Pulse of the Heartland

Presented by the

SRHCES
Susquehanna River Heartland Coalition for Environmental Studies

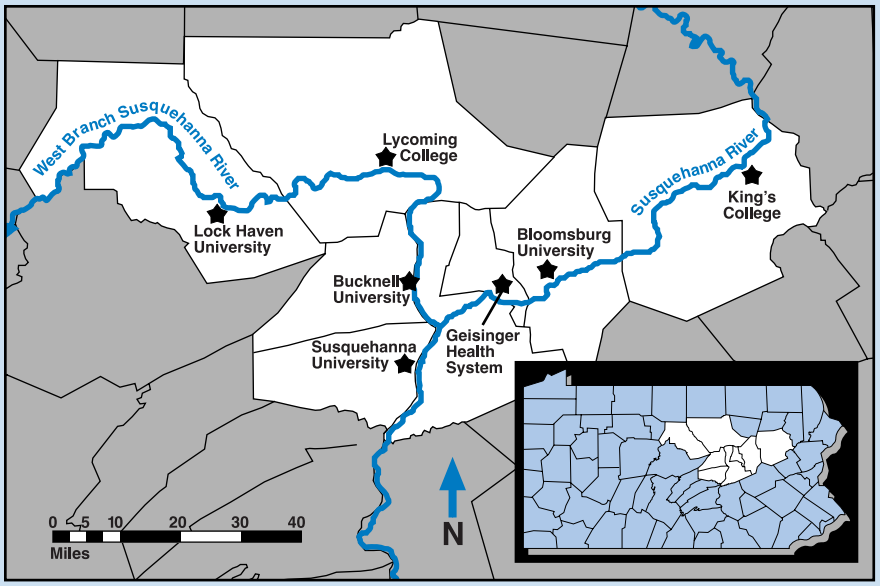
2013 ANNUAL REPORT

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.*



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

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

This year, the ***SRHCES*** *members joined the Conservation Catalyst Network, an international network formed to explore the unique role of colleges, universities, and research institutions as catalyst biodiversity conservation across large and complex landscapes.*

This year's report provides an overview of the impacts dams have on river systems. While many dams provide recreational benefits and help fuel the economy of nearby communities there may also be negative impacts to the waterway itself as well as the terrestrial habitat along the waterway.

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 on the humanities side, Geisinger Environmental Health Institute, and Sunbury Broadcasting.

Late in 2012, James Levitt attended SRHCES's monthly meeting. Levitt is the director of the Program on Conservation Innovation at the Harvard Forest, Harvard University, and is a fellow in the Department of Planning and Urban Form at the Lincoln Institute of Land Policy. He focuses his research on historic and present-day innovations in the practice of land and biodiversity conservation.

Levitt presented the group with an outline of the Conservation Catalyst Network (CCN), an international network formed to explore the unique role of colleges, universities, and research institutions as catalyst for biodiversity conservation across large and complex landscapes. He then invited the group to submit an application to join the network. The application was accepted and members of the Susquehanna River Heartland Coalition for Environmental Studies are now in the CCN.

Students from Lycoming College attended a week-long meeting for the Conservation Catalyst Network at Acadia National Park. Hosted at the Schoodic Education and Research Center, the session allowed the students to share information about their unassessed waters work, and learn about what other landscape initiatives colleges from throughout the world are involved with.

Monitoring the Susquehanna

Dr. Jack Holt

Professor of Biology
Susquehanna University

Dr. Holt continues to work with periphyton. Periphyton is the complex collection of algae, macroinvertabrates, fungi, bacteria, and other material that attaches to submerged surfaces such as rocks. He is hoping to obtain an unbroken data collection for at least a 10 year sample period. For the fifth summer he is re-occupying various transects on the Susquehanna River in the Byer's Island area near Shamokin Dam, PA.

Using periphytometers (a device that holds a group of glass microscope slides and is then submerged for a period of time in the River), Dr. Holt and interns Ian Murray, Austin Iovoli, and Andrew Anthony collect periphyton samples to further understand what types of communities exist in the Susquehanna River.

Benthic invertebrates samples in conjunction with the periphyton sampling provides a better understanding of the water quality and conditions of the River. In addition to continuing these projects, Dr. Holt will have one intern begin a study on surveying microbes in the river, focusing on bacteria.

After collecting water samples, interns, Ian Murray, Austin Iovoli, and Andrew Anthony document some basic information and store the samples in the boat.

Sean Reese

Aquatic Ecologist
Bucknell University

Sean Reese, of Bucknell University's Environmental Center, and intern, Jared Feindt will continue to survey the mussel populations in Buffalo Creek. Buffalo Creek is a shallow waterway surrounded almost exclusively by farmland. Agricultural practices can often add excessive amounts of nutrients and sediments to a waterway, which can lead to algal blooms and loss of habitat for aquatic organisms.

Looking for mussels requires spending a lot of time face down in a stream with a snorkel on.

Mussels are a natural filter feeder and are recognized as a very important member of the aquatic ecosystem. Some mussels use fish as a host for their glochidia, or larval stage. Certain mussel species can be functionally dependent of a specific host fish to complete its life cycle. Elliptio complanata are known to have higher success rates metamorphosing into juvenile mussels using the American Eel as their main host fish for their glochidia.

In 2010 and 2011 the United States Fish and Wildlife Service stocked American Eel's in Buffalo Creek. Reese is now assessing the impacts of the stocking on the native Unionid mussel population. He hopes his survey will provide population and recruitment data which will allow for future studies to investigate the effectiveness of American Eel introductions on native Elliptio complanata populations. Reese has 10 sites throughout Buffalo Creek with four surveys being conducted at each site for a total of 40 surveys this summer.

Reese will also be continuing his mussel survey work in the West Branch Susquehanna River. He is hoping to expand the surveys to sites on the main Susquehanna River as well.

Geoffrey Smith

Susquehanna River Biologist
Pennsylvania Fish & Boat Commission (PFBC)

Vicki Blazer

USGS Research Scientist

Geoffrey Smith and Vicki Blazer, are continuing to study the health issues present in smallmouth bass populations in the Susquehanna River Basin. Smith and his cooperators have found that in addition to parasites, bacterial and viral infections, and poor water quality, there are at least two more factors affecting the smallmouth bass population – melanosis and endocrine disruption.

Melanosis is a form of hyperpigmentation commonly associated with overexposure to UV radiation. It has been documented Pennsylvania fish as early as the 1980's. There are questions as to whether the factors driving melanosis could be contributing to the decline of smallmouth bass but a definitive association has not been made. PFBC is not certain what the exact cause of the pigmentation issue, but the fish studied so far seem healthy and anglers can consume a fish showing signs of melanosis.

Fisheries biologists are also noticing endocrine disruption in smallmouth bass populations. Endocrine disruptors are chemicals that can interfere with natural hormones present. This disruption can cause suppression of the immune system and has caused intersex within the smallmouth bass population.

Smith and others believe the excess amount of chemicals could be from point and non-point source run off into the streams and rivers. Chemicals introduced to the water then accumulate in tissue of organisms as well as in soil. Evidence suggests the reason that the smallmouth bass population is being affected more prominently than other species is due to the fact that they are nest-spawners. Nest-spawners dig a nest in the soil to lay their eggs. This puts eggs and larval fish in close contact with contaminated soils.

Intersex is a variation in reproductive characteristics, in males including testicular oocytes and presence of vitellogenin. Vitellogenin is a protein which is present in the yolk of an egg. Finding this protein present in males is evidence that some compound is activating a present, but typically inactive gene in these fish.

Passive water collection is being done to document the suite of chemicals and their relative concentration in the water. Tissue samples are also being collected and analyzed for evidence of endocrine disrupting compounds.

Dr. Peter Petokas

Research Associate
Clean Water Institute
Lycoming College

Dr. Petokas has entered his eighth year of Eastern Hellbender research in northcentral Pennsylvania. With the assistance of numerous student interns, he has captured and tagged over 1,500 of the giant salamanders including hundreds of recaptures.

In cooperation with Cornell University Dr. Petokas has been collecting samples for testing. These tests revealed that up to forty percent of the hellbenders in the northcentral region are infected with amphibian chytrid fungus, a disease attributed to the global amphibian decline crisis.

Emily Fogoros, Dr. Peter Petokas, Kourtney Mottern, and Jamie Huntley, Executive Director at the Camp Victory Nature Center. The interns spent their summer working to expand the educational materials and information available to campers.

The effect of this disease on the hellbender is not fully known.

A new project, initiated in the summer of 2012, was an investigation of the distribution of native and non-native crayfish in northcentral Pennsylvania. Dr. Petokas has expanded the study and is now planning a future monitoring program to assess when and how fast crayfish invasions take place. So far, the West Branch Susquehanna River sub-basin has escaped a full invasion by the large and aggressive Rusty Crayfish, though it has successfully invaded most of the Susquehanna River basin, including the from the New York headwaters to well below the confluences of the Susquehanna with the West Branch Susquehanna.

As the West Branch Susquehanna River's quality improves, he fears the Rusty Crayfish will invade into the far reaches of the West Branch sub-basin. Two species of native crayfish were found during research done in 1906 in the West Branch Susquehanna River. Of the two native crayfish species that were present, only one species remains and is restricted to smaller headwaters streams.

In cooperation with the Executive Director of Camp Victory (**CampVictory.org**) and various local, state, and federal agencies, Dr. Petokas is contributing toward the creation of wetlands to replace shallow, warm-water ponds at the camp. By removing sediment from one pond, it will be used to fill the others, which will then be planted with various types of wetland plants, resulting in a mix of different wetland environments. The goal is to increase ecological and biological diversity at Camp

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

Victory, improve water quality in the Mud Run watershed, and provide unique educational opportunities for students and campers in the environmental education program.

Dr. Petokas is currently serving as a mentor to the summer environmental education interns at the Camp's new nature center. Dr. Petokas assisted in the planning and development of the nature center, and, with the assistance of Lycoming College students, he created educational materials and displays that are now in use a the nature center.

Dr. Carlos A. Iudica

Associate Professor of Biology
Susquehanna University

Dr. Iudica is monitoring the amphibians and reptiles present at Susquehanna University's Center for Environmental Education and Research (SU-CEER). The 87-acre site is a former dairy farm located near campus. Dr. Iudica set tin roof material out on the ground, creating microclimates underneath. The microclimates are placed near ponds and checked at 15 day intervals at dawn. The amphibians and reptiles found are marked with chips. This allows for migration and diversity to be monitored. These macroclimate tins allow him and his students to monitor local migration and diversity of these important animals.

A Bat monitoring pilot project is also being continued at Woodward Cave, along Penns Creek and sites on Buffalo Creek. Audio data will be collected and analyzed for diversity of species, population composition, and activity. Funding for this project will be provided in part by the Pennsylvania Game Commission, with other funds from the Degenstein Foundation.

Dr. Iudica will travel this fall to Argentina to the International Raptor Research Meeting to present the results of two projects on owls. As reported in previous editions of the "Pulse of the Heartland", Dr. Iudica studied owl pellets for a number of years to identify what the owls were eating. Using this information he compared what different species of owls living in the same location were eating.

His lab will also continue work started in 2009 to identify vertebrate fossils found in a pitfall trap near Penn's Creek.

Dr. Jonathon Niles

Adjunct Faculty – Biology
Susquehanna University

Dr. Niles continues to work on the Unassessed Waters Project, as well as continuing with two post-flood studies in the Susquehanna River watershed. The Unassessed Water Project is an effort of the Pennsylvania Fish and Boat Commission (PFBC). PFBC staff and partners, such as Dr. Niles, are conducting field work at streams that have either never been assessed for fish

Dr. Niles's interns working on an unassessed stream.

populations, or were last assessed over 20 years ago. His sampling is focused on un-named tributaries in Loyalsock Creek, named and un-named tributaries in Rock Run, Pleasant Stream, Penns Creek and White Deer Creek.

Following flooding in the fall of 2011 caused by Hurricane Lee, Dr. Niles has collected fish population, BMI (Benthic Marcroinvertabrate Index), water quality, and fish diet samples from 30 tributary streams located in Loyalsock Creek watershed between Lopez and Barbours. Data will be used to broaden the understanding of how flood events affect macroinvertebrate population and brook trout popluations. Dr. Niles is also going to be using results to develop a timeline for recovery.

Sampling done after the flood showed the sites were severely depleted. Diversity of organisms has risen, however the population has not yet recovered to pre-flood levels. Dr. Niles hopes to acquire enough data to document how long it takes for both diversity and population numbers to return to ideal levels.

Following the flood, fish less than 150mm were completely wiped out. There has been one strong year class, with good reproduction again in 2013. These years classes should survive and spawn in the summer of 2014 and 2015 if no further flooding events occur. Sediment samples are also being taken at these sites to determine if there is any impact from forest removal associated with gas drilling on fine sediment inputs. If forest removal from gas drilling is increasing sediment input, aquatic life surveys may see a decline in populations.

Dr. Ben Hayes

Director of the Susquehanna River Initiative at Bucknell University

Dr. Hayes continued his detailed mapping studies of the West Branch Susquehanna River. Dr. Hayes looked at the channel morphology, island and floodplain features, and aquatic habitat along a 54km stretch of the River. This information will allow him to characterize the fluvial landforms

Matt Sirianni and Rob Jacob collecting gravity data.

and assess its geomorphic history. This is part of a larger interdisciplinary effort in collaboration with other Bucknell faculty, including Dr. Jessica Newlin (Department of Civil and Environmental Engineering), Dr. R. Craig Kochel (Department of Geology), Dr. Matthew McTammanay (Department of Biology), Dr. Robert Jacob (Department of Geology), and Sean Reese (Environmental Center).

In the lower reaches of the West Branch between Milton and Sunbury, SRHCES student intern Molly Gutelius used a high-resolution depth finder and side-scan sonar imager to map the river morphology, bedforms, and sediment textures. The data are bin processed and combined with terrestrial LiDAR coverages to produce sonar image maps (SIMs) and digital bathymetry maps (DBMs) of the channel and adjacent floodplain features. At numerous locations, they snorkeled and scuba-dove to characterize the size, lithology, relative age, and degree of armoring of the river bed sediments. Areas of groundwater upwelling, bedrock control, and relative ages of the channel are providing clues to natural history and aquatic habitat of the River. Molly also created a relational database of daily hydroclimatic data from 13 stations across the entire Susquehanna watershed to compare and contrast flood, drought, and baseflow conditions in the West Branch Susquehanna River and Susquehanna River for the past 150 years.

Upstream near the Great Bend at Muncy, PA, SRHCES intern Matt Siriannia used a LaCoste and Romberg Gravitron unit to determine if variations in the thickness of valley fill were detectable as deviations in the gravitational field and if micro-gravity techniques could be use to map the bedrock-alluvium interface. Laurentide glaciation during the early Pleistocene (~970ka) scoured bedrock and dammed the West Branch in this area, creating 100km long glacial Lake Lesley that extended from Muncy/Montoursville upstream to beyond Bald Eagle Creek. The exact location of the ice dam and the downstream valley fill architecture is not yet understood. Gravitational field readings at 50 locations over five transects were collected across the Muncy Creek and Susquehanna River valleys, covering an area of approximately 30km². Well logs and other geologic data are being used to refine the joint-inversion gravitational models to develop a glacio-fluvial isopach map of the river valley and determination of the density contrast between the alluvium and the underlying sedimentary bedrock. The location of the gravity low does not correspond with the present day location of the Susquehanna River, but is believed to reveal the Pleistocene location of the Susquehanna River and possible glacial ice dam.

Dr. L. Donald Duke

Visiting Professor of Civil & Environmental Engineering
Bucknell University

Dr. Duke is taking a closer look into flood mitigation in Susquehanna River towns, and the policies, regulations, and plans that are used to help protect property and public safety. Interns, Ellen Kalnins and Ryan Murphy, will familiarize themselves with the web of flood control policies in about eight different case study cities located from Lock Haven on the West Branch Susquehanna River and Bloomsburg on the Susquehanna River above the confluence, down to Selinsgrove on the Susquehanna River below the confluence with the West Branch Susquehanna.

Dr. Duke and the students are evaluating the diverse flood control approaches. Conventional structural changes such as walls, levees, and channel straightening are in place in some towns. Others employ hydrological approaches, such as flood plain management and off-stream detention. Still others take a planning approach, including municipal buy-outs of properties subject to repetitive flooding; code requirements for buildings in flood plains; and ecosystem plans for smaller tributaries. Some municipalities implement a mix of approaches, all adapted to the geographic, demographic, and hydrological conditions of each town in the region.

Dr. Duke and his students spent time talking to municipal officials. Here interns Ellen Kalnins and Ryan Murphy speak with staff from the City of Lock Haven at the Lock Haven levee.

Dr. David Matlaga

Assistant Professor of Biology
Susquehanna University

Dr. Matlaga will begin his first summer at the University with a population study on Japanese knotweed along the Susquehanna River. Japanese knotweed is an invasive plant that has come to dominate much of the riparian forests in the Northeastern Region. First introduced in the late 1800s as an ornamental plant, Japanese knotweed crowds out native plants.

In order to try and control the spread of this invading species, Dr. Matlaga is trying to understand more about the various ways Japanese knotweed reproduces. Japanese knotweed can grow from a seed, from a rhizome (an underground stem), or from stem engagements.

He and intern Chelsea Gowton will compare two different area types to see how successful Japanese knotweed is at reproducing. One area type is a site with an undisturbed area that has a Japanese knotweed canopy and other vegetation. The second area type is a disturbed area site that has been cleared of all vegetation. A plot was established at each site by planting a combination of the three types of reproductive propagules (seed, rhizome, and stem engagements).

A specialized camera designed to capture the amount of canopy cover is used throughout the planting process. This will show the amount of light that these plants will have during establishment and determine whether it is a significant factor in reproduction. Follow up visits to each site are made as the Japanese knotweed begins to grow. With growth rates, Dr. Matlaga will be able to compare the success of offspring depending on their environment. There is hope of controlling the invasion of Japanese knotweed once scientists understand more about how it reproduces and grows.

Dr. Matalga's Intern Chelsea Gowton holds Japanese knotweed seeds.

Dr. K and his team used canoes during their June data collection on the West Branch Susquehanna River. Here Dr. K is recording information while still on the water.

Dr. MD. Khalequzzaman

Professor
Department of Geology & Physics
Lock Haven University

Dr. MD. Khalequzzaman will be working on several projects this summer. Dr. K, as he is known, will be investigating sedimentation at three locations in the West Branch Susquehanna River watershed. He'll be looking at the Lock Haven dam, Foster Sawyer dam, and the Dubois reservoir. To study the sedimentation he'll focus on water quality above and below each dam.

Dr. K will also continue with monitoring AMD sites in the Beech Creek watershed. He'll assess levels of metals including: iron, manganese, aluminum, copper, arsenic, and zinc. Other parameters will include alkalinity, acidity, pH, sulfate, total dissolved solids (TDS), and oxidation-reduction potential (ORP).

Baselines for waterways in the Marcellus Shale formation will also be a focus for Dr. K this year. The Marcellus shale formation is being developed for the natural gas the shale formation holds. Dr. K is collecting baseline data that can then be compared to water quality data collected after natural gas wells are completed. He's adding eight new sampling sites in Beech Creek, Hall Run watershed, and six new sub watersheds in Clearfield County. Parameters for this study will include: TDS (total dissolved solids), pH, calcium, magnesium, sodium, barium, bromide, and chloride.

Dr. K and his team have also collected water quality data on a 60 mile stretch of the West Branch of Susquehanna River from June 14-17 starting at Keating and ending at Williamsport. The data collection came after a storm event and Hydrolab Data Sondes (DS 5) were used at one-minute intervals to take measurements. More than 2000 measurements were recorded for temperature, pH, dissolved oxygen (DO), DO% saturation, resistance, conductance, Total Dissolved Solids, salinity, and ORP. Additionally, 30 water samples and 10 soil samples were collected to analyze in the lab for additional parameters, including various metals and nutrients.

Once all the information is examined, the results of the field and lab analyses will be analyzed using ArcGIS software and statistical methods. The data will provide the insights into various physical, hydrologic, geological, and chemical processes have on the mixing of water in the main stem of West Branch of Susquehanna Rivers and its numerous tributaries. The data will help understand the role that soil, rocks, landuse, damming, and other anthropogenic activities play on the quality of water as the river flows downstream. The results will help identify areas of concern and make recommendations for better planning and management of water resources in the middle part of the West Branch of Susquehanna River and its watershed.

Dr. Mel Zimmerman

Professor of Biology
Director, Clean Water Institute
Lycoming College

Dr. Zimmerman continued three projects this summer. He had nine summer interns working with him this year.

Dr. Zimmerman began work with the Pennsylvania Fish and Boat Commission's Unassessed Waters Project in the initial year, 2010. He's continued working with the Program and has completed assessments on over 230 streams. This year the Lycoming College team focused on assessing the remaining unassessed streams in the Lycoming creek watershed, continued work in the Pine Creek watershed and started work in the Antes Creek and White Deer Hole Creek watersheds.

Another project Dr. Zimmerman is involved with is located on White Deer Hole Creek. He and his students are monitoring the effects of recently applied agricultural best management practices on four farms.

The practices included animal crossings and fences installed along the stream to keep animals out of the waterway and a riparian buffer of grass planted along the stream, inside the fence to help filter water running off the fields before entering the stream. Monthly sampling (as well as during storm events) is conducted at three sites on an unnamed tributary to White Deer Hole Creek in Elimsport, PA. The water samples are tested for nutrients such as nitrates and phosphates, as well as alkalinity, total suspended solids, and conductivity. Baseline data (collected for a year prior to BMP's) will be compared to this summer's data and future data in order observe potential impacts of the BMP's.

His third project is with Cromaglass, a company focused on making fiberglass wasterwater treatment systems, and with ArchaeaSolutions, Inc, a company experimenting with archaea organisms and how they react with environmental components. They are trying to determine if microbes from ArchaeaSolutions, Inc. can degrade wastewater in salt water environments and if they can continue to break it down once a preservative is added. Weekly testing focuses on biological and chemical parameters. The samples are analyzed to determine the efficiency of the organisms.

Number of Streams Sampled Through the Unassessed Waters Project:

	2010	2011	2012
PFBC Staff	217	304	261
Partners, including Lycoming College, Susquehanna University & King's College	88	438	626
Total Number of Streams Assessed	308	742	887
Miles of Streams Impacted	516	1,762	2,057

Dr. Christopher Hallen

Professor
Department of Chemistry & Biochemistry
Bloomsburg University

Dr. Cynthia Venn

Associate Professor
Department of Environmental, Geographical & Geological Sciences
Bloomsburg University

Drs, Hallen and Venn continued their collaboration. Dr. Hallen and Dr. Venn have been working together for several years on several water quality research projects. Working with them this summer were interns Franklin Rodemer, Amanda Pritzlaff, Chandra Dewar, Lynette Eichenlaub, and Bobby Kresch.

Work from previous years on abandoned mine drainage (AMD) will continue, adding four more sites to last year's sampling sites. Passive water samples are collected. The samples run through chemical analyses for - pH, alkalinity, turbidity, acidity, selected anions and cations, and trace metals.

The team also continued their long-term sampling program on the Susquehanna River, reoccupying transects in Danville, Watsontown, Milton, and Shady Nook to determine water chemistry across the transects to compliment macroinvertebrate work done by Dr. Mel Zimmerman and Dr. Jack Holt.

In addition to analyzing the chemical data from the Shady Nook transections, Amanda collected organisms from those transects to be analyzed for heavy metal accumulations. Previous studies revealed periodic elevated levels of lead, copper and manganese at certain stations in that area.

A new focus will be determining biochemistry in plants, specifically the effect of how changes in the molecules that transport metals from the soil to the roots (and above) affect the rate of transport. Ultimately, if the transport molecule, which is specific to each individual species, can be modified to add

Amanda Pritzlaff, Bobby Kresch, Dr. Chris Hallen, and Michele Plastow prepare to head out on the River to gather samples at Danville.

fertilizer or herbicide without affecting metal transport, use of fertilizers or herbicides can be diminished by selectively supporting or attacking each species of plant individually instead of by broadcasting, making the process both environmentally and economically favorable.

A few interns worked on water testing in the northern part of the state. They will evaluate their results in relation to the shale gas activity associated with hydrofracking taking place in the area. One project is in a 40 acre catch and release pond in Bradford County. The pond is downhill from a retention pond. They will also run chemical analyses on samples from a set of five wells in the area to determine if they are being influenced by the gas drilling activity.

Dr. Brian Mangan

Professor of Environmental Science & Biology
King's College

Dr. Mangan has several projects in motion for 2013. One project involves a partnership with the Pennsylvania Fish and Boat Commission (PFBC) and the United States Fish and Wildlife Service (USFWS) to identify the intermediate host of a parasite thought to infect smallmouth bass in Pennsylvania. Dr. Mangan collected macroinvertebrate samples at 20 sites across seven rivers in Pennsylvania using scuba and a dome sampler. He then isolated aquatic worms from these samples.

The dome sampler, created at the environmental laboratory where Dr. Managan began his career, is a device designed to sample macroinvertebrates from large rivers. A scuba diver takes the dome to the bottom of the river, seats it into the substrate (the river bottom) and then vacuums the organisms inside the dome into a net. The net holding the organisms is taken to the surface where it will be "live-picked" shortly thereafter.

The aquatic worms collected by this technique will be analyzed by USFWS scientists to determine if any of the worms are the intermediate hosts of the suspected parasite. The other invertebrates collected at Susquehanna River sites will be used by Mangan to document variations in macroinvertebrate biodiversity, biomass, and mercury burdens.

Dr. Mangan is also continuing his work updating the distribution of invasive species in the Susquehanna. He is researching the distribution of zebra mussels, Asian clams, and the rusty crayfish. He and his students will be looking for these species at each of 11 sampling locations on the Susquehanna River from the New York border to just north of Harrisburg. Mangan did a similar crayfish survey in 2008 and hopes to determine if the rusty crayfish have expanded their range in the River since then.

Finally, Mangan's team will continue to explore the phoretic relationship (one species living on another species without cost or benefit to the host) among aquatic midges and crayfish and hellgrammites at the Susquehanna River sites. Mangan and Mike Bilger (see page 11) were the first to report a phoretic relationship between midges and crayfish in 2012.

Some of the crayfish Dr. Mangan and his team found this summer.

Dr. LouAnn Tom

Assistant Professor of Chemistry
Susquehanna University

Previously, Dr. Tom worked as a chemist/senior scientist at Merck & Co. Inc. for 19 years. At Susquehanna University she conducts research using molecularly imprinted polymers (MIPs).

MIPs are designed to detect low levels of a specific molecule. This can potentially improve methods for analyzing pharmaceuticals and other toxins in water samples since it can detect lower limits. Dr. Tom has investigated the development of MIPs for a variety of compounds including pain killers, antibiotics, and insecticides. Many compounds found in pain killers, antibiotics, and insecticides have the potential to end up in waterways due to their persistence after passing through wastewater treatment facilities or from farm runoff.

For example, she has developed an MIP for

the analysis of avermectin, an antiparasitic drug and agricultural pesticide
produced by Merck at their Riverside PA facility. The compound is very toxic to freshwater aquatic life at concentrations lower than the detection limit of most conventional analytical techniques. This makes its analysis in waterways extremely difficult and time consuming.

Dr. Tom and her students are also designing an MIP to improve the detection of sulfadimethoxine, an antibiotic widely used to treat intestinal parasites in domesticated and farm animals. MIPs for the separation and detection of the enantiomers of chiral non-steroidal anti-inflammatory drugs (NSAIDs) are also being investigated. Another on-going project is the investigation of the use of MIPs for the removal of sulfur-containing compounds from diesel fuel for pollution concerns.

Another project in Dr. Tom's lab is development of MIPs for more effective methods to analyze pyrethroid insecticides. These insecticides are synthetic derivatives of pyrethrins and act as a neurotoxin in insects. Pyrethroids are not very soluble in water, and tend to concentrate in aquatic organisms. This is a threat to many organisms such as bluegill, lake trout, shrimp mayfly and zooplankton. Because pyrethroids are highly toxic to aquatic life and can contaminate surface waters and sediments, a chemical method for their analysis at environmentally relevant concentrations is in high demand.

Dr. Tom and her interns use a variety of instruments and equipment in their work.

Dr. Steven Rier

Associate Professor of Biology
Bloomsburg University

Dr. Rier conducted an in-lab experiment and extensively sampled Fishing Creek near Bloomsburg to determine if short pulses of elevated phosphorus observed during rain events stimulates subsequent algal production in streams.

Dr. Rier and intern, Keith Kinek, constructed twelve continuously flowing artificial stream channel models. They added simulated stream water containing all necessary minerals and nutrients for algal growth with the exception of phosphorus. Phosphorus was added in pulses of varying lengths and algal growth, algal biomass, primary productivity, phosphorus storage in algal cells, enzyme activities, and bacterial biomass were measured through time. They also periodically measured these parameters along with water chemistry in Fishing Creek to determine if similar patterns were observed in a natural system. The purpose of this study is to investigate the potential role of phosphorus pulses in stimulating uptake,

Keith Kinek takes a water sample from Fishing Creek.

storage, and productivity of algae and other microorganisms in the Susquehanna watershed above Sunbury. Through this experiment, Dr. Rier hopes to improve his understanding of microbial responses to variable nutrient loading and to lay groundwork for the development of more precise models for algal bloom prediction.

Josh Lookenbill

Biologist
Pennsylvania Department of Environmental Protection (PADEP)

Josh is working to pinpoint the main factor influencing the increase in mortality rates of young-of-year (YOY) small mouth bass. Since the first documented case of increased fish kills in 2005, further studies have lead biologists to believe the cause of death for most of the smallmouth bass is disease-related. Studies conducted in 2006 and 2011 on the West Branch Susquehanna, Susquehanna, and Juniata Rivers yielded the same results.

Because temperature seems to be a deciding factor in the health of smallmouth bass, studies have been done seasonally to show variations in temperature and how they can affect the health of smallmouth bass. By 2010, biologists documented lesions, caused by bacterial infections, in many of the warm water streams in the Susquehanna River Basin. An increase in intersex within the male population suggests there is a possibility of endocrine disruptors present in the waterways as well. These endocrine disruptors can compromise the immune systems of the YOY smallmouth bass and increases the need for further investigation of the increased mortality rates.

Preliminary data from studies conducted in 2012 provide the foundation for this year's studies. 2013's work includes collecting chemical and biological data from numerous sites within the Susquehanna River basin. Chemical data will include emerging contaminants, metals, and nutrients. These nutrients, including phosphates and nitrates, can lead to excessive algal growth and subsequent depressed dissolved oxygen.

Lookenbill and his colleagues are also focusing on temperature as a main variable in the mortality of the YOY

smallmouth bass. A low flow study will collect data seasonally, throughout the rivers flow cycles, in order to compare the warmer temperatures of low flow cycles with the cooler temperatures of normal to higher flow cycles. These periods of warmer temperatures could be detrimental to the health of the smallmouth bass.

Benthic macroinvertebrates, fish, and mollusks will be sampled at select sites to further indicate the water quality of the rivers. A better understanding of the aquatic community should help biologists narrow in on the cause of the deaths of the YOY smallmouth bass.

Pennsylvania Department of Environmental Protection staff spent time this summer gathering water samples from the River.

Mike Bilger

Research Scholar
Department of Biology
Susquehanna University

Senior Aquatic Biologist
EcoAnalysts, Inc.
Selinsgrove, PA

Bilger spent 32 years as a state and federal regulatory biologist working in both freshwater and marine ecosystems throughout the United States before moving to his current positions. As a member of the Susquehanna River Heartland Coalition for Environmental Studies since its inception he collaborates with the other members on a variety of topics including water quality, aquatic macroinvertebrate and fish taxonomy and ecology, and contaminant issues. He also works on projects with local county conservation district watershed specialists including Union and Snyder Counties as well as watershed groups like the Lower Penns Creek Watershed Association.

Bilger has partnered with the Snyder County Conservation District for an Ecology Day for the past several years. The event, held in New Berlin on Penns Creek, allows children and adults to collect water samples, macroinvetebrates, fish, and invasive species. Participants also learn about land use and pollution impacts to the Creek. Volunteers from the conservation districts, Susquehanna University, watershed association, and private citizens have made this day possible. Over 150 participants attended the sessions held in 2011 and 2012.

He continues to work with faculty and students on river ecology data collection and analysis. Bilger especially spends time working with Susquehanna University faculty members, Dr. Holt, Dr. Niles, and Dr. Iudica including posters and journal publications.

Dr. Ahmed Lachalab

Associate Professor
Earth & Environmental Sciences
Susquehanna University

Dr. Lachalab is investigating sedimentation in Faylor Lake. The Lake is a shallow, 140 acres impoundment located in Snyder County.

During his lake studies, Dr. Lachalab focuses on the sediment building up on the lake bed, not the sediment suspended in the lake's water. Working with four interns, they looked at specific parameters including locations of sediment emergence, sediment rate, variability of material, grain size, and effect of chemistry on the waterbody. Core sampling provides multiple years of data to analyze and will be compared with Ground Penetrating Radar readings. GPR is an important method is uses pulses to indicate changes in substrate without penetration into the lake bed. Another piece of information Dr. Lachalab factors in is the year the lake was built. This information helps in calculating sediment accumulations.

All of this data will be used to generate a 3D model showing the accumulation of the entire Lake. Dr. Lachalab may also project into the future, showing how sediment may continue to accumulate in the Lake.

Dr. Lachab and an intern gathering data this summer. The raft floating behind the boat is carrying equipment associated with the Ground Penetrating Radar.

Dr. Matthew McTammany

Associate Professor of Biology
Bucknell University

Dr. McTammany is continuing to work with diversity and community structure of macroinvertebrates in the Susquehanna River. Specific microhabitats can provide better homes for different species of aquatic insects. It's important to survey multiple habitat types to determine biodiversity and distributions of organisms in the River. Dr. McTammany and his students continue to identify organisms from a variety of microhabitats, including mid-river riffles, tributary confluences, backwaters, gravel shoals, and vegetated patches.

Dr. McTammany has two student projects this summer. An undergraduate student, Hannah Bohr, will be investigating the effect of rocks coated with a metallic precipitate (manganese oxide) on macroinvertebrate density and diversity. This will be done by sampling invertebrates from uncoated and coated rocks in the River, collecting invertebrates from rock baskets with uncoated and coated rocks, and an in-lab experiment introducing aquatic insect larvae to tanks with different type of substrate to determine if larvae avoid coated rocks if presented a choice.

A graduate student, Nicole King, is studying how much terrestrial predators living along streams vary from small headwater streams to large rivers and how much of their diets are provided by aquatic insects. Composition of aquatic insect communities will be determined along a stream size gradient by sampling in aquatic habitats and using traps to collect adult aquatic insects as they emerge from the streams. In addition, potential insect prey, spider density, and terrestrial predator composition will be evaluated through riparian surveys and pitfall traps.

Lizzie Walters and Hannah Bohr use the boat as a floating laboratory table as they process benthic samples from the West Branch Susquehanna River.

The Impact of Dams

Dams are barriers built to restrict the flow of water and retain a pool of water. To most people, they are a "necessary" addition to many waterways. Dams allow people to produce electricity, control flooding, and divert water for irrigation. The pools formed behind the dam provide areas for recreation, such as fishing, boating, paddling, and wildlife watching.

However, there is growing awareness of the negative impacts of dams on waterways. They create barriers that trap sediments and pollutants and prevent mussels, eels, and fish from migrating up and down the waterway. Many of these are ecological impacts hard to see at first, but their impact on the aquatic life of the Susquehanna River and Chesapeake Bay are becoming more evident.

Historic Uses of Dams

Dam construction in the lower Susquehanna watershed began in the 1600s. European settlers built them on small creeks and tributaries to power grist mills and saw mills. Later hammer and boring mills were constructed for the iron and steel industries. Powered by small streams with a mill dam, the dams backed up the water to both create a constant source of water that could be controlled and to sometimes create enough velocity for the water to turn the gear, or wheel, of the mill.

Between 1730 and 1900, over 450 mills of some type were built on Lancaster County streams (Landis, Ira, D., 1964. Old Mills Lancaster County. Community Historians Annual. Franklin and Marshall College Library). Many of these mills operated until the mid-1900s. A large number of these dams remain in place and are not regulated by either the Commonwealth or federal government. They can be a hazard to canoeists trying to navigate the stream. Many of the dams are washed out during large floods. This allows vast quantities of sediment trapped behind the dam to move to downstream reaches of the waterway.

By 1850, the lumbering era swept across the northern tier of the Susquehanna watershed. Numerous dams were built on local streams and rivers to allow for logs to be floated downstream to the sawmills along the river. Splash dams were "temporary" dams built on small creeks and streams to raise water levels. When the water had sufficiently built up, the dam was released and the rush of water would help float logs downstream.

In 1908 it was reported 8,000,000 board feet was released in a single log drive by a single splash dam (Taber III, Thomas

T. 1972. Sunset Along Susquehanna Waters: Williamsport, Leetonia, Slate Run, Cammal, Glen Union, Gleasonton. Lycoming Printing Company). It would have taken a large volume of water to move those logs.

Splash Dam on Six Mile Run

Some of the dams constructed during the lumbering era stayed on the waterways long after the last log drives. The dams continued to restrict the flow of water and created recreational pools of water for boating, fishing, and other water sports.

The Hepburn Street Dam in Williamsport is a large example of this. The dam was originally constructed to help control water levels in the West Branch Susquehanna River for the sawmills and log rafts that lined the River's bank. After the lumbering era ended, the dam remained. In the early 1980s the still wooden dam was replaced with a concrete structure, maintained today to allow for recreational boating on the River.

Brief article on the Hepburn Street Dam from a 1971 edition of the Williamsport Sun-Gazette newspaper.

According to a 2005 report by the American Society of Civil Engineers there were over 79,000 dams of various sizes in the United States. These dams were used for water storage, flood prevention, hydropower generation, irrigation, industrial use, or for recreational use. Most of these dams were built before scientists were aware of the negative impacts from dams. These potentially negative impacts range from changes in the waterway's channel to the inability of aquatic species to reproduce. These negative impacts can be far reaching and should be fully considered when making decisions related to dams and other, similar water obstructions.

River Morphology

Dams change the hydrologic and ecologic processes of rivers. They slow the water velocity, movement of sediment, and the overall shape of the river's channel. Scientists who study these physical processes use terms such as "river morphology" and "fluvial geomorphology" to describe the shape of a waterway's channel and how the channel changes over time.

A waterway's morphology is a function of many things:

- The composition and erodibility of the streambed and streambanks
- The types of vegetation found in the waterway and in the riparian buffer
- The vegetation's rate of growth impact
- The availability of sediment
- The size and composition of the sediment
- The rate the sediment moves through the system
- The rate sediment is deposited in the system's streambed, streambank, and floodplain
- The geological form of the watershed
- The flow regime of the waterway

The channel below the dam often becomes incised, with very steep, straight banks. This incision is a result of the eroding action of a confined stream of water. In an undammed waterway, the water flows downstream, but can shift side to side as it needs. When water is coming off, or out of, a dam it can only take one path.

An incised channel continues to erode, getting deeper and more incised. The material found on the bottom of the channel change too. Smaller rocks, pebbles, and other fine material are washed away until only large rocks or bedrock remains. This physical change in structure of the streambed leads to changes in the aquatic organisms that can live here.

Dr. Ben Hayes, member of the Susquehanna River Heartland Coalition for Environmental Studies, is a geomorphologist. Dr. Hayes and his colleague, Dr. Craig Kochel have researched the history of some of this region's waterways, and spent many hours in the field during the flooding in the Fall of 2011. The data they gathered is being used to better understand the process and morphology of local streams and river. For more on Dr. Hayes's current work, visit page 5.

Many organisms need different habitats during their life cycle. Eggs deposited in pebbles hatch and need larger rocks for food (they eat the plants and algae that grow on the rocks) and cover. As this small fish get bigger they need bigger food and different cover. Having a variety of habitat types in a stream reach helps ensure diverse aquatic life in the stream.

Sediment and Debris Build Up

As the flowing water slows down when it enters the pool behind a dam, sediment suspended in the water drops out and piles up behind the dam. In addition to components necessary for a healthy and functional ecosystem, such as dissolved oxygen and carbon, the sediment is often loaded with chemical containments such as pesticides, mercury, lead, and petroleum hydrocarbons.

Often the only way the sediment leaves is during a flooding event when it becomes stirred up again and is flushed out from behind the dam. When a dam is repaired or being removed, workers must be careful to not remove or release too much sediment at once. If a large amount of the trapped sediment is released at once there may be issues with the sediment blocking the gills on aquatic life, or depositing downstream on rocks where aquatic insects and plants live. If the flow of sediment is thick enough it may cover, and kill existing plant communities.

While too much sediment all at once is bad, plant communities do need a certain amount of sediment. Native Americans recognized this and put their crops in the fields on the river and creek bottoms. The spring floods would bring in sediment, or silt. That sediment would not be as depleted as the existing soil, and another year's crops could flourish.

If a dam restricts the flow of sediment, by trapping sediment behind the dam, it also prevents downstream areas from receiving enough sediment to replenish the soil of riparian areas. This can be a problem for agricultural producers as well as natural plant communities.

Trapping sediment behind a dam may seem like a great way to remove sediment and help clean-up the water, but in reality, it starves the stream channel of nutrients and limits growth of natural life below the dam. Creeks, streams, and rivers allow inorganic and organic materials, such as nitrogen and phosphorus, to move from terrestrial areas, on the waterways banks, to the oceans. Dams interrupt this process.

Leaves, twigs, branches, and other organic debris provide aquatic organisms, including fish, with food. If this material gets trapped behind a dam, the downstream sections of the waterway may be missing an important piece of the food web. The aquatic life in the rest of the food web will suffer.

Dr. Ahmed Lachab, member of the Susquehanna River Heartland Coalition for Environmental Studies, is studying the sedimentation of smaller lakes in Snyder County. For more information about Dr. Lachab's research, visit page 11.

Natural Processes Interrupted by Dams

Because dams are designed and intended to restrict the flow of water they also typically restrict the flow and cycles of aquatic life. The plants and animals that live in river systems have adapted to the cyclical conditions they experience – cold temperatures in the winter, high flows in the spring when snow melts off, less water and warmer water in the summer, and the cooling water in the fall.

Probably the most well known example of dams interrupting the flow of aquatic life in Pennsylvania is the American shad *(Alosa sapidissima)*. American shad were once one of the most valuable commodities of the region. The fish provided a food source for many communities.

As an anadromous fish, shad spend most of their adult life in saltwater, but need fresh water to reproduce. The American shad found in the upper Susquehanna and West Branch Susquehanna River spawn in early Spring. The eggs hatch and the shad fry (juvenile shad) stay in the creek or river it was born in until the next fall. Then, the young head downstream to the Atlantic Ocean. They spend most of their adult life here. When they are ready to spawn, or reproduce, they head out of the Atlantic Ocean toward the creek or stream they were born in.

Unfortunately dam construction has sectioned the river off, preventing travel by migratory fish. Most of the dams on the Susquehanna River and West Branch Susquehanna River lack functional fish passages. Some fish may survive going downstream, over the dams, but the adults trying to move from the Atlantic Ocean to fresh water to spawn are in trouble. Any structure over one foot high can hinder a shad's ability to pass upstream.

Another fish that needs to migrate in and out of the Susquehanna River Watershed is the American eel *(Anguilla rostrata)*. The American eel once represented twenty-five percent of the Susquehanna River's biomass, but now represents only one percent. This decrease in American eel population also has impacts to other forms of aquatic life in the Susquehanna Water.

A mussel native to the Susquehanna River, the *Elliptio complanata* (Elliptio for short), is also feeling the effects of the decrease in the American eel population. Elliptios use the American eel as a host during the larval stage of

Field workd being conduced on the Susquehanna River mussels.

their life cycle. Without the eel present, development of the young mussels can be hindered or stop all together.

This is bad for the species, but also for the creeks' and rivers' water quality. Mussels pull water in through their inhalant siphon and filter it through their gills. The mussels absorb some of the chemicals and pollutants in the water, and filter bacteria, algae and other small particles out before expelling the water and any waste. The low numbers of mussels in most of the Susquehanna River's watershed is being studied for the possible affect on water quality. *(See information about Bucknell's mussel research on page 3.)*

In 1976 the Susquehanna River Anadromous Fish Restoration Committee was formed. The group began looking at how dams were impeding the passage of fish like the American shad and American eel from the Atlantic Ocean to the creeks, streams, and rivers in this region. Dams on the lower portion of the Susquehanna River began installing fish passages. By 2000 Holtwood, Safe Harbor and York Haven all had fish passages complete. The next dam up the Susquehanna is the inflatable dam at Sunbury, known as the Adam T. Bower Memorial Dam. The dam is owned, operated, and maintained by the Pennsylvania Department of Conservation and Natural Resources' Bureau of State Parks as part of the Shikellamy State Park. Progress is being made on installing a fish passage here.

The plants that live in river systems and along the riparian edges also face challenges when the normal water cycle is interrupted by a dam. Plants in riparian zones are highly diverse. These plant communities are shaped by flooding which creates disturbance and can help plants spread by moving seed sources downstream. If the flooding lessens it can reduce the plant diversity downstream. The constant water in the pool behind the dam can also have a negative effect on plants and plant communities. The deeper water reduces the sunlight and cools the water, causing unfavorable conditions for some aquatic plants.

The water behind a dam is flowing much more slowly which changes the amount of oxygen and disturbance in the water. This lack of oxygen and movement in the water can also impact the plant life (and animal life) that can survive behind the dam.

Other plants need both the flood water of spring, and the drier, sunny summer days for their life cycle. The constant water in a dam pool hinders their ability to survive, let alone thrive.

Water Temperatures

The water in the pool behind the dam will typically warm-up from the sun exposure. Flowing water tends to be fairly uniform in its temperature. Water that isn't moving tends to warm-up more on the top and develop "layers" of temperature.

The top section of the water is the warmest because it receives the most direct sunlight. The middle layer is more temperate, while the bottom layer is the coldest. Often this layer is colder than the water flowing into the pool.

Aquatic organisms have developed to tolerate certain temperature ranges. When water temperatures go above or below this range, the organism begins to experience physiological stress. How long they can sustain this stress depends on how close the temperature is to the lethal level for that organism.

As water temperatures increase, the amount of dissolved oxygen decreases. Higher temperatures affect the solubility of dissolved oxygen. This decrease in dissolved oxygen is happening at the same time the organism's metabolism, respiration, and oxygen demand increase. So, a fish is stressed due to warmer temperatures and needs more oxygen. The water is warmer and therefore has less oxygen than normal. The fish becomes more stressed – higher temperatures compounded with less oxygen.

Another problem aquatic organisms experience when water temperatures go up is with toxic substances. The solubility of many toxic substances is increased and intensified as water temperatures go up. Some of these substances include cyanides, phenol, xylene, and zinc. Again, a high stress situation, warmer water, is being compounded by the increased solubility of toxic substances, further stressing the population.

Different life stages of the same species can have different tolerance ranges. Spawning and egg hatching are typically happening in the spring or fall when water temperatures are cool. If the water is too warm, the eggs may not hatch.

Aquatic insects are just as sensitive as fish to water temperatures, if not more sensitive. Water temperature is one guide to insects as they progress through their metamorphosis and change from one life stage to another. If the water temperature is too warm, they may progress too rapidly. At the same time, if the water temperature is too cold because they are stuck in the bottom of pool, they may not progress fast enough.

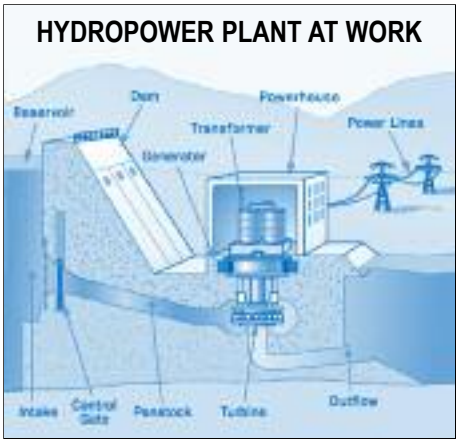
These effects can also be seen in the stream segments just downstream from a dam. The warm water leaving the dam can increase the water temperatures below the dam. The aquatic organisms in the stretch of river feeling this thermal impact are affected, just as those organisms in the dam pool.

If they can, the organisms that cannot tolerate the temperature range will often leave the area, retreating to areas with more tolerable temperatures.

Plants can't retreat however. Aquatic plants photosynthesize below the surface and contribute to the oxygenation of the water and consume carbon dioxide. They provide a rich habitat that provides food and shelter for other aquatic organisms. Some species of aquatic plants are fairly exacting in their requirements for water temperatures, depth of water, and physical properties of the bottom. If the water is too warm or too cold, the plant may not be able to tolerate the conditions and die. Some plants may not reproduce, or they may progress through their growth stages too fast, or too slow.

Benefits from Dams

The problems created by dams listed above are complex and not easy to resolve. While dams cause environmental problems, they also generate electricity, provide flood control, create areas for recreation, and can be used to store drinking water.



A hydro electric plant that produces electricity has three parts, an electric plant, a dam, and a reservoir. Water being stored in the reservoir, behind the dam, flows through an intake and pushes against blades in a turbine, causing them to turn. The turbine spins a generator, and electricity is produced. Hydroelectric power provides nearly one-fifth of the world's electricity, and is the cheapest way to generate electricity. Once the dam and systems are built, the energy source, flowing water, is free.

The lower Susquehanna has four hydropower plants. They have been operating for many years. The plant at York Haven came online in 1904. Holtwood began operating in 1910. Conowingo came online in 1928, with Safe Harbor beginning operations in 1931. These dams have all seen controversy over the years, however they also provide electricity and recreational benefits.

All the dams provide some type of recreational opportunities. Fishing, boating, and nature watching are fairly standard. Some also provide "river lots" for lease, operate community pools, and provide environmental education programming. Additionally, many of the companies own land adjacent to the River and provide trails, picnic areas, and playgrounds, serving in effect as community parks.

Other dams exist solely for recreation. The Adam T. Bower dam which forms Lake Augusta in Sunbury, PA, the Hepburn Street Dam in Williamsport, PA, and the Lock Haven Dam in Lock Haven, PA are in place to provide recreational boating opportunities. Many people in these communities and from throughout the region, use the pools behind the dams to power boat, water ski, and use personal water craft. The recreational benefits feed into economic benefits as the people who recreate purchase equipment and supplies for their activities. Some communities have developed community events along these dammed sections. Sunbury's Riverfest includes a cardboard boat regatta, while the City of Lock Haven hosts a summer concert series on a floating stage in the River.

Elsewhere in the Susquehanna watershed, dams were constructed to help control flood waters. By building dams and creating large areas where water can be impounded, flood waters can be "collected" and released back into the waterway at a sustained rate. The dams in Bald Eagle State Park (Bald Eagle Creek), at Currwensville (West Branch Susquehanna River), and the Tioga-Hammond Dams (Tioga River and Crooked Creek) are all examples of flood control projects. Typically, the United States Army Corps of Engineers (USACOE) is involved in the selection, design, and construction of the projects. Often, USACOE then manages the sites after construction, however the project at Bald Eagle State Park was turned over to the Commonwealth of Pennsylvania who is the lead partner in managing and maintaining the facilities.

Dam Removal

While the four hydropower dams on the lower Susquehanna are maintained and operate under federal and state regulations, many dams have outlived their usefulness. As mentioned before, many of these dams are not maintained and are unregulated.

The Pennsylvania Fish and Boat Commission (PFBC) has been working with various partners for several years now to remove dams that are no longer needed and are having negative impacts on a waterway's aquatic life. PFBC works to not just remove the dam, but to restore the stream's natural habitat through stream enhancement projects.

Due to PFBC's efforts, as well as other organizations, Pennsylvania removed more dams in 2012 than any other state. The 13 dams removed in Pennsylvania in 2012 brought the total number of dams removed in Pennsylvania since 1997 to 211. While dam removal is not the best choice in every situation, it can be the best choice in many situations.

Conclusion

Dams change the ecological function and form of a waterway. The impacts are complex and the solutions to remedying these impacts are even more complex. The research being undertaken by many members of the Susquehanna River Heartland Coalition for Environmental Studies is examining the water quality of various waterways in the region. This research helps document current conditions and track change over time. As projects develop to maintain dams or add fish passageways to existing dams this data can be used to help make decisions related to those projects and track the impacts from those projects.

Education, Outreach & Health

Newsradio 1070 WKOK

Newsradio 1070 WKOK and **WKOK.com** continue with a daily focus on local and global environmental issues, the Susquehanna River and a wide range of issues talked about by the Susquehanna River Heartland Coalition for Environmental Studies.

The status and health of the Susquehanna River and the Chesapeake Bay is a focus for WKOK. In January WKOK had the pleasure of talking to John Arway, Executive Director of the Pennsylvania Fish and Boat Commission, along with River Biologist Geoff Smith. The two came to the radio station for a sit down conversation about river impairments, water quality and disease that has hit the river's fish. In addition, we welcomed Harry Campbell, Pennsylvania Executive Director of the Chesapeake Bay Foundation who discussed land and water restoration, recreational activity and the health of local waters.

Some of our other guests have included Dr. David Minderhout of Bucknell University, talking about Native Americans, past and present, in the valley. Katie Faull, also a Bucknell University professor, is an occasional guest who keeps us up to date on the history of the Susquehanna, as well as the river being designated as part of the Captain John Smith Chesapeake National Historic Trail.

WKOK reporters have also had the chance to go on scene for a number of environmental stories. We had the chance to visit Little Shamokin Creek and discuss the restoration efforts underway at that location. We have also been on scene as the fabridam was inflated, along with various construction, updates and openings of riverfront activities in Sunbury.

Earlier this year WKOK's Mark Lawrence received a first place Pennsylvania Associated Press Broadcasters Association award for his Roundtable program entitled "River Rats." The program featured two local self-proclaimed "river rats" who talk about the decline in river life, but why, with help, the Susquehanna River can still be a good fishery.

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. There are many opportunities for collaboration and student involvement in these projects and several Bucknell University students will begin working with us soon. The EHI is currently involved in five primary projects:

- With funding from the National Institutes of Health, we are evaluating the relation of the food, land use, physical activity, and social environments in over 1200 townships, boroughs, and cities with body mass index among over 170,000 children.
- As part of the PhD dissertation research of Ann Liu, now completed, we examined relations of the burden of abandoned coal mine lands with community and individual impacts, the latter consisting of hemoglobin A1c levels in diabetes patients. Two papers have now been published about this work:
    1. Liu AY, Curriero FC, Glass TA, Stewart WF, Schwartz BS. Associations of the burden of coal abandoned mine lands with three dimensions of community context in Pennsylvania. *ISRN Public Health* 2012; ID 251201, 11 pp.
    2. Liu AY, Curriero FC, Glass TA, Stewart WF, Schwartz BS. Burden of coal abandoned mine lands and severity and progression of type 2 diabetes in Pennsylvania. *Health & Place* 2013; in press.
- We are examining the epidemiology of chronic rhinosinusitis, a common condition associated with considerable morbidity, with many links to environmental exposures, in collaboration with investigators at Northwestern University and the University of Chicago.
- The relation of Marcellus shale development with a number of health outcomes, including asthma, adverse pregnancy outcomes, cardiovascular disease, and cerebrovascular disease. We have received some pilot funding to get studies started and are continuing to prepare grant applications for other funding.
- We continue to make progress in our study of methicillin-resistant *Staphylococcus aureus* (MRSA)

and the relation of MRSA infection with animal feeding operations. This is the dissertation research of fourth-year PhD student Joan Casey. We found that residential proximity to high-density livestock operations and to crop fields to which manure was applied was associated with increased risk of MRSA infection (paper submitted for publication). In addition, we completed molecular typing on 200 MRSA isolates from patients and preliminary results link certain isolate features to livestock operations.

The spatial distribution of patients with specific isolate types (compared to controls) is in the Figure. So far, one paper has been published on this work:

1. Casey JA, Cosgrove SE, Stewart WF, Pollak J, Schwartz BS. A population-based study of the epidemiology and clinical features of methicillin-resistant Staphylococcus aureus infection in Pennsylvania 2001-2010. *Epidemiology & Infection* 2013; 141: 1166-79.

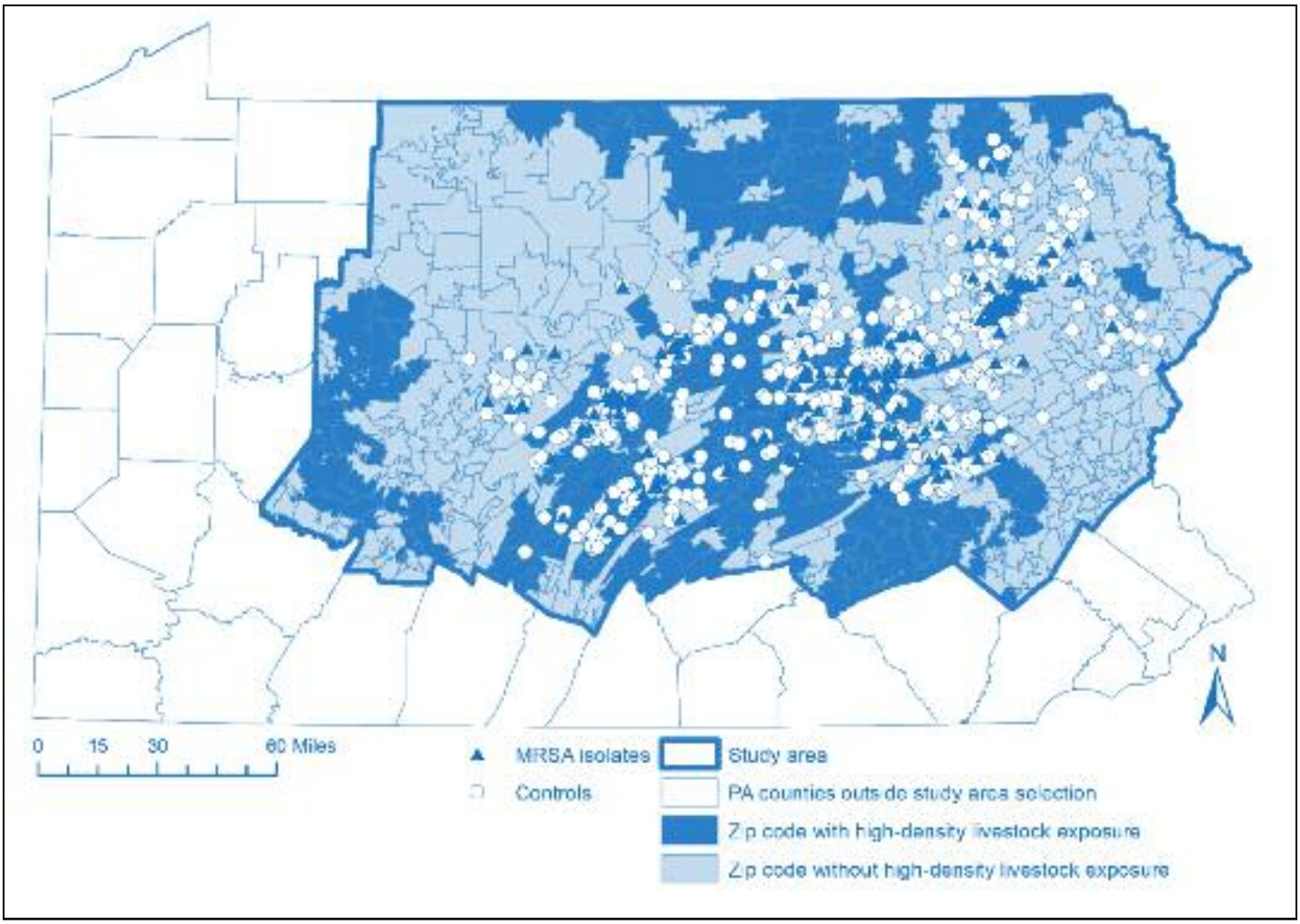


Figure.
The spatial distribution of MRSA isolates from infection patients (and controls) in Pennsylvania. The three primary MRSA isolate types that were evaluated in relation to animal operations were: community-onset negative for Panton-Valentine leukocidin toxin; isolates negative for the *scn* gene; and community-onset *spa* type t002 (figure prepared by Joan Casey).

Humanities

Dr. Alf Siewers

Associate English Professor
Bucknell University

Dr. Katie Faull

Dr. Al Siewers is working in collaboration with **Dr. Katie Faull** to release another book in the series *The Stories of the Susquehanna*. Dr. Siewers and Dr. Faull created the series to develop "interdisciplinary and multimedia approaches to the concept of region, place, and ethics in environmental studies." The volume currently being developed will focus on the Shamokin Dam area as well as life in a coal town.

Dr. Siewers is also an Affiliate Faculty Member of Bucknell's Environmental Studies Program. In this role, Dr. Siewers is working with two students this summer on research projects.

Abagail Mills

Abagail is researching the local conservation culture around the Susquehanna headwaters at Cooperstown, NY. She's examining the relation between the legacy of the Cooper and Clark families, environmental literary narratives, and community philanthropy there in preserving and restoring ecology.

Courtney Nelson

Courtney is studying the neighboring late eighteenth century communities of French Azilum and the Pantisocracy near Wyalusing, PA on the Susquehanna River. French Azilum was a settlement intended to harbor French aristocrats, fleeing the French Revolution. The Pantisocracy is the term associated with large landholdings of Joseph Priestley and his son. They were initially motivated to create a refuge for European intellectuals devoted to liberty. Both communities represent a strain of utopianism that marked the Susquehanna valley in the days of the early American republic, which set the stage for industrial development in the nineteenth century.

Dr. Brandn Green

Director of the Place Studies Initiative (PSI)
Bucknell University's Environmental Center

Faculty, students, and community members work in partnership with the PSI to undertake and support research within the social sciences and environmental humanities that examines the nature and role of "place" in the human experience. PSI's purpose is to facilitate and encourage investigation of the human dimensions of environmental issues through an array of projects located within three focus areas: Environmental Justice and Public Health; Environmental Humanities; and Sustainable Communities.

PSI is interested in working to address inequalities in exposure and health assets. By collaborating with local hospitals and health clinics, the initiative provides research internships for students interested in community public health. In addition, students and faculty actively engage in chronicling the health impacts of natural resource extraction legacies in the region. One current project in the Central Columbia School District involves assessing the impact of a new high-school track on the health of residents in the surrounding community.

PSI also is interested in connecting people and places through innovations in humanities research and outreach. At the leading edge of digital humanities initiatives at Bucknell University, faculty and students working on the environmental humanities view "place" as a central category in poetry, oral history, creative nonfiction, theatre, music, and archival scholarship. Their marquee projects are the "Stories of the Susquehanna Valley" book series and the Summer Writer's Institute for students. In the spring of 2013 PSI was instrumental in the presentation of "Same River," a multimedia exploration of the impact of Marcellus Shale development that included social science research, dance, music, and theatre.

The PSI also is helping to facilitate sustainable communities. "How do we build towns that will be viable in the future?" This question drives their research and outreach in a focus area that incorporates an eclectic group of scholars and community members. One current project includes developing a regional Blighted Housing Survey, investigating Asset-based Community Development in Sunbury, and creating a Field Studies Lab on Bucknell's campus that supports place-based research across the social sciences and humanities.

A.G."Jerry" Wemple

Professor
English & Creative Writing
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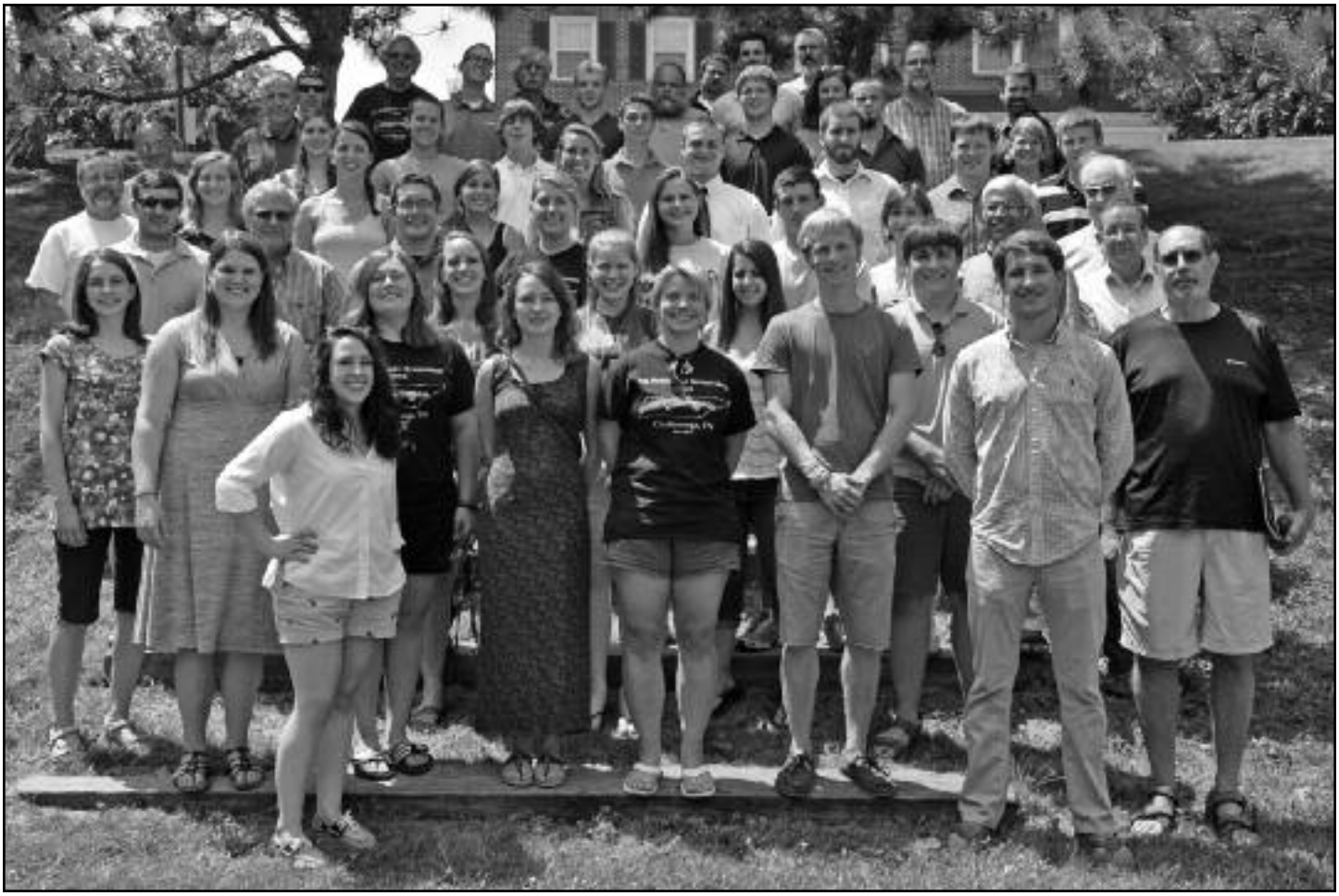
A.G. is currently working on the sixth annual "Watershed: The Journal of the Susquehanna." The publication includes historical and first-person essays, poetry, fiction, and photography. The Journal's purpose is to promote the Susquehanna River and its watershed by looking at its culture and environment through various lenses. This year, Wemple and intern Erik Kile, a senior Creative Writing and Studio Art major at Bloomsburg, are simultaneously modernizing their project and going green. They are creating digital copies of the Journal to distribute through USB flash drives.

For more information, or to submit work for consideration, contact **Professor Wemple at jwemple@bloomu.edu**.



SRHCES professors and students gathered at Lycoming College this summer to share information about their research. The summer 2013 interns presented brief summaries of their research projects. Some of the students will be continuing their research through next year while others will be wrapping up and summarizing results this fall.

This report was developed with input and support from the members of the Susquehanna River Heartland Coalition for Environmental Studies, H. W. "Skip" Wieder, Chelsea Brewer, Miranda Giraldo and Reneé Carey.

Susquehanna River Heartland Coalition for Environmental Studies

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