2022 Keystone Coldwater Conference & PA American Fisheries Society Joint Meeting

Oral Presentation and Poster Descriptions

Note: Student presentations are marked with an asterisk (*)

Friday, February 25, 2022

Concurrent Workshops: 1:00 pm – 2:30 pm

Fish Community Responses to Changing Environments Using the Thermal Fish Index
Presenter: Tim Wertz, PA Department of Environmental Protection
Co-Presenter: Matt Shank, PA Department of Environmental Protection

Measuring biological responses to changing environmental conditions is vital to watershed restoration and management. A variety of bioassessment tools are currently available to help researchers detect and interpret fish community responses to improving or degrading conditions. The Pennsylvania Department of Environmental Protection has developed a novel bioassessment tool called the Thermal Fish Index (TFI) to measure fish community responses to changing water quality, habitat quality and temperature. The goal of this workshop is to introduce the TFI, focusing on ecological concepts and interpretation. Numerous case studies will be presented to demonstrate real world examples of fish community responses to spatial and temporal environmental change. Finally, a discussion session will focus on establishing goals for restoration and measuring incremental progress while considering global climate change scenarios.

PATU Women, Diversity, & Inclusion – Efforts in PA and How You Can Get Started!
Presenter: Amidea Daniel, PA Fish & Boat Commission/PA Council of Trout Unlimited
Co-Presenter: Kelly Williams, Clearfield County Conservation District/PA Council of Trout Unlimited

Diversity covers many avenues, from age, gender, social, and economic backgrounds, to ethnic, and family backgrounds, and much more. Just as diversity is important for healthy stream ecosystems, so too, is it important for organizations like TU, to sustain the hard work, and dedication of protecting, conserving, and enhancing the waters, and trout we love, and enjoy. This presentation will introduce participants to PATU's Women, Diversity, and Inclusion work occurring in PA. Throughout the presentation, presenters will share examples of programs being implemented, ideas on how to get started (e.g., women's programs, STREAM Girls, STREAM Keepers), and suggestions on how to sustain what is started.

Concurrent Workshops: 3:00 pm – 4:30 pm

Building Community Around Conservation
Presenter: Jeff Yates, Trout Unlimited

In this rapidly changing world, with existential threats such as climate change, it's more important than ever to build an entire community around the conservation objectives you are focused on bringing to your local rivers and streams. In this workshop style presentation, Jeff Yates will discuss some of the

best practices in community engagement, with a focus on connecting with underserved and traditionally marginalized communities, in order to drive sustainable conservation projects and science and monitoring programs into the future.

Navigating the Waters of Youth Engagement
Presenter: Jessica Kester, Penn State Extension/PA Association of Environmental Educators
Co-Presenter: Spencer Gee, Penn State Extension

Water connects us all. It is a common denominator among individuals of differing minds, bodies, and beliefs. Today more than ever advocates for healthy waters are poised to make impacts on countless youth that will help shape not only present conditions but the future of our planet. You need not stand alone in these efforts and through this hands-on, activity-based presentation we will demonstrate best practices in water education and provide connections to the PA 4-H programs and resources that can be leveraged to better support freshwater conservation efforts across the state. Each county in the state has a 4-H program with access to youth, volunteers, and experience navigating the waters of youth engagement. During this presentation we will discuss how 4-H projects combined with local water conservation experts, researchers, anglers, and volunteers can better engage, retain, and inspire youth to take action and speak up for our limited water resources. All participants will leave with the understanding of how to connect with their local 4-H Educators, hands-on experience in a variety of activities to use with youth, multiple ready to use lessons on a variety of water issues, and an understanding of how the 4-H water resource projects and Trout Unlimited's watershed STEM (science, technology, engineering, math) education resources align.

Poster Sessions: 7:00 – 9:00 pm

***Developing a database of stream restoration projects in Pennsylvania to identify historic trends, advances, and future directions/strategic challenges**
Presenter: Abby Gearhart, Bucknell University
Co-Presenter: Timothy Zelikovsky, Bucknell University
Co-Author: Benjamin R. Hayes, Bucknell University

By conservative estimates, over 1.2 billion dollars has been spent on stream restoration in Pennsylvania over the past 40 years, yet little is known about the project outcomes and how restoration technologies have varied with location and time. Improving restoration designs and setting watershed priorities rely on making information readily accessible to the public, which is a primary goal of this project. Data were gathered from state, federal, and foundation databases on 5,198 projects completed from 1916 to 2020 in 66 of 67 counties in the state. The data was organized into spreadsheets and relational databases within a geographic information system (GIS) framework. The resulting database architecture followed that of the National River Restoration Science Synthesis (NRRSS) database compiled in 2005, which included up to 15 different intents for any given project. The data were categorized by project intent (e.g., goals of the restoration effort), cost, year completed, watershed, and other details. Various watershed groups and state and federal agencies did not organize their data in accordance with the NRRSS database, which makes it difficult to compile a single database for all projects. Also, the individual databases emphasized different things and precise locations weren't available for many projects. Nevertheless, sufficient information was available on important project records such as watershed name, county, cost, project description, and agency/organization. Of the records obtained from this study, only 8% of the restoration projects had more than one intent, with riparian management being the most common goal, followed by water quality. Other common goals were dam removal, bank

stabilization, habitat improvement, stormwater management, and aesthetics, recreation and education. Only recently have efforts adopted a holistic approach to include legacy sediment removal, improving stream-floodplain connectivity, and hyporheic exchange. Results from this study will help environmental agencies and natural resources managers implement adaptive management techniques in their restoration strategies as well as provide a more effective data reporting scheme that includes information on why projects were done, how it was planned, specific activities, types of professionals involved, and how the project will be monitored and evaluated, what successes and failures were identified, and project constraints.

***Analyzing fish population responses to the size of sediment in restored streambeds**
Presenter: Arielle Heisler, Susquehanna University
Co-Authors: Matt Wilson and Dan Ressler Ph.D, Susquehanna University

Agricultural practices have impaired the ecological function of streams in Central Pennsylvania. However, restoration projects have been implemented on these streams to reduce erosion and downstream sedimentation. We studied the effects of stream restoration in different watersheds to determine the effectiveness and response of fish populations to the size of sediment. At each site, fish and sediment samples were taken on a 100-meter reach of the stream. Fish samples were collected by electroshocking. Five sediment samples on the streambed were taken in eddy, pool, riffle, and transitional zones and analyzed in R Studio for mean grain size, sorting, carbon: nitrogen ratio, and organic matter fraction (loss of ignition). Streams separated into two categories: those that experienced an increase in sediment size due to restoration and those that did not change in sediment size after restoration. Fish populations appeared to follow similar trends, we saw population sizes of some species increase following stream restoration and those that did not. By studying the relationship between fish species and sediment size, we can determine a better understanding of the effectiveness of restoration through time and gain more insight on species habitat preferences.

***Presence of Microplastics in Freshwater and Marine Birds**
Presenter: Cara Brennan, Susquehanna University
Co-Author: Dr. Carlos Iudica, Susquehanna University

Microplastics have been found in aquatic invertebrates and fish. Because plastics are now a common component in their prey, piscivorous birds are at risk of consuming and accumulating plastics within their bodies. This study was constructed to understand the extent of microplastic presence in avian species and across tropic levels in relation to bioaccumulation. Birds were collected across mid-Atlantic states and dissected to retrieve the proventriculus and gizzard. A modified wet peroxide procedure was utilized, using potassium hydroxide (KOH) and hydrogen peroxide (H_2O_2) for chemical digestion to isolate the microplastics from the organic matter of the dissected organs of each bird. Digested samples were filtered over microfiber filters before being examined under a dissecting microscope. Anticipated results are a greater presence of microplastics in female birds due to nest building and infant care, as well as greater microfiber presence in marine birds than in freshwater species.

***Macroinvertebrate Habitat and Streambed Gravel Size Distributions Downstream from Stream Restoration**
Presenter: Colton Smith, Susquehanna University
Co-Authors: Matt Wilson and Dan Ressler Ph.D. Susquehanna University

Macroinvertebrate populations are used to indicate water quality. Stream restoration may dislodge sediments from the stream bed during construction of in-stream habitat structures and launch a pulse of material downstream from the restored zone. These sediments could jeopardize the composition and appropriateness of the streambed for macroinvertebrate habitat. The Wollman pebble count technique was used at 18 stream sites to determine mean grain size, sorting, skewness, and kurtosis of gravels larger than 1 cm (phi scale -3.5) in 2021. Macroinvertebrate populations were collected from these sites in 2020. Generally, mean gravel size increased and sorting values decreased with greater downstream distance from the upstream restoration site. Generally, macroinvertebrate populations saw minimal decreases in downstream areas and larger gravel sizes. Mean gravel size should be considered when looking at habitat sustainability so that an overall distribution of species is determined across stream systems.

***Assessing Stream Restoration Effectiveness with Macroinvertebrate Populations and Stream Bed Organic Matter**

Presenter: Connor Stewart, Susquehanna University
Co-Authors: Matt Wilson and Dan Ressler Ph.D. Susquehanna University

Agricultural streams have long been degraded due to human intervention and often require restoration work to be able to return to health. Stream restoration will not show change right away and time is needed to see actual positive effects in streams. Changes to sediment grain size and the quantity and solubility of organic material mixed with mineral sediments in the stream bed directly impact the habitat that macroinvertebrates interact with. To examine the changes that stream restoration efforts have on stream bed sediments, 8 locations in were sampled in 2017 and again in 2020 to determine trends in both the macroinvertebrate populations as well as measures of organic matter in the stream bed. For this study, loss on ignition (LOI) tests were conducted to determine the fraction of organic matter (oxidized at 550 □C) and C:N ratio (dissolved organic carbon divided by soluble total nitrogen in a sediment extract). Macroinvertebrates are organized by their Pollution Tolerance Value (PVT) used in the PA IBI (index of biotic integrity). Preliminary data suggest that insects with PVT = 6 made up a significant fraction of the early restoration and pre-restoration populations. Correlations between PVT and LOI, and PVT and C:N are also planned. We hope to demonstrate that the changes to the macroinvertebrate populations are consistent with changes to the streambed organic matter characteristics.

***Evaluation of bioassessment metrics across hydrologic and agricultural impairment gradients using fish communities**

Presenter: Hannah Klim, Susquehanna University
Co-Authors: Matt Wilson and Dan Ressler Ph.D. Susquehanna University

The type and intensity of impairment in streams is often assessed through measures of the macroinvertebrate, diatom, and/or fish communities present. These bioassessment metrics typically include measures of composition (richness, diversity metrics), functional guilds (filter-feeders, lithophiles), and a priori measures of pollution tolerance (e.g., Hilsenhoff Biotic Index). While the scores or ratings produced by common assessment metrics often reflect expected gradients of impairment (e.g., percent urban development or agriculture) they are designed to identify, recent studies suggest some underlying assumption about taxa life histories could be incorrect (e.g., thermal tolerance of sensitive stoneflies). In addition, fish communities can be more readily sampled and identified in the field than other commonly used taxa groups, allowing for more rapid bioassessments. To better understand how fish communities respond to physical or chemical changes resulting from agricultural or

hydrological impairment, we sampled thirty-six sites in central PA to collect data on fish populations, water chemistry, and sediment composition. We used multiple linear regressions to compare individual taxa to abiotic characteristics with well-characterized responses to land use to identify possible metrics for inclusion in bioassessment protocols. The inclusion of biotic and abiotic measures within individual metrics is uncommon and may help to better understand how streams respond to impairment. These linear regressions and species comparisons can then aid in adapting existing, or developing new, metrics based on community interactions and species responses.

***Comparison of fish communities represented by different gear types in LeBoeuf Lake, Pennsylvania**
Presenter: Kaleb Keech, Indiana University of Pennsylvania
Co-Authors: Darby Byington (Indiana University of Pennsylvania), David Janetski (Indiana University of Pennsylvania), Doug Fischer (PA Fish and Boat Commission), Brian Ensign (PA Fish and Boat Commission), Eric Billman (Brigham Young University-Idaho), and Casey Bradshaw-Wilson (Allegheny College)

Accounting for biases among different types of sampling gear is an ever-present challenge in fisheries management. While gear comparisons have been reported in many previous studies, rarely have fish data from electrified benthic trawling been compared with common sampling methods. We compared three gear types used to sample fish communities in LeBoeuf Lake, Crawford County, Pennsylvania. Six locations were sampled using electrified benthic trawling, fyke nets, and minnow traps in April and August 2021. In total, we captured 2,024 fish representing 30 species. Fish communities between April and August had overlap with common species (Bluegill and Black Crappie), however there were four species only found in April and seven species only found in August. Fyke nets captured a similar number of species (22 species) as the electrified benthic trawl (21 species), and minnow traps captured far fewer (6 species). The largest total number of individuals was caught in fyke nets at 1,316. Non-metric Multi-dimensional Scaling (NMDS) plots showed fish community composition was more similar within than among gear types, indicating consistent biases for fyke nets and electrified benthic trawling. Electrified benthic trawling captured a relatively high number of Round Goby, as well as Bluegill and Yellow Bullhead, while fyke nets captured primarily Bluegill, Black Crappie, and Largemouth Bass. Six unique species were only captured with fyke nets. While fyke nets were shown to collect more fish than other gear types, electrified benthic trawling may be desirable for targeting certain species such as invasive Round Goby.

***Monitoring Translocated Freshwater Mussel Species and Examining their Restoration Potential in the Clarion River Watershed**
Presenter: Marilyn Can, Indiana University of Pennsylvania
Co-Authors: Eric Chapman (Western Pennsylvania Conservancy), Jordan Allison (PA Fish and Boat Commission), Nevin Welte (PA Fish and Boat Commission), Grace Tillotson (US Forest Service), Joseph Duchamp (Indiana University of PA), David Janetski (Indiana University of PA)

To determine factors relating to the success or failure of freshwater mussel translocations, we studied various aspects of a translocation with the help of Western Pennsylvania Conservancy (WPC), Pennsylvania Fish and Boat Commission (PFBC), United States Forest Service (USFS), Elk and Jefferson County Conservation Districts, and Indiana University of Pennsylvania students in 2021. This translocation was initially carried out and monitored by WPC, PFBC, and USFS in 2015, 2016, 2018, and 2019, across 10 sites in the historically degraded Clarion River. We recorded environmental conditions at established relocation sites, analyzed existing survival and growth data of PIT-tagged translocated mussels, measured recruitment by surveying for juvenile mussels near relocation sites, and predicted

future recolonization of nearby tributaries based on host fish presence or absence. Average unadjusted survival as last measured in 2018 or 2019 was high (73%), indicating translocation success, but ranged considerably by site (18–86%) and species (31% [Flutedshell]–90% [Round Pigtoe]). We produced growth curves for the most common species: Mucket and Spike, to better understand how translocated mussels grew over time. On average, Spike grew 2.86 mm/year, roughly double the yearly growth for Mucket, 1.43 mm/year. We surveyed 90 0.25-m2 quadrats per site and found no evidence of recruitment. However, we documented anecdotal evidence of gravidity, indicating some level of reproduction. All tributaries surveyed (Spring, Bear, and Big Mill Creeks) had host fish species present, with Spring Creek having the greatest host fish species richness, suggesting the possibility for future recolonization of mussels. While we did not find evidence for recruitment of juvenile mussels, our results show that the Clarion River mussel translocation has been successful in terms of survival.

***Evaluation of Brook Trout Dispersal Following Culvert Removal**
Presenter: Nick Christensen, Indiana University of Pennsylvania
Co-Author: David Janetski, Indiana University of Pennsylvania

Culvert replacements are a high conservation priority for reducing stream fragmentation, yet post-replacement monitoring of fish populations rarely occurs. To address this shortcoming, we tracked brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta) movements after five culvert replacements in August 2020 in Bobby Run, Cameron County, Pennsylvania. Movements were tracked using a mark-recapture approach with PIT and elastomer tags, where fish were marked prior to culvert removal and recaptured at two time points after culvert removal. As a baseline comparative indicator of trout movement, we also monitored movements in a nearby control stream without passage barriers. Three months after culvert replacement we recaptured 25.7% of marked fish (102/396) in Bobby Run and 22.4% (92/409) in the control stream. Ten months after initial tagging we recaptured 11.9% (34/285) in Bobby Run and 17.7% (26/147) in the control stream. Overall, 13.7% (14/102) of tagged fish moved from their original location during first recapture in Bobby Run and 10.9% (10/92) in the control. During our second recapture, we found that 26.5% (9/34) of tagged fish moved from their original location in Bobby Run and 3.8% (1/26) moved in the control stream. Of the trout recaptured three months post culvert removal, 8.8% moved upstream past culvert replacement sites in Bobby Run compared to 8.7% that moved similar distances upstream in the control stream. During the second recapture, 23.5% of recaptured trout moved past a remediated culvert site in Bobby Run and 0% moved upstream in the control stream. These results suggest that trout in Bobby Run rapidly returned to baseline (similar to the control) movement patterns after culvert replacement. Overall, the information generated by our study will improve understanding of the benefits of habitat connectivity, which we anticipate will lead to more concrete justification for future stream restoration efforts.

***Physical habitat responses to bank stabilization and restoration of agricultural stream channels**
Presenter: Sierra Rider, Bucknell University
Co-Authors: Olivia Bongiovi and Matthew McTammany, Bucknell University

Agriculture can transform natural, cobble bottom streams into silt impeded streams with varying depths and velocity. To correct bank erosion and agricultural runoff, physical modifications to stream banks can be implemented to increase water velocity and manipulate the flow of water within the channel. By increasing water velocity and position, sediments can be transported and dispersed rather than lay at the bottom of the stream. State agencies (PA-FBC, PA-DEP) have partnered with local organizations (NPC, county conservation districts, watershed groups) and landowners to implement stream restoration practices along a number of agricultural streams in central Pennsylvania through the

Northcentral Stream Restoration Partnership. Bank stabilization and flow control structures were installed along a reach of Conley Run and Turtle Creek in Union County, PA. We conducted surveys of in-stream habitat before restoration, and again multiple years after to quantify changes in stream velocity, depth, substrate characteristics, and channel shape in response to structural modifications to the streams. Habitat conditions initially improved following stream restoration (less silt, higher velocity, higher cobble content): however, those initial benefits have declined based on more recent surveys. Site-based restoration approaches might yield initial benefits but have lower, long-term success, potentially due to sediment being moved within the reach or into the restored reach from unrestored areas upstream.

***Pattern and Color Variation in Brook Trout**
Presenter: Eamonn Powers, The Pennsylvania State University
Co-Authors: Sara J. Muller and Jay R. Stauffer (The Pennsylvania State University)

Little is known or understood about the diversity of color and patterning of the state fish of Pennsylvania, the Brook Trout (*Salvelinus fontinalis*). Often, anglers and fish enthusiasts refer to certain streams containing “darker fish” and others having more “spotty” fish. The purpose of this study is to quantify the patterning and coloration of Brook Trout from across the state of Pennsylvania, amassing data through an angler science project. Anglers submit pictures and survey questions to a database via a custom survey. To date, over 1,200 pictures have been submitted to this database. Initial submissions of Brook Trout by anglers from across the state of Pennsylvania show variation in the number of red spots and the appearance of parr marks on a variety of size classes, and overall variation in color morphs. Current results illustrate a high level of diversity in both coloration and patterning in Brook Trout throughout Pennsylvania. Going forward, coloration and patterning will be analyzed using location, water body qualities, and size as variables to further understand the diversity of patterning and coloration in Brook Trout. By understanding this diversity, insight into areas to target study of the genetic diversity and potential diversification of Brook Trout can be gained.

Saturday, February 26, 2022

Concurrent Sessions: 10:30 am – 10:50 am

The Compleat Angler on Penns Creek
Presenter: Paul Siewers, Bucknell University
Co-Presenters: Peter Foradora & Cat Jamison, Bucknell University

Humanities students studying nature literature find an especially meaningful connection between their studies and local watersheds by visiting Penns Creek and learning about fly fishing with help from local Trout Unlimited teachers. This effort illustrates how humanities courses can be integrated into watershed studies. Examples also from historical-journalism projects such as the "Stories of the Susquehanna" effort at Bucknell will also be provided.

Biological resistance by native Brown Trout impedes colonization by endangered European Eel
Presenter: Kyle Young, First Order Ecology
Co-Authors: Luke Cameron, Bournemouth University, UK; Lewis Naisbett-Jones, University of North Carolina, USA; Bill Perkins, Aberystwyth University, UK

Climate change will require many species and populations to shift their ranges but doing so will be difficult because habitat degradation has reduced abundances and thus emigrant numbers, while habitat fragmentation impedes migration. It is thus widely accepted that assisted translocations will be needed to help conserve biodiversity during the Anthropocene. We conducted a replicated, ecosystem-scale colonization experiment using the critically endangered European eel (Anguilla anguilla). We translocated wild juvenile eels into 13 headwater streams that were either fishless or contained allopatric resident populations of native Brown Trout (Salmo trutta). The results demonstrate that biological resistance by trout impedes eel colonization. After three months, we recovered 70% fewer eels in streams with Brown Trout, and recovered eels tended to be larger in streams with trout. Across sampling sites within trout streams, we found the number of recaptured eels decreased with the density of adult trout. Together, these results suggest size-selective predation by larger trout may be the mechanism by which trout impede eel colonization. Further experiments are required to directly test this and other hypotheses. We discuss the value of using headwater streams to conduct replicated, ecosystem-scale translocation experiments.

Power Analysis for Detecting the Effects of Best Management Practices on Reducing Nitrogen and Phosphorus Fluxes to the Chesapeake Bay Watershed, USA

Presenter: Paul McLaughlin, PA Cooperative Fish & Wildlife Unit, Pennsylvania State University
Co-Authors: Richard Alexander (USGS), Joel Blomquist (USGS), Olivia Devereux (Devereux Consulting, Inc.), Greg Noe (USGS), Kelly Smalling (USGS), Ty Wagner (USGS, PSU)

In 2010 the U.S. Environmental Protection Agency established the Total Maximum Daily Load (TMDL) which is a ``pollution diet'' that aims to reduce the amount of nitrogen and phosphorus entering the Chesapeake Bay, the largest estuary in the US, by 25 and 24\% percent, respectively. To achieve this goal the TMDL requires the implementation of Best Management Practices (BMPs), which are accepted land management practices for reducing pollutant runoff to nearby bodies of water. While the TMDL requires that the necessary management actions be in place by 2025 to eventually reach targeted nutrient loads, the ability to detect an effect of BMPs while assuming that one has occurred (i.e., statistical power) is still not well understood. The goal of this study was to investigate the power and required timelines to detect nutrient reductions in streams and rivers as the result of BMP implementation at the Chesapeake Watershed scale. Power estimates were produced using **SPA**tially **R**eferenced **R**egression **O**n **W**atershed attributes (SPARROW) models, which offer a flexible stochastic framework and were recently extended to allow for modeling multiple time steps. Nitrogen and phosphorus focused models were calibrated to estimate the power to detect reductions in numerous constituent flux sources. To confidently link changes in specific source variables to a decrease in constituent flux reaching the Bay's tidal waters, reductions in nitrogen inputs ranging from 30-65\% were required for the nitrogen model. In contrast, reductions in inputs of up to 80\% were not detectable under the phosphorus model. The timelines necessary to detect reductions in nitrogen flux ranged from 12 to several hundred years under different nitrogen scenarios of rates-of-change and management. The approach proposed here can help better understand the ability to detect the effects of BMPs on a regional scale and help guide future management actions and monitoring programs.

Development and validation of two environmental DNA assays for American Eel (Anguilla rostrata)

Presenter: Greg Moyer, Mansfield University
Co-Authors: Josh Grassi (PA DEP), Meredith Bartron (USFWS), Christopher Rees (USFWS), Heather Galbraith (USFWS)

We developed and validated two species-specific qPCR markers to detect American Eel environmental DNA (eDNA). Key steps in eDNA marker validation included assay design, specificity, and sensitivity testing, as well as in vivo lab and field experiments. Markers AME1 and AME2 targeted 116 and 129 bp fragments of the mitochondrial NADH dehydrogenase I (ND1) and cytochrome b (cytb) genes, respectively. Markers were 94 -100% homologous for all 49 aligned American Eel sequences. Specificity tests, with known DNA obtained from fish species (149 individuals from 124 spp. spanning 29 families), demonstrated the markers to amplify DNA derived from American Eel tissue exclusively with a failure of amplification from all other fish species. In aquarium trials, we observed a significant negative relationship between mean qPCR cycle threshold value and increasing number of eels per tank. We also assessed 35 sites on the East Coast (Maryland to Maine) known to contain populations of American Eel. All sites that harbor American Eels (n = 12) also tested positive for American Eel eDNA and those sites presumed absent of American Eels (n = 23) failed to amplify American Eel eDNA. In three cases, our assays produced positive detections in the lower portion of a watershed but failed to detect American Eel upstream of an impassible barrier in each of the same watersheds. Our encouraging results of in vitro and in vivo validation demonstrate the utility of using eDNA sampling for the detection and monitoring of American Eel in a variety of freshwater habitats in northeastern United States.

Concurrent Sessions 11:00 am – 11:20 am

Trout Unlimited Priority Waters
Presenter: Jake Tomlinson, Trout Unlimited

Trout Unlimited recently updated its strategic plan. As part of this updated plan, one of our goals is to "harness the collective power of TU more fully over the next five years". To help accomplish this goal, TU is working to identify a national network of shared priority waters for native and wild trout and to prepare a plan for fixing them. The strategy is simple, to develop a blueprint, inspire a call to action, and then to provide the necessary resources. The implications are enormous and will allow for a focused effort on priority waters through which TU can effect meaningful change. This discussion introduces the priority waters effort and will update participants on the status of watershed selection.

***Juvenile drift of round gobies (Neogobius melanostomus) in the French Creek watershed as a means of range expansion**
Presenter: Grace Hemmelgarn, Allegheny College
Co-Author: Dr. Casey Bradshaw-Wilson, Allegheny College

A newly introduced invasive fish, the round goby (Neogobius melanostomus), was discovered in the French Creek watershed in 2014 and is threatening the unique biodiversity within the stream system. Successful management strategies of this invasive species depend on accurate information about many life history strategies, including dispersal mechanisms. Most research on round goby natural dispersal within the French Creek watershed focuses on adults, but juvenile drift may be a form of downstream dispersal in French Creek that has not been examined. The objective of this study was firstly, to document whether juveniles were utilizing drift as a means of range expansion, and secondly, to describe abiotic factors correlating with drift density. Drifting larval and juvenile fishes were collected by placing drift nets across stream transects twice a month from June to August 2021 in the French Creek watershed at an invaded site, the last known location of the invasion front, and an uninvaded site. Drift nets were set an hour before sunset and sampled every hour for 5 hours. Preliminary results show drifting juvenile round gobies are present at the invaded site. Understanding the patterns of round goby

larval drift is necessary to inform management strategies that limit the dispersal of round gobies in the French Creek watershed and beyond.

***Influence of abiotic variables on biological recovery from abandoned mine drainage in a Western Pennsylvania watershed**
Presenter: Alexa Hershberger, Indiana University of Pennsylvania
Co-Authors: Dr. David Janetski (IUP) and Thomas J. Clark (Susquehanna River Basin Commission)

Abandoned mine drainage (AMD) is a prominent issue that impairs approximately 8,000 streams in the Appalachia Coal Region. Acidic drainage from abandoned mines occurs from the oxidation of iron, which dissolves metals that is detrimental to biological systems. Biological recovery, specifically benthic macroinvertebrate monitoring, has historically been a reproducible strategy due to the low cost and sensitivity of taxa. This study investigates the biological condition of the Bear Run Watershed (Indiana County, Pennsylvania) 10-15 years post-remediation, where the aquatic insect community has shown slow recovery despite improvements in water quality. Our objective was to identify factors that impair recovery, such as embeddedness due to substrate precipitates and streambed heavy metal composition. We found an overall higher macroinvertebrate abundance on artificial substrate (Hester-Dendy samplers) than on natural substrate (Hess samples) in both impaired and control streams. There were approximately twice as many individuals collected in reference reaches than the AMD reaches. Surprisingly, macroinvertebrate abundance on natural substrates did not differ between AMD and reference reaches, perhaps due to the abundant dipteran or potential variation among sites. The highest abundance of EPT taxa was found at an AMD site, but overall, the reference reaches on artificial substrate had a slightly higher EPT abundance. The chlorophyl a abundance did not significantly vary between site or substrate type. This suggests that the algal community has recovered from the remediation efforts and is not inhibiting the macroinvertebrate recovery. The chemical composition of the stream substrate and stream embeddedness are potential limiting factors for macroinvertebrate recovery.

Assessing Western Pennsylvania Stream Readiness for Mussel Recovery and Restoration
Presenter: Mary Walsh, Western Pennsylvania Conservancy
Co-Authors: Eric Chapman (Western Pennsylvania Conservancy), Nevin Welte (Pennsylvania Fish and Boat Commission), and Wendell Haag (US Forest Service)

To assist the efforts to recover streams in the Ohio River basin in western Pennsylvania, an assessment of the potential for successful freshwater mussel population augmentation or translocation occurred in this study of 13 streams. The growth and survival of juvenile live freshwater mussels were assessed as a measure of the viability of a future reintroduction. Juvenile Plain Pocketbook (Lampsilis cardium) were deployed in silos in which they were exposed to in-stream conditions in each of the study streams over 11 weeks. The growth and survival of the juvenile mussels were compared between reference streams, which have rich mussel communities, and streams with degraded mussel communities. Results from the study will be used to inform mussel conservation and restoration efforts.

<u>Concurrent Sessions: 11:30 am – 12:00 pm</u>

The Penn State Master Watershed Steward Volunteer Program Can Help You!
Presenter: Brad Kunsman, Penn State College of Agricultural Sciences, Penn State Extension
Co-Author: Erin Frederick, Penn State Extension

The Penn State Extension, Master Watershed Steward program was established to educate and empower volunteers to protect Pennsylvania's environmental resources. The goal of this volunteer training program is to expand citizen water and natural resources knowledge with Penn State's unbiased research-based information to broaden conservation outreach efforts in communities across the commonwealth. Join us to learn about our county program model, see how our volunteers can plug into your organization, and who you need to contact.

Master Watershed Stewards can help with the following and more!

- Answer landowner questions about stream-side property stewardship.
- Assist with stream restoration projects.
- Teach stream ecology or wildlife habitat classes.
- Write for municipal newsletters.
- Organize stream clean ups.
- Speak to neighborhood groups.
- Work with municipal officials on invasive plant removal projects.
- Create and staff educational displays.
- Work with children in formal and non-formal settings.
- Carry out water quality testing.

Using Environmental DNA in the Management of Two Invasive Fish Species in the Susquehanna River Basin

Presenter: Luanne Steffy, Susquehanna River Basin Commission
Co-Author: Aaron Henning, Susquehanna River Basin Commission

Two non-native fishes are currently in the early stages of invasion in the lower Susquehanna River Basin. Northern Snakehead (Channa argus), native to Asia, is expanding its range throughout the Chesapeake Bay watershed. Blue Catfish (Ictalurus furcatus), native to the Mississippi drainage, has likewise been expanding its range moving up the Bay into the lower Susquehanna River. Both are piscivorous and have the potential to negatively affect fish assemblages in the Susquehanna River and tributaries. Both species have been documented in the lower Susquehanna River and parts of the Chesapeake Bay (MDDNR 2016) through angler reports and traditional survey methods. Since 2019, the Susquehanna River Basin Commission has been using environmental DNA (eDNA) to monitor the distribution of Northern Snakehead and Blue Catfish in the lower Susquehanna watershed. These data are critical evaluation tools for cost-effective invasive species management of a large geographic area; particularly in the context of providing successful native fish passage through the four major dams on the lower 50 miles of the Susquehanna River. Positive results for the presence of both species were detected and generally consistent, with some range expansion observed from Year 1 – Year 3. This monitoring project is part of a multi-agency effort, with interstate, federal and state partners, working to reduce the negative impacts of invasive species and inform policy making within the Susquehanna River basin specifically through oversight of the Susquehanna River Anadromous Fish Restoration Cooperative. In late spring 2022, Commission staff will continue monitoring; focusing a new sample design based on most recent results with the goal of staying ahead of the invasion range and also verifying reported disjoint populations.

***Quantifying the roles of biotic and abiotic factors structuring stream fish communities**

Presenter: Chris Custer, Pennsylvania Cooperative Fish and Wildlife Research Unit, Pennsylvania State University

Co-Author: Douglas Fischer (PFBC); Aaron Henning (SRBC), Dawn Hintz (SRBC), Megan Kepler Schall (Penn State University), Matthew Shank (PADEP), Geoffrey Smith (PFBC), Timothy Wertz (PADEP), Tyler Wagner (USGS)

In the last two years, the "Our Pocono Waters" campaign has: educated the public about exceptional value (EV) stream designations; unified local businesses, NGOs, faith leaders, and sportsmen groups around stream protection measures; assertively countered false and misleading statements from developers about EV streams; and informed the community that the protection of the regions EV streams is vital to the resilience of the Poconos economy.

Understanding the relative importance of biotic interactions and abiotic habitat conditions structuring fish communities is critical for effective conservation and management, particularly in the face of global change. While it is well understood that both biotic and abiotic factors influence species distributions, past modeling efforts have struggled to incorporate both simultaneously. The focus on abiotic habitat factors when modeling distributions may limit our understanding of how communities will respond to changing environmental conditions as we know that biotic interactions are also primary drivers of species distributions. Recent statistical advancements have introduced methods that allow for modeling of species distributions with regards to both. However, many of these approaches are limited in their abilities to make direct inferences of the estimated species associations or the relative importance of biotic versus abiotic drivers. Importantly, they also often assume that biotic interactions are constant over space and time – which is likely not the case. To overcome these challenges, we implemented conditional random field models to better understand the factors that are important in structuring lotic fish communities in Pennsylvania, USA. Conditional random fields allow for modeling species occupancy or abundance with respect to both biotic and abiotic factors and allow for biotic interactions to vary across environmental gradients. Fish community data were collected over a period of 10 years across Pennsylvania, USA by Pennsylvania Fish & Boat Commission, The PA Department of Environmental Protection, and the Susquehanna River Basin Commission. The fish communities modeled included 76 species from 1116 sample sites. Initial results suggest that biotic associations play a particularly important role in the occupancy of most species. These associations were also found to be non-constant and varied along measured environmental gradients. These results highlight the importance of incorporating not only biotic and abiotic factors simultaneously, but also allowing for dynamic species associations across space and time. By creating a better understanding of the relative roles of biotic and abiotic factors in structuring freshwater fish communities, fisheries managers will be able to better prepare for the future under changing environmental conditions.

***Wood turtles & stream restoration: Opportunities for the conservation of non-target taxa**

Presenter: Richard A. Novak, The Pennsylvania State University

Co-Author: Julian Avery, The Pennsylvania State University

The Eastern United States is a biodiversity hotspot for freshwater turtles. Unfortunately, the long-term persistence of many of these species is threatened by habitat loss, illegal collection, and climate change. The North American wood turtle (Glyptemys insculpta) is one such species that occupies cold water streams in the northeast region, frequently occurring with trout and other game fish. In a nationwide effort to improve stream habitat quality and reduce erosion, stream restoration is being conducted on a nearly industrial level, with the primary goals of this work being fish habitat and water quality improvement. A review of stream restoration guidance literature indicates a lack of consideration for the effects of stream restoration practices on wood turtles and their habitat, despite the fact that this species occupies habitats that frequently overlap with stream restoration effort. Using a web-based survey of active stream restoration practitioners in Pennsylvania, I assess 1) common restoration

practices, 2) knowledge of wood turtle biology and habitat requirements, and 3) willingness to modify existing protocols to benefit wood turtles. Preliminary results show that while some practitioners may know wood turtles occur in their project areas, they have not taken targeted action for the species. In addition, I identify critical knowledge gaps that could hamper turtle conservation efforts and I propose outreach and education initiatives that could extend the utility of limited conservation dollars. This survey highlights an opportunity for increasing the return on investment into conservation projects by considering the historically overlooked wood turtle in design and implementation of stream work.

Concurrent Sessions: 1:00 pm – 1:20 pm

Watershed Friendly Property Certification
Presenter: Justin Mansberger, Penn State Extension

Do you keep your property environmentally friendly to welcome pollinators and keep our creeks healthy? Then your property might qualify for the Watershed-Friendly Property Certification Program, a collaboration between the Penn State Extension Master Watershed Steward Program and Nurture Nature Center. Learn more about the program including the certification process, ways to improve a property, and how to receive a sign signifying the property as Watershed Friendly. Program is applicable to all sizes of property.

***Population Ecology and Comparison of Methods for Sampling Invasive Round Goby (Neogobius melanostomus) in LeBoeuf Lake, Pennsylvania**
Presenter: Darby Byington, Indiana University of Pennsylvania
Co-Authors: David Janetski (Indiana University of Pennsylvania), Doug Fischer (PFBC), Brian Ensign (PFBC), Eric Billman (Brigham Young University-Idaho), Casey Bradshaw-Wilson (Allegheny College)

The invasion of Round Goby (Neogobius melanostomus) into the upper Ohio River basin through French Creek poses a threat to native fish communities. In 2014, Round Goby were likely introduced to the French Creek watershed via bait-bucket in LeBoeuf Lake (Erie County, PA). To better understand and manage this recently introduced population, we assessed Round Goby population characteristics and compared the effectiveness of different sampling gears in LeBoeuf Lake. Three gear types (fyke nets, minnow traps, and electrified benthic trawl) were compared during sampling events in April and August 2021. In April, we captured 88 Round Gobies using electrified benthic trawl, two with fyke nets, and one with minnow traps. For August sampling, 313 Round Gobies were captured using electric benthic trawl, one with fyke nets, and zero with minnow traps. Round Gobies less than 45 mm made up 51% of the April catch, 39% were 50-60 mm, and 9% were 65-95 mm. The August Round Goby catch was dominated by the smallest size class, with 87% less than 45 mm, 5% 50-60 mm, and 8% 65-109 mm. Sizes of gravid Round Gobies in April ranged from 46-90 mm, with ova numbers ranging from 63 to 282. No gravid females were captured in August. During April sampling all gobies were captured near the lake outlets but capture at other locations in August showed dispersal to other areas within the lake over the summer. We anticipate the site-specific and preferred gear type information generated by our study will aid management agencies in evaluating suppression and eradication efforts.

What scales are important for brook trout conservation? A look at the processes that shape brook trout diversity across space and time
Presenter: Shannon White, US Geological Survey
Co-Authors: Eric Hallerman (Virginia Tech), David Kazyak (US Geological Survey)

The genus Salvelinus has been described as one of the most diverse vertebrate clades with species often displaying significant intraspecific variation in life history, morphology, population genetic diversity, and behavior. Such diversity can make it difficult to identify the temporal and spatial scales that are important to consider in management to ensure the conservation of evolutionary significant sources of variation. For example, management of brook trout (S. fontinalis) is often challenged by complicated patterns of genotypic and phenotypic diversity that occur at both local and range-wide scales. Understanding the sources of this variation, which includes natural and anthropogenic processes that have occurred across geologic and contemporary scales, can help elucidate the most appropriate scales for management and conservation. Here, we review the major processes that have shaped phenotypic and genotypic diversity in brook trout populations in the United States. We then discuss how this information can be applied to support conservation decision planning to identify and preserve important sources of diversity in brook trout populations.

Taking the Long View: Temporal Attenuation of Abandoned Mine Drainage in the Mill Creek Watershed

Presenter: Andrew Turner, Clarion University
Co-Authors: Alicia Ramsey (Clarion County Conservation District) and Terry Morrow (Mill Creek Coalition)

Abandoned mine drainage (AMD) persists today as a leading source of water quality impairment in Pennsylvania, with more than 5500 miles of streams polluted by AMD. Runoff from mined areas has low pH and elevated concentrations of iron, aluminum, and other metals. Much effort and money has been devoted to remediation of these polluted discharges, which can involve either active or passive treatment technologies. The pace of reclamation is slow, however, relative to the magnitude of the problem, and some sites will not be addressed for many years. It has been observed that the water quality of these discharges, even if untreated, tends to show some “natural” improvement over time as the quantity of sulfide bearing minerals is depleted. Understanding how the chemistry of abandoned mine drainage changes over time is key in strategic planning for watershed restoration. The ability to predict future changes in the chemistry of AMD discharges will aid in prioritizing funds for restoration and in designing treatment methods and will inform system operations and maintenance. However, there are few studies of how the chemistry of AMD discharges change over time. The Mill Creek watershed in western Pennsylvania has been the focus of intensive restoration efforts. Formerly a productive cold-water fishery, the watershed was heavily mined in the mid 1900’s and there are now more than 60 significant sources of AMD to the stream. Beginning in 1990, the Mill Creek Coalition invested more than 12 million dollars into the construction and operation of 26 treatment systems. Clarion University faculty and students have monitored system performance over the past three decades. In this talk we present data from twelve discharges for time spans of 10 to 28 years. We analyzed these data by calculating yearly means for important variables including iron concentrations, and fit exponential decay models to the time series data. Preliminary analyses show that the natural attenuation rate of dissolved iron is highly variable among discharges. Averaged across sites, the rate of decline in iron concentration is approximately 1% per year, which corresponds with an iron loading “half-life” of 70 years. Ongoing sampling and analyses will include a focus on other metals and acidity as well as a consideration on how the characteristics of individual discharges relate to the rate of attenuation. In sum, our results suggest that AMD will be a persistent issue in this and other watersheds.

Concurrent Sessions: 1:30 pm – 1:50 pm

Using Live Stake Nurseries to Engage Communities
Presenter: Natalie Marioni, Penn State Extension

In 2021, the Penn State Extension Master Watershed Steward program received funding to install several live stake nurseries throughout Pennsylvania. Live stake nurseries consist of native shrubs that, when mature, will provide live stakes (branch cuttings) to local conservation organizations and streamside landowners. These shrubs will provide future material for riparian buffers regionally, aiding in source water protection. In addition to the watershed improvement aspect of these nurseries, an important component of our live stake nurseries is engaging local communities through educational workshops hosted by our Master Watershed Steward volunteers and working with partners for future live stake harvesting and installation projects. This presentation will provide an overview of our nursey installation projects including the many benefits of live stake nurseries, how to work with partners and landowners, and considerations for site and shrub selection. We will also discuss lessons learned related to engaging volunteers and the public in these nurseries, both during installation and in the future, and working with property owners. Live staking is a low-cost way for residents, Watershed Associations, and other environmental groups to make an impact in their community. These projects help introduce community members to live staking as an easy and viable option for making lasting water quality improvements on streamside landscapes. We intend to install additional live stake nurseries throughout our project counties, so residents and watershed focused organizations are aware of the wide-reaching benefits and trained on the methods for planting live stakes.

***Preliminary diet analysis of the invasive Flathead Catfish in the Susquehanna River Basin, PA**
Presenter: Sydney Stark, Wildlife & Fisheries Department – The Pennsylvania State University
Co-Authors: Megan Schall (Department of Biology, Pennsylvania State University – Hazleton), Geoffrey Smith (PFBC), Julian Avery (Pennsylvania State University), Tyler Wagner (USGS)

Invasive species are a growing global concern as they possess the ability to rapidly alter ecosystem dynamics. Maintaining healthy and sustainable fisheries requires managers to understand how introduced species alter aquatic community compositions and ecosystem functioning. Flathead Catfish are a large bodied piscivorous fish that have documented detrimental predatory effects on native fisheries in introduced regions. Flathead catfish can quickly become a dominant predator, alter aquatic communities, and have deleterious effects on species of concern and native species. Despite the Flathead Catfish being established in the Susquehanna River Basin, Pennsylvania for nearly 20 years, little is known about their direct predation effects. We conducted a multi-year diet study to gain an understanding of the predatory effects of Flathead Catfish in this river system. A total of 227 diets were collected from Flathead Catfish in the Susquehanna and Juniata rivers. Preliminary visual identification of 175 diets has revealed that fish are the most frequent prey items (n=95) followed by crayfish (n=46). Due to rapid rates of digestion, molecular analyses are being used to more accurately identify prey items in stomach contents to lower taxonomic levels and are on-going. We are investigating both the co-occurrence of prey items and species most likely to be consumed by Flathead Catfish. Identification of prey items will help managers be able to consider which species may be most vulnerable to predation by Flathead Catfish when developing policy to maintain healthy fisheries.

Brubaker Run Waste Coal Reclamation Project
Presenter: Jim Panaro, Robindale Energy Services, Inc.

The Hastings Refuse Project was a 4.5 Acre abandoned refuse pile located in Elder Township, Cambria County and is situated parallel to Brubaker Run which is located in the Upper West Branch of the Susquehanna River Watershed. Very sparse vegetation existed on the pile and the toe of the pile extended directly into Brubaker Run. Given the pile configuration, any precipitation event that would occur, the sediment laden runoff would flow directly into Brubaker Run. The abandoned pile also prevented the Landowner, living directly across from the pile, from utilizing this particular tract of real estate. Together, a joint effort and cooperation with the Bureau of Abandoned Mine Lands, the Department of Environmental Protection (Cambria Office), the Cambria County Conservation District, the Pennsylvania Fish and Boat Commission and Robindale Energy Services, Inc., a GP-1 Permit was obtained to remove the refuse from Brubaker Run and the remaining refuse was removed to further complete the reclamation of the entire site aiding in the Enhancement Project. There were 69,418 tons of coal refuse removed and transported to the Seward Power Plant and the overall project took four months to complete. By removing the waste coal and re-contouring the site to provide gentle slopes and stabilization, virtually all direct acidic runoff and sediment loading into the stream were eliminated. Working with and under the direction of the Cambria County Conservation District, Fish Habitat Enhancement Structures were installed for approximately 600 feet linear within Brubaker Run Project Area. Such structures included root balls, boulders, and single log vane deflectors. As with abandoned waste coal piles, vegetation at the Hastings site was non-existent. Upon completion of reclamation, any soil like material encountered was saved and applied to the site followed by lime and fertilizer. The site was planted with grasses to develop an unmanaged natural habitat land use where the landowner can start to maintain the area and realize the benefit the cooperative effort provided by the various agencies and industry.

Evaluation of downstream migration of silver American eel in the Susquehanna River basin
Presenter: Sheila Eyler, US Fish and Wildlife Service
Co-Authors: Josh Newhard, Rob Bourdon, Mike Mangold, and Steve Minkkinen (USFWS)

American eels were extirpated from the Susquehanna River as the result of the construction of large hydroelectric dams in the lower main stem of the river early in the 20th century. The most recent effort to restore eels to the basin started in 2008, when eels collected by the U.S. Fish and Wildlife Service at Conowingo Dam were transported upstream. Collections and stocking have occurred annually since that time. Eels were first reported to be maturing and making downstream migrations in the Susquehanna in 2013. Turbine mortality is a concern as eels will need to pass four main stem hydroelectric dams and a pumped storage facility before escapement to the upper Chesapeake Bay. This was the pilot year of a study designed to evaluate the timing and duration of eel downstream migration through the lower Susquehanna River. In 2021, a total of 16 mature eels were tagged with acoustic tags in the Susquehanna and Juniata Rivers and their migration was tracked at receiver arrays near Harrisburg, Marietta, and Havre de Grace, Maryland. Eleven of the 16 eels were detected at the most upstream receiver array in Harrisburg. Downstream migration occurred from August through October and correlated with high river flow events. Three tagged eels were detected at both the Harrisburg and Havre de Grace arrays, with a ravel time ranging from 9 to 42 days. The study will be repeated in 2022 and 2023 with more receiver arrays in the lower basin and planned release of 100 tags annually.

Concurrent Sessions: 2:00 pm – 2:20 pm

DCNR Funding and Riparian Buffers
Presenter: Vallie Edenbo, PA Department of Conservation and Natural Resources

Co-Presenter: Marlin Graham, DCNR Bureau of Forestry and Western Pennsylvania Conservancy

Vallie Edenbo will offer an overview of funding options from DCNR, and Marlin Graham will present the benefits of forest buffers and how to implement you own buffer project start to finish.

A century of stream restoration in Pennsylvania: What can we learn?
Presenter: Benjamin R. Hayes, Watershed Sciences and Engineering Program, Center for Sustainability and the Environment, Bucknell University
Co-Presenter: Abby Gearhart, Bucknell University
Co-Author: Timothy Zelikovsky, Bucknell University

We developed a database of 5,198 stream restoration projects completed in 66 counties across Pennsylvania since 1916. Despite substantial difficulties in gathering the data, we are able to draw conclusions about the design, implementation, and evaluation practices used and compare them with national trends. Only 8% of stream restoration projects had more than one intent, with riparian management being the most common goal, followed by water quality. Other common goals were dam removal, bank stabilization, habitat improvement, stormwater management, aesthetics, recreation, and education. Only recently have efforts adopted a holistic approach to include legacy sediment removal, improving stream-floodplain connectivity, and hyporheic exchange. More than half of the projects were located in watersheds for which a management or assessment plan had been prepared, yet these plans had a limited impact on the selection of the restoration site or the project design and implementation. Rarely were projects subjected to systematic pre-restoration monitoring or post-project evaluation, partly due to a lack of funding for these activities and partly because iterative, adaptive management approaches have yet to be widely embraced or required by the stakeholders and regulatory process. The most successful projects were ones whose design was preceded by a historical study documenting former channel conditions, which provides insights into the processes that need restored and potentially stable channel configurations and possible design/restoration models. Effective pre- and post-restoration monitoring should emphasize measurement of geomorphic and hydrologic characteristics, as these constitute the physical framework supporting riparian and aquatic ecosystems. Techniques for evaluating other water quality and biological components are also presented, especially as they relate to geomorphic variables. The general lack of systematic monitoring and objective assessments of completed projects slows the advance of restoration science and our ability to improve the health and resiliency of Pennsylvania streams.

***Evaluation of the Impacts of Land-Use on Stream Temperature and Water Quantity in a Karst Watershed of Central Pennsylvania**
Presenter: Lexie Orr, The Pennsylvania State University
Co-Authors: Jon Duncan and Beth Boyer (Pennsylvania State University)

The Spring Creek Watershed is a 370 km2, mixed land-use basin in central Pennsylvania underlain by substantial karst topography and situated in the headwaters of the Chesapeake Bay. The watershed is comprised of 33.6% agricultural, 42% forested and 23% developed areas and has undergone steady changes in land development in recent decades. This presentation focuses on variability in streamflow and stream temperature in urban, agricultural, and mixed land-use basins within the Spring Creek watershed. We explore hydrological processes contributing to the variability observed. Results reveal the strong influence of land use on status and trends of stream temperature and water quantity in this watershed.

Flooding the future for river chub? Predicted effects of climate change and urbanization on nesting activity
Presenter: Stanley J. Kemp, University of Baltimore

The river chub (Nocomis micropogon) is an acknowledged important keystone and engineer species in the Eastern Unites States, primarily through its mutualistic nesting behavior. Nests of this species are vulnerable to high flows caused by excessive precipitation and urbanization of watersheds, and the species is missing from many flashy watersheds. General predictions of increased precipitation through climate change in the Eastern US and increasing urbanization pressure call the future persistence of this species into question in many areas. In this study, we use published thresholds linking river chub nest disruption with stream discharge to interpret predictions of downscaled climate models and of future urbanization trends in terms of river chub nesting suitability. This was done for a case study watershed, Big Elk Creek, located in SE Pennsylvania and NE Maryland. Observed conditions of climate and hydrology from available sources (NCEI, USGS, CoCoraHS) are used to calibrate a regional climate projection, and for comparison with future predictions. We used a regionally calibrated stochastic weather simulator (LARS-WG 6) in conjunction with an inline climate change model (HadGEM2) to generate 500 years of simulated regional precipitation data. A quantitative relationship was developed between precipitation and discharge for the Big Elk Creek basin, which was used to determine the frequency of damaging flows predicted by the climate change projection. The amount of disrupted days and disruptive flow events were compared between present day observations (2010- 2021) and simulated data for 2061- 2080 under the RCP45 and RCP85 scenarios. Under watershed status quo conditions, there is a significant increase in disruptive flow events and disrupted days during the nesting season, but few significant differences between the scenarios. Combining these results with urbanization predictions greatly increases the future potential for disruption to river chub nesting activity. We explore the likelihood of persistence of river chub populations in Big Elk Creek given our results.

<u>Concurrent Sessions: 2:30 pm – 2:50 pm</u>

3RQ – Generating Awareness for Project Success (GAPS)
Presenter: Lisa Barreiro, Consultant to 3RQ

The presentation will give a brief introduction of Three Rivers QUEST (3RQ) including background, water monitoring program, and publicly available maps. It will also showcase WATERS, the water quality database used by many watershed groups and researchers in the area, to generate interest in using this free resource to handle water quality data (both chemical and limited biologicals) by conference attendees and/or organizations.

Beaver and Trout: Don't Believe Everything You think - Leveraging the Ecosystem Services of the North American Beaver as a Tool for Trout Stream Restoration
Presenter: Scott McGill, Ecotone

Beaver (Castor canadensis), once numbering in the tens of millions across North America, were nearly extirpated in the late 1890's. Recently, their numbers are increasing in many regions across North America. Their dams and the water they store provide important ecosystem services, including increased groundwater recharge, floodplain reconnection, water temperature reductions, radical reductions in peak flow discharges, enhanced wildlife habitat, nutrient processing, sediment storage, and wetland creation. Beaver and trout have co-evolved over millennia, and beaver have a role to play

in improving trout habitat, and even turning intermittent streams back into perennial stream that support cold water species. As a tool for restoration, beaver dams enhance water quality, provide ecological uplift, and provide effective stormwater management benefits. Long regarded as a nuisance species, beaver have only recently been promoted as an ecosystem engineer. Research from North America as well as Europe will be shared indicating beaver have a role to play in watershed restoration efforts and as an adaptation for climate change. Techniques which leverage and promote beaver colonization will be shared with numerous project examples and thermal regime data. Methods include planting regimes to develop food sources, floodplain reconnection to maximize stream power distribution across the floodplain, designing for long term aggradation, and incorporating beaver dam analogs (BDA's).

***Culverts are Associated with Disjunct Aquatic Assemblages**
Presenter: Isabelle Croteau, Juniata College
Co-Presenter: Benjamin Haussmann (Juniata College)
Co-Author: George Merovich and Christopher Grant (Juniata College)

Recently there has been an increase in awareness of the negative effects of culverts. To quantify the effects of culverts, NAACC (North Atlantic Aquatic Connectivity Collaborative) has created a scoring system for barriers. This scoring system is used to rate the barrier's passability for aquatic life. In this study we assessed the effects of culverts that scored in the middle range of the NAACC scale, because this is an area of uncertainty. The grey area of the scale we defined as between "Minor barrier" and "Moderate barrier" or .79-.40 scores. We want to home in on these barriers because of their significant effect on aquatic passage yet they are downplayed based on their descriptors. To measure their effect on aquatic passage, we collected data on the water chemistry, fish assemblages and macroinvertebrate surveys from above and below culverts. In a small watershed in Chester County, we found the net difference in diversity of the macroinvertebrates as well as the fish. We can find out if there is a positive or negative correlation between net difference of diversity and culvert scores. From this small sample set, we did find a positive correlation between culvert scores and the net difference of diversity in fish. Although, as culvert scores got higher the net difference became less, meaning the passability of those culverts was better. In this talk we will compare these results to a similar study we are doing in Huntingdon County. If we continue to find the positive correlations between these two metrics, the "minor" or "moderate" barriers will be proven to be detrimental to aquatic life. The culverts that were previously downplayed could actually be hurting the aquatic environment more than we know.

Plunketts Creek Berm Removal and Floodplain Reconnection
Presenter: Renee' Carey, Northcentral Pennsylvania Conservancy
Co-Presenter: Rodney Mee (Pennsylvania Game Commission)
Co-Author: 1SG Brandon Bleiler (333rd Engineering Unit, U.S. Army Reserves)

Plunketts Creek is a High Quality-Cold Water Fishery with naturally reproducing trout. An earthen berm was constructed along the Creek to protect structures at what was then the North Central Propagation Farm operated by the Pennsylvania Game Commission (now State Game Lands #134) from high water. A 2-phase project in 2020 and 2021 worked to stabilize eroding streambanks and reconnect Plunketts Creek with its floodplain. During phase 1 in 2020 we stabilized the eroding streambanks on an 850-foot stretch of Plunketts Creek using log and rock structures designed by the Pennsylvania Fish and Boat Commission and with funding from the Coldwater Heritage Program. By immediately stabilizing the streambanks, we eliminated the source of the sediment. Over time, the sediment on the stream bottom will flush out of the system. In 2021, as Phase 2, the partners removed the earthen berm along Plunketts

Creek and restored the Creek's access to the floodplain. The project reconnected Plunketts Creek and its floodplain for 2,200 feet; increased ecological function on State Game Lands #134; improved the opportunity for groundwater infiltration and recharge; reduced the impacts from high waters above and below the site (this site and the area in general was significantly impacted by the 2011 and 2016 flooding); provided material to improve Huckle Run Road so sediment will no longer wash off the Road and into Huckle Run (also High Quality with Naturally Reproducing Trout); and made it easier for the public to access the Creek for fishing (there'd be at grade access to the Creek instead of a steep bank). This project was only possible because of a partnership created with an Army Reserve Engineering Unit. Through the Innovative Readiness Training Program, the 1st Platoon of the 333rd Engineering Unit brought their equipment and used the project as a training exercise and skill building workshops.

Concurrent Sessions: 3:00 pm – 3:20 pm

Harnessing the Power of Subbasin Analysis to Inform Impaired Stream Restoration and Watershed Management
Presenter: Caitlin Glagola, Chesapeake Bay Foundation
Co-Presenter: Brian Gish (Chesapeake Bay Foundation)

Modeling sediment and nutrients is a key tool in the development and implementation of watershed restoration plans. Selecting the appropriate model and utilizing it to its full extent can be a daunting prospect, particularly when technical and financial resources are limited. It often calls for weighing the benefits of accuracy and precision versus expense and efficiency. Highly generalized approaches are frequently employed, decreasing the ability to pinpoint load sources and determine the optimal placement of best management practices. An alternative approach to maximize both precision and efficiency can be found in subbasin analysis. By dividing larger watersheds into smaller subbasins, models utilizing broader aggregation can be employed rapidly without losing valuable spatial specificity. The Chesapeake Bay Foundation (CBF) explored this approach when drafting Section 319 watershed management plans for two Pennsylvania watersheds: Halfmoon Creek (HUC-12; Centre and Huntingdon counties; HQ-CWF) and Pequea Creek (HUC-10; Lancaster and Chester counties; headwater tributaries designated as HQ-CWF). A dynamic approach was developed around the Stroud Water Research Center's free, online modeling package, Model My Watershed (MMW). The CBF employed a variety of methods, from localized source determinations to build-out analysis of best management practices, which led to informed decision-making of the watershed management plans. The end result is a strategy that leverages MMW's capabilities and puts precision nutrient and sediment modeling in the hands of conservationists. The CBF seeks to share the approach it has developed, highlight the lessons learned in the process, and discuss the future tools being researched to build upon this foundation. The ultimate objective is to have the organization's work lead to more effective, efficient, and democratized watershed planning, both inside and outside of the Chesapeake Bay Watershed.

***Total Dissolved Solids Trends in the Monongahela River**
Presenter: Joseph Kingsbury, West Virginia Water Research Institute
Co-Authors: Rachel Pell, Melissa O'Neal, and Paul Ziemkiewicz (West Virginia Water Research Institute)

The Monongahela River Basin has an extensive history of fossil fuel extraction, in particular coal mining. In late summer 2008 total dissolved solids concentrations exceeding the United State Environmental Protection Agencies secondary drinking water standards were detected. In response to this, the West Virginia Water Research Institute constructed a long-term monitoring plan that went into effect in the summer of 2009. Over the next 10 years we collected data consisting of dissolved metals, discharge, and

other traditional water quality parameters. Using this data, the West Virginia Water Research Institute in conjunction with the private sector developed and implemented a voluntary discharge management plan. Two other key remediation actions included Pennsylvania prohibition of processing waste flowback water at publicly owned treatment works and the construction of CONSOL Energy's reverse osmosis treatment facility in West Virginia. The objective of our study was to assess if any of these changes had a significant impact on the Monongahela River Basin regarding bromide, chloride, sulfate, and total dissolved solids concentrations and/or loadings. The river basin was divided into 5 reaches to perform a mass balance in each reach for all 4 constituents from which time series was created from these repeated mass balances. A Mann Kendall trend analysis, Sen's Slope analysis, and a Pettitt's Point Change test were performed on the mass balances and the individual concentrations at each site. Significant trends in mass residuals were detected in 3 reaches for at least one constituent, additional downward trends were detected among concentrations at 14 sites. Sen's Slope quantified the rate of change for significant trend changes (-28.14 – 9.15). The Pettitt's Single Point Change test determined when the downward trends started in relation to remediation efforts. A total of 28-point changes occurred between 2010 and 2018 with mainstem changes occurring earlier followed by changes in the tributaries after 2015. Based on these results we concluded that the discharge management plan and the CONSOL treatment facility played major roles in reducing bromide, chloride, sulfate, and total dissolved solids concentrations.

***Evaluating Current and Historic Fish Community Assessments in the Buffalo Creek Watershed**
Presenter: Riley Williams, Duquesne University
Co-Presenter: Kathleen Wilson (Duquesne University)

The Buffalo Creek watershed flows through eastern Butler County, western Armstrong County, and a small region of northern Allegheny County in western Pennsylvania. Buffalo Creek drains 171 square miles and flows into the Allegheny River north of Pittsburgh. The watershed contains 348.7 miles of streams that offer high-quality coldwater fisheries (HQ-CWF, 93.7 miles) and high-quality trout stocked fisheries (HQ-TSF, 250.7 miles). The health of the Buffalo Creek Watershed is declining, as stream impairment has increased 10.5% since 2008. A total of 37% of the watershed's stream miles are now impaired. Agriculture (16.9%), acid mine drainage (12.4%), and natural sources (10.4%) are just a few of the known sources of impairment within the watershed. The Audubon Society of Western Pennsylvania (ASWP) has coordinated conservation efforts to improve the health of the Buffalo Creek Watershed. From 2020 to 2021, 9 backpack electrofishing surveys were conducted at 100m reach sections throughout the Buffalo Creek Watershed. Water quality was measured on-site with a YSI-multimeter and turbidimeter. Ohio Index of Biotic Integrity (IBI) was calculated for fish community assessment and compared to data from 2013 Unassessed Waters surveys. Stream health improved at 4 sites, declined at 2 sites, and remained stable at 3. A decrease in simple lithophilic species was observed at the sites that declined in stream health. Geographic information systems (GIS) was used to analyze land use changes within the drainages of both sites that declined in stream health.

American Eel Restoration in the Susquehanna River Basin
Presenter: Aaron Henning, Susquehanna River Basin Commission

The American eel (Anguilla rostrata) is a catadromous fish species naturally occurring along the Atlantic slope of North America. Construction of dams and the subsequent loss of access to freshwater habitats have limited eel populations in the Susquehanna River Basin for the past century. Through resource agency efforts and via the relicensing of two major hydroelectric facilities a long-term restoration plan for the American eel was developed and implemented. Combined agency and industry efforts have led

to the reintroduction of over 2 million American eels to the basin since 2005 resulting in a unique opportunity to study and observe a major ecological reform in real-time. The Susquehanna River Basin Commission has led an on-going study documenting ecosystem dynamics before and after the re-introduction of American eels in three southcentral Pennsylvania streams. Five-year results from that study provide a variety of insights on residence time, site fidelity and growth rate that are important to overall eel management. From trapping and transporting to mussels and migration, the story of the return of American eel to the Susquehanna River is multifaceted and inherently fascinating. The reintroduction has influenced current research, facilitated outreach and education efforts and reimagined fish passage on the continent's longest, commercially non-navigable river.