Bucknell River Reporter

A QUARTERLY NEWSLETTER BY THE SUSQUEHANNA RIVER INITIATIVE

Vol. 1, Issue. 2 BUCKNELL UNIVERSITY ENVIRONMENTAL CENTER SPRING 2013

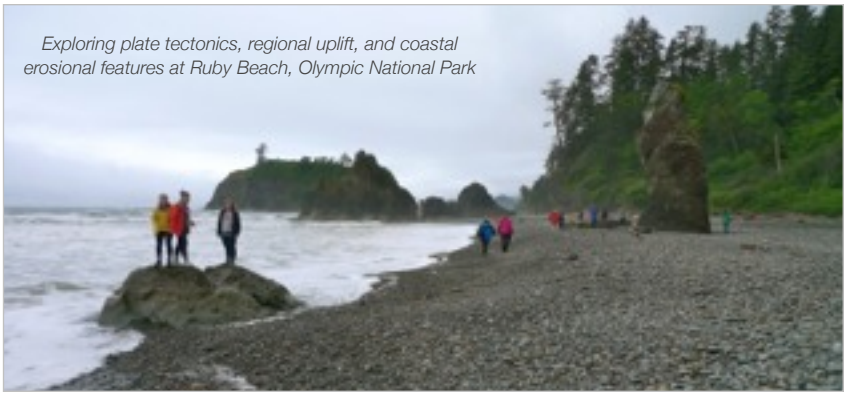
Teaching sustainability from a watershed perspective

By Dr. Benjamin R. Hayes, Susquehanna River Initiative Director

Bucknell on the Susquehanna (ENST 291) is an interdisciplinary, field-intensive, watershed-based course developed by the Susquehanna River Initiative to teach watershed sustainability, cultures and landscapes, and global change. In May and June 2012, twelve students and three faculty spent 21 days traveling from the forested headwaters to the coastal areas of the two largest estuaries in the United States: the Susquehanna and the Chesapeake Bay and the Olympic Peninsula and Puget Sound. We explored the societal, economic, and environmental aspects of sustainability involving real-world problems in these watersheds and met people achieving lasting change.

We hiked, sailed, paddled, and swam. We touched glaciers and held baby shrimp and salmon. We met with Native American leaders, dredged for oysters and ate fish, crabs, and mussels. We explored beautiful forests, mountain streams, marshes, and and coastlines. We compared and contrasted declining populations of shellfish, salmon, herring, and shad. We studied green architecture, urban stormwater management, roof-top agriculture, stream and wetland restoration, fisheries management, and innovative economies that provide more sustainable alternatives. Students found it life-changing, and reflected on their experiences in both paper journals and online. You can view the course Flickr™ photos, Twitter™ feeds, Facebook™ posts, and Tumblr™ articles at:

`www.eg.bucknell.edu/sri/teaching/enst291.php`



Exploring plate tectonics, regional uplift, and coastal erosional features at Ruby Beach, Olympic National Park

The river: Still in the news!

Fortunately, there have been no large-scale floods, pollution events or other catastrophes recently on the River, but smallmouth bass melanosis, a condition popularly known as "blotchy bass" or "black spot," and the "impaired" (or not impaired) status still makes the news, along with reports from a wide range of observers. The sides to an issue, of course, equal the number of discussants!

One must wonder how the decisions now being made or the practices currently accepted will affect "The River" in the future. You may have noticed Dr. R. Craig Kochel's premise in the previous issue that we are still seeing the effects of the rapacious logging that made Williamsport the home of millionaires. And one might be tempted to wonder if the scenario may not be repeating itself in the natural gas boom, the extent of which remains to be seen.

Now that we are presumably mitigating abandoned mine discharge, another by-product of Pennsylvania prosperity, we are faced with the matter of *"chemicals of environmental concern."* These chemicals from various inorganic compounds are not unique to Pennsylvania. But since "The River" is likely to transport many of them, everyone who lives near it, or drinks water from it, or recreates in it, should have some concern.

In this issue, we feature such diverse topics as the undergraduate course "Bucknell on the Susquehanna," a brief overview of fish and human interaction with the river, and a *Diving Deeper* article by aquatic ecologist Dr. Matthew McTammany on his research into its invertebrate benthic microorganisms.

As always, we include internet links for those who want more detailed information; we urge you to use them! For more information visit us at:

`www.eg.bucknell.edu/sri/`

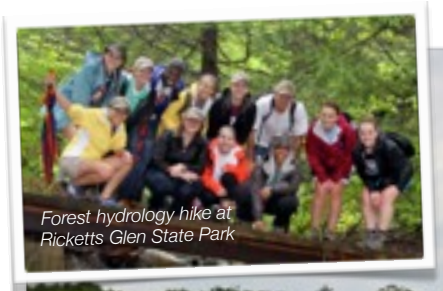
Dr. Fred Swader
Editor

SUSQUEHANNA RIVER INITIATIVE

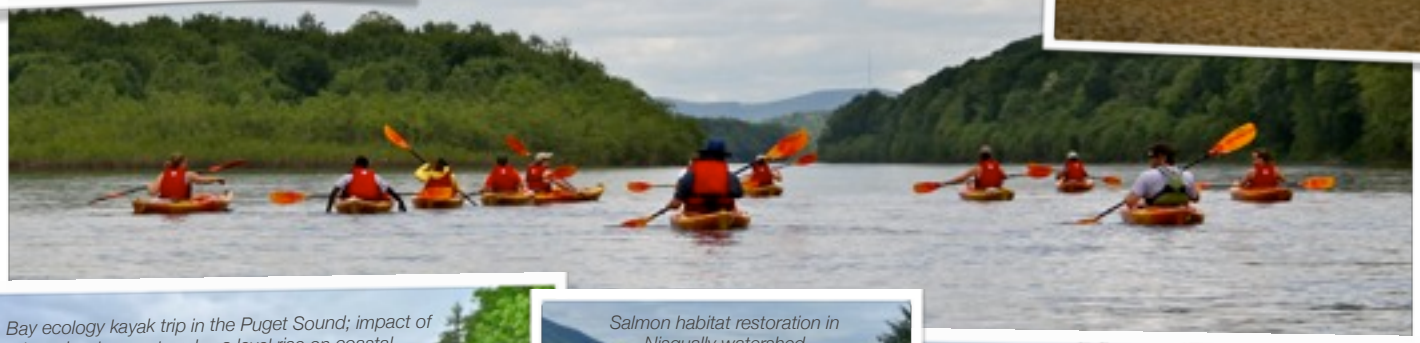
Bucknell UNIVERSITY ENVIRONMENTAL CENTER

Bucknell on the Susquehanna (ENST 291)

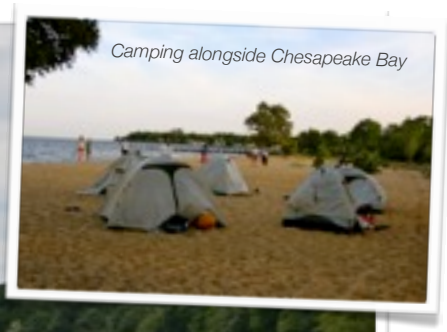
Watershed sustainability from the Susquehanna and Chesapeake Bay to the Olympic Penninsula and Puget Sound



Forest hydrology hike at Ricketts Glen State Park

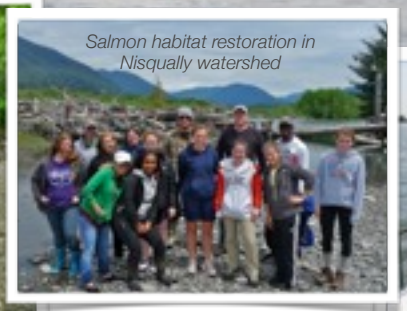


River ecology and geology kayak trip down the West Branch Susquehanna River



Camping alongside Chesapeake Bay

Bay ecology kayak trip in the Puget Sound; impact of urban development and sea level rise on coastal communities

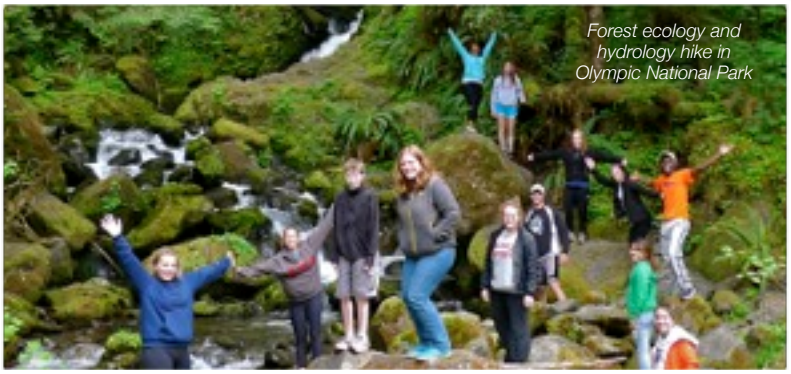


Salmon habitat restoration in Nisqually watershed

Studying bay ecology on skipjack sailboat on the Chesapeake Bay

Natural hazards; salmon habitat restoration; glaciers and global warming hike in Mount Rainier National Park, WA.

Oysters and commercial fisheries at Taylor Shellfish, Puget Sound



Forest ecology and hydrology hike in Olympic National Park

[Photos: Ben Hayes]

Bucknell River Reporter

Vol. 1, Issue 2 (Spring 2013)

Published quarterly by the *Susquehanna River Initiative*, which is devoted to creating new teaching, research, and outreach activities that connect students and faculty to the Susquehanna and to helping monitor and improve the health and sustainability of our watershed.

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Seeing the river up close and personal

Editorial

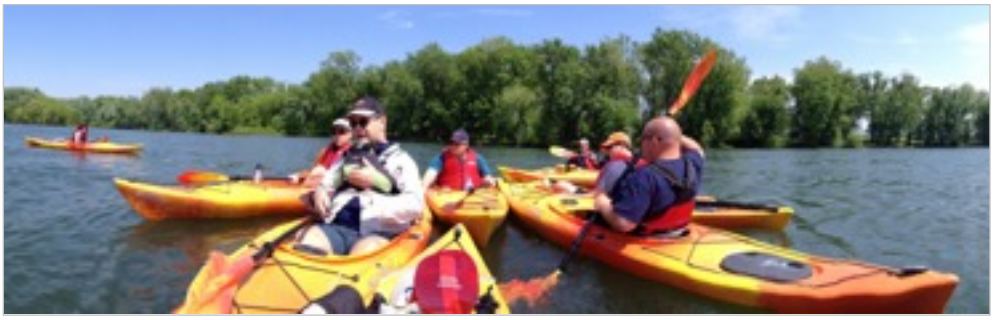
By Fred Swader, Ph.D., Faculty Associate

Perhaps you've seen the Viking River Cruise advertisement on public television extolling the *"Splendor and magnificence of European rivers."* It features a beautiful river scene with fall foliage ablaze with color, and a magnificent castle overlooking what might be the Main or the Rhine river in Germany.

Discussing ongoing aquatic ecology and fluvial geomorphology studies as we float downstream. [Photo: Ben Hayes]

Because of its bedrock gorge and fall line in its lower reaches, the Susquehanna, is not suited to the large cruise ship industry on the scale depicted in the ads. This is a fortunate situation, because there are not likely any facilities on the river that could handle the wastes from such enterprises; and because we need not fear wake (or collision) damage from all the associated river traffic that would be here if the river supported it. Besides the delightful and historic Hiawatha paddle boat cruise on the West Branch upstream of Williamsport, Carnival and Viking River Cruise Lines probably won't show any interest in the Susquehanna.

At the same time, I wonder whether we really "see" the river in the absence of guided tours and cruises: many people, (myself included) usually have only a limited view of the river as we look over solid barriers on the bridges (most likely installed to prevent gawking at the river while driving). Combined with the need to monitor our driving at the same time, we are lucky to obtain a brief glimpse of the corpus of the river — the water. And, unless it is threateningly high (or low); the condition of the river seldom registers anything more than "yep, it's still there!"



Civil and Environmental Engineering Professor Donald Duke discusses historic flood policies and the traditional use of dams, levees, and other structures to reduce impact flooding on towns along the Susquehanna River. [Photo: Ben Hayes]

A May 2013 educational kayak sojourn sponsored by the Susquehanna River Initiative re-introduced me to the power and the majesty of the river. As a life-long canoeist and boater, my Old Town Dirogo 12-ft kayak felt like the sports car equivalent in self-powered watercraft — light, fast, maneuverable, and close to the water surface. I felt more sensitive to the current and the wind, and intimate with surface waves and ripples: they look much bigger when you're lying flat on the surface of the water!

After a pleasant and informative trip from Milton State Park, we arrived at "Bucknell Landing," a docking facility that did not exist the last time I boated in the Bucknell channel. It was a unique experience — I'm glad to have participated, and to have become at least casually reacquainted with the river. But it made me wonder about you: when was the last time, if ever, that you "saw" the Susquehanna up close?

Fortunately, there are several options for seeing the river, such as the seasonal ferry at Millerstown, paddle boats at Williamsport and Harrisburg, and canoe or kayak excursions from a number of local outfitters. (You might even have a neighbor with a boat and access to Lake Augusta!) Any of these will provide a safe way to experience the river.

The point is that the river is a unique resource and experience — and there are many ways to experience it. There's no better time than right now — or sometime during the next three months — to do it!

So I urge you to try it! And, as they say in the travel magazines, " 'someday' usually means 'never'," so make firm plans

Diversity and Variability of Benthic Macroinvertebrates in the Susquehanna River(s)

By Matthew E. McTammany,
Associate Professor of Biology and Environmental Studies

Explaining patterns of diversity, distribution, and density of organisms is a fundamental pursuit of ecology. Unfortunately, organisms from large rivers like the Susquehanna River are relatively understudied due to difficulty sampling in deep, flowing water, particularly using methods developed for shallow streams. However, large rivers are significant components of our landscape, connecting headwater regions to downstream water bodies and integrating a number of geological and land-use changes along the way.

Organisms in rivers respond to these external influences and can be useful in understanding human effects on the environment, but only if their natural patterns of diversity and density are known. In addition, large rivers are geomorphically complex and therefore might contain unique communities and extensive variability in density and diversity of organisms (collectively referred to as "community structure") within their banks. These patterns in community structure might be in response to physical and chemical conditions in different locations, availability of different food resources, or interactions between benthic communities (e.g., organisms from a tributary upstream drifting into the river).

For the past three years, students from my research lab have been exploring various aspects of the benthic macroinvertebrate community in the Susquehanna River to answer basic questions about their diversity and abundance. We've sampled from dozens of locations and identified thousands of benthic macroinvertebrates from hundreds of different genera. The patterns emerging through our studies inspire me to understand the processes that determine benthic macroinvertebrate community structure in our local river system.

Figure 1. A freshly-hatched mayfly adult emerges onto the surface of the Susquehanna River and prepares to fly off in early May. [Photo: Ben Hayes]

Differences between rivers

Our explorations initially involved assembling a database of benthic macroinvertebrate information collected by government agencies (PA-DEP, NY-DEC, SRBC, USGS) over 20 years, with the help of Mike Bilger (EcoAnalysts, Inc., Selinsgrove, PA), to identify broad spatial and temporal patterns of diversity. This database revealed several patterns in the river:

(1) benthos was dominated by Ephemeroptera (mayflies) and Trichoptera (caddisflies), comprising over 50% of the benthic community at all sites and over 90% at some sites;

(2) a small number of taxa (*Hydropsyche*, *Cheumatopsyche*, *Maccaffertium*, and *Isonychia*) were abundant at all sites;

(3) each river (West Branch, North Branch, mainstem) contained taxa that were not found in other rivers; and

(4) human activities caused several changes to the benthic community over the 20-year period of record, some intentional (e.g., spraying to kill larval black flies) and some unintentional (e.g., spread of non-native Asian clams and rusty crayfish). A manuscript from this study is nearing completion to be submitted to the journal "Freshwater Science" this year.

The "river bug database" showed patterns at very broad scales, but we are also interested in patterns and processes operating at more local scales. One such interesting pattern involves the confluence of the West

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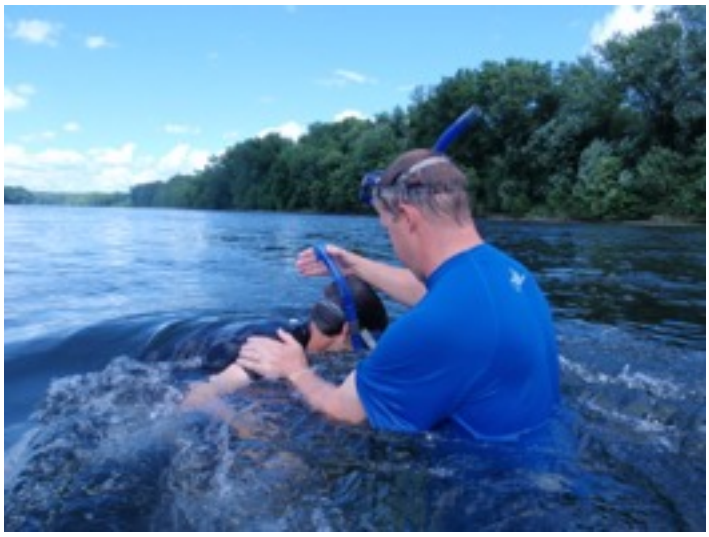
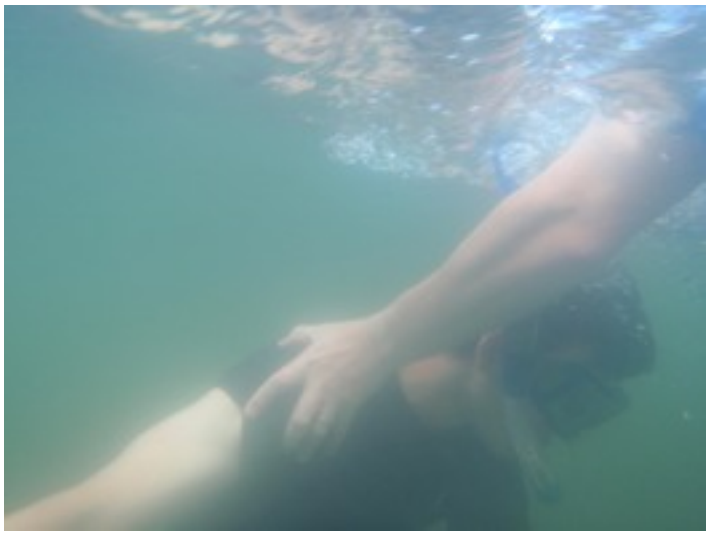
and North Branches at Sunbury and the downstream mixing (or not) of water and benthic communities from these branches. Several students (Matt Wilson, Jamie Chakany, and Haley Coffin) and I deployed rock baskets in summer 2011 (Figure 2) to collect benthic invertebrates in the West Branch near Milton, the North Branch near Danville, and the mainstem near Hummels Wharf. A new biology graduate student, Nikki King, identified invertebrates from these samples and will be presenting results from these samples at the Society for Freshwater Science conference in May 2013. Preliminary results indicate that benthic invertebrate communities at sites downstream of the confluence were structured similarly to branches upstream, depending which side of the river you are on (i.e. communities in the mainstem from the west side of the river were more similar to communities from the West Branch). This pattern could result from either differences across mainstem transects due to the lack of lateral mixing of water from the branches or longitudinal connections of benthic communities from each branch with communities in the mainstem through drifting benthic macroinvertebrates.

Figure 2. Rock basket sampler in the West Branch Susquehanna River. Benthic macroinvertebrates colonize rocks in the samplers over 6 weeks and can provide a standardized method for comparing communities across sites. [Photo: Matt McTammany]

Differences within a river

On an even more local scale, our lab has been conducting studies assessing the causes of variability within the West Branch Susquehanna River. Matt Wilson's master's thesis in biology examines interactions among riffle communities by quantitatively sampling benthic macroinvertebrates from 10 riffles along 40 km of the West Branch (from Montoursville to Lewisburg) to determine how communities might be linked across space and time via "metacommunity" processes. Matt sampled by rubbing organisms from rocks within a defined area with his hands under water that was up to a meter deep and flowing extremely fast (at times, > 1 m/s). Even with weight belts and an anchored sampler, I literally needed to hold him in place and shield his snorkel from overflowing (Figure 3). Matt's sampling must have appeared strange to those unfamiliar with benthic sampling – anyone floating by on a boat probably thought I was drowning my graduate student!





Figures 3A and 3B. Matt Wilson being held underwater while collecting a Surber sample from the West Branch in a riffle near Watsontown, PA. [Photos: Ashley Bruno]

Matt's project has yielded some fascinating information about variability in benthic communities within and among riffles. Matt found that patch dynamics, species sorting, and mass effects (e.g., from organisms drifting downstream) were important at structuring communities within riffles but that neutral processes help to explain patterns at broad spatial scales (e.g., between riffles). Processes linking riffle communities also seem to depend on dispersal ability of benthic macroinvertebrates and whether organisms are dispersing as flying adult insects or

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drifting aquatic larvae. This was particularly apparent by Matt's study of the riverine benthic community upstream and downstream of a small tributary, White Deer Hole Creek. River communities near the mouth of the tributary were significantly different from communities collected elsewhere in the river and were more similar to communities in White Deer Hole Creek. Obviously, White Deer Hole Creek has an influence on community structure in the West Branch, but whether this influence is caused directly by delivery of drifting organisms or indirectly by modifying physical and chemical conditions of the river (and producing species sorting effects) is unknown at this time.

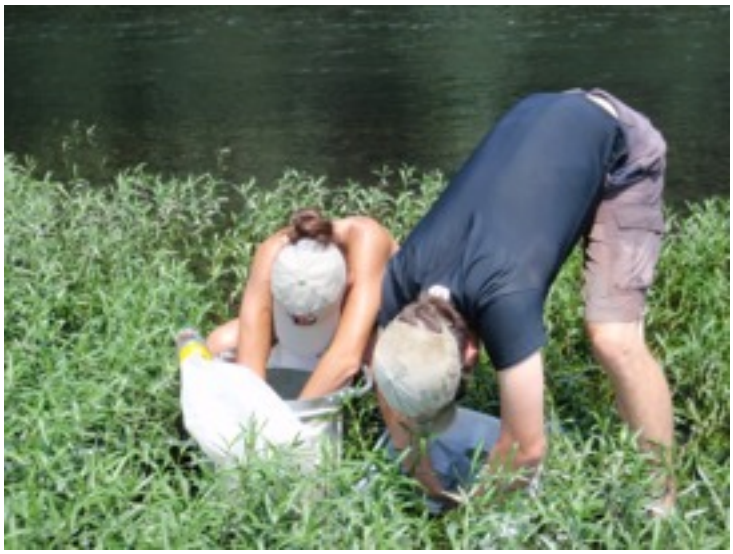


Figure 4. Ashley Bruno and Matt Wilson collecting benthic macroinvertebrates from a vegetated shoal site on the West Branch near Milton, PA. [Photo: Matt McTammany]

The lab's most local-scale study has been Ashley Bruno's senior thesis project comparing benthic macroinvertebrate communities in distinct microhabitats – shoals (shallow habitats with fast flow and gravel substrate) and backwaters (deep habitats with slow flow and sand/silt substrate) with and without emergent vegetation (*Justicia americana*, American water-willow). Sampling a variety of unique microhabitats (Figure 4) has enabled our lab to collect organisms heretofore not encountered in our studies or even any other studies of the river. To date, Ashley has found more than a dozen genera of aquatic insects and other invertebrates that were not previously recorded from the river, which inspires me to continue exploring these unusual habitats in the river in order to quantify biodiversity of the whole river community instead of riffle communities.

Looking Ahead

Our studies have thus far taken us from the macro-view of the whole Susquehanna River Basin to the micro-view of extremely localized variability in community structure among different microhabitats in the West Branch. These studies reveal extremely complex relationships between benthic communities and physical and chemical characteristics of the river. In many cases, two samples collected 50 m apart can be more different than samples collected literally hundreds of miles apart and from different rivers! But what factors drive such extreme variability? How does this variability influence the interactions between the river and the landscape? What are the implications of the patterns and structuring processes of benthic macroinvertebrate communities for bioassessment of human impacts on river water quality? My lab will continue to dive deeper into processes structuring benthic macroinvertebrate communities of the river and how these organisms connect to broader

Freshwater mussels in the river

by Sean P. Reese, Susquehanna River Initiative Aquatic Ecologist

Freshwater mussels (Unionidae) are one of the most endangered taxonomic groups in the United States. Approximately 12 species of mussels reside in the Susquehanna River. The eastern elliptio mussel *(Elliptio complanata)* was once the dominant species, but the population over the past fifty years has been declining and is suffering from a decline in young of the species, for reasons that have yet to be determined. One major factor may be the loss of the American eel from the upper Susquehanna River basin due to damming. *E. complanata* mussels are dependent on specific host fish to complete their life cycles. Since eel populations are a tiny fraction of what they were one hundred years ago, *E. complanata* have relied upon other benthic species of fish, such as the Tessellated Darter *(Etheostoma olmstedi)*, to complete their life cycle. Bucknell river scientists are helping to assess how the reintroduction of eels to northcentral Pennsylvania may affect mussel populations in the river and its tributaries.

Mussel filter feeding on the bed of the West Branch Susquehanna River near Milton, PA. [Photo: Sean P. Reese]

Fish, people, and the Susquehanna River

By Sean P. Reese, M.S., Aquatic Ecologist, Bucknell University Susquehanna River Initiative

For hundreds of years people have relied upon the Susquehanna River and its watershed as a cultural and economic resource. The dynamics and uses of this great river have changed over many years, but one aspect of use has remained constant: fishing. The fish community we see in the river today is not the same one early humans would have witnessed. Like the river itself, the resident fish community has evolved over time. Many early records talk of hundreds of commercial fisheries along the banks of the Susquehanna and the abundance of American Shad (*Alosa sapidissima*) and American Eel (*Anguilla rostrata*) in its waters.

American shad is an andronomous species of fish migrating from the Atlantic Ocean and the Chesapeake to the calm waters of the Susquehanna to reproduce. Records dating back to the late 1600s and early 1700s show that early people living along the Susquehanna relied heavily on the shad and their migration up the river as a means for survival. Today the American Shad presence in the Susquehanna is diminished due to many impediments in the river such as dams, barring the shad from migrating up stream. Dams and other blockages hindering migrating fish is not a new issue in our great Commonwealth. On November 27, 1700, Pennsylvania passed one of its first of many laws barring the construction of fish weirs stretching across rivers and streams from shore to shore; and it called for the destruction or removal of any existing structures of similar type. The issue of shad migration up the Susquehanna River waged on for over 150 years. Governor Andrew G. Curtin signed a law in 1866 to investigate pollution in mountain lakes and streams and the stopping of the spring shad runs by dams. This law brought about the formation of the Pennsylvania Fish and Boat Commission.

The **American Eel** is also hindered by dams and impediments along the river. Eels are a catadromous fish, living in freshwater for most of their lives until sexual maturity and migrating to salt water (Sargasso Sea) to reproduce. Young eels return to freshwater to start the cycle all over again. Eels too were a vital part of the commercial fishing industry in Pennsylvania. Archaeological records show that Native Americans fished for eel using baskets and weirs long before Europeans came to Pennsylvania. The relative absence of eel in the Susquehanna has an impact on the biology of the river.

Many species of Unionid freshwater mussels use fish as a host for their larval stage. Certain species of mussels are functionally dependent on a specific host fish to complete their life cycles. Mussels in locations without the specific host fish face complications with reproduction leading to a diminishing population and eventual extirpation or extinction. The Eastern Elliptio (*Elliptio complanata*) was once the dominant species of mussel in the Susquehanna drainage but in recent years has been shown to have a declining population. American eels are the main host fish for *E. complanata*, and the absence of eels due to damming and other blockages on the river is thought to be a factor in the decline of the population.

The Susquehanna is still facing new complex and complicated issues that affect its fisheries. **Smallmouth bass** are not native to the Susquehanna River but have arguably become the premier sport fish in its waters. About 450 smallmouth bass were first introduced into the Delaware River on October 26, 1870, and were introduced into the Susquehanna shortly after. The fish immediately took to the river and in only a few years were found throughout the river and its tributaries.

The Pennsylvania Fish and Boat Commission has been given the enormous task of protecting our Commonwealths fisheries. Its studies have shown that the river is getting warmer and that oxygen levels and pH of the water are exceeding protection criteria. A once world-class smallmouth bass fishery now faces bacterial infections in young smallmouth bass causing a drastic decline in population levels and hyperpigmented melanosis (blotchy bass syndrome) in adults; the PAFBC has spent over half a million dollars investigating this problem and has asked other groups to take action. Since the shad wars of 1695, Pennsylvanians have always been concerned about fish in the river and PAFBC's call to action will help ensure the Susquehanna River remains a vibrant, healthy aquatic ecosystem for years to come.

West Branch Susquehanna River above Watsontown, Pennsylvania [Photo: Ben Hayes]

Watching the river flow

By Fred Swader

The Susquehanna River provides some sixty percent of the inflow to the Chesapeake Bay. The other tributaries are the Potomac and the James River, which provide twenty and ten percent, respectively.

LEWISBURG – The West Branch at Lewisburg drains an area of some 6847 square miles, and extends 228 miles from its source to the confluence with the main stem (North Branch) at Northumberland.

In the first quarter of 2013, the Historic Average (HA) flow rates (1939-2012) were: January 8 billion gallons per day (bgd); February 9 bgd; and March 13 bgd. There were substantial deviations from the average on Jan. 16, when the flow reached 25 bgd; on Feb. 1, 48 bgd; and for the period Feb. 11-Mar. 12 substantially below the HA at about 5 bgd. After a short spike to 18 bgd from March 13-16, the flow again returned to below the HA, ending the month at 6 bgd.

DANVILLE – The river flow pattern is similar to that at Lewisburg but at a higher flow level because the watershed above Danville is some 11,220 square miles. The January HA flow rate was about 10 bgd; for February it was about 12 bgd; and for March, 21 bgd. There were major flow "spikes" during the period from Jan. 13-21, with a peak flow rate of 25 bgd on Jan. 16, followed by another one from Jan. 31 through Feb. 8, with a peak flow rate of 48 bgd. As at Lewisburg, the flow rates for the period Feb. 11 through March 12 were below the historic average at about 5 bgd, followed by a small spike above the HA from March 12-16, when the flow rate peaked at about 18 bgd.

HARRISBURG – Harrisburg has a drainage area of 24,100 square miles. It includes both branches of the River and the drainage from the Juniata River basin. Although not in the Central Susquehanna region, it provides some contrast to the values given above. The historic average flows at Harrisburg are January 24 bgd (nearly constant); February 30 bgd (increasing almost linearly from 24 bgd to 36 bgd); and March 42 bgd, with a similar linear increase from 36 bgd to 58 bgd. Spikes in the flow rates occurred as upstream, with peak rates of 71 bgd on January 15, 122 bgd on Feb 2, and 63 bgd on March 16; and below HA flows for the period Feb. 11 through March 13, when flow rates averaged 29 bgd. There was an additional spike (not seen at Lewisburg or Danville) on January 29, with a peak flow of 59 bgd.

These data are derived from records maintained by the US Geologic Survey and available online at:

`www.waterdata.usgs.gov/pa/nwis`

Presenting our findings

A sampling of presentations of Initiative-associated research recently given at regional and national conferences:

NEWLIN, Jessica T., Benjamin R. HAYES; and Kayla YEE*, 2013. *Morphologic Investigation of the West Branch of the Susquehanna River in North-central Pennsylvania*, Large Rivers Research Symposium, World Environmental and Water Resources Congress, American Society of Civil Engineers, Cincinnati, OH.

WILSON, Matthew J.*; Matthew E. MCTAMMANY; Sean P. REESE; Benjamin R. HAYES; and Michael BILGER, 2012. *Spatial and Temporal Patterns of Benthic Invertebrate Communities in the Susquehanna River Revealed Using Data from Twenty Years of Surveys by Multiple Agencies,* Abstract ID 7010, Society for Freshwater Science Annual Meeting, Louisville, KY.

WILSON, Matthew J.* and Matthew E. MCTAMMANY, 2013. *Tributary influences and localized mass effects impact community dynamics of large river benthic macroinvertebrates.* Society for Freshwater Science Annual Meeting, Jacksonville, FL.

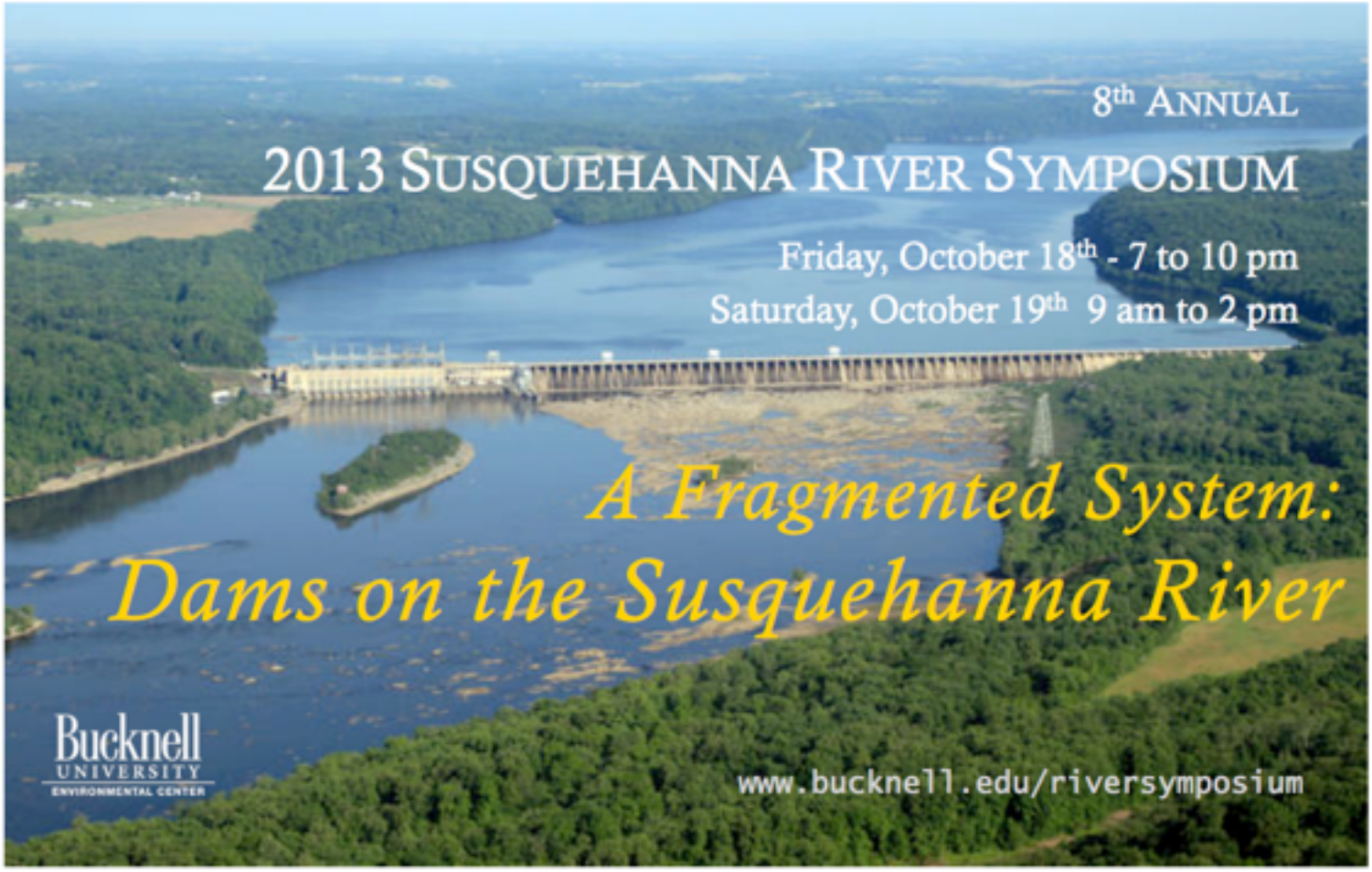
KING, Nicole R.* and Matthew E. MCTAMMANY, 2013. *Macroinvertebrate communities across a gravel bed river reflect conditions in upstream branches due to lack of lateral mixing.* Society for Freshwater Science Annual Meeting, Jacksonville, FL.

MCTAMMANY, Matthew E., and Paige UEHLING*, 2013. *Influence of filter feeders on seston availability and quality and resulting changes in filter-feeder communities along a riffle in the Susquehanna River.* Society for Freshwater Science Annual Meeting, Jacksonville, FL.

BRUNO, Ashley* and Matthew E. MCTAMMANY, 2013. *Qualitative assessment of biological communities and physicochemistry in vegetated and non-vegetated microhabitats of the West Branch Susquehanna River.* Bucknell University Kalman Symposium, Lewisburg, PA.

WILSON, Matthew J.* and Matthew E. MCTAMMANY, 2013. *Habitat, space, and scaling influence community structure of large river benthic macroinvertebrates.* Bucknell University Kalman Symposium, Lewisburg, PA.

** Bucknell student*



Bucknell Susquehanna River Initiative

The Susquehanna River Initiative creates new teaching, research, and outreach opportunities for faculty and students at Bucknell University. It focuses primarily in the hydrologic, ecologic, and engineering sciences, but also involves others in the humanities and social sciences, especially related to historical changes in land use, cultures, and communities in the watershed. Sustainability, global connections, and long-term changes are important issues being addressed by the faculty and students involved in Initiative studies.

In addition to the river monitoring, aquatic community assessments, and habitat studies, the Initiative maintains instrumented field stations at the Montandon wetlands and Roaring Creek forested watershed and leads educational paddling sojourns and natural history outings.

Public outreach activities include stream and wetland restoration projects, teaching workshops, annual river symposia, and public seminars.

Environmental data and discoveries are shared with our collaborative research partners, including the Susquehanna River Heartland Coalition for Environmental Studies, U.S. Geological Survey, Chesapeake Bay Commission, Smithsonian Institution, Susquehanna River Basin Commission, Pennsylvania Department of Environmental Protection, U.S. Environmental Protection Agency, and the Nature Conservancy.

New Interdisciplinary Courses

- Watershed System Science
- Stream Restoration
- Bucknell-On-The-Susquehanna (BotS)

Scholarly Research

- River ecosystems and aquatic habitat
- Fluvial processes and channel change
- Sediment transport and erosion
- Watershed hydrology and flooding
- Groundwater-stream connections
- Wetlands hydrology and ecology
- Stream restoration and river engineering

Community Outreach and Service

- Contributing to the River Basin Commission's *State-Of-The-Susquehanna* assessment
- Stream and wetlands restoration projects
- Annual Susquehanna River Symposium
- Ecologic and Geomorphic Factors for Stream Restoration (short course)
- Instrumented teaching and research facilities

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