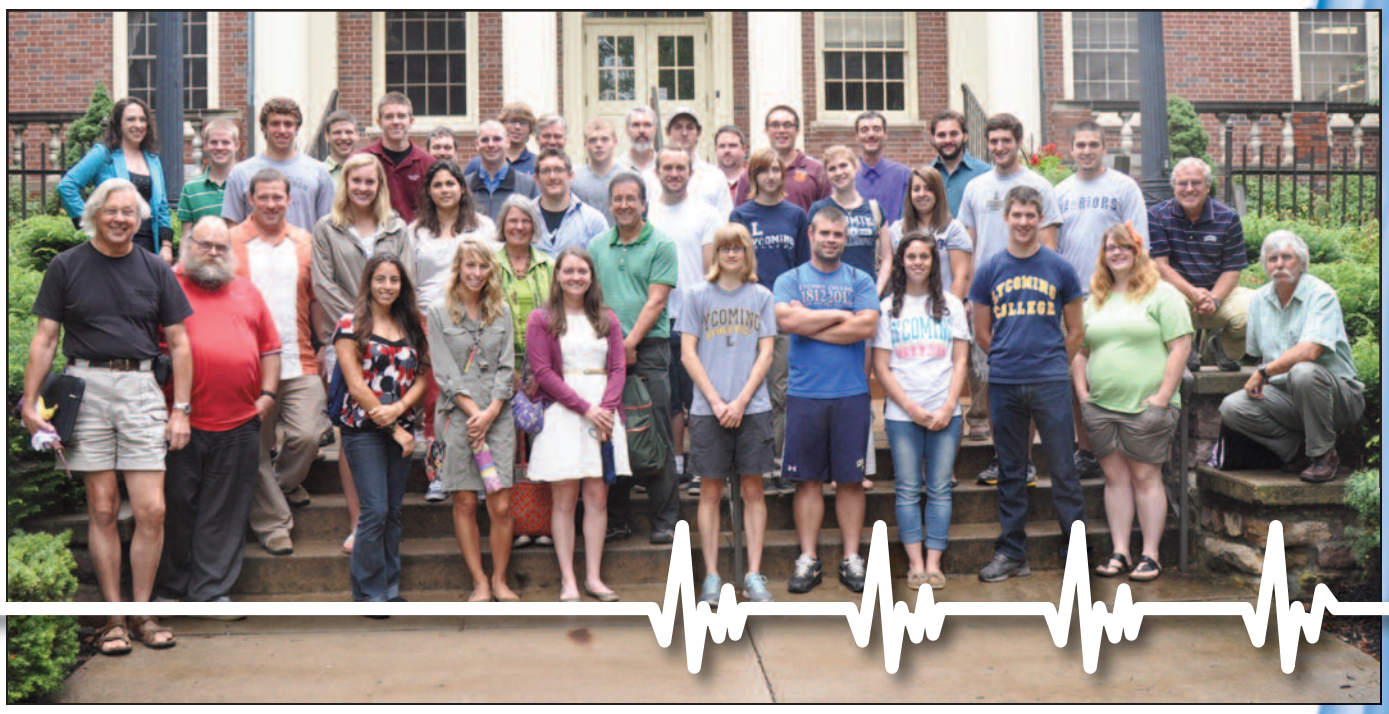
2012

Pulse of the Heartland Annual Report



Presented by the

SRHCES

Susquehanna River Heartland Coalition for Environmental Studies

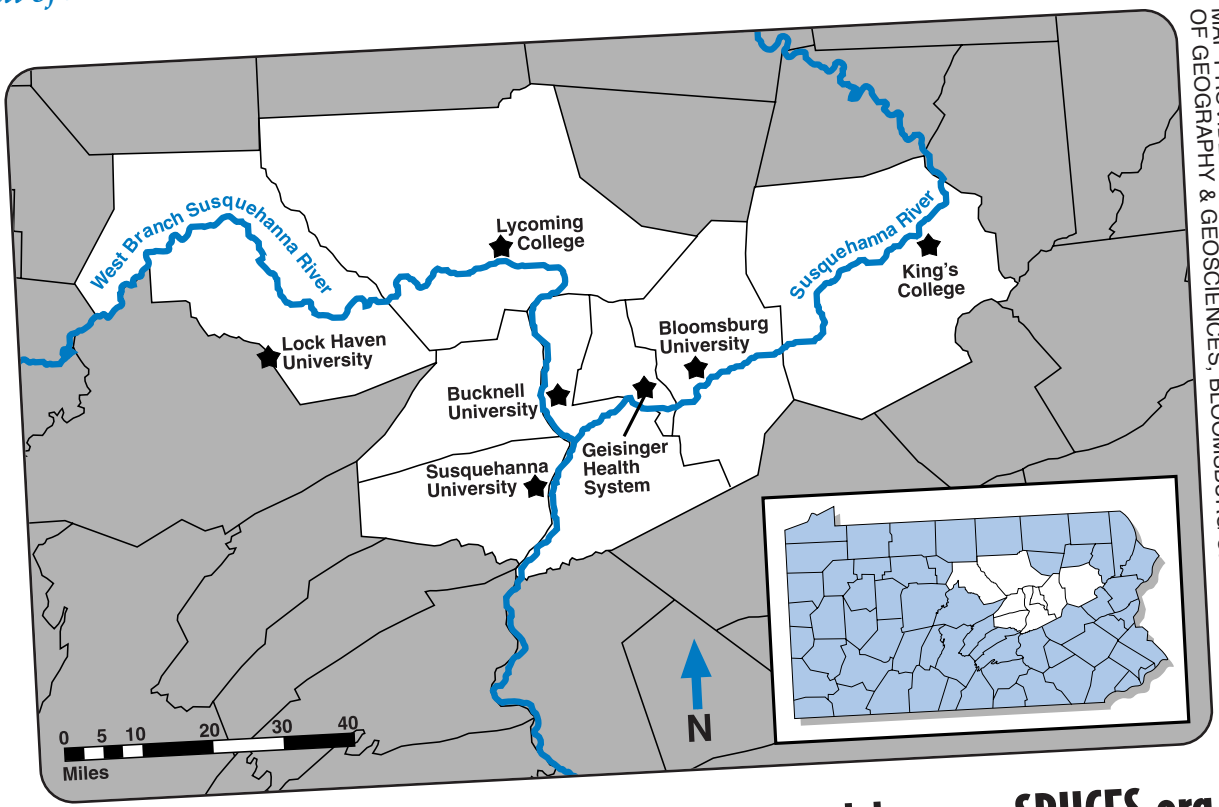
Susquehanna River Heartland Coalition for Environmental Studies

The Susquehanna River, and the watershed it encompasses, are arguably this region's most important assets in defining the quality of life for all who live, work and play within its boundaries. Because the Susquehanna River 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, Trout Unlimited, 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 and staff's impressive talents are engaged to address environmental issues within the watershed.

Additional promotion and support for this effort have come from sponsors such as WVIA (Northeastern Pennsylvania's public broadcasting station), Sunbury Broadcasting Co., The Daily Item, the Foundation for Pennsylvania Watersheds and the Degenstein Foundation.

Included in this report, you will find summaries of the projects and activities within the various fields in which SRHCES has become involved. Additionally, you will find updates on our partner the Nature and Human Communities Initiative, the efforts of Sunbury Broadcasting, and information regarding the historic flooding the region experienced in the Fall of 2011.



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

For more information about SRHCES, please visit www.SRHCES.org.

Monitoring the Susquehanna

Dr. Md. Khalequzzaman

Lock Haven University of Pennsylvania

Dr. Md. Khalequzzaman (Dr. K), professor of geology at Lock Haven University, is continuing his work on assessing water quality with the Pennsylvania Senior Environmental Corps, this summer with the Clearfield chapter. Along with members from PASEC and three student interns, Dr. K is monitoring this area much like his Beech Creek watershed studies in the past. He is looking at a surface water reservoir in Dubois that provides water for 17,000 people to determine if there are any acid mine drainage and Marcellus shale drilling impacts. Dr. K is testing for barium, chloride, waste water discharge, methane gas, and other metals related to AMD when testing water samples. He is focusing mainly on Marcellus areas to see if there are connections between flow back water discharge problems and methane bubbling through wetlands as a consequence of fracking.

Continuing his Beech Creek study this summer, Dr. K looks for problems in the water due to acid mine drainage and Marcellus shale. His monitoring sites found an issue last summer in Council Run, where their data collection indicated an issue with the AMD treatment. During a road construction project, materials were dredged from the river bed, impacting the stream's ability to adjust pH. This monitoring brought up the issue, which caused the construction crews to repair the road and the problem is now going away. He continues to collect data once a month, sometimes finding an elevated level of barium and sodium in the water. Expanding the study, Dr. K is looking more at the chemical and physical degradation of the water.

Dr. K is also continuing his Hall Run watershed work with their water supply and filtration plant, monitoring AMD and Marcellus activities there. While most activities (i.e. seismic tests) have slowed down in Clinton County, Dr. K is now looking at a tributary that goes into the water supply. He looks to hopefully compare and contrast his data (along with his Beech Creek and Clearfield studies) with another group's work in the future to supplement what he is working on.

The Susquehanna River Heartland Coalition for Environmental Studies (SRHCES) is a unique collaboration of professors and students working together to:

- Research and study the ecological conditions and processes in the watershed of the Susquehanna River and the West Branch Susquehanna.
- Create educational opportunities to promote student interest and involvement in the natural resources of the Susquehanna River watershed.
- Create a partnership that connects post secondary students attending institutions in the Susquehanna heartland region with local communities and environmental organizations.

The focus of the majority of the coalition members is to gather data to assess various parameters of the Susquehanna River. This section of the Pulse provides summaries on a variety of research that SRHCES members are conducting. This is by no means a full description of the projects, research, and activities the members have undertaken. Visit the SRHCES website for more information about the group and its efforts, www.srhces.org.

Dr. K (right) conducts water testing

Two of Dr. Zimmerman's interns examine a trout with John Wright

Dr. Mel Zimmerman

Lycoming College

Dr. Zimmerman, biology professor and director of the Clean Water Institute at Lycoming College, is currently involved in three projects. The first is his ongoing work with the Pennsylvania Fish and Boat Commission, on the Unassessed Waters Initiative. This year, the project has gained funding from the National Fish and Wildlife Foundation, a national nonprofit foundation chartered by Congress, who sent representative John Wright along on their orientation. Additional funding has come from local watershed groups like Pine Creek Preservation and Pine Creek Headwaters Protection. This state-wide initiative involves several colleges and universities including three SRHCES (Lycoming, Susquehanna University and Kings College). Zimmerman spends his summer sampling previously unassessed streams to document the presence of trout populations. Depending on population size, these data can be used to provide special protection to these streams. In 2011, Zimmerman and his team of 9 interns completed 98 stream assessments in the Pine Creek Watershed and to date in 2012 they have completed over 60 in Pine and Lycoming Creek Watersheds.

Zimmerman's second project involves river monitoring. He and his interns placed rock baskets in Danville and Watsontown, then allowing them to incubate for six weeks. After this period, they collect the baskets and identify and count the macroinvertebrates. These data are used as part of an ongoing study of water quality of the lower West Branch and North Branch of the Susquehanna River.

Dr. Zimmerman also collects basic water quality data on a monthly basis, including conductivity, nitrogen and phosphorus, and total dissolved solids. They also collect samples of periphyton algae and send them to Dr. Jack Holt (Susquehanna University) for analysis.

He also continues to work on monitoring the effects of application of best management practices (BMPs). With the cooperation of the Lycoming County Conservation District, currently, four farms in the White Deer Hole Creek Watershed are involved. This long-term project involves collecting baseline water quality (including concentration/loads of sediment, phosphorus, and nitrogen) and follow changes as BMP's are completed. Dr. Zimmerman and his team also look at fish and macroinvertebrate populations above and below each farm. The ultimate goal of the project is to demonstrate how BMPs can improve and sustain local water quality.

Dr. Zimmerman is also looking at the long-term effects of flooding on two tributaries of Loyalsock Creek (Big Bear and Ogdonia creeks). Dr Zimmerman and his students have been monitoring these streams for over 10 years and the devastating flood of September 2011 had a drastic effect on these watersheds. His work is focusing on the recovery of fish and macroinvertebrate populations in these streams.

Dr. Peter Petokas

Lycoming College

As a research associate for the Clean Water Institute at Lycoming College, Dr. Petokas has started a new project this summer that intermingles with his long-term hellbender research. Petokas is working with Michelle Herman, a senior at Lycoming, on her

Seining for crayfish in Roaring Branch. Lycoming College interns Chelsea Taylor, Clark Thompson, Chelsea Brewer, and Michelle Herman. Stream restoration structures are visible in background.

biology honors thesis, a study of crayfish in the West Branch watershed. This research complements the hellbender and stream ecology work Petokas has been involved in, as well as provides insight into the ecology of the eastern hellbender with respect to its food preferences, since hellbenders subsist almost entirely on crayfish. The study also looks to provide a perspective on native crayfish and their interactions with hellbenders, since crayfish are not extensively studied or researched.

As Dr. Petokas enters his seventh year of hellbender work, the crayfish study looks to expand upon knowledge of both animals. He and Herman have been catching approximately 150 crayfish to observe every day in the field. Herman then measures the 10 largest males and females five ways and removes their tails to obtain tissue samples. Already she has discovered disparate numbers of males and females; some sites have yielded twice as many males as females, with the opposite occurring in other sites. Petokas and Herman are looking at rusty crayfish, especially, hoping to find out how far the invasive species has made it into hellbender watersheds. Petokas has found that the Loyalsock Creek is almost 100 percent rusty crayfish. He is also looking to find the rusty crayfish's effect on the native crayfish and whether they are eliminating their presence. Dr. Brian Mangan has been studying crayfish in the northern branch of the Susquehanna, finding that the rusty crayfish had made its way all the way up the river. He also found that this species had high levels of mercury in them, especially those found upriver. Dr. Petokas is hoping his research will possibly shed some light on the health problems and rapid decline of hellbender populations; perhaps the mercury in the rusty crayfish has affected the levels of mercury in hellbenders.

In 2010, Dr. Petokas and his students completed a plant and animal inventory for Camp Victory, a summer camp for children with chronic illnesses. Fully equipped to care for children with many medical needs, Petokas looked to create a nature center there. Two years after completing the inventory, Camp Victory has now completed construction of the nature center. The building is facility ready for fun, educational nature experiences. The plan is to have college interns work as environmental educators in the new nature center each summer.

Dr. Petokas and his students provide education and outreach to local schools, environmental groups, and the general public. If you would like to report a Hellbender sighting, request information on the Eastern Hellbender or vernal pool ecology, or schedule a presentation for a group, Dr. Petokas can be reached via email at petokas@lycoming.edu.

A hellgrammite collected during one of Dr. Mangan's studies.

Dr. Brian Mangan

King's College

Dr. Brian Mangan, professor of environmental science and biology at King's College, is working on several projects this summer. To begin with, he is analyzing long-term data sets of the river, looking at temperature and flow. The data spans back from the early 1970s to present day on the north branch of the Susquehanna. He is concentrating on an increasing trend in water temperature to see during what periods heating is occurring most. He is also looking to account for variation of flow over the years.

Dr. Mangan continues his mercury contamination studies with crayfish and insects. This year, one student is helping him study terrestrial deerflies to see how mercury is moving through the food chain. In order to capture these flies, the student rides a bicycle in a blue shirt (deerflies are attracted to the color blue), raising a net over his head to catch the flies within a certain route for a certain period of time. They then analyze the samples for mercury, attempting to see how far terrestrially the mercury is moving out of the water. He is also looking at spiders and their prey for mercury levels.

Along with three student interns, Dr. Mangan is helping with the Unassessed Waters Initiative as part of King's College. He is focusing mainly on the Upper Lehigh watershed.

Dr. Cynthia Venn
Dr. Christopher Hallen
Dr. Jennifer Whisner
Bloomsburg University

Dr. Cynthia Venn, associate professor in the Department of Environmental, Geographical, and Geological Sciences and Dr. Christopher Hallen, professor in the Department of Chemistry and Biochemistry at Bloomsburg University, continue to collaborate on their summer water quality research projects. They are reoccupying their sampling transects sites at Milton, Watsontown, Shady Nook, and Danville. Their water chemistry work is in support of Dr. Jack Holt and Dr. Mel Zimmerman's biology and invertebrate work. In addition, along with Dr. Jennifer Whisner, assistant professor in the same department as Dr. Venn, they are hoping to pinpoint the source of lead occasionally found in the water samples taken near the Sunbury side of the Susquehanna opposite the Shady Nook boat launch in Shamokin Dam. Dr. Whisner will sample the soil and groundwater in the area and analyze the samples for heavy metals. Drs. Venn and Hallen have found high levels of lead, manganese, and copper during low river discharge at the Shady Nook sites, especially near Byer's Island near Shamokin Dam. The lead may be leaching out into the river from natural lead ore deposits as suggested by documents describing lead mining in the 1840s-50s in that area. Lead concentrations may be diluted during higher river levels and therefore not obvious at that time.

Dr. Venn and Dr. Hallen are also monitoring Catawissa Creek (along with several other creeks) for the effects of abandoned mine drainage from the Oneida #3 mine drainage system, which flows into Tomhicken Creek, a tributary of Catawissa Creek. They have also found high levels of aluminum, very low pH, and low alkalinity in Little Tomhicken Creek, in the headwaters of the Catawissa Creek watershed.

They are also continuing their efforts to characterize water chemistry in the Briar Creek watershed, collecting and analyzing biweekly samples from ten sites on behalf of the Briar Creek Association for Watershed Solutions. Drs. Venn and Hallen are also looking at pristine lakes, such as Crystal Lake, in Lycoming/Sullivan County, PA, near areas with active Marcellus shale drilling to establish baseline chemistry data. Data collected from the sites visited by the Venn/Hallen team include pH, conductivity, dissolved oxygen levels, temperature, and turbidity. Preserving both unfiltered as well as filtered samples, the professors use and inductively coupled plasma optical emission spectrometer to analyze samples for the presence of arsenic, aluminum, barium, strontium, cadmium, copper, lead, nickel, zinc, chromium, manganese, and iron. Using intense heat, the instrument will excite every metal in the sample, allowing for easy data gathering and more time for data analysis. Concentrations of anions and simple cations are determined by ion chromatography. These data are being gathered by student interns in order to be presented at a poster session in August associated with Geisinger Medical Center and the Susquehanna Valley Field School.

Another important goal of this summer's work is to georeference current and previous sampling locations and assemble all analyses into a single spreadsheet that will be made available to other researchers through the Heartland Coalition. Recent Bloomsburg University graduate Caitlin Heller is overseeing this part of the project, as well as the day-to-day operation of the lab.

Rier interns Steve Baade and Meredith Salmon viewing stream results.

Dr. Steve Rier
Bloomsburg University

Dr. Steven Rier, associate professor of biology and ecology at Bloomsburg University, is working on two projects this summer along with his three interns, Steve Baade, Kyle Halat and Meredith Salmon. His main focus this summer is on stream cleaning, in association with Dr. Jon Niles. Dr. Rier's lab is focusing on the bottom of the food chain including algae, bacteria and nutrients in streams that have been "cleaned" since the flooding last fall.

Stream "cleaning" efforts could have a detrimental effect on the stream and its habitats, including the potential for microbial communities living on the stream-bed to take up phosphorus and nitrogen. Rier and his interns are looking at nutrient retention in stream reaches to determine if there could be potential impacts on trout fisheries and whether cleaned reaches "leak" more nitrogen to down-stream receiving waters like Chesapeake Bay. The goal of this study is to hopefully address economic questions surrounding stream "cleaning," and whether there are economic tradeoffs associated with bulldozing, straightening, and dredging streams after flooding.

Rier's second project involves phosphorus. Microorganisms such as algae and bacteria have the potential to store phosphorus that gets flushed into streams during storm runoff events. Dr. Rier and his team are hoping learn the significance of these brief phosphorus pulses to overall phosphorus dynamics in streams. Because excess phosphorus from fertilizers, sewage and detergents can harm aquatic ecosystems, understanding how microorganisms respond to phosphorus pulses might help us to better regulate this form of pollution.

Engineering student Kayla Yee mapping the bathymetry of the West Branch of the Susuquehanna as part of Dr. Benjamin Hayes' studies.

Dr. Benjamin Hayes

Bucknell University

Dr. Benjamin Hayes, director of the Susquehanna River Intiative at Bucknell University, is working with senior civil and environmental engineering student Kayla Yee this summer. Along with Professor Jessica Newman, they are mapping the physical habitat of the West Branch of the Susquehanna from Muncy to Lewisburg. Hayes is fascinated by the natural history of the Susquehanna, one of the oldest rivers in the world. He and Yee are looking at fingerprints from glacial processes over the past 900,000 years, including multiple ice ages. Kayla is mapping the bathymetry of the West Branch, coupling data from Lidar data sets of the adjacent floodplain and valley floor areas to create an accurate numerical model of the hydraulics of the flood flows. This information is critical to help with the understanding of sediment erosion, transport, and deposition. They are mapping bedrock outcrops in the channel, looking to see how the islands formed. They cover 2.5 miles a day, looking at large bed forms (pools, riffles, midchannel bars, etc.) to learn how they formed, when they formed, and to draw connections between physical habitats and ecological conditions.

Dr. Matthew McTammany

Bucknell University

Dr. Matthew McTammany, professor of biology and environmental studies at Bucknell University for the past nine years, is continuing to study macroinvertebrates in microhabitats. He and his students sample the Susquehanna for benthic invertebrates, looking at non-riffle habitats in order to get a complete picture of the biodiversity of the river. They also conduct studies within riffles to see the variability and microdistribution of benthic invertebrate communities.

This summer, he started a more specific study involving one species and it effects on the Susquehanna River ecosystem. Black fly spraying is a Pennsylvania Department of Environmental Protection (PA DEP) program done every two weeks during warm months (due to the rapid life cycles of the flies in the summer). Bacillus thurigenensis israelensis (Bti), a bacterium commonly used as an insecticide, is sprayed on the river specifically to kill black fly larvae by binding in their guts and killing them. Black flies, along with many caddisflies and mussels, are filter feeders, feeding on organic material as it is transported by the water current. Dr. McTammany is looking to determine if there are any consequences of this spraying program, as the elimination of a filter feeder can affect the food web of the Susquehanna.

As a separate project, Dr. McTammany and his students are using information from the PA DEP, Susquehanna River Basin Commission,

Dr. McTammany, along with interns Matt and Ashley, during their study of microinvertebrates in microhabitats

New York State Department of Environmental Conservation, and U.S. Geological Survey, to finish a comparative study of benthic invertebrate data collected by these agencies from 1990-2010. They have been analyzing spatial and temporal patterns of invertebrates, trying to put a broad picture together of biological conditions of the Susquehanna that includes some factors controlled by humans. They are also working on a manuscript to submit as a summary of their analysis of the data. Analysis of these data prompted the black fly spraying study.

With the help of Sean Reese, McTammany and Bucknell University continue to run real-time water quality stations in Milton and Danville. These stations were established in July of 2009, collecting 96 observations per day from each station.

Sean Reese

Bucknell University

Sean Reese, a river scientist for Bucknell University's environmental center, began a project with the U.S. Fish and Wildlife Service in conjunction with the U.S. Geological Survey involving a mussel survey in Buffalo Creek of Union County. This summer was the first year for Reese's project. He enlisted help from Bucknell student Mike Huffner and students assisting Dr. McTammany and Dr. Hayes over the summer (also of Bucknell University) to help gather data.

Mussels used to be able to migrate from the Chesapeake Bay to the headwaters of the Susquehanna by attaching their larva to migratory fish. Certain species of mussels attach more easily to certain species of fish, depending on their life cycle. Acting like a giant filter, mussels remove detritus and sediment from the river and Bay, improving water quality. Elliptio complanata, a mussel that used to be common to the Susquehanna River and Buffalo Creek, uses the American eel to migrate. The American eel was reintroduced into the Buffalo Creek area two years ago, and Reese wanted to examine their impact on the mussel population in the area.

Setting up a series of sites upstream and downstream of the reintroduction site, Reese checks to see how far the eels have migrated. He hoped to find mussel repopulation as well, recording species richness, abundance, and spacial distribution to make conclusions about whether the population is beginning to recover or pick up.

Bucknell student Mike Huffner assists in the mussel survey project involving river scientist Sean Reese and the U.S. Fish and Wildlife Service.

Dr. Jack Holt

Susquehanna University

Dr. Jack Holt, a professor at Susquehanna University, continues to work with algae on several interrelated projects. For the fourth summer, he is working with a monitoring system with transects in various locations on the River. Dr. Holt is mainly responsible for transects in the Shady Nook, or Byers Island area. Dr. Mel Zimmerman is assisting in the lower West Branch, doing field work and giving Dr. Holt the actual slide samples to analyze. From these samples, Dr. Holt is looking for periphyton, or algae that grow attached to rocks and plankton, which grow free-floating in the water. They are also looking at benthic invertebrates (mostly insects) at the Byers Island transects.

By looking at the gathered slides under an electron microscope or scraping them to extract DNA, Dr. Holt has amassed enough data to attempt to make

statements about how the river might be changing and how it might respond to aspects of weather and climate. He is also looking to compare the diversity of the algae collected through the DNA data. So far, he has collected over 90 species of algae, just in plankton.

Dr. Ahmed Lachalab

Susquehanna University

Dr. Ahmed Lachhab, assistant professor of earth and environmental sciences at Susquehanna University, began a project at the Walker Lake impoundment of Middle Creek. Using bathymetry data, Lachhab is analyzing the accumulation of sediment in the lake since it was built in 1971. Since sediment accumulations have been ongoing since the '70s, it is important to know the sediment load in the ground, not in the water. Dr. Lachhab uses Ground Penetrating Radar (GPR) with multiple frequency antennas to perform surveys to detect the accumulation in the entire Walker Lake reservoir. After retrieving this data, Lacchab and his three interns will generate a 3D model showing the accumulation of the entire lake, perhaps projecting into the future concerning how long it will take to have a certain amount of accumulation in the water.

Using the same procedure, Dr. Lachhab is also studying Lake Augusta. Here, sediment accumulation is the largest near Shamokin Dam. He and his students are looking to know the bathymetry of the north and west branch of the impoundment of this lake, as well as the lake itself. They are also monitoring the water for basic water chemistry data.

Continuing his work on 11 sites on Middle Creek, Lachhab is collaborating with several environmental engineers at Bucknell University to help with the chemistry of the samples. In an effort to be aggressive with this project, Lachhab is using the water quality index (WQI) and biological indexes (along with Jack Holt) to assess water quality in this stream in order to complement biological data.

Dr. Carlos Iudica

Susquehanna University

Dr. Carlos Iudica, an associate professor of the Biology Department at Susquehanna University, continues to work on several long-term projects related to vertebrates affected by the Susquehanna River in Pennsylvania along with his interns. By the end of this summer, Dr. Iudica will have a scientific paper published in a peer-reviewed journal about an owl eating a bat in Pennsylvania. For the first time in Pennsylvania, an incident of an owl eating a bat has officially and properly been documented.

Dr. Iudica's book entitled ***The Bats of Pennsylvania*** will go to print during fall of 2012. The book looks at the 11 species of bats native from PA and explains their relationship to the River. He also mentions the disease "white nose syndrome," (a fungal infection that kills bats in large numbers while they hibernate). He is also co-authoring a book chapter on ecology and conservation of bats in the area.

He is continuing to look at minks, measuring the concentration of mercury in different tissues in their body. After a few years, this project has culminated in a vast amount of data. Dr. Iucida plans to publish a paper on this project as well. Once his database on minks, foxes and coyote is completed, Dr. Iudica plans to create a comparison study between the differently-sized carnivores in Pennsylvania that he has studied – minks, foxes and coyotes – according to size and field ecology.

In addition, he continues to collect data for his paleoecological study of cave sediments, looking at the layers of soil that accumulate over time to figure out what species have inhabited the caves and to reconstruct previous vertebrate assemblages.

Dr. Jonathon Niles

Susquehanna University

Dr. Jon Niles, a professor at Susquehanna University, is continuing his work with the Pennsylvania Fish and Boat Commission on the Unassessed Waters project. Along with student interns Andy Anthony, John Panas and Sam Silknetter, Dr. Niles plans to evaluate 60 streams this summer.

Interspersed with the Unassessed Waters data collection, Niles is using the same standard procedure to study 30 streams for data concerning the flooding in the fall of 2011. Dr. Niles and his students electroshock the trout, collect them in buckets, and measure them. They also collect algae samples (although hard to find this summer) and macroinvertebrates in the same streams. After three passes of 100 meters of stream, the five largest trout are examined for their diet, which

is regurgitated and collected in vials. Through standard collection of trout, algae, benthic macroinvertebrates, and basic water quality data (pH, conductivity, etc.), Niles has interspersed the Unassessed Waters work with a more specific look at flooding impacts. His most significant findings to date were the absence of trout in the 3-6 inch range.

Geoff Smith

Pennsylvania Fish & Boat Commission

Geoffrey Smith, a Susquehanna River state biologist for the Pennsylvania Fish and Boat Commission (PFBC), has been working with smallmouth bass since 2005. Smith, along with other members of PFBC and Dr. Vicki Blazer, a U.S. Geological Survey researcher, have been looking for the cause of repeated fish kills in recent years and their connection to the disease affecting young-of-year smallmouth bass and the black spots found on many adult smallmouth bass in the river.

Smallmouth bass

Smith and the PFBC are looking to the DEP and state government to support their case for the Susquehanna being added to the impairment list as "high priority," or a list of streams regulated by the federal Environmental Protection Agency. With this listing, the Susquehanna would receive more funding and attention, making it possible for Smith and Blazer to continue to look at different variables affecting the sick smallmouth bass.

The Susquehanna River smallmouth bass populations, and especially the young-of-year smallmouth bass, have been found to be among the worst in Pennsylvania. The adult fish are being found with black spots on them, called "blotchy bass," and the young-of-year males are exhibiting signs of intersex, meaning they are producing eggs. Various causes have been studied, but a definite cause has yet to be singled out. Smith indicated it could be a combination of things, including hormonal issues, the presence of "columnaris" bacteria in the air and water, compounds in the water complicating endocrine function, or variables yet undiscovered.

Mike Bilger

Susquehanna University

Mike Bilger, a Research Scholar at Susquehanna University and senior aquatic biologist for EcoAnanlysts, Inc. in Selinsgrove, supports the rest of the River Group biologists with their projects. Joining the group in 2005 originally as a biologist with the U.S. Geological Survey, Bilger has worked with Jack Holt, Jon Niles, Carlos Iudica, as well as others, jumping around to help out where he is needed.

Some projects he has assisted with include one of Jack Holt's, where he and two of his Susquehanna students placed rock baskets, Hester-Dendy samplers, and diatometers at Shady Nook sites to conduct water quality monitoring. He also co-authored a report with Holt on algae, macroinvertebrates, and water quality with the Lower Penns Creek Watershed Association, which was published. Bilger also teaches an Ecology Day on Penns Creek at New Berlin assisted by other river group members. He has worked with John Niles on tributaries to Penns Creek and Matt McTammany on the mainstem Susquehanna and Juniata macroinvertebrate communities the results ending up being presented by their students at the Society of Freshwater Scientists' annual meeting in Louisville, KY. He has also assisted Steve Rier, Brian Mangan, and Peter Petokas in other related water quality projects.

Bilger is considered an aquatic macroinvertebrate expert. He also does fish community work funded by the Snyder County Conservation District on the West Mahantango Creek, identifying bugs, fish, algae, and testing water quality.

Mike Bilger considers it a unique opportunity to work with SRHCES, whose goal of funding undergraduate programs at six universities provides for student involvement in all related projects.

Mike Bilger teaching Ecology Day at New Berlin on Penns Creek 2011.

The Susquehanna Colloquium

Dr. Alf Siewers

Bucknell University

Dr. Alf Siewers, associate professor of English at Bucknell University, has worked on several projects alongside fellow University humanities professors Katie Faull and Brandn Green. The most important news, as a result of the work of Siewers, Faull, Green and the Susquehanna River Heartland Coalition for Environmental Studies have helped the Susquehanna River officially gained national designation as a connector trail to the Captain John Smith Chesapeake National Historic Trail. This designation, made possible with support from the Haudenosaunee (Iroquois) Confederacy, was announced by the National Park Service on May 6, 2012. In attendance at the ceremony was Sid Jamieson, the liaison between the Iroquois Nations and Bucknell University. This designation took five years to achieve with the help of undergraduate interns.

A new group is now being formed in Harrisburg to discuss a vision for the John Smith Trail, now that the Susquehanna River is designated. Drs. Siewers and Faull represent the delegation from the Heartland Coalition, with support from Skip Weider. This group is focused on the humanities, looking to maintain cultural heritage and historic landscape.

Dr. Siewers is also co-editor of The Stories of the Susquehanna, along with Dr. Faull. This series of peer-reviewed books highlights stories of the region's environment in cooperation with the Bucknell University Press. The first volume, entitled "On Native Americans and the Susquehanna Valley," by emeritus professor of anthropology at Bloomsburg University David Minderhout, will be released by the end of the year.

Alf continues to convene the Susquehanna Colloquium on Nature on Human communities, the branch of SRHCES that focuses on humanities and the social science aspects of the environment. The group is led with the help of Brandn Green. Projects for the group include Bloomsburg University's Jerry Wemple's ***Watershed: The Journal of the Susquehanna***, an interdisciplinary journal focusing on the spirit of the region.

Four student interns are helping the humanities team at Bucknell this summer. Two students assisted with a project involving the historic and cultural mapping of the Susquehanna River between Sunbury and Harrisburg. One student is mapping the land holdings of Joseph Priestley, the Northumberland native who discovered oxygen. The final student is researching and mapping the locations of Susan Fenimore Cooper's writing.

Dr. Katie Faull

Bucknell University

Dr. Katie Faull, professor of German and humanities at Bucknell University, was part of the team responsible for achieving the Susquehanna's designation as part of the Captain John Smith Chesapeake National Historic Trail. She is also co-editor of ***Stories of the Susquehanna*** and a member of the Susquehanna Colloquium.

Dr. Faull is also assisting the two students creating the cultural mapping of the Main Branch from Sunbury to Harrisburg, which will soon be available for public viewing on Bucknell's website. She is also working on mapping a historical representation of the North Branch of the Susquehanna River based on the 18th century from Sugar Run to Wilkes-Barre.

Dr. Faull is co-teaching a course called ***Susquehanna Country*** with Dr. Siewers this fall. The 200-level course will combine English and environmental studies, taking parts of classes both professors have taught before and putting them together. Focusing on the 1700s and early 1800s, the class will look at the literary and cultural history of the Valley and the River during the transition from a dominant Native American culture to the European cultures that are dominant now. Last fall Dr. Faull also taught a course on the Susquehanna, where students worked on mapping the River's cultural heritage.

This summer, Dr. Faull continued translating the diaries of early European inhabitants of the river and their interactions with Native Americans. She also developed a kayaking tour of the North Branch associated with the John Smith designation, focusing on eighteenth-century relations between Moravian Christians and Native American communities.

Brandn Green

Bucknell University

Brandn Green, professor in Bucknell's Environmental Department, is the director of the Nature and Human Communities Initiative, a group interested in applied social science research occurring within the region. The group focuses on the human-nature interaction among all cultures and organizations surrounding the environment in the watershed, partnering with community organizations to do research in the environmental humanities.

Green is also associated with the Rivertowns Iniative, a group seeking written material from citizens and cultures in the area about the River. The group hosts symposiums, field trips, speakers, and uses student and scholar research to bring together towns in the central Susquehanna region.

This summer, Green developed, with Ben Marsh and Carl Lochte, a housing survey for students to use that towns throughout the region can now use to see what housing is currently available in the area in order to apply for funding. He is also working with the Urban Institute in Washington, D.C. and local United Way organizations on Community Platform, a database of nonprofit organizations which will develop a 211 non-emergency call system in order to get a feel of the nonprofit texture in the region.

A view of the mouth of the Loyalsock creek where it meets with the Susquehanna river.

Flooding and the Susquehanna

As ten inches of rain fell in eighteen hours, horror stories could be heard up and down the East Coast, especially in Vermont, New York, and Pennsylvania. The storm continued to move. Property was damaged as the rain reached Louisiana, Mississippi, Florida, and Alabama. This swift accumulation of water was one for the record books, as it took down bridges on New York State roads, Pennsylvania highways, and smaller roads everywhere in between. Mountain streams picked up massive amounts of water, a force that pummelled buildings of all sizes and purposes. Roads collapsed. People were stranded, life-flighted, lost power, and even lost loved ones.

Tropical storm: also known as a hurricane, typhoon, (tropical) cyclone; characterized by low-pressure systems, heavy rain, thunderstorms, strong winds

Tropical Storm Lee rocked watersheds from Vermont to the Chesapeake from September 1 through September 5 of 2011, with Hurricane Irene preceding it at the tail end of August. Although only a third of the size of Agnes, the destruction left behind for clean-up will still be memorable for decades. Compared to Agnes' 30 million tons of sediment, the 4 million tons of sediment left in Lee's wake seems insignificant. Although sediment-wise this storm seems to rank low in history, the rain and water flow during the storm itself are what made it so exceptional. Lee ranks as one of the highest examples of river flow in the history of the lower Susquehanna.

Sediment: loose particles of clay, mud, silt, dust, etc. that can be stirred up from a powerful water velocity during a storm; can cause steambed movement, habitat issues, floodplain skewing

Flooding is a natural disaster characterized simply as a large overland flow of water. For the Susquehanna River community, however, this means river flooding – water breaking over bends and banks when the water becomes higher than the channel itself. With the submergence of land and the power of water, floods can permanently alter a river's course, wreck homes, destroy roads and disturb the natural habitat of certain species living near the floodplain. The flooding around the Susquehanna is usually caused by a tropical storm, or a storm involving a cyclone or hurricane (although this effect often does not reach Pennsylvania, when tropical storms are just referred to as hurricanes) with thunder and lightning, strong winds, and a lot of rain.

Aftermath of Lee in Barbours, Lycoming County

Slabtown Bridge in Lycoming County after Lee

Some theorize that recent flood events are a consequence of global climate change. Although this may not explain all flooding, an increase over time in the amount of flooding and severe storms may lead many to point fingers at global warming. Post-Irene, Vermont government officials have advocated looking into this issue, with the possibility of federal relief money given towards their efforts in order to protect susceptible communities.

The most disastrous floods involving the Susquehanna and its tributaries were Tropical Storm Agnes (1972) and a sudden snow melt-off in 1996. In the fall of 2011, the east coast experienced the effects of Tropical Storm Lee. Both of the previous floods were destructive and devastating, but neither matched the seeming desire of Tropical Storm Lee to destroy anything in its path.

In 1972, Tropical Storm Agnes was the first to cause massive damage and evoke public attention in recorded history. Agnes was responsible for the biggest sediment deposit (30 million tons) the Chesapeake area has experienced in modern times. Yielding an average of 8 inches (18 inches

Collapsed bridge/road in Burlington, Vermont after Tropical Storm Lee

in some places) of rain throughout the watershed, this tropical storm wreaked havoc on the flow of the Susquehanna for ten days with an average of 15 times the normal flow rate. Three days of rain were responsible for a 10-day period of overwhelming torrents, sediment deposit, mud, destruction, and significant property damage.

The snow melt-off in 1996, although not as destructive, is among the most memorable for people studying flooding in this area. This event occurred in January, bringing over 12 million tons of sediment into the Susquehanna tributaries and the Chesapeake Bay. This startling amount, however, seems to have no residual effect for the area, as concluded after studies conducted post-Lee in regards to the long-term effects of the snow melt.

Flooding impacts almost every aspect of a watershed. Floods have been occurring naturally since the beginning of time, and the land and animals associated with water habitats have learned to adapt. Even without the addition of human impact, flooding has dumped sediment into the Susquehanna River and Chesapeake Bay watershed, changing its course and its makeup over time. Channels have been widened and deepened, meanders changed, and floodplains reconfigured. Hill slopes can change, stream channel velocity can change – nothing is set in stone when it comes to the Susquehanna River. And flooding can only be a small part of these changes. The area has a strong fingerprint of glacial processes that have occurred over the past 900,000 years, surviving multiple ice ages (including three large ones). As one of the oldest rivers in the world, the ecosystem has rebuilt itself multiple times due to natural disasters.

Floodplain: flat area next to a river or body of water that experiences the worst effects from tropical storms/hurricanes/etc.; includes the area from its banks to any area that encloses the water

In regards to specific research completed by members of SRHCES, the Susquehanna itself seems to have changed, but not drastically, from the effects of Hurricane Lee. Dr. Jonathan Niles, through his field work on the Unassessed Waters Initiative (combined with his separate flooding monitoring research) has discovered that trout in the 3-6 inch range have almost completely disappeared from the headwaters. Although this research took place several months after the flooding, data like this is suggestive of natural disaster. He has also found that algae are absent in the reaches he and his interns examine. Because of the possibility for constantly changing properties of the watershed, flooding may not be the only explanation for the absence or presence of organisms.

Dr. Niles also concedes that flooding has a positive impact on some species. Although without concrete data from Tropical Storm Lee, it is quite likely that species that live beneath rocks can benefit from certain aspects of flooding. Flooding can increase the amount of nutrients in a body of water, especially freshwater, that is conducive for reproduction. Some fishes may take advantage of added nutrients and the relative predatory quiet in order to increase the size of their population.

Submerged cars in streets in Burlington, Vermont after Tropical Storm Lee

In Dr. Peter Petokas' (Lycoming College) studies this summer, he has found indications of flooding impacts within his hellbender/crayfish studies. Among crayfish populations, Dr. Petokas and his students found severe declines in crayfish abundance in the lower reaches of Loyalsock Creek, while abundance was significantly greater in the upper Loyalsock. Dr. Petokas and his students also found significant changes in the stream substrate where hellbenders occur, with complete habitat loss in some areas due to deposition of finer sediments, and an increase in suitable habitat in others. Research on flooding impacts is an incomplete

Section of Wallis Run Road collapsed in Lycoming County

science, since issues that could have been documented were perhaps never looked at pre-flooding.

Dr. Craig Kochel and Dr. Ben Hayes of Bucknell University have been working with four students to complete a detailed GIS map and field study of the geomorphic impacts of the flood along Lycoming Creek, Loyalsock Creek, Muncy Creek and Fishing Creek. This summer, they looked for changes in several things, including channel position, active channel width, gravel bars and islands, exposed bedrock, and the extent of floodplain inundation. Their detailed data analysis revealed extensive changes in channels, streambanks, and floodplains, including channel migration and bank erosion. Gravel bars extended significantly; gravel was transported in large quantities downstream. Kochel and Hayes will continue this research to document in detail the changes that have occurred along four of the major streams that are tributaries of the Susquehanna and West Branch Susquehanna River.

Gravel bar: heavily built up area of sediment, often consisting of larger pieces of gravel; there are several different types of gravel bars (point, mouth, mid-channel) differentiated by where they are found in the river; often found in slow-moving shallow river areas

Sediment deposits take a toll on vegetation as well. When vegetation is destroyed or washed out by extreme flow, animals no longer have a place to live, eat, hide, and find shade. The habitat variety available for different species quickly deteriorates as large pieces of gravel within the sediment loads wreak havoc on any plants clinging to life on the riverbed or adjacent riparian zones. Dissolved fertilizers and pollutants taken along for the sediment ride also cause a major problem. Fertilizers are absorbed by phytoplankton, which in turn can proliferate and alter water chemistry and oxygen availability, impacting the entire food chain. Contaminants can also work their way up the food chain and accumulate in tissues and organs, or have immediate lethal impacts on aquatic life. Sediment can also clog fish gills, which are essential for oxygen uptake and ion exchange .

Phytoplankton: self-feeding (autotrophic) plankton (organisms living in the water current, unable to swim against it)

From a human perspective, benefits from flooding have always been well-known. Despite the possibility of massive destruction and the prospect of rebuilding ruins, humans have reaped the benefits of flooding on crops since the beginning of time. Living along large rivers like the Nile River or the Ganges Rivers allowed ancient civilizations access to extremely fertile soil, rich with the benefits of the powerful water's ability to transport and redeposit nutrients.

A resident of Jean Lafitte, Louisiana paddles his boat through flooded streets

But how are problems caused by flooding fixed? Is there a way for humans to undo all of the damage a flood can cause?

To begin with, the destruction a flood can cause on manmade buildings and civilization is almost limitless. Water flowing over a floodplain can be powerful and swift, rising up several feet past its normal level. Despite the obvious street flooding and transportation issues, the power lines, roads, homes and property damage that can be caused, what can happen to the river itself?

As seen with Hurricane Agnes, millions of tons of sediment can be carried into a watershed, staying for years at a time in the Chesapeake Bay, the Susquehanna, and any of its tributaries. This sediment, while not dangerous in itself, can cause several different types of problems depending on the amount and severity of the dumping.

Chute cut through game farm, partly filled with gravel and flanked by 2 m thick sand deposits (Loyalsock Creek).

Berm breach near green-roofs and reconnection of channel to floodplain anabranches (Loyalsock Creek near Forksville).

Chute across a farm, eroding multiple channels and depositing sand and gravel below berm breach (Muncy Creek).

Ground view of one of the channels cut along Muncy Creek on the left photo. Note the remains of a corn field.

Sediment often makes the water less clear, causing it to appear dirty, but this clouding is often not the biggest issue.

After the water level goes down and homes are still being put back together, communities and organizations often jump to stream clean, or try to "fix" the river. Applying techniques such as dredging and digging the river channel deeper can cause water to move more rapidly and become in turn more powerful again. This also causes the banks of the river to erode more quickly, causing even more damage long-term. The banks can then collapse, tearing apart chunks of land that washes away into the river system, clogging waterways, dams, and bridges with trees and land.

Rivers need room to overflow and by widening the river (also causing it to become more shallow), naturally more and more land is in danger of being affected by the water more easily. Rivers also form gravel bars, building and moving them over time and changing its own flowing course. These often form after flooding or post-flood stream cleaning interventions as the river tries to regain its equilibrium, its natural path. Although not usually the most aesthetically pleasing aspect of a river, gravel bars help change the floodplain in a natural way, over time, to slow down the water in order to regain calm. Attempting to straighten a river's course after flooding can also prove problematic. The sinuosity of a channel helps to establish the course and natural flow rate. If straightened out, the water continues to gain velocity, dredging up more sediment and invoking the issues involved therein.

Flow rate: volume of water that passes through a certain cross-section of waterway for a given period of time; cubic meters per second

Stream cleaning is controversial for a couple of reasons. First, people have a hard time justifying the continued damage in the immediate aftermath of a flood. They want a quick fix now, for the damage occurring now, finding it hard to look into the future and the bigger impacts the stream cleaning will eventually have. Another big issue, land ownership rights, turn the issue toward the law. Does the state have the right to tell people not to dredge or try to fix the river as it destroys their property? Even with best intentions in mind, many

Dredging: using machinery to excavate sediment from the riverbed in an attempt to keep waterways usable

landowners have an issue with giving up the right of transforming their own property.

Beginning August 28, 2011, Hurricane Irene began a catastrophe not seen in decades in the upper Susquehanna River. Farther north, Burlington, Vermont, a town now famous for the amount of destruction it saw last fall, caught Irene full blast and has learned a lot of lessons from their recovery approach. Out of 251 towns in the state of Vermont, 225 were affected by her rain. Six deaths, 13 towns and 50,000 people completely out of power for several days – Irene had no mercy. 3,500 homes, 229 businesses, 629 historic buildings, 20,000 acres of farmland, 500 miles of state road, and 2,260 parts of the highway were wiped out.

Although it may seem hard to do, most scientists suggest in the wake of destruction like this to still allow the river to do what it needs to do to get back on track. Bulldozers and other heavy machinery were seen everywhere in Vermont in the wake of Irene as people panicked to try and control the massive force of the river. Flood relief money is spent on these practices and hardly anyone practicing them realizes the possible negative consequences. Although many of these techniques are useful for immediately controlling damage, their long-term side effects include decades of water velocity build up, resulting in an issue even more challenging to surmount.

Attempts to fix the flood also worsen issues already being caused naturally. While the river is already dumping sediment and eroding the riverbanks, the added sediment and velocity changes caused by stream cleaning destroyed areas of trout stream (approximately 77 stream miles).

Preparing for a flood is almost impossible to do. State officials in Vermont are attempting to learn lessons about how floods work, can be predicted, and managed, but often it is about letting nature take its course, destructive or not. Basing the future on previous floods is not foolproof. Many people purchase or build homes and businesses based on a floodplain figured by Agnes or other tropical storms and floods that have occurred previously. But the floodplains, especially after human intervention, are constantly changing, attempting to shift to a path of least resistance, building up gravel bars and depositing sediment in new locations.

Tropical Storm Lee heavily damaged states as far away as Texas. Many areas of Pennsylvania received the worst from Lee. Many parts of Lycoming County, including areas in Hughesville, Picture Rocks, and Montoursville were evacuated. Two bridges over Loyalsock Creek – the Route 973 bridge in Loyalsockville and a railroad bridge in Montoursville – were completely destroyed. Expenses from these damages alone have cost the state more than $20 million. Wilkes-Barre and Harrisburg also suffered extreme damage and had to evacuate some community members, spending hundreds of millions of dollars on repairs to roads and thousands of homes.

Almost a year later, communities are still recuperating. Government officials, landowners, and people everywhere are attempting to work together to bring towns and homes back together and to repair roads and bridges that were damaged.

Overarching questions:

1) ***Is global climate change the reason for the thirteen storm systems that passed through the Susquehanna watershed in 2011? How can we use this knowledge to predict and prevent as much flood damage as last September?***

2) ***What are proper stream cleaning methods? Should people be allowed to "fix" the river and its tributaries in order to relieve immediate flood damage, despite the larger problems it may cause for the community in the future? How can everyone work together to create safe flood relief decisions?***

3) ***What does the future hold for flooding? Can the areas hit hard last year survive another flood? What can we do to continue to recover?***

Public Awareness, Education & Health

Geisinger Environmental Health Institute (EHI)

The joint Geisinger-Johns Hopkins Bloomberg School of Public Health EHI, directed by Dr. Brian S. Schwartz, continues its ongoing studies in environmental epidemiology in the region. These include the following studies:

- We are evaluating the relation of the food, land use, media, physical activity, and social environments in communities with childhood body mass index among over 70,000 children with a Geisinger primary care provider. Our first study on this was published in the American Journal of Preventive Medicine last year.
- We have secured new funding from the National Institutes of Health as part of the Johns Hopkins systems-oriented childhood obesity center. This new Center has three research projects, one of which is centered at Geisinger, and will apply complex dynamic systems and agent-based models to the obesity epidemic in the region.
- Ann Liu, a doctoral student at the Johns Hopkins Bloomberg School of Public Health, completed her thesis research on the community and individual-level impacts of coal abandoned mine lands (AMLs). There is increasing concern in the public health community about living in communities with what has been termed chronic environmental contamination. Her first paper, that found that the greater the burden of AMLs in communities, the higher the community socioeconomic deprivation, was published in the peer-reviewed journal ISRN Public Health. Her second paper, being prepared for publication now, found that higher AML burden was associated with worse diabetes early in the disease course and worse progression over time in 28,000 Geisinger diabetic patients using hemoglobin A1c levels, a biomarker of diabetes severity and control.
- Our work continues on the epidemiology of methicillin-resistant Staphylococcus aureus (MRSA) in the region. This is the doctoral thesis research of Joan Casey. The incidence of MRSA has increased dramatically over the past decade, with over 4,000 cases during this period. We are currently completing analysis to determine whether animal feeding operations in the region are contributing to the disease burden given the common use of antibiotics in animal feeds at concentrated animal feeding operations (CAFOs).
- We have been studying the epidemiology of chronic rhinosinusitis in Geisinger's patients. This is a chronic condition with a significant patient and population disease burden. It has many links to environmental exposures.
- The EHI's most recent efforts involve the Marcellus shale. We have applied to the National Institutes of Health for funding for a study of Marcellus-related air pollution and asthma outcomes in 30,000 Geisinger patients with asthma and 30,000 controls without asthma. We are also involved with Geisinger's larger efforts to launch a variety of Marcellus-related studies. We have obtained well and pipeline data from the state and are entering well completion report data into a geospatial database for use in future epidemiologic studies.

WKOK

Newsradio 1070 WKOK continues to be an active partner with the Susquehanna River Heartland Coalition for Environmental Studies. News stories and interviews continue to focus on environmental issues. We air the reports in our daily newscasts, on our live telephone talkshow ***On The Mark*** and on Roundtable (our 1-hour panel discussion show).

In September, the historic flood hit the Central Susquehanna Valley. In addition to extensive coverage of damage, safety issues and rebuilding, WKOK focused on the science of floods and the impacts of development on the river, creeks, streams, other tributaries and aquatic life.

Topics have included the State of the Susquehanna River, in which we have talked with the Pennsylvania Fish and Boat Commission. The focus included water quality and the decline of smallmouth bass. A Roundtable program featuring two of the area's best known 'river rats,' Jim Charles and Ken Mauer, talked about the declining fishery.

WKOK ran a series of stories featuring Paul Swartz, the executive director of the Susquehanna River

Basin Commission. Topics included issues such as the monitoring of water withdraws from the river. In addition, we cover the increased water quality of the river and the commission's monitoring of nutrients and sediments. As with many organizations, funds are tight, so WKOK also ran a story covering the funding challenges facing the SRBC.

WKOK has continued their coverage of the Marcellus Shale discussion, talking with those who are both for and against drilling. We have also covered extensively the fracking process and the environmental consequences it may bring.

With WKOK's continuing coverage of The Valley's rich history, one ***On The Mark*** program featured Bucknell University professors Katie Faull and Alf Siewers talking about the designation of the John Smith Trail, the Moravian Diaries and a student created website that focuses on the Marcellus Shale. Most recently, WKOK got a two year update following the Gulf Oil Spill. We spoke with Bloomsburg University professor Cynthia Venn who gave us the latest on the oil plumes, as well as microorganisms.

WKOK also continues to get updates on the Shikellamy State Park marina building, following the educational initiatives that are being planned for the building.

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