that such a project can be used for other species and localities.

Presenter: Sara Mueller; sjm5467@psu.edu

Buffalo Creek Watershed (Tributary to Allegheny River) Fish Monitoring and Water Quality Analysis

* Kathleen Wilson and Brady Porter

Duquesne University Department of Environmental Science and Management (ESM) in partnership with Audubon Society of Western PA, funding sources include Growing Greener Grant and 3 Rivers Quest

The Buffalo Creek watershed is a tributary to the Allegheny River with 348.7 miles of streams, containing 93.7 miles of High Quality – Coldwater Fisheries and 250.7 miles of High Quality – Trout Stocking Fisheries. In recent years, the watershed has been experiencing declining water quality with the most prevalent pollutants being abandoned mine drainage (AMD, 12.4%), agricultural runoff (16.9%), and unknown source (26.3%). To guide Audubon Society of Western PA rehabilitation activities, we conducted water quality testing through chemistry analysis and fish community indices. Over the last year, on-site water chemistry and grab samples were collected and analyzed according to Title 25 Pa. Code § 93 Water Quality Standards and a recently developed mass ratio analysis by Cantlay et al 2021. Backpack electrofishing was conducted at 10 sites between 2021 and 2022, and enumeration data was analyzed through the Ohio Index of Biotic Integrity (IBI) and Pennsylvania Thermal Fish Index (TFI). Our IBI index scores were within the Very Good and Exceptional ranges and our TFI scores ranged from cold, cool, and warm water assemblages, despite being a cold-cool water system. When compared with the water chemistry collections, the toxic metal and general water quality exceedances that were found were not reflected in the fish community. AMD was detected in each sample, with upper Buffalo Creek showing higher frequency of signature ions. Our recommendations are to further investigate the sources of certain metals, like selenium and silver, and to install AMD treatment systems below problematic mines.

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Poster Presentation Abstracts

* INDICATES A STUDENT PRESENTER TO BE JUDGED

Aquatic macroinvertebrate colonization and decomposition rates of the invasive Japanese knotweed (*Fallopia japonica*) and a native control, American sycamore *(Patanus occidentalis*)

* Ben Spitz, David G. Argent, William G. Kimmel

PennWest – California

Japanese knotweed (*Fallopia japonica*) is a highly invasive plant that has become established throughout much of the United States and Canada. This plant grows in dense stands with persistent rhizomes and broad leaves. Although it grows in various habitats, it is most often found overwhelming riparian zones. As these riparian communities shift, so does the resulting leaf litter. Aquatic macroinvertebrate communities depend on this leaf litter and detritus. The objectives of this study are to compare macroinvertebrate colonization and decomposition rates of Japanese knotweed to a native control species, American sycamore (*Platanus occidentalis*). Artificial leaf packs were constructed with dried leaves of both species. These leaf packs of different species were then set in Pike Run, a tributary to the Monongahela River in southwest Pennsylvania. The leaf packs were removed from the water and processed after four and eight weeks. The macroinvertebrate communities of the Japanese knotweed and American sycamore leaf packs were found to be relatively similar. In some cases, colonization of the Japanese knotweed leaf packs occurred more frequently than the native species. However, Japanese knotweed leaf packs were found to decompose much faster than the American sycamore. These results imply that the changes in leaf litter as Japanese knotweed invades a riparian zone may not have a large impact on macroinvertebrate communities.

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Documenting Spatiotemporal Trends in Fish Communities of the National Park Service Eastern Rivers and Mountains Network

* Morgan Stum, Matthew Marshall, Caleb Tzilkowski, Frances Buderman, and Tyler Wagner

School: The Pennsylvania State University

Freshwater fish populations are declining at unprecedented rates, largely due to anthropogenic factors such as habitat loss, changes in land use, pollution, invasive species, and climate change. This is unfortunate because not only do freshwater fish make up nearly 25% of global vertebrate diversity, but they are a critical resource for monitoring the biological condition of freshwater ecosystems upon which many organisms and humans rely. In 2013 – 2014, the National Park Service started using freshwater fish taxa as a bioindicator of stream condition by incorporating wadeable stream fish communities into their list of "vital signs" for long-term monitoring in the Eastern Rivers and Mountains Network (ERMN). The ERMN is a group of park units located in the central to northern Appalachian region, spanning portions of West Virginia, Pennsylvania, New Jersey, and New York. During 2022 and 2023, the ERMN fish communities are being resampled using backpack electrofishing along with the collection of a suite of water quality and habitat variables. The objectives of this study were to 1) provide a contemporary baseline inventory of stream fish communities in the ERMN parks, 2) assess biologically relevant shifts in fish community composition throughout parks relative to the 2013 – 2014 fish survey, and 3) re-evaluate the importance of key water quality and/or habitat factors for species occupancy. These objectives are necessary for proactive fisheries management, which includes habitat conservation and restoration. Preliminary observations indicate that colonization and local extirpation have occurred since the 2013 – 2014 survey.

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Evaluation of the reach and catchment level effects of riparian buffers on fish communities

* Sierra Rider, Matthew McTammany, and Steve Seiler

Bucknell University

Land transformation from forested to agriculturally dominated landscapes has caused many negative impacts on aquatic habitats. The conversion, coupled with farming and livestock practices, creates complex physical, chemical, and in-stream habitat stressors on stream communities. Riparian buffers have been a key practice used to mitigate impacts of agriculture on stream communities, however, it is not clear how the size, distribution, and types of riparian buffer contribute to cumulative benefits of riparian buffers. This study aims to evaluate reach scale and catchment scale effects of land cover type (agriculture, forest, newly installed riparian buffers, established buffers) on water temperature and chemical parameters within six watersheds in Centre and Lycoming counties. Temperature loggers were deployed from May to October 2022, at transitions between landcover types on 6 watersheds and temperature data was used to calculate average, maximum, and minimum daily temperature for each reach. An upper and lower site was established in each watershed where the fish community was assessed in July and chemical characteristics were measured monthly. Fish diversity was higher in the lower sites. Temperature consistently increased in reaches with heavy agricultural use, and watersheds with historically higher agricultural use tended to have higher concentrations of nitrogen and phosphorus. By determining impacts at the reach-scale, cumulative-scale impacts can be better understood. Understanding impacts at this scale can aid restoration partners to target agricultural land where riparian buffers may provide the greatest benefit on stream health.

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Evaluating walleye (*Sander vitreus*) spawning effort on constructed rock rubble reefs in Raystown Lake

* Autumn Holdsworth, Andrew Garman, Brenden Nauman, and George Merovich

Juniata College

In this study we are currently evaluating the use of constructed rock rubble by walleyes for spawning in 2 locations of Raystown Lake. We created custom mesh-covered traps and deployed these in Apr 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 2,500 m 2 for over 2,600 trap-days from Apr 1 to May 6. During this time, we collected 51 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 10^{o} C (50^{o} 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 Apr and May of 2023, after rock rubble reefs are in place, we will sample the same areas again, over constructed reefs and in control areas, to complete this BACI-designed (before-after-control-impact) study. Perhaps what we learn could help with future habitat restoration for walleye spawning so that the walleye fisheries in the lake could depend less on stocking efforts and save management dollars for other needs.

Student Presenter: Autumn Holdsworth; HOLDSAG20@juniata.edu

Exploring relationships between periphyton biomass, substrate disturbance, and benthic macroinvertebrate diversity related to the McCoy Dam removal in Spring Creek of Centre County, Pennsylvania

* Bridget J. Reheard and C. Paola Ferreri

The Pennsylvania State University

Since the turn of the 21st century, dam removal has accelerated across the United States in the interest of reducing human safety hazards and restoring stream integrity. Though the usage of this practice has increased, little research has been done on its long-term effects on biological and ecological health. To assess the feasibility of measuring long-term implications, we selected the former McCoy-Linn Dam site of the Spring Creek watershed in Centre County, Pennsylvania as our focal point. Our objectives were to (i) assess current benthic macroinvertebrate diversity upstream, at, and downstream of the former dam site, (ii) collect measurements of substrate disturbance and riparian zone health, (iii) measure periphyton biomass in the stream as chlorophyll a concentrations to evaluate potential relationships related to the dam removal. In May 2022, we sampled above, at, and downstream of the former dam site. From each site, benthic macroinvertebrates were collected, sorted, and keyed to family or genus in accordance with the PADEP Rapid Bioassessment Methods. Chlorophyll a samples were collected and analyzed using EPA method 446.0 and converted to total periphyton biomass for a metric of stream productivity. Disturbance and riparian health information were collected qualitatively using the PADEP Physical Habitat Evaluation Form for Riffle/Run Prevalence, the bottom half of the Pfankuch Form for substrate evaluation, and the QBR index for riparian habitat. Statistical analyses are in progress to evaluate relationships among benthic macroinvertebrate diversity, habitat variables, and distance to the former dam site. Outcomes of this study will help inform long-term monitoring programs that seek to evaluate effects of dam removal on stream ecosystems.

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Linking in-stream and landscape-level conditions to macroinvertebrate assemblages in the Little Juniata River watershed

* Brendan Nauman and George Merovich

Juniata College

The Little Juniata River is a renowned wild brown trout fishery that drains central Pennsylvania to the Susquehanna River at Duncannon. Despite numerous anthropocentric factors that continue to threaten watersheds world-wide, little is known about the conditions in the Little Juniata River watershed that supports its popular cold-water fishery. Consequently, we conducted a watershed-wide study to classify current ecosystem conditions. We surveyed basic water chemistry and benthic macroinvertebrate assemblages, and we also measured in-stream physical habitat conditions and examined land use land cover data for 47 different sites throughout the watershed. Macroinvertebrate IBI scores varied widely from pristine (94.1) to highly degraded (16). Using NMDS and principal component analysis, we found IBI scores and macroinvertebrate assemblages varied with water chemistry and with various measures of in-stream and watershed-scale land use that represented an environmental disturbance gradient. Land use relationships will allow us to model in-stream conditions across the watershed in un-samples tributaries. Our findings will provide insight for prioritizing restoration areas and efforts in the watershed.

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Piloting the use of stable isotope analysis to understand trophic dynamics of invasive Flathead Catfish *Pylodictis olivaris*

* Natalie Ann Thomas, Schall, M.K., G.D. Smith, S. Stark, T. Wagner

The Pennsylvania State University

Flathead Catfish *Pylodictis olivaris* are a piscivorous invasive species introduced into the Susquehanna River Basin, PA. Since first documented in the Susquehanna River in 2002, research efforts have worked to provide fundamental information on this emergent threat. Prior research has provided information on current range, population characteristics, and predation through a diet study, however, little effort has been made to quantify the impacts that Flathead Catfish may have on other species. Importantly, it is not known if Flathead Catfish are competing with other predatory fish species for food resulting in dietary shifts or limited food availability. Stable isotope analyses using nitrogen isotopes are going to be used to investigate trophic relationships between Flathead Catfish and other predatory and prey species. In this study, muscle samples were collected from 35 Flathead Catfish from two sites in the Susquehanna River. Nitrogen isotopic ratios were used to compare differences between sites and fish length. As expected, nitrogen enrichment (trophic position) increased with increasing fish length, suggesting that Flathead Catfish reach higher trophic levels as they increase in size. A similar increase in trophic position with fish size was observed at both sites. The results of this study demonstrate the feasibility of this technique to identify the direct and indirect effects Flathead Catfish have on the trophic structure and energy flow of aquatic communities within the Susquehanna River.

Student Presenter: Natalie Ann Thomas; nat5286@psu.edu

Restoration measures on stream biofilm and fish abundance in the Little Arnot watershed, PA

* Jeff Kozlowski, Morgan Marchakitus*, Heather Bechtold, and Steve Seiler

Commonwealth University of Pennsylvania – Lock Haven

The legacy effects of human disturbance are long lasting in forested watersheds. Common disturbances found in the mid-Atlantic region of the US include historic railroad structures, natural gas extraction infrastructure and timber harvest practices. Restoration techniques that reconnect channel flow and riparian areas and increase large woody debris can provide greater connection of streams to nutrient fluxes, groundwater, and habitat for algae and fish. Our project evaluates the influence of stream restoration techniques including chop and drop and large-scale earth movement on habitat, fish abundance and biofilm biomass in the Little Arnot (LiAR) watershed in northwestern Pennsylvania. Our before-after and control-impact design includes 2 years of habitat, fish, and algal measures pre-restoration in LiAR and in the undisturbed control watershed. Our findings suggest that the LiAR watershed lacks large wood and is nutrient limited. Habitat quality is poor due to lower abundance of deep pools, low photosynthetic active radiation, and low residence time due to high in-stream water velocity. Wood restoration and rechannelization efforts occurred in late 2021 and early 2022 and we present the emerging results of rechanneling and flooding and increased light availability. Such large wood restoration projects reconnect the stream to its floodplain, decrease downstream flooding, and restore biological functions but take many years of monitoring to best assess success of these mitigation efforts.

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Significant differences in average pH and alkalinity found among streams with differing bedrock geologies

* Katarina Frantz and Gregory Moyer

Commonwealth University of Pennsylvania – Mansfield

Anthropogenic and natural acidification affect water chemistry as well as aquatic biota for many streams in the Tioga River Basin of Pennsylvania. Anthropogenic acidification is caused by numerous abandoned coal mines in the area. Natural acidification is often explained by acid rain and/or tannic acids that influence the water and soil of the area; however the influence of current soil composition from the weathering and breakdown of parent geology could also explain natural acidification in this region. We assessed whether stream pH and alkalinity differ depending on the geological formation underlying the stream. The geological formations we chose were as follows: Allegheny Pottsvile (n = 9 sites, 5 streams), Burgoon Sandstone (n = 18 sites, 9 streams), Huntley Mountain (n = 23 sites, 7 streams), and Lockhaven (11 sites, 7 streams). Our results show significant differences in pH and alkalinity among formations (all $p < 0.001$). Our initial results imply that natural acidification found in these streams may be best explained by the geologic bedrock formation making for a simplistic model to predict stream pH based on underlying geology for the region of study; however, further sources of variation are currently being assessed.

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PFBC Freshwater Mussel Surveys in 2022

Dakota Raab, Gregory Lech, Jordan Allison, Kyle Clark, Katelynn Sallack, and Nevin Welte

Pennsylvania Fish and Boat Commission

The mission of the Pennsylvania Fish and Boat Commission (PFBC) is to protect, conserve and enhance the Commonwealth's aquatic resources and provide fishing and boating opportunities. As a partner of the Pennsylvania Natural Heritage Program, the PFBC is tasked with protecting threatened, endangered, and special concern species which includes completing inventory surveys to describe their distributions. Freshwater mussels are frequently characterized as the most imperiled taxonomic group in North America; but, while awareness of the vital role they play in aquatic ecosystems is growing, they are still largely overlooked and understudied. While the PFBC has targeted fish species in the Commonwealth for more than a century, the tracking of freshwater mussel species occurrence and range is, comparatively, in its infancy. In 2022, the PFBC conducted timed visual surveys in five of the Commonwealth's six major drainages to better determine the presence and range of freshwater mussel species, especially Species of Greatest Conservation Need (SGCN). In total, more than 12,000 individuals representing 43 species were encountered. Of the 43 species, 26 are categorized as SGCN in the PA State Wildlife Action Plan. Additionally, mussels propagated at PFBC's Union City Aquatic Conservation Center and the United States Fish and Wildlife Service's White Sulphur Springs National Fish hatchery were stocked in various waterways to promote species recovery efforts and will be highlighted. These combined efforts will help guide future species recovery projects and demonstrate the importance of collaboration among stakeholders to achieve the goal of freshwater mussel restoration in Pennsylvania.

Presenter: Dakota Raab; draab@pa.gov

Trout response to multiple habitat restoration techniques in the Kettle Creek watershed

Ivie Foster, Allison Lutz, and Shawn Rummel

Trout Unlimited

Evaluating the effectiveness of on-the-ground restoration projects is an ongoing issue in conservation biology for salmonids. Trout Unlimited has evaluated and refined multiple state and federal protocols to create a set of metrics that are efficient to measure in the field while still generating a robust data set. We used these metrics to evaluate habitat improvement projects within the Cross Fork and Kettle Creek watersheds, which measured the response of salmonid populations to improvements in aquatic organism passage, improvements in dirt and gravel roads (DGR), large wood additions, in-stream habitat enhancements, and riparian restoration. There were 24 total sample sites that had multiple habitat parameters measured. Trout metrics (biomass, density, condition scores, size class distribution, YOY counts) were calculated based on electrofishing surveys, and redd survey data from 2013-2021 was analyzed to determine the density of redds in treated versus untreated stream segments. Habitat sites installed between 1999-2007 were found to have higher brown trout density and combined brook/brown trout biomass. Condition scores of brook trout were higher at DGR sites compared to habitat sites and reference sites. Brown trout had higher condition scores at habitat improvement sites compared to other site groups. Redd density was significantly higher in stream segments that had a restoration project take place. The longer habitat structures were in place, the more residual pool area (>1 ft deep) and average stream depth, which in turn creates thermal refugia and may build resiliency among salmonids in a changing climate. The results of this study provide a framework for future fieldwork and analysis that measures the effectiveness of stream restoration projects.

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Evaluation of Aquatic Organism Passage at Road-Stream Crossing Improvement Projects in Pennsylvania

Shawn Rummel, Jacob Tomlinson, Allison Lutz, Kathleen Lavelle, and Amy Wolfe

Trout Unlimited

Road stream intersections are a leading factor of habitat fragmentation and barriers to aquatic organism passage (AOP). Pennsylvania has approximately 180,000 road miles overlapping over 86,000 stream miles. Limited AOP impacts species, like salmonids, that rely on cold contiguous habitat and the ability to move upstream to spawn. Frequently when a culvert presents a barrier to AOP it is undersized/lacks flood resiliency. Undersized crossings offer a smaller area for water flow, increasing flow velocity through the structure and limiting fish passage, debris transport, and threaten roadway infrastructure. TU has been a lead partner in Pennsylvania to assess crossings for AOP through North Atlantic Aquatic Connectivity Collaborative (NAACC). TU has strategically replaced crossings to reconnect crucial brook trout habitat while encouraging smart design for increasing flows/storm events and a changing climate. A 2015 policy update in PA dictated crossings on dirt/gravel roads to be built to bankfull. Between 2015- 2017, 229 crossings were replaced. TU randomly selected 46 of these crossings of various structure types to evaluate and quantify the effectiveness of completed road/stream crossing projects in terms of design specifications, project cost, and AOP. NAACC data was incorporated with longitudinal profiles of both constructed and reference reaches at each site. NAACC scores and USFS FishXing models were used to determine AOP/flood resiliency through crossings. In brief, the results of this study revealed round culverts to be the most limiting structure type, structures were on average less than bankfull width, and continuous substrate throughout the constructed reach was lacking. The results of this study provide technical guidance and recommendations on practical approaches to maximize project success with respect to AOP as well as providing geomorphic continuity between the upstream and downstream segments.

Presenter: Kathleen Lavelle; Kathleen.Lavelle@tu.org

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