PULSE OF THE HEARTLAND

2015 ANNUAL REPORT

Presented by the

SRHCES

Susquehanna River Heartland Coalition for Environmental Studies

2015 has been a year of moving forward for the Susquehanna River Heartland Coalition for Environmental Studies (SRHCES). Organizational and administrative functions are transitioning to the Foundation for Pennsylvania Watersheds. This won't change the SRHCES's members' monthly meetings to discuss individual research projects, opportunities for collaboration, or the issues faced in their research. It won't change the ability of group members to collaborate, partner, and share information. And, it won't change production of this report every year.

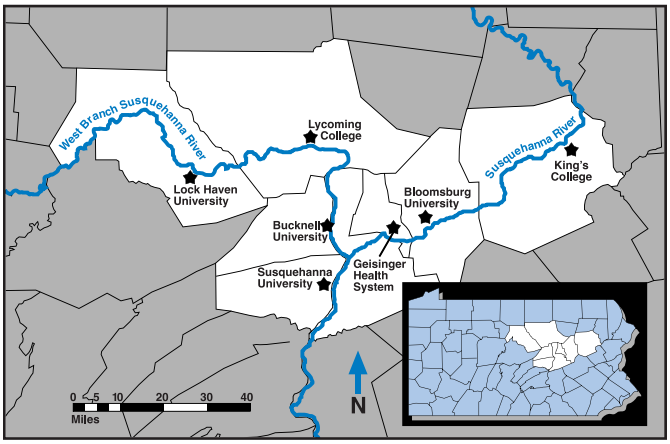
What it will change are things most people don't see — the behind the scenes organization of the monthly meetings, or the discussions with the members about when they will be ready to share their findings with the group.

Regardless of the organizational changes of SRHCES the Susquehanna River, and its watershed, will continue to define the quality of life for all who live, work and play within its boundaries. The River will continue to be this region's most important asset, and it will continue to provide half of the fresh water that reaches the Chesapeake Bay. The Susquehanna River's influence extends beyond Pennsylvania to the lives of many within the Chesapeake Bay area.

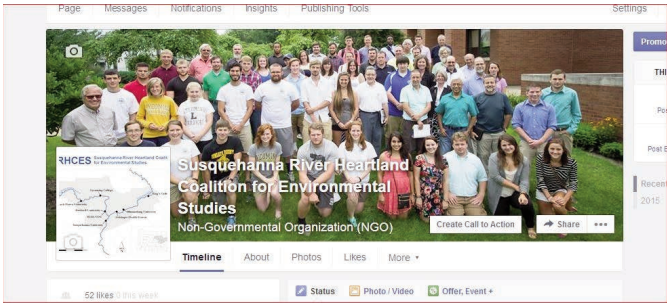
The six regional colleges and universities who joined other partners, including Geisinger Health System, Northcentral Pennsylvania Conservancy, and SEDA-COG, to work with state agencies and Chesapeake Bay affiliates to form the Susquehanna River Heartland Coalition for Environmental Studies (SRHCES) continue to expand their knowledge and understanding of the River and its tributaries. Often, as they answer one question, they discover new questions to ask, research to conduct and develop methods and tools to undertake that work. Through the Coalition, the faculty, students and staff's impressive talents are engaged to study and monitor environmental issues within the watershed. Additional promotion and support for this effort have come from sponsors such as Sunbury Broadcasting Co., the Foundation for Pennsylvania Watersheds and the Degenstein Foundation.

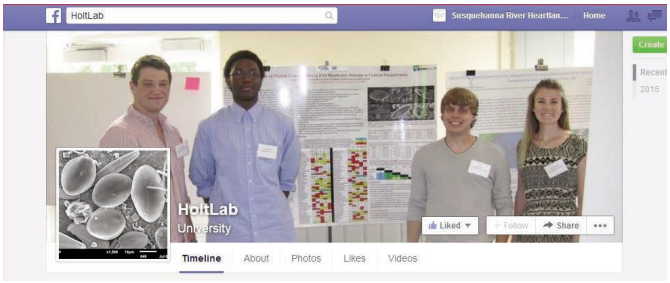
With the growing use of social media, SRHCES now has a Facebook Page. You can "Like" us at ***www.facebook.com/srhces****. While you are there, you can also take a look at what Dr. Jack Holt has underway (search for HoltLab) and Dr. Mel Zimmerman (search for Clean Water Institute). With the help of the students, these pages help show what a summer of field work is like, as well as how the in lab processing takes place.*

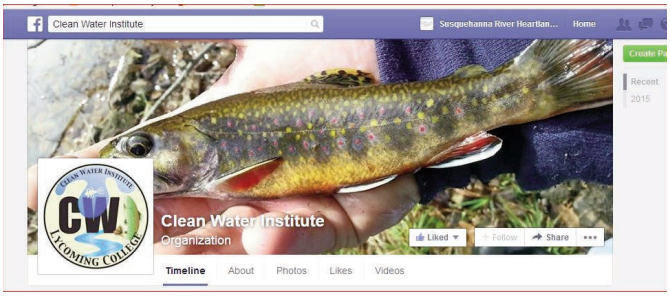
We hope you enjoy the updates on the scientists' work and research related to the Susquehanna River and the terrestrial habitat along its banks. We've also included updates from our partners, Geisinger Environmental Health Institute, and Sunbury Broadcasting.



MAP COURTESY OF JEFF BRUNSKILL, DEPARTMENT OF GEOGRAPHY & GEOSCIENCES, BLOOMSBURG UNIVERSITY







Monitoring the Susquehanna

Dr. Alan Marchiori

Assistant Professor of Computer Science
Bucknell University

Alan is working closely with Dr. Benjamin Hayes to develop low-cost water quality instruments that can be wirelessly networked for monitoring of remote watersheds. Along with electrical engineering student intern **Ward Prescott** they designed and built a waterproof water quality "sonde" equipped with a Arduino-based microprocessor to measure and record pH, ORP, DO, conductivity, temperature, and water depth. The sonde can send the readings via cellar modem to multiple base stations and to a centralized database server on campus. This data can then be connected to a web-based visualization tool where users can view multiple real-time parameters and download past data.

Dr. Jessica Newlin

Assistant Professor of Civil & Environmental Engineering
Bucknell University

Jessica is working closely with Dr. Benjamin Hayes to study catchment hydrology, sediment transport, and stream channel change. Along engineering student intern **Zachary Boyd** conducted a hydrogeomorphic assessment of the White Deer Creek watershed. Data on the soil, land use, geology, climate, and topography of the watershed were mapped and modeled in a GIS framework. Bucknell aquatic ecologist Sean Reese and students **Sean DuBois, Edward Carrington III**, and **Tucker Cotrell** helped Zach conduct electrofish surveys and collect aquatic habitat and channel morphology. Spatial variation in the stream and aquatic communities reflect the watershed's hydroclimatology, geology, and historic land use changes such as logging, beavers, dams, flood control levees, and fisheries management.

CONDUCTIVITY

Conductivity is the water's measured ability to pass an electrical current. It is affected by the quantity of total dissolved solids (TDS), often dissolved chemicals or salts, in the water.

Conductivity is measured in micromhos per centimeter (µmhos/cm) or microSiemens per centimeter (µS/cm). A healthy conductivity rate for inland streams and rivers falls around 500 µS/cm or less.

If test results show a change in conductivity that may mean there has been a change in the amount of TDS in the water. Many sources of TDS are natural; however, municipal run-off and wastewaters can increase the amount of TDS beyond healthy levels.

ABBREVIATION KEY:

(PA)DEP:	(Pennsylvania) Department of Environmental Protection
GIS:	Geographic Information System
NFWF:	National Fish and Wildlife Foundation
PFBC:	Pennsylvania Fish and Boat Commission
SRBC:	Susquehanna River Basin Commission
USGS:	United States Geological Survey

Dr. Benjamin Hayes

Director, Watershed Sciences and Engineering Program
Susquehanna River Initiative
Bucknell University

In addition to working with Alan Marchiori, Jessica Newlin, and Sean Reese on the aforementioned watershed monitoring and assessment studies, Ben continued his research on fluvial processes and the physical conditions in the West Branch Susquehanna River. He serves as Project Manager of the Heartland Coalition's involvement with the SRBC on the collaborative study of the impact of roads and pipelines associated with natural gas development on wetlands and aquatic

A restored Miller Run flows through Bucknell's campus.

habitat. He also collaborated with **Dr. Matthew Higgins**, Department of Civil and Environmental Engineering and student intern **Amanda Craver** to install weirs and instrument the agricultural treatment wetlands near Ard's Farm Market. Ben's stream restoration interests have been focused on Miller Run, the small stream that flows the campus of Bucknell University. In June and July, he worked with professionals from the US Fish and Wildlife Service and PA Department of Environmental Protection to a headwater section of Miller Run near Bucknell's golf course. The stream channel was severely degraded and forced underground through a pipe buried beneath the driving range. In June the channel was "daylighted" and now flows through a naturally designed channel with a 100-ft buffer vegetated with native plants. Old pipes, rip-rap, drain tiles, and an abandoned bridge were also removed and new wetlands built to capture and filter storm water runoff. Preliminary monitoring suggests improved base flow, a 30 to 40% decrease in flood peaks, and greatly improved aquatic and terrestrial habitat.

Ben also continues to serve as Vice President of the northcentral region of Trout Unlimited and works closely with chapter leaders in the Susquehanna watershed to preserve and protect native brook trout habitat.

Sean Reese, M.S.

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

Sean worked with Brian Mangan from Kings College, Mike Bilger from Susquehanna University and Robert Michener from Boston University on research funded through Pennsylvania SeaGrant. His work explored how invasive Rusty Crayfish are impacting native snail communities on the Susquehanna River. **Edward Carrington III**, a senior Biology student and **Sean DuBois,** a junior Biology student helped with conducting surveys this summer to assess the densities of native snail communities at sites having both low and high invasive crayfish densities. They also performed mesocosm experiments in lab to assess the predation rates and feeding pressure of native and invasive crayfish on native snails found within the series of sites along the North Branch and main-stem of the Susquehanna River. Sean has begun in-situ exclosure experiments to assess the predation pressure of Rusty Crayfish on native snails at different habitats within the River. He hopes this study can help shed light on the impacts of invasive species along a longitudinal scale in large rivers such as the Susquehanna.

Dr. Jack Holt

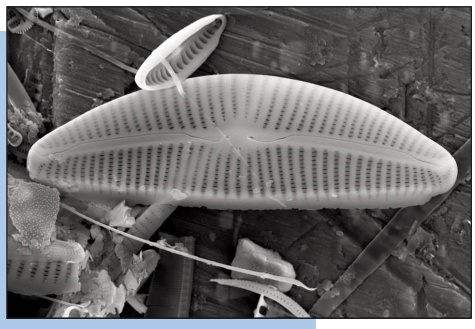
Professor of Biology
Susquehanna University

Since the beginning of June, Dr. Holt and his team has been sampling a transect of the Susquehanna River at Byers Island. They deployed rock baskets (artificial substrates for benthic invertebrates) and diatometers/tiles (artificial substrates for biofilm taxa especially diatoms) at five sites along the transect, and have taken water samples and multimeter readings across the transect on a weekly basis since June 1.

For six weeks this past summer, Dr. Holt and his interns have been sampling five headwater streams on Penns Creek Mountain in Bald Eagle State Forest. The Holt crew takes water samples and collects diatoms on a weekly basis from all five streams: Henstep Run, Coral Run, Lick Run, Green Gap, and Little Weikert. All the streams are within 10 km and have similar geology and hydrology. They are each two meters wide, shaded by hemlock and birch, and have small boulder, cobble, and sand substrate. Diatom communities from these are much more diverse and variable than they had anticipated. So far, they haveidentified 84 species from stones in the five headwater streams, but anticipate finding more when they examine samples from sediment and plants. Holt's summer interns include Amir Alwali, Brian Rothbard, Grace O'Malley, and Dylan Kutz. In addition to Byers Island and the headwater research, they are also studying macroinvertebrates in the Susquehanna River and the headwater streams, investigating the presence of diatoms both on and within the macroinvertebrates. For current updates, visit "HoltLab" on Facebook.

DIATOMS

Diatoms are microscopic algae. Some diatoms are suspended in the water, while others attach to the rocks and debris on the bottom of the stream. The types of diatoms found in a water body are based on the temperature and pH of the water as well as how fast the water is flowing, how much shade is along the body of water, and many other water quality factors. Some scientists feel diatoms are one of the best ways to understand the water quality of a stream since the diatoms are "glued" in place.



A diatom found at one of Dr. Holt's stream sites.

Dr. Holt and interns at Henstep Run, one of five headwater streams in his diatom study.

Susquehanna Greenway River Town

This Program provides assistance to Susquehanna Greenway communities that seek to revitalize and celebrate their River connection, based on four key principles:

- Respect and work with the nature of the Susquehanna River
- Connect with the River (physically, visually, spiritually)
- Involve people with the River and with their River Town
- Recognize that economic development favors River Towns

~ susquehannagreenway.org

Dr. Carlos Iudica

Associate Professor of Biology
Susquehanna University

Susquehanna University

Dr. Iudica is researching the diets of coyotes in north central Pennsylvania. He receives coyote stomachs from counties along the northern borders of Pennsylvania and dissects them, identifying fur and bones in order to determine the coyote's diet. The most common prey include vole, mice, white tail deer, and ruffed grouse. Dr. Iudica and his team compare the stomach contents of the coyote to the amount of snow on the ground when each coyote was hunted. His study should indicate the effects of climate change on the coyote population. This study could give biologists information that will help them manage coyote habitats.

In February, Dr. Iudica found evidence of three to four families of barn owls within a three-mile radius on the Rife farm in Mifflinburg. To investigate this high concentration of owls, he and his intern Rebekah Smith are looking into the small mammal population on the farm. In addition to dissecting owl pellets, Dr. Iudica and his team set 100 live mammal traps once a month in the border vegetation of a crop field. Preliminary results indicate an inflated population of rodents. In June, they were expecting to capture three individuals out of one hundred traps, but found sixteen. Most of the rodents found have been white deer mice, but they have also found short-tailed shrew.

In cooperation with Dr. Tanya Matlaga, the Iudica team is also conducting a salamander displacement study. This study expands on the salamander species demography research of David Muñoz, a graduate student at Penn State, and his work with the Salamander Population and Adaptation Research Collaboration Network (SPARCnet).

The project run by Susquehanna University interns Emily Mausteller and Michelle Gillette is based out of Camp Karoondinha, a 400-acre Boy Scout camp in Mifflinburg, PA. At each of six sites at the camp, they have set up 40 cover boards made from square-foot pieces of plywood that serve as artificial habitats for the salamanders. Species found at the camp include northern two-line, red-backed, northern red, Allegheny Mountain dusky, northern dusky, northern slimy, long-tailed, and marbled salamanders. They have also found several red spotted newts. Each species found in the site is recorded, but the focus of the study is on the red-backed salamanders. Each red-backed that is found is marked with florescent elastomer, then either returned as a control or displaced 25 or 50 meters from their original location, sometimes across small streams or over dirt roads. The objective of this study is to

Susquehanna University interns of Dr. Iudica collect data from a stream near a salamander study site.

determine the ability of the salamander to travel across such obstacles and distances. At each site, they also record air temperature, water temperature (when applicable), and ground temperature, and collect samples of leaf litter to process for macroinvertebrates.

For current updates on the Matlaga research projects, visit the "Matlaga Labs" Facebook page.

Dr. Md. Khalequzzaman (Dr. K)

Professor of Geology & Physics
Lock Haven University

Last year, the Susquehanna Greenway Partnership designated Lock Haven as a River Town, with the goal of promoting ecological development and tourism. With funding from Anadarko Petroleum and the River Town Task Force, the Susquehanna Greenway Partnership is sponsoring a mapping project of the West Branch Susquehanna River. The river mapping project is coordinated by Dr. K and Bob Rolley of the *Lock Haven Express*, with the goal of creating an interactive river map from Renovo to the Love Run tributary in Wayne Township. Interns from Lock Haven University and Lycoming College are helping to generate coordinating depth readings, GPS coordinates, and landmarks that will be used to create a map for boaters and tourists. The project also includes the installation of webcams along the river, which can be accessed online over a live feed.

Dr. K's summer interns include Bethany Shaffer, Cody Wheeler, James Fricke, and Brad Slaughter. This year, he and his team are continuing to monitor the water and sediment quality in Marcellus Shale drilling regions in Clinton, Centre, and Clearfield Counties. Members from the Pennsylvania Senior Environment Corps (PaSEC) help collect water samples for this community-based monitoring program that has been ongoing since 2010. Due to elevated levels of barium found in several sub-watersheds in Clearfield County, Dr. K and his team increased sampling sites and frequencies at a number of locations in the county. In addition, they collected soil, sediment, and rock samples and analyzed the elemental makeup of these samples using X-ray Fluorescence spectrometry, an elemental analysis technique. Preliminary data show a correlation between the levels of barium in the water samples and the levels of barium in the sediment and soil samples.

Dr. K's intern Bethany Shaffer takes a depth reading for the Susquehanna River Mapping Project.

Interns at Lock Haven are involved in a NFWF-funded GIS study of the Baker Run and Marsh Creek watersheds. They use GIS data in addition to LiDAR, a high-resolution topographic map created with laser pulse transmissions. They are able to compare a topographical wetness index of the area to a topographical map of the watershed, which shows the locations of all dirt and gravel roads. They will then collect water samples to analyze the runoff associated with dirt and gravel roads that are used by Marcellus shale drilling operations.

Dr. Ahmed Lachhab

Assistant Professor of Earth and Environmental Sciences
Susquehanna University

In Sunbury, PA, the West Branch Susquehanna enters the main stem of the river, but the two branches remain distinguishable as separate channels until they pass through a Lateral Mixing Zone that runs from Sunbury through Selinsgrove. Dr. Lacchab and intern Tyler Menz are researching the effect of precipitation on this Lateral Mixing Zone. They are also studying how the physical and chemical dynamics in the river compare to biological changes. They are able to collect eleven water quality parameters from HydroLab sondes at each testing site. In addition, intern Michelle Barakat analyzes water samples in the lab with Ion Chromotography. As a result of this study, it was determined that as the discharge increases due to precipitation events, the Lateral Mixing Zone moves away from the West Branch and towards the North Branch, then shifts back towards the West Branch.

Lachhab is studying Middle Creek in Snyder County, PA, in order to understand how small streams such as this are affecting Susquehanna River and eventually the Chesapeake Bay. He and his interns Hareem Zain and Andrew Van Woer are looking at how the geomorphology of Middle Creek affects the length, location, slope, and limnology of the waterway. In addition, they collect data to determine Water Quality

Dr. Lacchab and interns Michelle Barakat and Andrew Van Woert retrieve four sondes from the Susquehanna River.

Index, Shannon Diversity Index, Pollution Tolerance Index, and Cocconeis percentage. They have found correlation between the Water Quality Index and the diversity in aquatic species, noting a decrease in water quality and species diversity downstream from locations of agricultural runoff and other pollutants.

Josh Lookenbill

Biologist

The Department of Environmental Protection (PADEP)

The Department of Environmental Protection (PADEP) in cooperation with other federal, state and local partners continue to collect physical, chemical and biological samplesas part of the monitoring effort on the Susquehanna River. New this year, cooperators are working through a Causal Analysis/Diagnosis Decision Information System (CADDIS) assessment. CADDIS is a process formalized by the US Environmental Protection Agency to gather data in order to come to a scientific consensus on the cause of a defined problem. This process is used by PADEP to determine the most likely cause of impairment on a waterway. A report detailing the results of CADDIS is scheduled for release this fall.

PADEP continues to monitor and assess the Susquehanna River and its tributaries. To this end, the department collects algal, benthic macroinvertebrate, fish, and mussel samples for analysis. They also collect water and sediment samples in order to measure parameters such as water temperature, pH, dissolved oxygen, specific conductance, and turbidity.

DISSOLVED OXYGEN

Dissolved oxygen is the oxygen available in the water for the aquatic organisms to breathe. Oxygen is diffused into the water from air, by fast moving waters, and as a byproduct of photosynthesis. The more the water moves, the higher the oxygen level will be.

Also, the cooler the water is, the more oxygen it can hold. Trees, plants, and shrubs along a stream bank provide shade to the stream. This helps the water stay cooler, which means it can hold more dissolved oxygen.

Although good oxygen levels are often challenging to pinpoint since oxygen levels fluctuate naturally between day and night, generally good oxygen levels fall around 7 mg/L or higher.

If oxygen levels remain below 1 or 2 milligrams per liter of water for just a few hours, many fish can die.

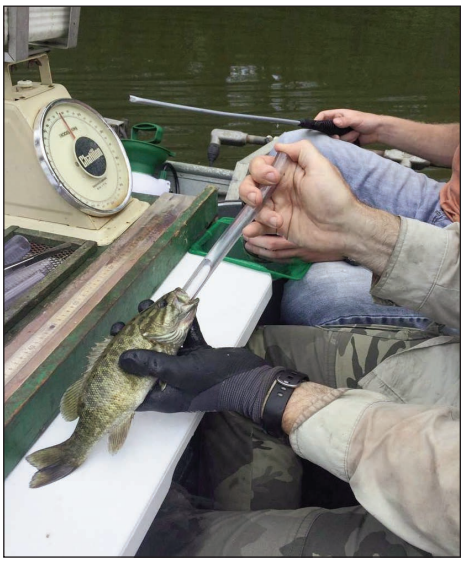
Dr. Brian Mangan

Professor of Environmental Science and Biology

King's College

Director, Susquehanna River Institute

Smallmouth bass and crayfish are considered reciprocal predators because each can prey on the other at certain stages in their lives. Dr. Magan is interested in both of these animals and is researching the diet of bass and crayfish in the Susquehanna. Mangan is working to develop a method for measuring the density of rusty crayfish in the river, and investigating any connection between the rusty crayfish population and the nesting success of smallmouth bass. Since the high water level and turbidity prevented a natural nest predation study, Mangan and his crew built ten sampling arrays with artificial nests to deploy in areas of known high and low crayfish density. On half of the arrays that they deployed, they stationed a replica of an adult bass to see if that lowers the number of crayfish on those arrays.



Dr. Mangan's crew performing gastric lavage on a smallmouth bass.

In order to measure crayfish density, Mangan and his team designed a unique sampler. This square-meter sampling cage uses pressure washers to drive crayfish into a funnel that leads to a collection screen at the back of the cage. His previous crayfish surveys in 2008

and 2013 have demonstrated that the river is inhabited by rusty crayfish in northern and southern reaches of the study area with pockets of Allegheny crayfish in between. Density measurements of crayfish in the river will provide researchers with a more reliable estimate of the possible ecological impacts of these important keystone species. Sean Reese from Bucknell University, is also involved in the project, investigating the impact of crayfish on snails and other organisms in the river.

As an outgrowth of the initial crayfish project, Mangan is also studying the smallmouth bass diet through stable isotope analysis and gastric lavage. He has collected a dozen bass by electrofishing from Wilkes-Barre to Harrisburg, in addition to fourty fish from boat electrofishing at three sites with high crayfish levels and three sites with low crayfish levels. Mangan and his team perform gastric lavage to flush the stomach contents of the bass, and sort the contents into four categories: fish, insects, crayfish, and "other." Robert Michener, manager of Boston University's Stable Isotope Laboratory, will be performing stable isotope analysis on crayfish and benthic invertebrate samples collected at sites along the river to help the team determine the diets of select predators and prey.

Dr. Matthew McTammany

Associate Professor of Biology
Bucknell University

Dr. McTammany's macroinvertebrate riffle study has been ongoing since 2012. In the summer of 2012, Dr. McTammany and his crew surveyed 10 riffles in the West Branch Susquehanna River between Montoursville and Lewisburg. In the following years, they have focused on the three lower riffles near Allenwood, Milton, and Lewisburg. Interns Meghan Reilly and Tyler Wenzel are helping Dr. McTammany this summer. In each riffle, they conduct a quantitative sample of macroinvertebrates. Each sampling site consists of nine locations, or patches, arranged in a three-by-three grid. At each site, they take three surber samples of macroinvertebrates. With this data, they are able to compare the variability in the macroinvertebrate communities between different locations within the riffle, and between each riffle. Since this project has been collecting data since 2012, they are also able to compare the data between years. At each site, they also conduct basic water chemistry and note physical parameters such as the substrate composition, flow, and depth.

One of the goals of this study is to record the spatial patterns of the community: the variability of special patterns and the consistency between riffles and from year to year. He has noted that the species found at each site differs, but the placement and concentration of macroinvertebrates remains consistent. So, while the communities themselves are different, the spatial patterns are similar. He has also found that patches in each riffle that are connected by flow (one directly downstream from the other) are more similar than patches along the same transect.

Dr. McTammany is also working with Jordan Barton, a second year grad student at Bucknell, on his Marcellus Shale Sedimentation project. Jordan is studying the physical patterns of ecosystem change in addition to the biological outcomes of gas drilling. Jordan is studying seven streams in the Susquehanna River watershed, from southern New York to central Pennsylvania. Each of the sites represents a land use category— forested, agriculture, and ag developed (small town), either in a drilling region or a region not influenced by drilling. SRBC monitors water quality at each site using remote sondes. At each site, Jordan studies ecosystem changes by sampling macroinvertebrate populations, water chemistry, and leaf decomposition. The leaf decomposition study began in May, when Jordan installed oak and maple leaf packs in coarse and fine mesh bags. The coarse mesh bags allow macroinvertebrates to colonize the leaves, while fine mesh limits the community to microbes. This study should show how sedimentation reduces decomposition by placing the leaves in an anoxic environment and by limiting the availability to consumers.

MACROINVERTEBRATES

Macroinvertebrates are the insects, crustaceans, molluscs, arachnids and annelids you find in flowing water. These animals don't have a backbone (invertebrates) and are big enough (macro) you can see them with just your eyes. Benthic macroinvertebrates are those animals that live in the substrate on the bottom of water systems, as opposed to other macroinvertebrates that might be found swimming in the water column.

The species of macroinvertebrates you find gives you information on the water quality. Some species need more oxygen, while others are more tolerant of different types of pollution.

One method to collected macroinvertebrates is to shuffle your feet and kick around in a stream for a specific period of time over a specific distance and collect all the materials that is "released" by the kicking. Most protocols, or procedures, specify the size and type of net to use. Often, it's a D-Frame Kick Net.

Dr. Johnathon Niles

Professor of Biology
Susquehanna University

Mike Bilger

Aquatic Ecology Research Scientist
Susquehanna University

In early June of this year, Susquehanna University opened the Freshwater Research Laboratory, a new initiative funded by a Richard King Mellon Foundation grant. This lab is now the main center for Susquehanna's aquatic research. The grant also funded new electrofishing and water testing equipment that was put to good use this summer.

Dr. Niles has been busy conducting his fifth year of stream assessments for the PFBC Unassessed Waters Initiative. Stream assessment sites this year include First Fork Sinnemahoning and Swatara Creek. Niles is also continuing to track the progress of the flood recovery process in the Loyalsock Creek Watershed. He is able to compare the current state of the watershed to the data that he collected in the summer of 2011 before Tropical Storm Lee flooded the area.

Bilger and his team are also involved in six stream restoration projects with PFBC. In cooperation with the Northcentral Pennsylvania Conservancy (NPC), they are doing pre- and post-stream restoration comparisons by sampling fish and macroinvertebrates. They are doing construction this summer, and plan to reassess the streams in 2016 and 2017. So far, the post-stream restoration data is encouraging—young of year brown trout were recently found in Turtle Creek, which was an unsuitable trout habitat before restoration.

Dr. Petokas's interns use a sein and electrofishing equipment to sample a small stream for salamanders and crayfish.

This summer, Bilger and his team are also working on stream restorations of Upper Kish and Hungry Run with the Mifflin County Conservation District, and Maiden Creek and Saucony with the Berks County Conservation District. In cooperation with SRBC, they are conducting pre-construction sampling of Cheekie's Creek and the Susquehanna River.

Bilger and the SU interns are working with Megan Schall from Penn State University to study small mouth bass from four sites on the Susquehanna, and at Penn's Creek, Chillisquaque Creek, Mahanoy Creek, and White Deer Creek. They use boat electrofishing to collect bass from four of the sites, then take a tail clipping on all bass over twelve inches in order to conduct a DNA analysis.

In a joint study with Brian Mangan from Kings College, Bilger is dissecting the stomach contents of 14,000 crayfish and identifying benthic macroinvertebrates from sample sites. Niles and Bilger are also partnering with Jack Holt and Ahmed Lacchab to assist them with their study of the Susquehanna River at Shady Nook.

Dr. Peter Petokas

Research Associate, Clean Water Institute
Lycoming College

Dr. Petokas from Lycoming College is continuing his study of the Eastern Hellbender. This summer, he and his interns Ryan Orgitano, Logan Stenger, Sam Wanner, and Kalynn Newman constructed 25 concrete and fiberglass nest boxes, which they plan to install at the end of the summer to add to the 17 nest boxes already in the river. These structures are constructed to resemble the hellbender's natural nest locations under large rocks in the river, but provide much easier access in order to tag adult hellbenders and collect eggs.

Dr. Petokas raises juvenile hellbenders that he collected as eggs from nest boxes in the Susquehanna.

Last October, Dr. Petokas was able to collect hellbender

eggs, 85 of which he sent to the Bronx Zoo to be raised and released as part of their hellbender head-start program. Seven hellbender larvae remain at Lycoming College, where they are being raised and studied and will eventually be released back into the local habitat. Dr. Petokas and his team will revisit all nest boxes in the fall with the hope of collecting more eggs.

In addition to collecting eggs, Dr. Petokas tags and monitors the adult hellbender population. By tagging the hellbenders, he is able to collect data on their habitat, lifespan, and territory, and has found one previously tagged individual eight miles upstream from its original location.

Dr. Petokas is also continuing a distribution survey of native and non-native crayfish in the north central region. He is collecting data on the crayfish population by sampling streams to create a density estimate and taking measurements of individual crayfish. The invasive Rusty crayfish drives out all native crayfish species and is especially problematic in the Loyalsock Creek.

A new project that Dr. Petokas is beginning this summer is a streamside salamander study. In collaboration with Jon Niles from Susquehanna University, Dr. Petokas is working to quantify the salamander species along small trout streams and develop a baseline relationship between salamander and trout populations. The sampling method involves mapping the habitat along the stream bank, then removing rocks in order to collect animals, which will be identified for species and age class.

Dr. Petokas also serves as the intern mentor for Camp Victory, a 130 acre facility that hosts 29 different camps for children with special needs. Interns Ivy Spako and Blyss Bieber lead environmental education programs for each group of children that come to the camp. They are also working on designing a coloring book that will feature favorite locations at Camp Victory.

Dr. Steven Rier

Professor of Biology
Bloomsburg University

High water levels in June delayed Dr. Rier's stream study, but he was able to proceed with his project as the levels declined later in the summer. His project involves taking water samples and scraping rocks for microbes twice a day for a 12-hour comparison. He and his team compare data from productive and less productive streams and can also compare the stream data to data collected from the river.

Another research project involves the phosphorus and nutrient dynamics of creek, as well as a 24-hour study to investigate the response of microbes to dark and light conditions. Rier is also interested in the macroinvertebrate population, and has noticed an absence of the usually common whirligig beetle.

Rier and intern Kiera England are partnering with Dr. Dan Spooner at the USGS station in Wellsboro to use microbial metrics in the detection of frack water spills. They have created simulated brine spills in the USGS lab in order to observe the response of the microbial community, and could use this data to detect any negative impacts on the waterways due to natural gas drilling.

Geoff Smith

Susquehanna River Biologist
Pennsylvania Fish &
Boat Commission (PFBC)

Geoff Smith from the Pennsylvania Fish and Boat Commission is studying possible causes for early fatality in largemouth bass. He is working off the hypothesis that low thiamin concentrations in smallmouth bass cause early mortality or later immune suppression. Either the parents are deficient, causing the young of year fish to have low levels, or the juveniles are themselves deficient. This is a multi-dynamic study involving genetic analysis by Penn State University and contaminant analysis by USGS to determine the diet quality and egg quality of largemouth bass.

Michigan State has been researching largemouth bass virus since 2012, and similar problems have been detected in lake trout in the great lakes. As soon as water levels allow, PFBC is planning to collect data on the length of adult fish and any physical anomalies. In the fall, they plan to look into the relative abundance and average length and weight of adult smallmouth bass throughout the basin.

Dr. Cynthia Venn

Professor of Oceanography, Marine Geology,
& Aqueous Geochemistry
Bloomsburg University

Dr. Christopher Hallen

Professor of Chemistry
Bloomsburg University

Dr. Venn and Dr. Hallen are working on a variety of water chemistry projects in the Susquehanna watershed. Intern Dean Colb is helping to test water from the Rausch Creek Water Treatment Center in Valley View, PA. The

crew from Bloomsburg has found that prior to entering the treatment center, the water has low pH and high levels of iron and sulfate due to abandoned mine drainage (AMD) contamination from two abandoned mines that drain into the creek. Rausch Creek is diverted to the Water Treatment Center so that all of the water from the creek can be processed using an AMD active treatment system.

Another project with intern Eric Thompson involves testing the change in water chemistry as streams run through state parks to see if the water quality is being impacted by recreational use. They are testing at Tuscarora, Locust Lake, Francis Slocum, and Nescopeck State Parks in the North Branch watershed, and will soon be expanding to include Little Pine and Swatara State Park in the West Branch watershed. The streams and lakes in the state park are sampled in order to compare the chemistry of water flowing in to the chemistry of water flowing out of the park. Preliminary results indicate that the water chemistry is fairly consistent. They are looking into further research on one outlier, a creek in Tuscarora State Park that triples in conductivity from when it enters to when it leaves the park.

pH

Although pH measures acidity in the water, it also indicates a waterway's balancing act between acidic and basic, or between positive and negative hydrogen ions. The pH scale runs from 0 (strongly acidic, high concentration of positive hydrogen ions) to 14 (strongly basic, high concentration of negative hydrogen ions).

Despite the negative connotation of the word "acidic," a waterway wants to strike a balance between having too many or too little positive hydrogen ions. In fact, ideal pH generally falls between six and eight in an aquatic environment.

If the pH is too far at either end of the spectrum, fish will avoid the waterway or die, eggs can become deformed, algae cannot grow as well, etc.

pH can be affected by many different sources including contaminated run-off and AMD. The pH can differ dramatically from day to day, or even at different times throughout the same day, largely as a result of photosynthesis.

Bloomsburg is also involved in a geochemical stream analysis of Fishing Creek in Orangeville, PA. This analysis consists of a 24-hour sampling cycle to track the circadian changes in water chemistry. Partnering with Dr. Rier and his intern Kira England, Dr. Venn and intern Matt Mattesini sampled the creek every four hours and found expected variations in pH, dissolved oxygen, and other parameters. Matt is also analyzing the samples to see if there are similar daily variations in dissolved major anions and cations as well as 11 heavy metals. Using these data as a baseline, they measure productivity levels twice a day, at the times of maximum and minimum pH and oxygen.

In addition, intern Dan Tompkins is comparing water samples from Perkiomen Creek and the Schuylkill River to investigate the effect of land use (including land cover, bedrock, and mines and quarries) on water quality. He has expanded his study to include analysis of soil samples taken near his two study areas. In this, he is working with Dr. Matt Ricker, also in the Environmental, Geographical and Geological Sciences Department at Bloomsburg University. They plan to compare the results to those of a similar study on soil from islands in the Susquehanna River near Bloomsburg.

Dr. Jennifer Whisner

Assistant Professor of Groundwater Hydrology & Geomorphology
Bloomsburg University

Dr. Whisner's goal for this summer is to "bring science to the people." She is focusing on advocacy, education, and communication by conducting outreach programs in coordination with the Columbia-Montour Coalition for Source Water Protection. The goal of the outreach programs is for Colombia and Montour County residents to learn how their actions affect the waterways and to understand the regulations that the township puts in place. With the right exposure and education, residents will have more incentive to care for the waterways with actions such as properly disposing of wastes, managing sewage systems, and reducing the use of fertilizer runoff.

The Coalition for Source Water Protection is also encouraging water suppliers to develop source water protection plans, and has had success recently in the implementation of Wellhead Protection Zones. They also promote green infrastructure (rain gardens, plants, water retention basins, etc. to reduce runoff and excess water entering the storm drains) and stream restoration projects. The Colombia County Conservation District will soon host 500 middle schoolers for Water Education Day at Briar Creek Lake, to bring clean water education to the next generation.

The second project that Dr. Whisner is involved in is a water quantity citizen science project. This project joins the CrowdHydrology experiment organized through the University at Buffalo Department of Geology and USGS. Citizens are taught how to read water levels from a gauge in a creek or river, and can report the water level through a text message. The project also involves installing rain gauges in the creek

and tributaries of Fishing Creek Watershed. Before Bloomsburg's involvement, there was only one reporting rain gauge and one stream gauge in the watershed. Locations for new rain gauges include an organic farm, Benton High School, and possibly Rickett's Glen State Park.

Dr. Mel Zimmerman

Professor of Biology
Director, Clean Water Institute
Lycoming College

Dr. Zimmerman is working on a project to survey small storm water drainage pipes in the Williamsport area. The Williamsport Area Joint MS4s (Municipal Separate Storm Sewer Systems) are a collection of 261 discharge sites located in Fairfield Township, Hepburn Township, Loyalsock Township, Lycoming Township, Montoursville Borough, Old Lycoming Township, Pennsylvania College of Technology, and the City of Williamsport. Using a DEP form for Outfall Reconnaissance, Lycoming Interns Hannah Dulovich and Peter Gnocchi measure and describe the outfall pipe and note if there is water discharge. If there is discharge, they perform basic water chemistry tests on the drainage water. They report their data to the Williamsport Area Joint MS4s, who will decide if further tests should be conducted. In accordance with the Chesapeake Bay Pollution Reduction Plan, any storm water drainage system must meet certain pollution reducing standards to preserve the local ecosystem and reduce the amount of phosphorus, nitrogen, and sediment that drain into the Chesapeake Bay.

The Clean Water Institute is also continuing research with CromaFlow (previously CromaGlass). Dr. Zimmerman's research involves sampling water from the Kelly Township Sewage Treatment Facility, which recently installed a CromaFlow unit that deals with industrialized wastewater and sewage water. This unit uses a Sequence Batch Reactor for aeration and sludge settlement in order to remove nitrogen, phosphorus, and other pollutants as part of the facility's wastewater treatment. Twice a week, interns Ali McNett and Dom Novella collect influent water samples, effluent water samples, and grab samples from within the unit in order to run a variety of water chemistry tests measuring the percentage of pollutants removed by the unit. They plan to continue the project for three to six months.

Dr. Zimmerman's interns Dom Novella, Jen Monico, Abbi O'Connor, and Ali McNett process a kick sample from Mill Creek.

NUTRIENTS - NITROGEN AND PHOSPHORUS

Nitrogen is found naturally in the environment and is an essential nutrient to plant life. Nitrate is the most significant form of Nitrogen in terms of water quality. Nitrates are used in fertilizers for lawns and agricultural crops. Additionally, nitrates can be found in municipal and animal wastes.

High concentrations of nitrates cause an increase in water plants, algae, and planktons. The more plants there are in the water, the more oxygen they'll consume as they grow. This can lead to oxygen depletion.

Generally, healthy nitrogen levels should be around 0.5 milligrams per liter of water (0.5 mg/L) or less.

Phosphorus, like nitrogen, is a nutrient naturally present in the environment. But when found in high concentrations, phosphorus can disrupt the natural ecosystem by increasing the growth of algae, water plants, and plankton which provide food for fish. Again, the more plants there are in the water, the more oxygen they'll consume as they grow. This can lead to oxygen depletion.

Some sources of high phosphorus concentrations include detergents and municipal fertilizer run-off. For human beings, consuming too much phosphorus can lead to digestive problems.

Healthy phosphorus levels generally fall below 0.05 mg/L.

When there is an excess of these nutrients in the water, a condition known as "eutrophication" occurs. Eutrophication means that there is an increase in chemical nutrients to a degree which is unhealthy for the body of water. When an excess of nutrients enters the waterway, algae, aquatic plants, and plankton will grow wildly. The plants will then choke up the waterway and use up large amounts of oxygen. This rapid growth of aquatic plants will eventually die and, with its decay, uses up more oxygen—ultimately lowering dissolved oxygen levels in the water.

Clean Water Institute intern Jen Monico is studying the invasive Japanese Knotweed. This non-native, invasive plant can cause declines in the native riparian plant community, since it competes with native plants for resources and space along the shore of the waterway. She is studying its prevalence in two sites in

Montoursville: on Canfield Island at the Riverfront Park and along the Loyalsock Creek near the Williamsport Regional Airport. She is also incubating Japanese Knotweed leaves, silver maple leaves, and oak leaves at a location in Mill Creek near Warrensville in order to compare the Japanese Knotweed's potential as a food source for macroinvertebrates.

Another continuing project is the Susquehanna River monitoring project, where interns collect macroinvertebrate samples from rock baskets at a site in Watsontown and water quality information from eleven sites along the West Branch Susquehanna. In addition, Dr. Zimmerman and his team are contracted to assess at least 20 streams this summer for the PFBC Unassessed Waters Initiative. They also continue to assist the PFBC Stream Restoration Projects, most recently helping a restoration project at Limestone Run in Montour County.

To learn more about current projects, visit the "Clean Water Institute" page on Facebook.

Science for River Sustainability

Behind the scenes, environmental research often means processing and identifying hundreds of macroinvertebrates, counting slides of microscopic rotifers, or running water chemistry on a row of samples. When we step back, we can see how these individual data collections and research projects fit into the larger picture of using science for conservation and sustainability. Maintaining the sustainability of the Susquehanna River is a cooperative effort involving the decisions of organizations throughout the watershed. The data that SRHCES partners collect is used to make decisions that will promote the health of the watershed and those who call it home. Whether it is a first order tributary stream, the Susquehanna River, or the Chesapeake Bay, each watershed benefits from conservation efforts made from informed decisions. The Susquehanna River Basin drains over 20,000 square miles, primarily in Pennsylvania and southern New York. The river drainage basin empties into the tidal portion of the Susquehanna River, which is a primary tributary to the Chesapeake Bay. As the largest estuary in North America, the Chesapeake Bay is a valuable resource to protect. Unfortunately, the Bay is negatively impacted by high nutrient loads and pollutants from its tributaries. The Susquehanna River contributes nitrogen, phosphorus, and pollutants from abandoned mine drainage, agricultural runoff, and other non-point sources. This places the Susquehanna River and its tributaries in a vital role in maintaining the health of the Chesapeake Bay.

Dr. Zimmerman's interns Dom Novella and Clayton Good electrofish a section of stream for the Unassessed Waters Initiative

On a local level, regulations and conservation work improve the quality of smaller watersheds around creeks and streams. Of course, these streams are often tributaries that impact a larger waterway. When a farmer makes the choice to participate in Best Management Practices, it benefits the farm and surrounding area, as well as the Susquehanna River, and ultimately, the Chesapeake Bay.

The river and its tributaries are vital to the Pennsylvania ecosystem, and provide human resources, including drinking water and opportunities for angling and recreation. SRCHES supports ecological research, education, and conservation efforts in the watershed. The coalition also addresses local flooding issues by supporting flood control measures and floodplain management. The decisions surrounding the health of the river and bay are made possible by the collection, analysis, and interpretation of data. SRCHES partners are involved in research projects that collect data in the Susquehanna Watershed and use that data to inform important ecological decisions.

Bob Weber from the Pennsylvania Fish and Boat Commission is involved in the collection of data that affects decisions in the watershed. As a fisheries biologist, Bob coordinates trout management and stocking activities and fieldwork evaluations. His

primary project is coordinating teams to collect data for the Unassessed Waters Initiative (UWI). Since the start of UWI in 2010, PFBC and their partners have surveyed approximately 2,800 streams across the state of Pennsylvania. Through this project, PFBC is able to sample unassessed streams in the Susquehanna Watershed in order to expand knowledge of fish species distribution in the area. This project is an example of how PFBC takes a proactive role in water management. The UWI provides baseline data for future research and can indicate areas that are being negatively impacted by human development, resource extraction, highway construction, runoff, or other activities. To this end, teams from PFBC and partner organizations conduct assessments at designated stream sites. UWI partners include Bucknell University, Indiana University of Pennsylvania, Juniata College, Lycoming College, Susquehanna University, California University of Pennsylvania, Trout Unlimited, and the Western Pennsylvania Conservancy.

At each site, UWI teams collect physical and chemical data from the stream. They report the width of each stream every 10m, along with related notes about the stream and surrounding area. Teams conduct basic water chemistry at each site as well, measuring conductivity, water temperature, pH, and alkalinity. The water chemistry values indicate the status of the stream and can give more information about what may be considered a suitable trout habitat.

To collect biological data about the stream, the UWI team uses electrofishing to sample a 100m stretch of water. The electrical pulse delivered to the water temporarily paralyzes fish in the stream so that they are visible for identification or netting. The team keeps track of which species of fish are found at each site. However, they are particularly interested in the trout population. The presence of wild trout in a stream can make that waterway eligible for protection. Further, wetlands surrounding a wild trout stream are eligible for an Exceptional Value designation from the DEP. This UWI research directly impacts the permitting process regulated by the DEP. PFBC publishes data from the UWI online, and updates the catalogue at least four times a year. The DEP refers to this report during the permitting process. Permits can limit any encroachment on important waterways, such as oil or gas extraction, commercial development, or construction. When permitting a wild trout stream, the DEP will prohibit construction or disruption of a stream during the spawning seasons each spring and fall. As the experts on trout populations, PFBC provides commenting and review of permit applications.

The Clean Water Act passed in 1972 set water quality standards nationwide. The scientists in SRHCES reference Clean Water Act standards. When they are looking at the data they collect, they often compare their results to what the Clean Water Act requires. The Pennsylvania Department of Environmental Protection (DEP) supports these standards by submitting a bi-annual water quality report to the Environmental Protection Agency (EPA). Gary Walters is Chief of the Assessment Section of the Division of Water Quality Standards. The Assessment Section is responsible for collecting the data used in determining whether surface water quality standards are being met. Water quality standards are based on the usage designation of the surface water (streams or lakes in PA's case), which can include aquatic life, water supply, recreation, and fish consumption uses, as well as a "special protection" status for the highest quality waters.

The water quality assessment for lakes and streams includes water chemistry and samples of benthic macroinvertebrates ("water bugs"), fish, and algae. Stream assessments also include a physical habitat assessment and pathogen data, while lake assessments include rooted aquatic plant mapping and sampling. Added in the 1980's, benthic macroinvertebrate data is the newest parameter that the DEP collects. This parameter is most relevant to an aquatic life use designation. The insects living in the stream or lakebed are nearly immobile, and have a relatively long life span. This causes them to have long-term exposure to any water contamination, and since many benthic macroinvertebrates have great sensitivity to water temperature and pollution, they are great indicators of the health of the water. Pathogen data is especially relevant to recreational usage, as the presence of pathogens in the water increases the risk of infection for individuals using the lake or stream for boating, angling, or other forms of recreation.

In addition to conducting their own sampling, the DEP utilizes the USGS Statewide Water Quality Network. USGS uses sondes to monitor ambient water conditions at 176 stations. Ambient water refers to areas of lakes or streams that are minimally affected by human activity, allowing these readings to serve as a reference point for other data that is collected. Some USGS sites have been collecting data since the mid 1950-s, which allows Walters and his team to analyze trends in water quality over time. The newest sondes offer continuous monitoring, recording data over 100 times a day, which allows scientists to study the daily fluctuations of the water system and better analyze water samples.
The DEP also works with volunteer groups such as the Senior Environmental Corps. Members of these volunteer groups are taught how to measure or read water monitoring equipment and report this data back to the DEP.

Analyzing this data allows Walters and his team to designate lakes and streams for one or more protected uses. Once they have a protected use designation, the water systems are monitored to make sure they continue to meet the criteria to qualify for that level of protection.

The Susquehanna River Basin Commission is an agency committed to the responsible management of water resources in the Susquehanna Watershed. The commission is composed of partners from Maryland, New York, and Pennsylvania, working cooperatively to manage water quality and supply, promote floodplain management practices, and protect biological resources.

SRBC's Monitoring and Protection Program collects data from thousands of site visits every year. In order to gain biological data, they sample the fish population by electrofishing, collect macroinvertebrate samples, and scrape rocks and other submerged surfaces to collect the algae, microbes, bacteria, and detritus that make up the periphyton community. In addition to biological data, they collect water samples to analyze chemistry, and read data from sondes programmed to collect water chemistry measurements as frequently as every five minutes. Water chemistry parameters include pH, dissolved oxygen, temperature, turbidity, specific conductance, nutrient levels (various forms of nitrogen and phosphorus), organic carbon levels, alkalinity, suspended solids, dominant ions, and the presence of dissolved metals, oil & grease, and/or radionuclides. They also measure the water flow discharge using acoustic Doppler velocitimeter and River Surveyor instruments, assess the habitat in and around the waterway, record weather data, and collect geomorphic data by measuring the stream channel and categorizing the sediment.

SRBC uses this information to discern trends, assess current conditions, and evaluate the success of conservation strategies. They put this data to use when making regulatory decisions and conducting compliance investigations. Real time flow data is used in the agency's Early Warning System in the event of flash floods or other flow events. SRBC also regulates water withdrawal based on the data collected by the Monitoring and Protection Program. Several years ago, the Commission adjusted their "pass-by" flow conditions (i.e., low-flow thresholds that limit or eliminate water withdrawal to avert or minimize stress to aquatic organisms during low-flow and drought conditions) to better reflect seasonal requirements of the aquatic community and the typical flow patterns observed. Data are also used to advise conservation efforts such as storm water flow remediation and abandoned mine drainage treatment.

SRHCES creates partnerships with these and other agencies in order to promote education and sustainability. Throughout each of these organizations, decisions and regulations aim to protect resources in the Susquehanna Watershed. Accurate data collection and interpretation allows these organizations to make informed decisions that will maximize the availability of resources and protect the future health of the watershed. The data that these agencies collect is applied in permitting processes and conservation projects, demonstrating how science can be applied to promote the sustainability of the Susquehanna River Watershed.

ALKALINITY

Alkalinity is the water's ability to resist changes in pH. This is a natural phenomenon, but often with the addition of pollutants, water systems are less capable of balancing the pH and keeping waterways healthy. Since alkalinity can create a sort of buffer against various forms of acidic pollution, the higher the alkalinity the more resistant the stream might be to external influences like acid rain. Many rocks, especially limestone, are sources of natural alkalinity. If water can neutralize acids, the buffering capacity of alkalinity would give stability to the pH of a waterway necessary for fish, plant life, and other organisms to live. Affective alkalinity levels usually begin around 20 mg/L and higher.

Updates from Our Partners

Geisinger Environmental Health Institute (EHI)

The joint Geisinger-Johns Hopkins Bloomberg School of Public Health EHI, directed by Brian S. Schwartz, continues its ongoing studies in environmental epidemiology in the region. Several investigators and staff of the Geisinger Center for Health Research are involved in these studies, including Annemarie Hirsch, Agnes Sundaresan, Lisa Bailey-Davis, Joseph DeWalle, Jake Mowery, Sy Brandau, Jennifer Irving, and Dione Mercer. There are many opportunities for collaboration and student involvement in these projects and several Bucknell, Lock Haven, and Bloomsburg University students have been working with us, most recently Hannah Walters (Lock Haven) and Mona Mohammed (Bucknell).

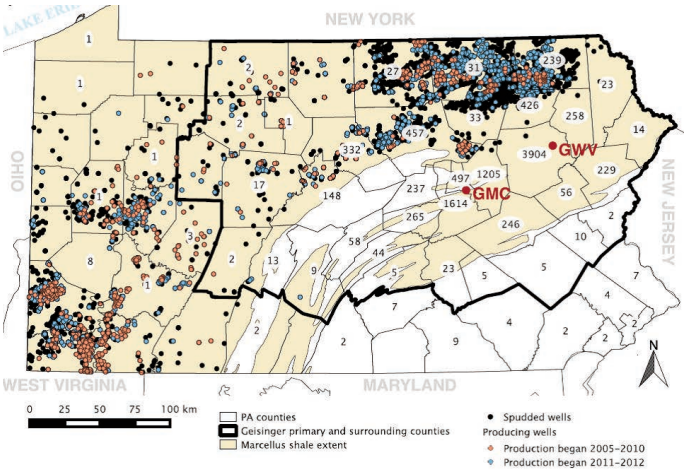
The EHI is currently involved in four primary projects:

(1) Animal Feeding Operations (AFOs) and Links to Health

We first focused on links of swine and dairy/veal operations to risk of methicillin-resistant *Staphylococcus aureus*, and this resulted in four publications. We are now working with Deborah Sills and Mona Mohammed at Bucknell University to update all the nutrient management plans (NMPs) that we first collected in 2009, and possibly include poultry operations for the first time. We then plan to address several questions, for example, how NMP information changes over time and possible links between poultry operations and risk of gastrointestinal illness. We are also currently completing analysis between AFOs and pregnancy outcomes.

(2) Unconventional Natural Gas Development (UNGD) (with funding from the National Institute of Health [NIH])

We have completed an analysis of UNGD in relation to building radon levels in the state; this was recently published in *Environmental Health Perspectives*, the journal of the NIEHS. Our first paper on UNGD and pregnancy outcomes has been accepted for publication in the journal *Epidemiology* (see **figure** from that paper above). Our first paper on UNGD and asthma exacerbations was submitted to a journal for consideration for publication in June 2015. The asthma work is the PhD dissertation project of doctoral student Sara Rasmussen and the pregnancy analysis was led by Joan Casey, who received her PhD at Johns Hopkins and is now a post-doctoral fellow at the University of California at Berkeley. The EHI has also developed a regional Marcellus Impact Pilot Program and made six awards totaling $100,000 to principal investigators from six different institutions that will provide research opportunities for nine students. The awards are listed in the box to the right.



Map of Pennsylvania from Geisinger Environmental Health Institute study on unconventional natural gas development and pregnancy outcomes. The map identifies the study region; the spatial distribution of spudded and producing wells in the state; locations of two primary Geisinger hospitals; and the number of deliveries by county from 2009 to 2012.

(3) Childhood Obesity (NIH-funded)

These studies are ongoing, using data from 163,000 children between ages 3 and 18 years from 2001 to 2012. We have made several new observations about the role of community and healthcare factors in relation to childhood body mass index trajectories. For example, we found that antibiotics cause weight gain in children, and are now planning studies of the gut microbiome to evaluate whether this might be through impacts in the gastrointestinal microbial ecology. We also found that community socioeconomic deprivation is also associated with BMI trajectories in a paper published in Obesity. We expect five more papers in the next year.

(4) Chronic Rhinosinusitis (CRS) (NIH-funded)

CRS is a disabling inflammatory condition of the upper airways, specifically the nose and sinuses.

FOR MUCH MORE INFORMATION ON THE GEISINGER ENVIRONMENTAL HEALTH INSTITUTE (EHI), visit our website at: http://www.geisinger.org/for-researchers/institutes-and-departments/pages/environmental-health-institute.html.

This study is funded for five years of work. We have just published a paper in the *International Forum of Allergy and Rhinology* on a systematic review of the occupational and environmental epidemiology of CRS. We are currently completing analysis of a number of community factors in relation to CRS, including unconventional natural gas development, community socioeconomic deprivation, and residential greenness (using the normalized difference vegetation index from satellite data).

GEISINGER ENVIRONMENTAL HEALTH INSTITUTE'S (EHI) AWARDS MARCELLUS IMPACT PILOT GRANT PROGRAM

Geisinger's Environmental Health Institute received applications requesting a total of $145,000 for their recent call for proposals. The proposals selected for funding include six different institutions and will involve field work at sites throughout Pennsylvania. In addition, these projects will provide research opportunities for 9 students (8 undergraduate and 1 graduate). Below are the grants awarded to researchers from the Susquehanna River Heartland Coalition for Environmental Studies.

Dr. Steven Rier, Bloomsburg University (with United States Geological Survey Partners): *"Developing Biofilm Markers for Monitoring the Impacts of Unconventional Oil and Gas Development on Stream Ecosystems"*

Dr. Jonathan Niles, Susquehanna University & Dr. Chris Grant, Juniata College: *"Assessing Potential Impacts of Unconventional Natural Gas Extractions and Mercury Concentrations on Trophic Food Webs of Unassessed Headwater Streams"*

Dr. Melvin Zimmerman & Dr. Peter Petokas, Lycoming College: *"An Assessment of Eastern Hellbender Population Trajectories and Water Quality as Determinates of Watershed Health"*

Dr. Md. Khalequzzaman: *"Determination of the Sources of Turbidity in Waterways in the Marcellus Shale Gas Drilling Region"*

Dr. Bailey-Davis and the Geisinger Health System: *"Pennsylvania Farmers' Perception of Agricultural Impacts from Unconventional Natural Gas Development in the Marcellus Shale"*

WKOK

Mark Lawrence
Newsradio 1070 WKOK Program Director
Sunbury Broadcasting Corp

Newsradio 1070 WKOK continued its consistent coverage of critical environmental issues in the 2014-2015 year. We featured guests and topics pertaining to the declining health of the Susquehanna River, local Climate Change impacts, and even the 'reduce/reuse/recycling' efforts of a local brewery.

One of the many highlights from the past year was WKOK's coverage of Susquehanna University's grand opening of its Freshwater Research Institute. The institute, subsidized by a $2.25 Million grant from the Richard King Mellon Foundation, contains state-of-the-art equipment and a specialized laboratory to study the river and its problems. We reported on this and followed up with additional interviews.

In terms of the River's problems, WKOK spoke several times with John Arway, director of the Pennsylvania Fish and Boat Commission. Arway lamented the continued decline in the health of the small mouth bass population. Researching the cause of this problem is one of the main goals of the SRHCES research universities. Arway also introduced the Save Our Susquehanna initiative, a fundraiser to help secure funding to tackle the river's problems.

Recently WKOK aired two features pertaining to the environment. NYU intern Nick Rakauskas was the reporter and producer of the reports. The first report details the symbiotic relationship between Damian Malfara, owner of Old Forge Brewing Company, and farmer Brian Tworkoski. Malfara takes his used brewer's grain, and instead of sending it to a landfill, gives it to Tworkoski, who in turn uses it to supplement his cattle feed. The cattle are later sold to Old Forge Brewing Company for beef.

The second report describes the efforts of the Northcentral Pennsylvania Conservancy to repair a tributary of Limestone Run in Montour County. The goal is to have the stream removed from the impaired list. By doing so, the Conservancy aims to stabilize the surrounding ecosystem.

WKOK also provided an open mic for environmental groups on its On The Mark and WKOK Sunrise programs. Mark Lawrence interviewed a host of individuals including Drake Saxton (a regional environmentalist concerned about toxic sites in and around Sunbury), and Ed Perry of the National Wildlife Federation, touting the federation's Climate Change Campaign. WKOK also interviewed representatives from the Friends of the Shikellamy State Park, Susquehanna River Cleanup Crew, and the Marcellus Shale Coalition.

WKOK aims to continue its coverage of all environmental issues, topics, and initiatives. To hear the environmental coverage WKOK has done so far, visit **wkok.com**.

Past Interns... Where Are They Now?

MATTHEW BOYD
Susquehanna University – Dr. Carlos Iudica

Matthew Boyd is currently enrolled in a Masters of Advanced Teaching program at American University, where he is majoring in Science Education. He graduated from Susquehanna University in 2013 with a degree in Biology. While at Susquehanna, he worked with Dr. Iudica researching the winter diets of Great Horned owls in northern Virginia. They found a high percentage of meadow voles in the owl pellets they dissected, indicating that the introduction of Great Horned owls could potentially serve as a natural method of population control for agricultural areas adversely affected by meadow voles. Matthew presented the results of his research at the Pennsylvania Academy of Sciences Conference in Bradford, PA, the National Conference for Undergraduate Research in LaCrosse, WI, and the Worldwide Raptor Research Conference in San Carlos de Bariloche, Argentina. He feels that these presentations provided him with experience in science communication and gave him a résumé boost for grad school and the future. Matthew has been student teaching in D.C. with plans to graduate this summer and begin teaching high school biology in a Title I school in D.C. in the fall.

BRITTANY BUCKLEY
Lycoming College – Dr. Mel Zimmerman

Brittany Buckley is currently an Assistant Superintendent at the West Plant of the Williamsport Municipal Water Authority/Williamsport Sanitary Authority. During 2011 and 2012, Brittany was involved in multiple projects at the Clean Water Institute (CWI), including researching Hellbenders with Dr. Petokas, sampling and analyzing Rose Valley Lake, and assessing streams for the Unassessed Waters Initiative. Brittany believes that her internship with CWI was the best experience she had at Lycoming College. Through CWI, she was able to gain laboratory experience, respect for the community, and a love for the environment around Williamsport. After graduating from Lycoming, she was hired as a laboratory technician at the Williamsport Sanitary Authority, and was promoted to Assistant Superintendent in May of 2015. She now oversees the treatment of industrial and municipal wastes. Her work focuses on maintaining the health of the local environment and the Chesapeake Bay.

LYNNETTE EICHENLAUB
Bloomsburg University – Dr. Cynthia Venn

Lynnette Eichenlaub is enrolled in a graduate program at West Virginia University. She feels that having hands-on research experience during her undergrad at Bloomsburg gave her an edge when applying to grad schools. While at Bloomsburg, Lynnette studied water samples from a catch and release pond in Wyalusing, PA, noticing a high pH around 9.8 that she attributed to high rates of photosynthesis during times of direct sunlight. Not only did her research help her while applying to grad school, but it also helped her to work independently, discover a fascination with chemistry, and gain confidence that would help her in her future studies. Lynnette is currently studying rock and sediment cores at the Geological Survey of Northern Ireland. Lynnette will be looking at the traces of fluid found in the core samples and will be doing sedimentary geochemistry on the core to determine what minerals and elements are found within it. Lynnette attributes who she is today as a scientist to the influence of Dr. Venn and her experiences at Bloomsburg.

PHILIP GRIFFITH
Lock Haven University – Dr. Md. Khalequzzaman

Philip Griffith is currently employed by Key Environmental, Inc. in Carnegie, PA. Before graduating from Lock Haven University this past May, Philip spent two years interning for Dr. K. His work for Dr. K focused on gathering water data from multiple streams in the Susquehanna watershed, and consolidating this data into tables and graphs. He used analytical methods in ArcGIS, a mapping platform, to show spatial patterns in water chemistry and to determine locations of potential issues. Philip feels that he gained valuable experience in computer programing, teamwork, and presentation that benefit him in the job he holds now. He now works as a Staff Geologist at Key Environmental, Inc., and his job includes monitoring wells and chemical contaminants in the groundwater.

SAMANTHA PFISTER
Bloomsburg University – Dr. Cynthia Venn and Dr. Christopher Hallen

Samantha Pfister recently graduated with a Master of Science from the University of Pittsburgh. She completed her undergrad at Bloomsburg University and was able to conduct geochemical research under Dr. Venn and Dr. Hallen. Her focus was on a baseline study of the Briar Creek watershed to gain an understanding of the typical characteristics of the watershed. Over the course of approximately one year, she completed biweekly water sampling, analyzed multiple field parameters such as pH and alkalinity, and conducted laboratory analyses. Samantha feels that all of the field excursions and opportunities at BU helped her gain a position as a graduate student at the University of Pittsburgh. Her research at Pitt consisted of geochemical characterization of a carbonate oil and gas reservoir in the Permian Basin of northwest Texas. She also characterized two groundwater formations overlying this reservoir (one of which was the Ogallala aquifer) to ensure there was no leaking from the oil and gas formation into these groundwater resources. Samantha is currently working on a scientific paper to be submitted for publication in the near future.

AMBER ROCK
Lycoming College – Dr. Mel Zimmerman

Amber Rock is finishing a PhD in Ecology, Evolution, and Environmental Biology at Miami University in Oxford, OH. From the fall of 2006 through the summer of 2009, she worked for Dr. Zimmerman, professor of Biology at Lycoming College and director of the Clean Water Institute (CWI). While at CWI, Amber conducted an independent honors project researching the communities of rotifer zooplankton and ciliate protozoans in Cromaglass wastewater treatment units. In addition, she sampled several streams for water quality information. She feels that CWI provided her with experience and knowledge in ecological research that helped prepare her for her future education. Her research now focuses on aquatic food chain efficiency. With the ~5,000 L tanks at Miami University's Ecology Research Center, she is able to replicate natural conditions while manipulating different factors. In these large-scale mesocosm experiments, she is able to investigate how factors such as light supply, nutrient supply, and top predator identity affect food chain efficiency.

CORY TREGO
Lycoming College – Dr. Mel Zimmerman

Cory Trego is enrolled in a Master's program at West Virginia University working towards a degree in Wildlife and Fisheries Resources. During his internship at the Clean Water Institute (CWI), he assisted with projects including the Unassessed Waters Initiative and the Susquehanna River monitoring project. In addition, he presented at the Acadian Program in Winter Harbor, ME. In the Regional Conservation and Stewardship program, they discussed how large-scale land use, local culture, and regional economic trends impact our waterways.

Cory is grateful for the opportunity to gain a diverse background in stream ecology and conservation through CWI. He is now examining the impact of large-scale habitat restoration and land use on the trout population in the Shavers Fork of the Cheat River near Snowshoe, WV. His research will help with stream restoration to improve trout habitats throughout the Appalachian mountain range.

EMILY VEBROSKY
Lycoming College – Dr. Mel Zimmerman

Emily Vebrosky is pursuing an Environmental Science degree at Louisiana State University in the School of the Coast and Environment. She graduated from Lycoming College in 2014 with a degree in Chemistry and a minor in Environmental Science. While at Lycoming, Emily was able to combine her interests in chemistry and environmental science during an internship at the Williamsport Municipal Water and Wastewater Authority. She presented the research from her pilot study *Acclimated cultures of freshwater archaea and bacteria degrade synthetic sewage in a salt-water environment* at the 8th Annual Susquehanna River Symposium. She feels that her work with Lycoming College's Clean Water Institute helped prepare her for grad school by teaching her skills in conducting independent research as well as group research. Her internship helped her to gain experience working in the lab and in the field. For her thesis at Louisiana State, she is researching the photodegradation of pesticides in freshwater and saltwater throughout a 24-hour period.

SRHCES professors and students gathered at Lycoming College this summer to share information about their research.

The summer 2015 interns presented brief summaries of their research projects.

Some of the students will be continuing their research through next year while others will be wrapping up and summarizing results this fall.

This report was developed with input and support from the members of the Susquehanna River Heartland Coalition for Environmental Studies, H. W. "Skip" Wieder, Abbi O'Connor and Reneé Carey.

Special thanks to the Degenstein Foundation for their continued support of the Susquehanna River Heartland Coalition for Environmental Studies.

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