Pulse of the Heartland

2016 ANNUAL REPORT

Presented by the

SRHCES

Susquehanna River Heartland Coalition for Environmental Studies

SRHCES

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

In recognition of this tremendous asset, six regional colleges and universities joined other partners, including Geisinger Health System, Northcentral Pennsylvania Conservancy, the Forum for Pennsylvania's Heartland and SEDA-COG, to work with state agencies and Chesapeake Bay affiliates to form the ***Susquehanna River Heartland Coalition for Environmental Studies*** *(****SRHCES****). 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 Daily Item, the Foundation for Pennsylvania Watersheds and the Degenstein Foundation.*

SRHCES*'s members meet monthly to discuss individual research projects, opportunities for collaboration, and the issues faced in their research. These meetings provide a forum to not only share information, but to also discuss partnerships.*

SRHCES *has been meeting for a number of years now. The summer work with interns from the various member colleges and universities has allowed the man-power necessary for the SRHCES members to take on a variety of research projects, as well as provided those students with invaluable field experience. This year's report provides an overview on the reintroduction of eels to Buffalo and Pine Creeks and the effect that they have on the ecosystem. These fish play a more important role in the ecosystem than some believe, and is integral to the health of the river.*

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 in the humanities field, Geisinger Environmental Health Institute, and Sunbury Broadcasting.

FRONT COVER: *SRHCES professors and students gathered at Lycoming College this summer to share information about their research. The summer 2016 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.*

REINTRODUCTION OF EELS TO THE PINE CREEK & BUFFALO CREEK DRAINAGES

Eels and their Role in the Ecosystem

The American eel is a species of fish inhabiting a large range in the Western hemisphere, from Greenland to Brazil and as far west as the upper Mississippi River. Originally thought to be a purely freshwater species, research has shown that these fish are in fact catadromous, using brackish (a mix of salty and freshwater) and saltwater habitats to spawn and swimming up into freshwater habitats to mature. Some eels choose to even stay in salty and brackish water their entire lives, while others move in between the two throughout their lives.

The American eel is both an integral part to the Susquehanna River watershed and the lives of the Eastern elliptio mussel.

The American eel starts its life no larger than about an inch in the Atlantic Ocean and by the end of its life can end up over 5 feet long if it is female and 3 feet long if it is male. After growing out of their larval stage, they become what is known as glass eels. They are called this because of their transparent bodies. After they reach inland waters, they continue to grow into what are called "elvers." They are differentiated from the glass eels by the pigmentation that is found in their skin. After this stage, they become "yellow eels," which are the sexually immature adult phases for the fish. Finally, after many years of life they become "silver eels," a fully grown and sexually mature fish.

It can take up to 20 years for the eels to mature. When they do, they return to the Sargasso Sea, a stretch of the Atlantic Ocean between the Azores and the West Indies, where they mate. After mating once, they die. The larvae are not strong enough to swim back on their own, so they rely on the currents to take them back to the coast. Once they reach coastal waters, they begin swimming up the nearest river.

The eels prefer a variety of habitats, mainly where they have access to hiding places such as submerged logs or under large rocks. American eels are a predatory species, feeding on fish, crustaceans, insects and even dead animal matter. They also provide food for a number of species as well, including larger fish, mammals, birds, and reptiles. Eels were also caught regularly by humans for consumption, although this has lessened on the Susquehanna River possibly due to overall population decline and damming along the river.

Perhaps one of the most important roles that the American eel plays in the Susquehanna River watershed is that of a transportation service. The eels share a special relationship with a species of freshwater mussel called the Eastern elliptio (*Elliptio complanata*). The Eastern elliptio is a sedentary species of mollusk that needs a host to move the Eastern elliptio larvae to new sites. To do this, they parasitize the eels with their larvae called glochidia, which attach themselves to the gills of the eel. The larvae stay on the gills of the eel for around 20-30 days, and then detach to eventually come to rest on the bottom of the river where they will begin to mature. Although the mussel can use a few fish species to perform this task, they seem to prefer the American eel. The mussels tend to have a higher success rate of completing its metamorphosis or life cycle using the American eel as a host fish.

The Eastern Elliptio and its Role in the Ecosystem

The Eastern elliptio is a species of freshwater mussel that is found along the northern and mid-Atlantic East Coast. The Eastern elliptio varies in appearance, reaching shell lengths of up to 100mm, typically in the shape of an oval with dark olive or brown coloration with some green bands occasionally occurring. This species of bivalve can live to be 100 years old. They provide food for a number of different species of mammals, fish and birds.

Along with most mussels, they are primarily filter feeders that have the ability to remove pollutants and sediments from the environment. Because of this, they

are extremely important to freshwater ecosystems and play a large role in the health of many waterways, including the Susquehanna River. The mussels themselves can also be used to determine the health of a river, and their absence could have negative results. It may not come as much of a surprise then, to learn that parts of the Susquehanna River watershed are lacking in these mussels.

Mussels pull water in through a siphon and filter it through their gills. When doing this, they filter out bacteria and algae as well as other particles. Some chemicals and pollutants are also retained by the mussel, now free of sediment and some pollutants, the rest of the water and excrement is expelled. This process is extremely important to the cycling of the Susquehanna River watershed and many other rivers in which the mussels are found.

Historic Levels

The populations of these mussels are linked with those of the American eel, as they have an important relationship. Scientists have known about the importance of these animals for some time. Stocking programs for eels in the Susquehanna River began in 1938 and continued to 1977. During this time, the population of mussels was healthy, with a wide range of ages for the Eastern elliptio, as well as a large geographical range.

The amounts of these species were much higher in the past. At one point before there were dams on the Susquehanna, the annual American eel harvest was around one million pounds in the Susquehanna watershed. The eels were also harvested by fisheries and made up a significant portion of the fish collected on the Susquehanna River. Eastern elliptio mussels are the most common species of freshwater mussel in the Northeast, but their populations are much less abundant in the Susquehanna watershed than in the Delaware River watershed, to the point where there are some streams with little to no elliptio presence. In other waterways in the watershed, their presence is limited to big old mussels, with no larvae or immature members of the species.

Many American eels do not make it past the Conowingo dam, thus preventing the Eastern elliptio's from moving upstream.

Dams

In the late 1990s, a survey of freshwater mussels was conducted in multiple rivers on the East coast. The survey found a healthy variety of young and old mussels throughout the Delaware River, while parts of the Susquehanna watershed only had big old mussels. One of the driving factors for the spread of these mussels and their ability to reach new habitats is the presence of eels. The Delaware River flows through New York, New Jersey, Pennsylvania and Delaware for around 330 miles without any barriers. The river sustains a healthy population of eels and consequently Eastern elliptio mussels.

The Susquehanna on the other hand, tells a different story. Many dams have been erected in the river, making it much harder for the eels to make it upstream. When the eels reach a dam, only a portion of them make it over. This pattern continues until almost no eels are crossing the dams. In the Susquehanna River, the eels are stopped at mile 10 by the Conowingo dam. The migration routes of the eels in the Delaware River have stayed intact for generations, but in the Susquehanna the fish are finding it increasingly difficult to maintain their routes.

The dams are not only affecting the migration of the eels, but the Eastern elliptio as well. The mussels once relied on the eels to take them to new locations, but now less and less are reaching up the Susquehanna River. Below the dams can be found mussels of a variety of ages and sizes, while above them can only be found older and few young.

Aquatic Impacts of Decline

The decline of eels in the Susquehanna River watershed affects a large part of the environment as a whole. The mussels are not able to filter river water, helping to make it cleaner. In the Delaware River, the mussels that are present throughout the entire system filter the water 6 times before it reaches the ocean, leading to a much healthier waterway. The dams in the Susquehanna River prevent this kind of health.

A lack of eels can have a cascading effect on the Susquehanna River watershed. A decline in eels may have lead to a decline in mussels. The lack of mussels can cause the river to have less in system filtration, resulting in more sediment and pollutants staying in the water. Other organisms that require certain levels of water quality to survive suffer from the lack of viable habitat caused by the unfiltered water. These organisms could be fish, invertebrates, plants, and even microorganisms. The terrestrial plants and animals around the river are also affected as well through a decline in food and nutrients.

Reintroduction

Despite the decline of eels in the river, efforts are being taken to rejuvenate the population. The government has recognized the importance of the American eel to the health of the Susquehanna River watershed and a number of reintroduction projects are currently under way. Some scientists are trapping the eels that they find at the outfalls of the dams and relocating them above the dam so they can continue swimming upriver.

Julie Devers is a scientist with the US Fish and Wildlife Service (USFWS) and has been tracking the recovery of the eels for many years. Julie is continuing her work studying the reintroduction of eels into the Susquehanna River watershed. To do this, she is studying the presence of Eastern elliptio mussels in different locations. Surveys were taken at 13 sites using a mesh screen looking for the presence of baby mussels. Many were found below the Conowingo dam, but few were found above it. Because the eels cannot make it over the dam on their own, the Eastern elliptio cannot use them to complete their reproductive cycle.

The USFWS has been petitioned to list the American eel under the Endangered Species Act, but found that listing is not warranted at this time. However, the USFWS has recommended that eels be allowed to access habitat upstream of dams. Eel stocking programs above dams in the Susquehanna River were underway from 1938 to 1980 but stopped from 1980 to 2008. Starting with a small scale stocking in 2008, the USFWS stocked increasing numbers of eels above the dams each year until 2016 when Exelon, the owner of Conowingo Dam and Muddy Run Pump Station, assumed responsibility for stocking.

Progress

To assess the ecological response of reintroducing eels upstream of dams, the USFWS conducted intensive experimental eel stocking in Pine and Buffalo Creeks in the West Branch of the Susquehanna River. No eels were found in Pine and Buffalo Creeks before stocking in those creeks began in 2010. Mussel surveys in the same creeks turned up relatively high numbers, however, no baby mussels were found. From 2010 to 2013, approximately 120,000 eels were stocked in each of Pine and Buffalo Creeks. In 2014, another survey was done specifically looking for the presence of baby mussels. Not many were found in Buffalo Creek but more were found than in 2008. Pine Creek saw a 40% increase in the number of baby mussels, suggesting that the restocking programs are successful. Julie is preparing for another sampling period that will take place in 2019.

The importance of the American eel to the Susquehanna River watershed is often overlooked, but they are an integral part to the ecosystem. Without them, the watershed is missing a cog in the wheel and their absence affects all other organisms. Despite the decline in the species, recovery efforts are underway, with varying levels of success. The Eastern elliptio mussel may find its way back into previously uninhabited streams, and hopefully the population of both species can be restored to healthy levels. With the recovery of these species comes a healthier environment and a healthier watershed.

MONITORING/RESEARCH

Dr. Md. Khalequzzaman

Professor, Department of Geology and Physics, Lock Haven University

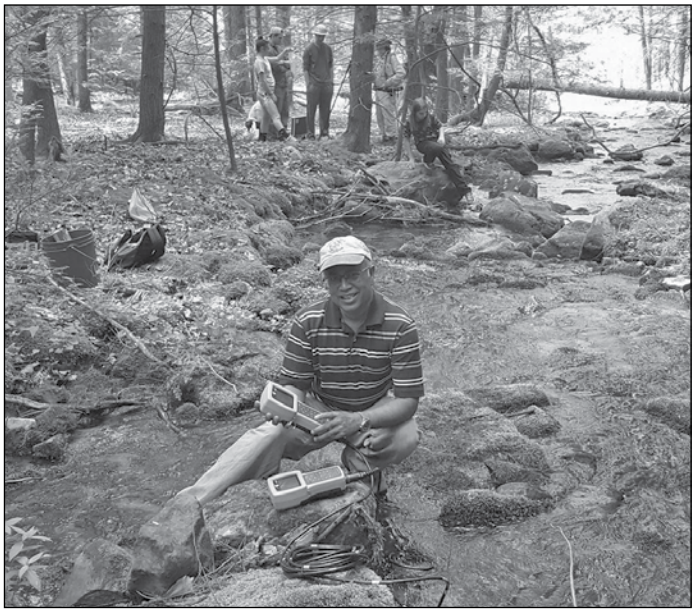
Dr. Md. Khalequzzaman (Dr. K), professor of geology at Lock Haven University, is continuing his long term project monitoring and assessing the water quality in the watersheds of Clearfield and Centre counties. On this project he is collaborating with the PA Senior Environmental Corps (PASEC). In the field, he is collecting 20-25 samples from locations within regions containing Marcellus shale drilling sites, and in some sites below those regions. From the information gathered he will be able to understand if Marcellus shale drilling affects water quality in the area. As this is an ongoing project, Dr. K has seen that the amount of Marcellus shale drilling activities have gone down in the area over the past years.

Dr. K is also working on 3 new projects this summer with the help of his interns. The first project is being funded by Geisinger, and is an effort to try to understand the sources of turbidity in the streams that feed into the Susquehanna River. Turbidity is the amount of cloudiness in the water that is typically caused by sediments and other small particles. Dr. K's goal is to determine where these sediments are coming from. He and his interns are collecting soil samples from various areas including agricultural sites, Marcellus shale drilling sites and sites that mix the two. By analyzing the chemical signatures from the sites as well as those taken from river sediment, Dr. K and his team hope to be able to determine the sources of the sediments that are causing the turbidity. So far, their research has shown that Marcellus shale is not the main contributor to the turbidity and that floodplains and croplands are contributing a significant amount.

Students from Lock Haven University sample water for a project funded through Geisinger.

His second project is a collaboration with professors from Susquehanna University. Together, they are taking geological and biological surveys of 5 streams in Penns Creek watershed to find a baseline for what healthy streams should look like. Dr. K is handling the sediment analysis of the streams, as well as helping with the mapping of the areas. Using GIS modelling, he is able to pinpoint where to take the samples from to ensure that the researchers are surveying healthy systems.

The third project Dr. K worked on this summer is similar to the second but focuses on the drinking water sources for Lock Haven. One of Dr. K's interns traveled to 5 sites within Lock Haven watershed and took water samples. After analyzing the pH, DO (dissolved oxygen), and organic content, they will hopefully identify if there are any traces of pollution in the water sources. For this project they are looking more at the organic material than the inorganic.



Dr. K and his students working at Penn's Creek.

Dr. Melvin Zimmerman

Professor, Department of Biology, Lycoming College

Over the summer of 2016, the Lycoming College Clean Water Institute (CWI), under the direction of Dr. Mel Zimmerman and Dr. Peter Petokas, supported 10 summer interns working on various water quality and population ecology projects.

Although interns help each other and rotate through the various projects, each student is assigned a specific project to process data and write reports.

Lycoming Students Ali and Jennifer taking water quality measurements.

This will be the 7th year that CWI has been a partner in with PA Fish and Boat Commission (PFBC) Unassessed Waters project, which is funded by Degenstein Foundation and National Fish and Wildlife Foundation. To date, CWI has assessed over 500 streams using PFBC protocols that include electrofishing. Pennsylvania is fortunate to have a vast flowing water resource comprised of over 83,000 miles of flowing water. As of February 2016, the PFBC and its partners have surveyed 8,210 streams comprising over 30,588 miles. Of this total, there have been 3,988 stream sections (13,629 miles) in which wild trout have been documented and designated for protection by PFBC. The primary threat to unassessed wild trout waters is inadequate water quality protection due to the unknown condition of the trout population and the resulting permitting actions that are not properly conditioned to protect wild trout. Over the summer they worked in parts of Lycoming and Tioga counties and Pine Creek watersheds on 40-50 streams.

Ryan from Lycoming College with a Brown Trout in Mill Creek.

Another project is the Lycoming County MS4 (Municipal Separate Storm Sewer System) outfall analysis project which is funded by the MS4 coalition. Stormwater outfalls are found at the end of pipes where stormwater is discharged into local waterways. This outfall analysis work is required under the county MS4 permit. This is the second year that CWI is working with the county MS4 coalition of partners (Old Lycoming Township, Loyalsock Township, Montoursville Borough, South Williamsport, Williamsport, Lycoming Township, Hepburn Township, Fairfield Township and Penn College). CWI interns are following PA Department of Environmental Protection protocols to assess and monitor these outfalls.

CWI has been working on several projects in the Loyalsock Creek Watershed in coordination with the Loyalsock Creek Watershed Association and Northcentral Pennsylvania Conservancy (NPC). These include being a partner in the development of a Rivers Conservation Plan for Loyalsock Creek. The PA Department of Conservation and Natural Resources funded development of the plan thru a grant to Lycoming County. CWI interns are also, assisting with the cane pole fishing derby on Rose Valley Lake and assisting in building and continued monitoring of fish habitat/bank stabilization projects on Mill Creek, Elk Creek and Wallis Run. These projects are designed by PFBC and involve a number of partner volunteers and funding thru grants to the NPC or watershed group. The main focus of CWI is in pre and post monitoring of fish populations. Rose Valley Lake is in the watershed and this will be the 10th year of CWI participating in the "Great North American Secchi Dip-In" – the Dip-in is an international effort in which volunteers produce a "snapshot" of the transparency of lake water in the United States and Canada.

CWI partners with SRHCES to share water quality monitoring data for over 20 sites on the river. On July 15th Lycoming College hosted SRHCES's 5th summer meeting. Over 60 summer interns and faculty from SRHCES organizations shared information on their projects funded through Degenstein Foundation.

Dr. Peter Petokas

Research Associate, Department of Biology, Lycoming College

The Eastern hellbender (*Cryptobranchus alleganiensis*), is a species of aquatic giant salamander endemic to eastern North America. For 11 years, undergraduate students in the Clean Water Institute (CWI), under the direction of Dr. Peter Petokas, have been monitoring the health of Eastern hellbender populations in various watersheds in Pennsylvania and New York. Most recently the group has built and deployed artificial in-stream habitat structures to support and monitor nesting success, and to provide eggs and larvae for a beginning

The hellbender team: Dr. Petokas, Lycoming interns: Seth Lansberry, Sarah Musheno, and Toby Boyer

head-start program. One new project this year involves blood sampling to further assess individual hellbender health. Environmental hellbender DNA is also being sampled in order to locate previously unknown populations of hellbenders in remote watersheds. Interns are funded through the Degenstein Foundation and Geisinger Environmental Health Institute, and a Haberberger undergraduate research fellowship awarded one of the interns.

Taking blood sample from an eastern hellbender.

Seth Lansberry measuring the length of a hellbender.

Dr. Petokas is also the intern mentor for environmental interns working at the Nature Center at Camp Victory – a summer camp for children with special needs. He is also providing guidance for the creation of wetlands at Camp Victory and the development of environmental education resources at the camp.

Dr. Robert Smith

Professor, Department of Biology, Lycoming College

Dr. Robert (Bob) Smith is a new assistant professor in the Biology Department at Lycoming College. He has a BS in Biology from Millersville University where he was advised by Dr. John Wallace. After spending a short time working at the Stroud Water Research Center as an intern and at Normandeau Associates, Inc. as a biologist, Bob went to the University of Maryland, College Park where he received his MS and PhD in Entomology advised by Dr. Margaret Palmer and Dr. Bill Lamp. During his final year of graduate school, he was awarded a National Science Foundation Science, Engineering, and Education for Sustainability (SEES) fellowship that funded a 3 year postdoctoral research position working for Dr. Allison Roy in the Massachusetts Cooperative Fish and Wildlife Research Unit at the University of Massachusetts, Amherst. Following his postdoc, Bob worked for 1 year as a visiting assistant professor in the Biology Department at the College of the Holy Cross (Worcester, MA).

His broad research interests include asking basic and applied questions about stream ecosystems, but his main area of expertise is in aquatic entomology. Bob has published research studying headwater streams, wetlands, and agricultural ditches and has performed basic and applied research on aquatic systems in forested, agricultural, and urban landscapes. His current research projects examine the natural history of aquatic insects, dispersal by aquatic organisms, novel approaches for improving urban streams, and multidisciplinary approaches for sustaining aquatic resources in human dominated environments. When he's not studying aquatic systems, he is either hunting, fishing, playing ice hockey, or spending quality time with his wife and 2 daughters.

Dr. Matthew McTammany

Professor, Department of Biology, Bucknell University

Dr. McTammany, a professor of biology at Bucknell University, is using inverse modelling to estimate rates of photosynthesis and respiration in the Susquehanna. Using data collected over the past 7 years from water quality sensors located in Milton and Danville, Dr. McTammany and his student, Katie Faulkner, are looking

for factors that may help determine whether these areas of the river are net sinks or net sources of carbon dioxide or CO2. Some factors that they are looking at include river flow, water temperature, organic matter, turbidity, and nutrient concentration - all of which contribute to river metabolism. Katie will be continuing this work as her honor's thesis this year.

Dr. McTammany is also completing manuscripts from various research projects on river invertebrates. In these studies, the distribution and diversity of different benthic invertebrate groups was analyzed across a range of habitats. Backwaters, waters found behind islands in the river, were compared to riffle environments, shallow fast moving sections of the river with the surface broken by gravel or rocks. Habitats with submerged vegetation were also compared to those with no submerged vegetation. Dr. McTammany also studied the influence of manganese oxide, a compound found on rocks in the river, on the presence of invertebrates. Through snorkeling surveys, Dr. McTammany and his students noticed that areas covered with manganese oxide contain fewer organisms than those without it.

A new project that Dr. McTammany is taking on involves a collaboration with PA Department of Environmental Protection, Union County Conservation District, PA Fish and Boat Commission and Buffalo Creek Watershed Alliance to study stream restoration efforts on health of local streams. Dr. McTammany is monitoring a tributary of Buffalo Creek, specifically near sites of riparian management and streambank restoration. This project started in summer 2016 and will be ongoing through the coming year. Dr. McTammany's students in his fall 2016 freshwater ecology class will assist with initial monitoring for this project.

Mizuki Takahashi

Professor, Department of Biology, Bucknell University

One of the main projects that Dr. Takahashi's research team at Bucknell University is working on is concerned with hellbenders, a species of giant aquatic salamander found only in the eastern United States. Taking water samples of selected tributaries, Dr. Takahashi and his students are trying to determine if hellbenders inhabit these waters through analysis of environmental DNA (or eDNA), the DNA of the target animal left in the environment. This method saves the time of actually looking for the secretive salamanders, as well as minimizes the risks of disturbing them or their habitats. Hellbenders breed in late August and early September in Pennsylvania. So one hypothesis that Dr. Takahashi tested was that the concentrations of eDNA would increase during the breeding season because of their breeding migration, male-male competition and gamete (reproductive cell) release. The data collected by Dr. Takahashi and his students supported this hypothesis in some tributaries, but not in others.

Dr. Takahashi sampling for eDNA.

Dr. Takahashi and his students have analyzed over 150 samples with some positive results. In 8 tributaries of the West Branch Susquehanna that were surveyed, 4 that were previously known to have hellbenders continued to show signs of them, and 2 that previously had no evidence were now found to contain eDNA of hellbenders, suggesting that they are now inhabiting those waterways. Environmental data was also collected at these sites, including pH, water flow, dissolved oxygen levels and conductivity, but they did not seem to have a significant effect on the estimated concentrations of eDNA. Using the eDNA technique, the research team is now trying to identify the breeding habitats of the newly found populations. Their ultimate goal is to promote the conservation of declining hellbender populations in the Susquehanna River Basin.

Sean Reese

Project Scientist, Bucknell University

Sean Reese has been working on finalizing work that he, Professor Brian Mangan (Kings College) and Mike Bilger (Susquehanna University) have been doing since last summer as part of a PA SeaGrant project to look at the impacts of invasive rusty crayfish (*Orconectes rusticus*). He was researching how the rusty crayfish impacts native gastropod (snail and slug) communities in the Susquehanna watershed. In addition, they looked at gastropod densities and communities at 7 longitudinal

sites along roughly 200 miles of river. They assessed native and invasive crayfish predation rates on three species common to the Susquehanna drainage: tadpole snail (*Physella acuta*), crested mudalia (*Leptoxis carinata*) and Virginia horn snail (*Pleurocera virginica*). The rusty crayfish not only has the potential to outcompete and extirpate native crayfish species, but also to decrease the species diversity among native gastropods to the Susquehanna watershed. This has the potential to have a cascading effect on the Susquehanna's benthic ecosystem.

Dr. Benjamin Hayes

Watershed Sciences and Engineering Program, Bucknell Center for Sustainabillity and the Environment

Ben conducted studies of milling and logging legacy alterations to several streams in the Mid-Atlantic and New England regions and continued his geomorphic mapping of streams and peri-glacial deposits in Union County, PA. His work with Jessica Newlin on mapping and modelling of Pleistocene outburst floods in the West Branch Susquehanna River was recently published in the journal *Earth and Space Sciences* (American Geophysical Union). His work with R. Craig Kochel to assess the geomorphic impact of catastrophic flooding by Tropical Storm Lee in September, 2011 on Lycoming, Loyalsock, Muncy, and Fishing Creeks was published in the January 2016 edition of the journal *Geosphere* (Geological Society of America). Ben continues to serve as director of Bucknell's Watershed Sciences and Engineering Program and is the chair of the 2016 Susquehanna River Symposium.

Dr. Jonathan Niles

Assistant Professor, Department of Biology, Susquehanna University

Dr. Niles, professor at Susquehanna University and part of the Freshwater Research Initiative, and his 8 interns were involved in a number of projects this summer. One study is on the biological effectiveness of instream restoration structures at agricultural sites. These structures are used to hold back sediments from eroding into the streams and decreasing the health of the waterways. The study aims to determine whether these structures also have a biological benefit to the stream biota (fish and stream insects), which Dr. Niles believes

Dr. Niles and his student measure trout in Conklin Run to better understand stream health.

they do. Sites are monitored in Snyder, Union, Montour and Northumberland counties both 1 year before and 2 years after construction to determine any changes in the biological communities found there. At the sites, all fish species present are identified and counted, as well as benthic macroinvertebrates. The project is in partnership with the Northcentral Pennsylvania Conservancy (NPC), PA Department of Environmental Protection (PADEP), the PA Fish and Boat Commission (PFBC) and county conservation districts.

There are also 30 long term sites that are being monitored in the Loyalsock Creek drainages that have been monitored since 2011. Water quality measurements are being taken, as well as fish and macroinvertebrate data to observe the changes in the biological community after a flood that occurred in 2011. Dr. Niles is also

Dr. Jon Niles and students electrofishing on Conklin Run to test water quality.

continuing to work on the Unassessed Waters Initiative, hoping to reach the 700 stream mark by the end of the summer 2016. Over the past 6 years of the program, Susquehanna University has assessed the waters of around 615 streams for the PFBC and Dr. Niles is hoping to assess 75 to 85 more streams by the end of the summer.

Two of Dr. Niles' students this summer were each working with graduate students from Penn State University on projects. The 1st project with Penn State University is collecting temperature and telemetry data from Brook Trout. They are also looking at the interactions these fish have with the non-native Brown Trout to determine if there are preferential habitats for the fish considering temperature and proximity to other species. The 2nd project with Penn State University is a study of endocrine disrupting compounds in groundwater seeps in creeks with Smallmouth bass populations. Finally, Dr. Niles is working on a project collecting data with Juniata College, looking for the presence of mercury in headwater streams at both sites where Marcellus shale drilling has and hasn't occurred.

Mike Bilger

Grants Program Manager, Freshwater Research Initiative, Susquehanna University

Mike Bilger continued his work this summer with the Freshwater Research Initiative, of which he has been Grants Program Manager since July 2014. He is involved in a number of Susquehanna River related projects as well. One project, a collaboration with Dr. Jack Holt, has Mike taking samples of algae and invertebrates at Shady Nook sites. Using rock basket samplers and diatometers, they are trying to gather information on the diversity of organisms in the area. Another project Mike is involved with deals with research on the rusty crayfish. The project aims to gather information on the distribution and diet of these organisms.

Mike is also in collaboration with Dr. Jack Holt and Dr. Ahmed Lachhab on another project assessing the differences between invertebrate species, diatoms and water quality in 5 headwater streams off of Jack's Mountain. His research is showing that the similarities in these streams are as low as 17-19% for diatoms. The similarities are less than 50% for invertebrates. Collections at the 5 sites were taken from different seasons as well, to assess the waters at different times of year. Mike is also monitoring the presence and health of macroinvertebrates and local fisheries in the waters near Fort Indiantown Gap, which he has done since 2002.

Mike is also monitoring farm restoration projects with the Union, Snyder, Montour and Northumberland County Conservation Districts. He is studying the biological communities in the area, before the restoration, 1 year after they were completed, and next year as well to assess their effects on the waterways. He is also looking again at macroinvertebrate communities and fish, as well as in Mifflin County, the most agriculturally occupied waters around the drainage. His goal is to look at the Best Management Practices and see whether they are making a difference in the health of the streams.

Dr. Jack Holt

Professor, Department of Biology, Susquehanna University

Dr. Holt's lab has been involved in 3 large projects through the summer, 2 on the main stem of the Susquehanna River and 1 on 5 headwater streams. Although the students in his lab have particular responsibilities, they all work together as a team on days when multiple hands and backs are needed (e.g. collecting and retrieving passive samplers and routine water sample collections).

Dr. Holt and his students have been monitoring diatom biofilm communities and benthic macroinvertebrate communities at 4 sites on the Byers Island transect for 8 years. Sites 1 and 2 are on the west side of Byers Island and sites 3 and 4 are on the east side. For both communities they use passive sampling (rock baskets and Hester-Dendy Multiplate samplers for the macroinvertebrate communities and diatometers for the diatom biofilms; deployed on June 9) and active sampling (kicks and stone collections for macroinvertebrates and diatoms, respectively). Active samples are taken at 100 meter intervals upstream from sites 1 and 2 for 500 meters. Site 1 is in the West Branch plume while sites 2-4 are in the plume of the main stem, coming from the north. Still, each of the main stem plume sites show individual characteristics, especially during this low flow summer.

Amir Alwali led the team working on diatom community samples at sites 1-4 for several weeks and presented his preliminary results at the Landmark Research Conference at Moravian College on July 28. Marta Mendez has led the team working on the macroinvertebrate communities during the summer

2016. She has collected the active samples and passive samples. She is involved in picking and sorting the animals from the collections. This project is a cooperative effort with Michael Bilger and Ahmed Lachhab.

The diatom community monitoring for a young-of-year Smallmouth bass is a portion of a larger project that includes fish, macroinvertebrates, and diatom biofilms at specified locations on the lower West Branch, upper mainstem, and tributaries of the Susquehanna River, 11 sites in all. Joshua Levesque has led the team working on diatom community samples in this longitudinal river study. He has collected stones at each of the specified sites and the diatom communities have been removed and cleaned. He and Tori Ross presented his preliminary results at the Landmark Research Conference at Moravian College on July 28.

This is the second year that Michael Bilger, Ahmed

Students from Susquehanna University assist Dr. Holt in looking for invertebrates.

Lachhab, and Jack Holt have mentored student interns to study the macroinvertebrate communities, diatom communities, and water chemistry of 5 headwater streams that flow down the north face of Jack's Mountain, part of the Penns Creek watershed into Penns Creek. Last year they found that, although the chemistry is quite similar from one stream to the next, the macroinvertebrate and diatom communities are quite different from each other. Summer 2016 they set out to repeat the samples and methods of last year. In addition to examining the upper reaches of the respective streams, they chose 1 stream, Green Gap, to examine in a longitudinal study to its confluence with Weikert Run. These samples are being processed by Grace O'Malley working with Michael Bilger on the macroinvertebrate communities and Brian Rothbard working with Jack Holt on the diatom communities. Although they examined diatom communities on stone, sediment, and plants in the summer of 2015, the summer of 2016 they restricted the investigation to diatom biofilms on stones.

Dr. Iudica is researching the ecology of these small rodents.

Dr. Carlos Iudica

Professor, Department of Biology, Susquehanna University

Dr. Iudica is continuing to work on predators present in the Susquehanna ecosystem. Currently, he is focusing on the feeding ecology of coyotes along with 5 of his research students. He is also studying the diets of barn owls in the watershed. With other students, Dr. Iudica is collecting owl pellets and examining the contents as well as identifying the remains to determine the diet of the owls. He is also conducting research on the ecology of small mammals including insectivores and rodents with other students. In addition, Dr. Iudica is working to finish a number of publications including one on the diet of the two fox species found in Pennsylvania, the winter diet of mink, and previous results on the diet of coyotes. Many of these animals are top predators in Pennsylvania and they all utilize and cycle the resources of the Susquehanna watershed. Because of their position in the food chain, these species often accumulate large and sometimes sub-lethal amounts of toxins such as mercury and lead.

Ahmed Lachhab

Associate Professor, Earth and Environmental Sciences, Susquehanna University

The summer of 2016 was a busy time for Dr. Lachhab and his 3 students. Dr. Lachhab has been involved in multiple projects that include: co-directing a program to Iceland during the month of July; starting the Smallmouth bass project, with Jon Niles from Susquehanna University, by monitoring 9 sites (Middle Creek, Penns Creek, Buffalo Creek, Mahantango

Dr. Lacchab and students during the monitoring of Green Gap stream one of 5 Penns Creek headwater streams where there is ongoing hydrogeochemical study.

Creek, Wiconisco Creek and 4 other sites on the Susquehanna River) and hydrogeophysical study of Montandon Marsh, in collaboration with Rob Jacob from Bucknell University, and a shallow heterogeneous unconfined aquifer at the Center for Environmental Education and Research (CEER).

He has continued the ongoing hydrogeochemical study of 5 Penns Creek headwater streams at Bald Eagle State Forest. The Penns Creek headwater project carries a series of investigated projects including stream discharges, water chemistry and temperature monitoring. This project started in the summer of 2015 and focused on comparing transversally all these properties along a relatively similar elevation. Data collected during the summer of 2015 has led to preliminary results showing that all streams were similar in term of water chemistry when compared along the same elevation. The newly collected samples completed this summer are incorporating transversal and longitudinal directions to study the dynamic of these streams. Early results showed that these streams are changing significantly fast from the headwaters to their confluences.

Dr. Holt, Dr. Lachhab and students during a visit to the headwater streams in Bald Eagle State Forest.

On a different related subject, they are making good progress on improving the water quality index by exploring all pre-existent expressions based on the literature and our pre-existing method in order to identify the most effective parameters that can generate the best formula for a new water quality index expression for streams similar to the ones we are investigating.

Both a section of Susquehanna River and Pecks Pond Lake at the Delaware State Forest have been surveyed for bathymetry (depth) and sub-bottom sediment deposit. This is a collaborative project between Dr. Chad Freed from Widener University and a graduate student from the University of Pennsylvania. The method adopted in this survey integrates the use of a sub-metric GPS with a high resolution ground penetrating radar survey technique. All water samples from 4 different projects either directly under his supervision or from other colleagues within the SRHCES have been analyzed in his lab.

Dr. Lou Ann Tom

Professor, Department of Chemistry, Susquehanna University

Susquehanna University

During May and June 2016, Lou Ann Tom has been a program director for two back-to-back Susquehanna University Global Opportunities programs, guiding 21 students in an active-learning program designed to immerse them in the culture and history of the Hawaiian Islands. As a result, she didn't have any research students the remainder of the summer 2016, but continues to prepare for fall research evaluating the degradation of pharmaceuticals using catalytic photodegradation. Through a grant from the Foundation for Pennsylvania Watersheds, she has purchased Microtox, an in-vitro testing system which uses bioluminescent bacteria to detect toxicity in water. This will be used to evaluate the effectiveness of degradation by measuring toxicity before and after treatment to degrade active ingredients in pharmaceuticals. Evaluation and use of this equipment will continue with research students during the academic year. Evaluation of Susquehanna River water and possibly sediment for the concentration of metals using atomic absorption will also continue and use of x-ray fluorescence for this analysis may also be initiated.

Dr. Matt Persons

Professor, Department of Biology, Susquehanna University

Dr. Persons is studying mercury transport and bioaccumulation in spiders as part of a collaboration with Brian Mangan at King's College. In 2008, a study was done on the diets of songbirds which found that 70% of the mercury was coming from spiders, but spiders only comprised 30% of the bird's diet. These songbirds had mercury levels even higher than fish-eating birds. This led Dr. Persons to try to discover more about the accumulation of mercury in spiders. To do this, he, along with student interns, have collected over 2,500 spiders comprising 105 species and 19 families from 33 locations in central Pennsylvania. These sites included headwater streams, riparian zones near and away from power plants, agricultural sites, AMD-impacted areas and uncontrolled mine-fire locations. When collecting from sites near power plants, he found that the spiders there contained 3 times more mercury than sites around headwater streams or agricultural areas. In Centralia, PA, and other mine fire sites, Dr. Persons, Dr. Mangan and student interns found spiders with mercury levels 9 times higher than those in agricultural systems and 3 times higher than those around power plants. Some spider mercury levels were even higher than that of halibut and other mercury-concentrating fish species. Dr. Persons believes that these high mercury levels are due to the fact that many ground spiders feed on other spider species, as well as cannibalize each other. This, combined with evidence that they pass mercury to their offspring, allows them to accumulate and concentrate mercury efficiently. Surprisingly, one of the species found at two mine-fire sites, appears to be a new species previously undescribed.

Hailey Shannon, one of Dr. Persons students, collecting spiders.

Dr. Persons is working on another spider project as well. He and his students are submerging different spider species in the lab to measure inundation tolerance. The goal of this study is to gather data on how riparian spider communities respond to periodic flooding. Preliminary evidence suggests that many species can survive submergence for many hours by creating a plastron or breathing bubble. This bubble allows oxygen to diffuse through the surface like a scuba tank, greatly increasing the amount of time they can stay submerged. Many hairy species of spiders like wolf spiders and fishing spiders are particularly good at maintaining breathing bubbles underwater. Other spider species enter into hypoxic comas where they greatly lower their metabolic rate until the water recedes.

Dr. Steven Rier and Dr. Jennifer Whisner

Professors, Department of Biology and Department of Environmental, Geographical and Geological Sciences, Bloomsburg University

The Professors at Bloomsburg are currently involved in a number of projects. Dr. Steven Rier and his students are working with the USGS Northern Appalachian Research Lab in Wellsboro on a large-scale year-long simulated brine spill experiment in outdoor raceways that have been set up to mimic natural stream ecosystems. These raceways were naturally colonized with algal, microorganisms and macroinvertebrates and were stocked with fish. Raceways then experienced brine pulses of varying magnitude and duration to simulate frac water spills associated with unconventional gas drilling. An array of ecosystem-related parameters is being measured for one year following the brine pulses.

Dr. Rier's students taking water samples.

Interns from Bloomsburg University working with Dr. Whisner to install monitoring instruments in the Fishing Creek watershed.

Dr. Rier and his students have completed construction on a real-time monitoring station on Fishing Creek near Bloomsburg that collects water quality and weather data at 15 minute intervals. This information is uploaded to a server and will eventually be available to the general public. Dr. Rier is also studying how microbial communities in streams respond to phosphorus pollution using the Bloomsburg University Artificial Stream facility and through high frequency sampling of Fishing Creek near Bloomsburg. His lab is also doing preliminary work on a potentially toxic cyanobacterium that has been blooming in Fishing Creek the last several years. Dr. Rier, in collaboration with Dr. Amber Pitt, also have a student looking at the interactions that take place between hellbender salamanders and native and exotic species of crayfish.

Dr. Jennifer Whisner, Dr. Ben Franek and students are working on installing instruments and collecting data to form the basis of a hydrologic monitoring and flood forecasting system in the Fishing Creek watershed. Students are compiling rainfall data, and collecting stream depth and discharge data to help determine how the watershed responds to rainfall events for the Fishing Creek Hydro Watch project. These data will be used to construct models that relate patterns in rainfall to potential flooding in the Fishing Creek watershed, and provide the public with information on when the stream is safe for recreation.

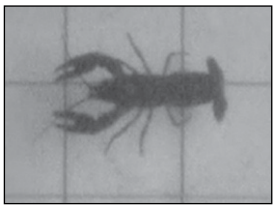
Dr. Matt Ricker, Dr. Jennifer Whisner and Dr. Mike Shepard are looking at the importance of deltaic deposits and river islands in major tributaries in removing suspended sediments, metal pollutants, and improving water quality of surface waters entering the greater Susquehanna River system.

Dr. Brian Mangan

Professor, Department of Biology, Kings College

Dr. Brian Mangan and his students are working on two different projects during 2016. In the first project, they continue to explore the ecological interactions between crayfish and Smallmouth bass in the Susquehanna River. So far Dr. Mangan and his team have examined the diet of Smallmouth bass at 6 sites along the river, and linked crayfish abundance to bass condition. They have also developed a method and protocol to reliably measure crayfish density in wadeable rivers, and they subsequently examined the relationship between density and the relative abundance of crayfish estimated with baited wire traps. Additionally, they are exploring possible behavioral differences among river crayfish species in regard to their aggression, exploration of their surroundings, and response to predators. Dr. Mangan has been working with Mike Bilger (Susquehanna University) and Sean Reese (Bucknell University) on this project, and they investigated the diet of crayfish in the river and the impact of crayfish on snail populations, respectively.

In a second project, Dr. Mangan and students are following the trail of mercury contamination in a riparian forest. Previously, Mangan's lab had demonstrated that forest salamanders in these areas were contaminated with mercury. Since this contaminant had likely worked its way through the food chain, he and his students will be sampling prospective salamander macroinvertebrate prey such as beetles, centipedes, millipedes, ants, spiders, snails, and earthworms, to see which of their prey are most responsible for the mercury.



Crayfish in Dr. Mangan's lab.

Finally, Dr. Mangan has also been collaborating with Dr. Matt Persons, professor of biology at Susquehanna University. Dr. Persons and his students have been investigating the ecology of ground spiders, including of

late, the use of these spiders as indicators of mercury contamination. The Mangan lab has been providing mercury analysis of spider samples collected by Dr. Persons and his students.

Geoff Smith

Susquehanna River Biologist, Pennsylvania Fish and Boat Commission (PFBC)

Geoff's research focuses for summer 2016 continue to include investigation of factors contributing to disease among young-of-year Smallmouth bass in the Susquehanna River and its tributaries. He is working with collaborators from Penn State University, US Geological Survey (USGS), Michigan State University, PA Department of Environmental Protection, and Susquehanna University's Freshwater Research Initiative to better understand the different factors that are contributing to disease outbreaks and other health issues observed in Smallmouth bass. These include physicochemical water quality, contaminants, parasites, and viruses such as Largemouth Bass Virus to evaluate the interplay among the parameters.

New for 2016, is a large collaborative research project funded by Pennsylvania SeaGrant with Dr. Ty Wagner at USGS Fish and Wildlife Cooperative Research Unit at Penn State University to assess population characteristics of invasive Flathead catfish in the Susquehanna River along a gradient of establishment levels. The focus of the project will be determining if there are different growth characteristics in different portions of the Susquehanna River where they have been established since the early 2000s and others where they are only now showing up. Other side benefits of the project will be, population modelling to try to determine detection probabilities at different abundance levels and setting baseline population conditions within this river system. This will be the first comprehensive survey focusing on this species in the Susquehanna River since its detection in 2002.

Jason Fellon

Watershed Manager, PA Department of Environmental Protection (PADEP)

Jason Fellon is a Watershed Manager for the PA Department of Environmental Protection (PADEP) and is the project advisor for a stream corridor restoration grant, funded through Growing Greener, with Northcentral Pennsylvania Conservancy (NPC), PA Fish and Boat Commission (PFBC) and various county conservation districts.

Jason and the partners provide landowner outreach, project design and construction for stream restoration projects ranging from 150-4,000 feet in length. The purpose of these projects is to improve the health of the streams in the area. A total of 17 streams in PADEP's Northcentral region are being restored by the partnership in 2016. A survey conducted by PADEP biologists determined the streams are impaired. This means the water quality and the variety of fish and aquatic insects is limited. Much of the impairment comes from eroding stream banks. The variety of aquatic invertebrates in the streams was limited to sediment-tolerant organisms due to the large amounts of erosion that are causing sediments to coat the bottom of the waterways. This smothers the aquatic insects and changes the habitat. For a healthy environment it is important for a stream to have a diverse range of aquatic invertebrates, but the streams in the area primarily have sediment-tolerant species.

To further improve the situation, project partners are also looking at other Best Management Practices that can be implemented – planting trees and shrubs in the riparian buffer, stabilizing stream crossings for livestock and farm equipment, and fencing livestock out of the stream. This project is part of a partnership with the PFBC who helps design the instream aspects of the projects and works with the conservation districts to get the instream structures installed. Eight conservation districts are being serviced in this project which also receives grant funding from the NPC. The amount of work each site requires varies greatly, from small 400-500 feet projects to projects that are 700-800 feet long. This is an ongoing project that has been servicing the local waterways for 7 years.

Several landowners along Limestone Run in Montour County have partnered with PA DEP, PA Fish and Boat, the Montour County Conservation District, and Northcentral Pennsylvania Conservancy to install multilog vanes and mudsills to stabilize the stream banks, eliminate eroding stream banks, and create fish habitat.

HISTORICAL & CULTURAL IMPORTANCE OF THE SUSQUEHANNA RIVER

Introduction

by Brian Mangan

Like the story of the blind men attempting to describe an elephant, perspective means everything when each of us considers the Susquehanna River. Some who live in its flood-plain consider it with fear and recall the stories or scenes of major floods. Others rely on the river for their drinking water and view it as a resource vital to their lives. Still others use the Susquehanna to cool their power plants, and they consider the river their partner in commerce. All of us, however, are blind to some degree about this important resource.

As an ecologist who has studied the Susquehanna River for over three decades, I will be the first to admit that my perspective of the river is far too limited. I perceive it through the lens of science, and I confess to sometimes understanding little more than the gentlemen and their elephant. My training demands that I follow approved steps and methods if I wish to determine something scientific about this ecosystem. If I do things right, and do not become side-tracked by bias or too little information, then I might gain some insight into a relationship between the river and the organisms that call it home. There are many types of scientist looking at this river, each through their own science lens, each with their own perspective and purpose.

In some versions of the story the blind men argue about what they perceive until their disagreement leads to impasse. It is not uncommon for scientists to do the same. Each is passionate about their work and conclusions. And these passions sometimes lead us to demands of priority. In other versions of the story, however, the blind men listen to each other's descriptions of the elephant and reach a point of understanding the whole through collaboration. Sometimes all it takes for this outbreak of consideration is a single catalyst, a wise voice, an ancient idea.

Sid Jamieson and his Haudenosaunee brethren remind us that there were many who visited the river's shores long before us, and they too had perspective. Their knowledge was of a Susquehanna before this age of impairment that we now occupy. And while they were no less reliant on this river than we now are, their perspective, a seminal understanding of connectedness, holds the promise of leading the rest of us who are at times blinded by our perception.

Scientists and others who claim to have the Susquehanna's best interest in mind are at a place in time where we can declare the importance of this resource now and for the future. Many, many voices must become as one if we are to speak effectively for this river. What better catalyst for collaboration than the Haudenosaunee ideal manifest in the "words before all else," words ripe with consideration for all parties, human and otherwise. This ancient ideal with proven meaning for today can guide us into this future, and enable us to dream what the Susquehanna River can again be.

Historical & Cultural Importance of the Susquehanna River

by Sid Jamieson

Before the Europeans came to North America, the Native Americans had been using the entire length of the Susquehanna River primarily for travel, trade, diplomacy, hunting, fishing, and access to the Atlantic Ocean. Post-European arrival, the River took on even more importance for trade and diplomacy.

In 1744, the Iroquois leadership sent a chief via the Susquehanna River to a meeting in Lancaster, PA with the then governors of the new colonies. At that meeting, the chief encouraged the governors to form a union similar to the ancient Iroquois structure of peoples' rights and governance. In 1987, Congress unanimously passed Concurrent Resolution S.76 recognizing the contributions of the Iroquois Nations to the democratic principles of the United States Constitution. One, therefore, might correctly say that the Susquehanna River was a contributor to today's democratic principles.

Sid Jamieson represents an ancient culture of conservation, balance, and the interconnectedness of ALL things. Sid is a retired lacrosse coach for Bucknell University. He is a Native American of the Cayuga Nation of the Iroquois Confederacy. Sid's very close relationship with the Iroquois Nation leadership played an integral part in gaining critical Iroquois support for the eventual designation of the Susquehanna River as a National Historic Water Trail.

These traditional people continue to lead a holistic way of life which is founded upon the ideology of "we are all part of all that is beneath us; all that is around us; and, all that is above us." The opening address of all meetings and ceremonies is known as "the words that come before all else" – reminding everyone gathered of their

responsibilities to honor and respect Mother Earth and the living focus of the universe.

The Haudenosaunee, or "people of the longhouse," commonly referred to as Iroquois or Six Nations, are members of a confederacy of Aboriginal nations known as the Haudenosaunee Confederacy. The Haudenosaunee Nations maintain a unique spiritual, cultural and historic relationship with the land. They consider themselves as being one with the land and stewards thereof. They do not consider themselves to "own" the land.

The Susquehanna River Basin is perhaps the most important waterway in the development of this country. It was the equivalent of today's New York State thruway; the Pennsylvania Turnpike; and Route 95 in Maryland. Eleven trading paths intersected near present-day Sunbury, PA, connecting the East Coast to the center of North America and the Great Lakes. It was a major route for trade and diplomacy among Indian Nations as well as interactions between Iroquois and Euro-American cultures.

Quite clearly, there is a lack of education at many levels regarding this ancient thruway and the natural laws of life as related to the Susquehanna River Basin. Two of the ancient clans are named eel and turtle. Today, it is difficult to find an eel in the upper reaches of the Susquehanna where they were once plentiful. And species of turtles have disappeared as well. And, we no longer find shad where they were once plentiful.

Many of the ancient sites along the River have long since been forgotten, destroyed, or pilfered. Petroglyphs have been shattered, destroyed by construction of dams. Land containing known historically significant archaeological sites has been sold for development and water polluted by industrial use. The destruction of forest and agricultural lands which leads to a host of other very negative impacts on the ecosystem not to mention the lives of humans.

Several years ago, an Onondaga Nation chief sent a letter to Sid informing him that the Susquehanna River was "sick". The River needed Sid's help in doing whatever he could to bring this area's stretch of water back to good health.

Around this time efforts were underway to designate the Susquehanna River a National Historic Water Trail. One critical criteria in a proposal to the National Park Service was to seek the support of the Iroquois Nations. Historically, the Iroquois had a dominate influence along the River.

Sid along with Bucknell University professors Katie Faull and Alf Siewers, made trips into Iroquois territories where they met with top Iroquois leadership and members of the Haudenosaunee Environmental Task Force (HETF) to discuss what the Water Trail designation would lead to. Those meetings eventually led to the HETF chairman writing a wonderful letter supporting the Susquehanna River becoming a National Historic Water Trail. The letter follows:

> *The mission of the HETF is to assist Haudenosaunee Nations in their efforts to conserve, preserve, protect and restore their environmental, natural and cultural resources; to promote the health and survival of the sacred web of life for future generations; to support other Indigenous Nations working on environmental issues; and to fulfill our responsibilities to the natural world as our Creator instructed without jeopardizing peace, sovereignty, or treaty obligations. However, as Indigenous Nations, we realize that all things are interconnected and do not wish to limit our activities to those listed above.*
>
> *The HETF base their relationship or partnership with other organizations on the three principles peace, unity and a good mind, which is the foundation of the Haudenosaunee Confederacy. In doing scientific research in our territories, we interpret these in today's terms as Respect, Equity and Empowerment. Empowerment comes from sharing of knowledge between our two entities. Equity is sharing of resources at an equal level. Respect comes from understanding each other social, political, and spiritual. Communications must work both ways in order to come to consensus.*
>
> *Therefore, HETF supports the proposal for the Susquehanna River National Historic Trail connecting to the Chesapeake Bay Historic Trail. The Haudenosaunee have significant cultural and historical resources in this area. We believe this is an excellent opportunity to discuss the cultural significance of the area, including but not limited to; the protection of burials; repatriation of human remains and funerary objects; customary usage; cultural interpretation on signage and literature; the protection and restoration of the environment.*

Letters of support from the governors of New York, Pennsylvania, and Maryland were also filed. On May 16, 2012, all parties met with the Director of the National Park Service at the confluence of the Susquehanna River and the Chesapeake Bay to officially sign the documents declaring the Susquehanna River as a National Historic Water Trail. It is with significance that the spiritual leader of the Iroquois Nations, Tadadaho Sid Hill, signed the declaration on behalf of all six Iroquois Nations.

As stewards of all that is above us, below us and all that is around us, the people of the Haudenosaunee Nations welcome discussions on behalf of the next seven generations.

UPDATES FROM OUR PARTNERS

WKOK

Mark Lawrence

The Sunbury Broadcasting Corporation's Newsradio 1070 WKOK is a media partner in the SRHCES. WKOK has been working for many years to increase public awareness of the environmental issues facing the Chesapeake Bay, the Susquehanna River and the entire watershed.

During the summer, WKOK airs the radio series, *Boroughs to the Bay and Beyond*, which focuses on the critical issues facing the air, water and land in the Central Susquehanna Valley. To do this, the station partners with the SRHCES and universities to address different topics in interviews. The overall health of the river, wildlife, the Valley's residents and visitors are just some of the topics covered by *Boroughs to the Bay and Beyond*.

WKOK is also a partner with the Sunbury River Festival, and worked to promote this year's theme, 'Reconnectin' with the River.' The festival featured a wide range of educational activities, boat and kayak paddling and related opportunities.

Geisinger Environmental Health Institute (EHI)

Dr. Brian Schwartz/Dione Mercer

The joint Geisinger-Johns Hopkins Bloomberg School of Public Health (JHSPH) Environmental Health Institute (EHI), directed by Dr. Brian Schwartz, is continuing ongoing studies of environmental epidemiology in the region. Several investigators and staff of Geisinger's Department of Epidemiology and Health Services Research work on these studies. They continue to welcome collaborations and student involvement in all of their projects. Most recently they have been working with students Kaitlyn Shultz (Shippensburg) and Dalton Stewart, Shai Gerstle, and Matthew Geiger (Bucknell) on some of the projects that are described below. Additional details about the projects as well as publications, press and presentations can be found on their website at http://www.geisinger.org/research/centers_departments/environmental/.

The EHI continues to be involved in 4 main projects:

1. **Animal feeding operations (AFOs) and links to health**
   After publishing their work on the relation of AFOs to risk of methicillin-resistant *Staphylococcus aureus*, they have received new funding from the Fisher Center Discovery Program at Johns Hopkins University to examine gastrointestinal illnesses and possible links to poultry AFOs in the Geisinger region. They are working with Dr. Deborah Sills from Bucknell to obtain updated nutrient management plans for swine, dairy/veal, and poultry operations, the last of which will be the focus of their analysis.

2. **Unconventional natural gas development (UNGD aka "fracking")**
   This work, funded by the National Institute of Environmental Health Sciences (NIEHS),has led to several recent publications on relations of UNGD to adverse pregnancy outcomes and asthma, and another one that will appear soon on nasal and sinus, migraine headache, and fatigue symptoms. The asthma study is part of the thesis research of Sara Rasmussen, a PhD candidate in environmental health sciences at the JHSPH. They found an association of asthma exacerbations in proximity to natural gas development. This work was recently published in *JAMA Internal Medicine*. Additionally, the EHI is in the middle of the funding period for the Marcellus Impact Pilot program grants that were awarded last year. These grants were given to support pilot projects at 5 local universities as well as 1 project at Geisinger.

3. **Childhood obesity (NIH-funded)**
   They continue their work with childhood obesity and the built environment. They have found associations between antibiotic use and childhood weight gain as well as prenatal antibiotic use and early childhood weight gain. Their findings on childhood weight gain were recently published in the *International Journal of Obesity* and the findings in the prenatal and early life cohort have been submitted for consideration. They are currently conducting analysis of allergies and antibiotic use and this work has been submitted to a journal for consideration.

4. **Chronic rhinosinusitis (CRS; NIH-funded)**
   They are approaching their fourth year of work examining CRS and its relation to community factors and environmental factors. They have completed longitudinal surveys of over 7,000 participants in the Geisinger service area to assess sinus and nasal symptoms over time. They are now using the survey data coupled with over 600 participants' computed tomography (CT) scans of the sinuses to better understand this disease. A paper was published in the journal *Allergy* which examined the incidence of disease as found in the electronic medical records at Geisinger.

This report was developed with input and support from the members of the
Susquehanna River Heartland Coalition for Environmental Studies,
H. W. “Skip” Wieder, Christian Swartzbaugh and Bridget Kane.

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

SRHCES

***Susquehanna River Heartland Coalition
for Environmental Studies***

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