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Stream of Consciousness

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Christie Anderson ('13) teaches at a workshop in Washington County.

A Summer with ALLARM

By: Courtney Blinkhorn

Over eight summer weeks in 2011, the ALLARM crew traveled 3,826 miles to conduct eleven Marcellus monitoring workshops, all in different counties of Pennsylvania. The team consisted of ALLARM's directors, Julie Vastine and Jinnie Monismith, and four Dickinson students: Christie Anderson, Katie Tomsho, Ruby Stanmyer and me. The goal of Marcellus monitoring workshops is to build volunteers' capacity to monitor small streams and waterways for early detection of the impacts from Marcellus Shale natural gas extraction in Pennsylvania.

The practice used to extract this natural gas is called hydraulic fracturing, or "fracking" for short. It involves pumping millions of gallons of chemical-containing water into a well to fracture the shale rock, which releases the gas trapped within. As the natural gas is released, the high amount of pressure forces 20-40% of water back out of the well. This water, called flowback, is contaminated with chemicals, salts, and heavy metals, which, if not disposed of properly, can contaminate surrounding surface water. Contamination is devastating to the health of the stream and to those who rely on the water source (Soeder & Kappel,

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2009).

The summer of 2011 was the busiest eight weeks of travel in the organization's history. The workshops attracted a diverse crowd, including high school students, fishermen, concerned landowners, farmers, local mayors, and members of water monitoring organizations. For the summer ALLARM staff, the typical workshop trip was a three-day adventure. We would load up a white, Dickinson College minivan with monitoring kits, presentation materials, and overnight gear to hit the road. Depending on the workshop, either two or three students went along with one of the directors to present the protocol and aid with hands-on activities. We would embark on a three to four hour road trip out of Cumberland County to the Northwest, Southwest, and Northeast gas regions of Pennsylvania. Due to the extended distance of most workshop locations, we left the night prior to the workshop and spent the night in a nearby hotel to avoid getting up three hours before sunrise to travel across the state.

The venue for the workshop was always a surprise, ranging from a living room on an organic farm, to an elementary school's basketball court, but we always somehow managed to make it work. We took turns presenting different aspects of the protocol and all helped with hands-on activities.

Our workshops teach volunteers to both identify and monitor small stream sites that may be effected by Marcellus Shale drilling activity. The weekly procedure that volunteers are encouraged to follow includes three aspects: chemical monitoring, water quantity monitoring, and visual assessment. Due to the briny qualities of the shale rock, the flowback water contains extremely high concentrations of salt. Salt has an electromagnetic charge that can be measured by conductivity and total dissolved solids (TDS); therefore, these are the parameters that volunteers measure on a weekly basis. Barium and strontium are also consistently found in flowback water, so when volunteers see a spike in conductivity/TDS, it is important that their water also be tested for these signature chemicals to develop a strong case that the spike was in fact caused by Marcellus gas extraction activities. The second aspect, water quantity monitoring is important so that a comparison can be drawn between chemical measurements to determine if an apparent spike is a pollution event rather than an issue of dilution. Visual assessment is the third component, which allows volunteer to determine if a spike in conductivity is a pollution event or simply because there is less water in the stream. It involves carefully documenting land disturbances, spills and discharges, gas migration or leakages, and compliance with sedimentation and erosion plans. We recommend that volunteers obtain as much baseline data (before drilling activity begins) as possible in order to have a reference point to detect future pollution events.

We conduct two hands-on activities during our workshops to help volunteers better understand the functionality of this protocol. The first is to teach people how to locate their monitoring sites with a mapping exercise and the second is first-hand experience with the meters to practice chemical monitoring. The hands-on portions of the workshops were always my favorite because it was the best time to get to know the volunteers and truly understand why they were in attendance. Although these aspects of the workshop became routine, the individuals were anything but, always telling their different stories and expressing gratitude for our work.

After the first workshop, we generally spent another few hours in the car in transit to the location for the following day. We spent another evening in a hotel, eating whatever the local cuisine may be, before the second workshop. After the second day of training, we traveled back to our home base in Carlisle. These trips were generally three consecutive, long days, but between the quickly established sense of solidarity among all of us, and our road trip playlists, it didn't really seem like a job. Ever since I chose to go into the environmental field my freshman year at Dickinson, it has been difficult for me to realize that change doesn't come easily. This summer, it became most evident to me while working with community members at the workshops. Many people feel powerless to stop the destruction of their land and it is a very difficult thing to discuss. It was important for me to appreciate the specific role I could play the field, rather than get lost in the immensity of environmental issues.

Ruby Stanmyer ('13) assists workshop participants in locating monitoring sites on a map.

Courtney Blinkhorn ('13) and Ruby Stanmyer ('13) smile before heading to their next workshop.

One instance that made me realize this impact was at our workshop in Tioga County. One of the volunteers approached me and explained that she was currently monitoring her local stream. She then said something that really stuck with me: "I was starting to think that we were alone in this. Thank you so much for coming, it is a great thing that you are doing." It was a very simple thing for her to say, but her appreciation gave me a better perspective of the true purpose of our job. Part of what ALLARM does is reach out to those who are concerned about the dangers of gas drilling and let them know that they aren't alone in their concerns.

It was an incredible eight weeks where we trained 250 volunteers to monitor Pennsylvania's streams. By the end, my colleagues and I had memorized the answers to the hands-on activities, could repeat each of the presentations in our sleep, and knew the counties and roads better in Pennsylvania than our home states. I was sad to give my last visual assessment presentation as a part of our cohesive team.

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The Marcellus Shale Proposal Impact Fee and You

By: Shanice Grant

Governor Corbett announced his Impact Fee in Pittsburgh.
https://stateimpact.npr.org/pennsylvania/2011/10/03/corbett-announces-40000-per-well-impact-fee/

After entering adulthood, many people look back on their lives, revisiting old memories of swimming, fishing, wading, or skipping rocks in the water. Our waters were safe for recreational purposes, and sometimes, if we were lucky, we would even sneak a drink hoping our parents did not notice. We learned to appreciate the beauty of nature around us. The beauty engulfed us all and became the home of many imaginary friends. From kings and queens of the forest to warriors and water nymphs, these adventures helped to shape the lives we lead today. We dreamt of growing old, and raising our own families this way. In recent years, however, I am afraid that dream is becoming less and less of a reality.

Pennsylvania has become one of the focal points for shale gas extraction. According

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to FracTracker.org, from 2008 to 2011 the percent total of Marcellus Shale wells drilled in Pennsylvania increased from approximately 5% to 68% of the total gas wells drilled in the state. As this number continues to grow, so too does the amount of potential damage (from road destruction to environmental changes) that might take place in the communities where wells are located. Out of the thirty-seven states with extractable natural resources, Pennsylvania was the only state without a severance tax, a type of tax that is imposed by a state on the extraction of natural resources to offset the potential social, economic, and environmental damages. The issue of a tax or impact fee has been heavily debated in Pennsylvania, especially in recent years with shale gas exploration on the rise. In 2011, Pennsylvania's Congress developed the Marcellus Shale Unconventional Gas Well Fee (Gas Well Fee), one component of House Bill 1950.

From the time of its inception, the Gas Well Fee has been known by many names, from Severance Tax, to Impact Fee and now Unconventional Gas Well Fee. The cause for the constant change in name has to do with the exact definition of each term and how that affects what goes into the fee itself. An impact fee is a monetary charge placed upon drillers in order to help with the damages that the community sustains during the years that the drilling company is in that location (State Impact, 2012). This differs from a severance tax because paying for impact fees becomes part of the process for drillers; it does not fall under the same political power as regular taxation does. In other words, a drilling company paying the impact fee is similar to the company meeting any other requirement that must be met before and during the time period in which drilling takes place (Impact Fees, 2011). According to each term the Unconventional Gas Well Fee is more aligned with an impact fee than a severance tax. Texas was formally the first state that enabled an impact fee in 1987. From 1987 to 2008, tewnty-eight states have joined the ranking of states that enact fees and the number continues to rise, now with Pennsylvania being added to the list (Nelson, 2008).

This has been Pennsylvania's Congress' third attempt at revising and reworking certain aspects of the fee in the past few years. The proposal for the latest impact fee was released in 2011, was voted on February 7, 2012 and passed. Many people still fear, however, that it will not do enough to repair the damages that drilling companies have caused and will continue to cause.

The newest gas well fee now before the Senate is the fee that Governor Corbett created in November of 2011. This is a county optional fee, leaving the counties 60 days to decide if they want to have fee enacted. A few of the main components of this bill includes: a $40,000 per-well payment in the first year; $30,000 in the second year; $20,000 in the third year; and no more than $10,000 in years four through ten. (Begos, 2012). The decreases in the money flow toward the counties has to do with the fact that each year the drilling companies' profits decrease as well (most gas is obtained in the first year of drilling and significantly decreases with each year). The money received from this fee goes directly to the county and is used for issues that have arisen due to the drilling in that county. Seventy-five percent (75%) of the money paid will be given directly to the counties and municipalities, while the other 25% will go to the commonwealth. Of the 75% that is given to the counties and municipalities, 36% is to be retained by the county where the unconventional wells are located. The money given to the state is to be used for environmental protection, roads and bridge health studies, emergency response, and pipeline safety (Begos, 2012). The remaining 27% would then be distributed among the municipalities where the wells are located. It also restricts the municipalities' zoning regulations exponentially, allowing the drilling companies to drill near areas such as schools and public parks. It also includes various penalties for those who violate the regulations, bonding requirements, noise limits, liability, audits, and more (Detrow, 2011).

Pennsylvania's capitol biulding in Harrisburg.
http://stateimpact.npr.org/pennsylvania/2011/11/15/do-this-weeks-impact-fee-votes-matter-its-complicated/

Tanya Dierolf, the director of outreach at Citizens for Pennsylvania's Future (PennFuture), believes that the impact fee, although helpful to the people who have suffered from drilling, has a lot of room left for improvements. The money that the counties receive is generally 1 - 2.2%, making it one of the lowest fees in the entire country.

Another opposing argument to House Bill 1950 (which has since been passed), unrelated to the impact fee, is the fact that the bill has limited municipalities' ability to zone around drilling. Drilling can take place as close as 500 feet to a home, school, and/or park. "A poorly-regulated gas industry will be able to drill in residential neighborhoods, bringing thousands of gallons of toxic chemicals, thousands of tractor trailers, noisy 'round the clock, polluting drilling, all as little as a football field away from homes, day care centers, and playgrounds," said Jeff Schmidt, Director of Sierra Club's Pennsylvania chapter.

"I believe that Pennsylvania will prove that the balance between environmental protection and the development of this world class resource is possible," said Scott Perry, PADEP Director of Bureau of Oil and Gas Management. This is the hope of many of the citizens of this great state. From the workers and entrepreneurs; to scientist and citizens, the public and private sectors must band together and within the next few months use what we can from this bill to our advantage and raise our voices about that which needs to be changed.

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Marcellus, National Parks, and Potential Effects from Natural Gas Drilling

By: Kieran Avis

Since 1916, the National Park Service has managed and protected the beautiful national parks of the United States of America. Currently, the oil and gas industry has been developing ways of extracting natural gas from the Marcellus Shale geological formation which primarily underlies the states of Pennsylvania, New York, West Virginia, and Eastern Ohio. There are thirty-three units of the National Park System located in the Marcellus Shale region or the areas directly surrounding it. While the demand for jobs and energy is high in the country right now, as a nation we cannot sacrifice the few national treasures that do exist. Marcellus Shale drilling would likely have numerous effects on the surrounding environment including potential water contamination, air quality degradation, excess sedimentation and dust, increased truck traffic; high water use needs; as well as noise and light pollution (to name a few) (Moss, 2011).

Hydraulic fracturing is the current method being used to extract the natural gas from the Marcellus Shale area. High volume hydraulic fracturing, developed in the late 1990s, uses horizontal drilling to reach the shale and then fractures it with high pressure and fluid to extract the previously economically unattainable natural gas. The fluid

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The parks along the Deleware RIver are abundant in wildlife, such as bald eagles. (Moss, 2011)

consists mostly of water, but sand is also used along with hazardous materials such as demulsifiers, corrosion inhibitors, friction reducers, clay stabilizers, and scale inhibitors. Horizontal wells require a massive amount of water for fracking (2-10 million gallons per well). There are currently two main methods for handling the waste water. One method is to capture the water and transport it via trucks to a recycling facility that removes solids from the water so it can then be reused, significantly increasing truck traffic in the region. The other method is onsite storage and treatment which increases the potential for a release into the surrounding environment. Onsite storage and treatment also increases the overall surface area, or land, required for the well (Moss, 2011).

Roughly 36% percent of the Delaware River Watershed is on top of the Marcellus Shale (National Parks Traveler, 2011). This percentage puts the national park units along the Delaware River most at risk for degradation. However, currently there is a moratorium on natural gas drilling within the Delaware River Watershed. The Upper Delaware National Scenic and Recreational River, Middle Delaware River National Scenic River, and Delaware Water Gap National Recreational Area annually have up to 5.4 million visitors, which provide both excellent recreational and economic activity. The parks along the Delaware River are home to abundant wildlife including bald eagles, peregrine falcons, and black bears (NPCA, 2011). The Delaware River Basin provides half of the drinking water for New York City (NationalParksTraveler, 2011). If drilling is eventually allowed in this area of the Marcellus Shale there could be severe impacts not only on the parks and wildlife, but also on the lives of many people if that drinking water is polluted.

The impacts of the Marcellus Shale drilling are not fully understood yet, but some of the possible effects to the national parks are: water contamination from the disposal of drilling fluid, reduced stream flow and ground water levels, air quality degradation, impaired wildlife, impacts to night skies, impacts to cultural resources, and many other safety concerns (NPCA, 2011). As Cinda Waldbuesser, Pennsylvania senior program manager for the National Parks Conservation Association, stated, "The economic benefits of natural gas development must not compromise the long-term benefits of protecting water quality and preserving our national parks, which are already economic generators for local communities" (National Parks Traveler, 2011).

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Sale of Bottled Water Banned on Campus

By: Morissa Glatman

Some students might have missed the cover story in last year's Spring/Summer edition of the Carlisle Gazette, in which the Carlisle Borough was praised for earning the Phase IV Excellence in Water Treatment award from the Partnership for Safe Water. The article explains that the recognition is rarely awarded, and that Carlisle's water treatment plant is also the first in Pennsylvania to receive this award (Carlisle Gazette, 2011).

Despite Carlisle's clean water many Dickinson College students have bought BRITA filters and reusable water bottles that have incorporated water filters. Also, some students have such an adverse reaction to the taste of Carlisle's tap water and do not want to buy water filtering technology, that they buy bottled water on a daily basis.

According to multiple sources, bottled water is no safer than tap water. Actually it's the opposite; there are stricter regulations on tap water than bottled water (Food & Water, 2012). Not only is bottled water no safer to drink than tap water, bottled water is also more expensive; bottled water can cost up to 10,000 times tap water ($0.0015 per gallon vs. $10.00 gallon) (Education Database, 2012).

Bobble is a brand of reusable water bottle with incorporated water filters. http://www.sonoma-glenellenmkt.com/grocery-blog.html?bpid=1622

EarthNow is a Dickinson College student-run organization aimed at promoting sustainability on campus through campus wide events and campaigns. EarthNow's vice president, Lauren Jeschke, sat down with ALLARM to discuss EarthNow's current efforts to "Take Back the Tap," by getting the sale of bottled water banned on campus.

"We started the 'Take Back the Tap' campaign in Spring 2011. We first showed a movie called *Tapped*, and we got a petition and signatures. Our goal is to have no more bottled water on campus." Even though EarthNow officially started this campaign last year, they have done similar efforts in the past. *Tapped* is a 2009 documentary illustrating the faults of bottled water and the bottled water industry.

EarthNow's goal is two-fold: first, to ban the sale of bottled water on campus, and second, to install filters on all the water fountains on campus. "Last semester we did a lot of tabling, and I think it went really well. We also met with facilities about installing the filtration system, and dining services about not selling bottled water anymore," said Jeschke.

She went on the say that both facilities and dining services were very receptive to the idea, because of the economic benefit, since "they wouldn't have to buy bottled water anymore." To "ban bottled water" simply means that bottled water would not be available for sale on campus anymore.

Jeschke also mentioned that students should be excited about this because if the infrastructure were to be in place, then they would not have to buy bottled water to get "good tasting water," and it will also save a tremendous amount of money.

"Consider this," said Jeschke, "You don't like the taste of some of the older water fountains [due to old pipes], so you buy bottled water every day, let's say the cheapest, too. That's sixteen weeks a semester, times seven days a week, times two (for two semesters), and bottled water is approximately $1.25… That's approximately $300 per year for bottled water. You could buy your textbooks with that amount of money! And in for four years, that's $1,200!"

Also, Jeschke laments about the commodification of water, "It's taking something that is a free and natural right, and turning it into something to buy… and in a lot of places, bottled water comes from local municipalities."

She also talked about the social injustice involved with bottling water, explaining that,"it's not the most socially responsible thing to do. Big [water bottle] companies buy land in towns which then start pumping the town's water. I remember reading about a town in Texas that had a drought and all the water had already been bottled by a large [water bottling] company. So the company just moved onto another town [to pump water], meanwhile the citizens of the town where the drought had been were left with a huge problem."

An example of this is in the case of Poland Spring (Nestlé

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brand), who extracts water out of the water table or "water mines" in small towns, like in Fryeberg, Maine. In Maine, as well as in seven other states in the U.S., there is "absolute dominion," a rule that "permits a landowner to intercept ground water that would otherwise have been available to a neighboring water use," explains the Water Systems Council. In other words, where the absolute dominion rule is in effect a large water bottling company can buy land and have no restrictions on the amount of water that they extract (Water Systems Council, 2003).

According to The Story of Stuff Project (TSOSP) and Free Range Studios, one third of bottled water comes from the tap anyway, and throughout the "life-cycle" of bottled water there is immense environmental damage. First, there is the "extraction and production where oil is used to make water bottles. Each year making the plastic water bottles in the U.S. takes enough oil and energy to fuel a million cars." Then, they explain how it takes even more energy to ship the water bottles across the world, only for a consumer to drink it for a couple of minutes. "The big problem," the TSOSP says, "is disposal," as "80% of them end up in landfills where they will sit for thousands of years, or in incinerators where they are burned releasing toxic pollution." Annie Leonard, one of the co-directors of TSOSP, followed water bottles placed in recycling bins from California all the way to an area near Madras, India, where instead of being recycled "the bottles were slated to be down cycled," or in other words, made into "lower quality products" that are made to be thrown out. Leonard also states that there is socio-injustice with

Joan Smedinghoff ('15) demonstrates the use of a Brita water filling station outside of the Dickinson cafeteria.

disposability as the bottles were "shipped all the way to India just to be dumped in someone else's backyard" (TSOSP, 2010).

Tara Lohan, a senior editor of the online newspaper, *AlterNet*, and editor of the book *Water Matters: Why We Need to Act Now to Save Our Most Critical Resource*, says "the industry is making a killing," as in, "rich nations like the U.S., where potable water flows from taps in most everyone's homes and costs pennies, people are still shelling out extra bucks for bottled water."

However, it might not be that easy to ban bottled water on campus. Dan Webster, the Sustainability Projects Coordinator at the Center for Sustainability Education (CESE) here at Dickinson, says the "difficulty with this is contracts, the contracts with each separate dining facility: the Underground, the Snar, the Quarry, the D-Den, and a big issue is where do you want to start? Is it going to be a whole sale ban or is it going to a phase-out? Or even start with no bottled water at events?"

Although Webster mentions that there are great possibilities for EarthNow's efforts, since a lot of other schools, many of Dickinson's competitors, like Middlebury and University of Vermont, are already making this change. They have already started the process of phasing-out water bottles, and phasing-in water filtration systems. He suggests that we could do some sort of competition with these schools concerning bottled water on and off campus.

Georgetown University, Tufts University and University of Toronto are just a few big universities that have already started this process of phasing-out bottles, and phasing-in water filtration systems (Bosque, 2012). The University of Vermont has pledged by 2013 not to have the sale of bottled water on campus, and "in preparation…as many as seventy-five water fountains on the campus will be converted to water refilling stations" (Bosque, 2012).

It's not just colleges and universities that have started phasing-out water bottles, state agencies have started as well (Chan, 2009). In 2008, the New York City Council stopped buying bottled water "in favor of tap water" from more installed water fountains (Lee, 2008). Then, in 2009, New York Governor David A. Paterson signed an executive order directing state agencies to phase out the purchase and use of bottled water at government workplaces, noting not only financial reasons but also environmental concerns. In 2007, Gavin Newsom, the mayor of San Francisco "prohibited spending city money on single-serving bottled water" (Chan, 2009).

Some of the fountains that EarthNow is looking at range from $1,299 to $2,150, and have numerous features like touch-free technology, and an option for chilled water (Jeschke, 2012). However, they are also "proposing the cheaper spigot version in order to cover more of campus, but it depends on what facilities is willing to do" (Jeschke, 2012).

EarthNow presented a proposal on banning the sale of bottled water on campus as well as the installation of many new water fountains and filters to Student Senate who approved the resolution with an "overwhelming majority," according to Jeshke. She says that EarthNow "will be working with facilities and dining services to implement filtration systems and to cease the existing water bottle contracts so that bottled water will be available only in the D-Den." Over the summer, Dickinson facilities began this process by installing a Brita water filtration system on one of the water fountains outside of the student cafeteria.


An example of a water bottle filling station attached to a water fountain, found at Vassar College, in Poughkeepsie, NY. This company (Elkay) sells elaborate fountains, anywhere from $1,481- $7,443.
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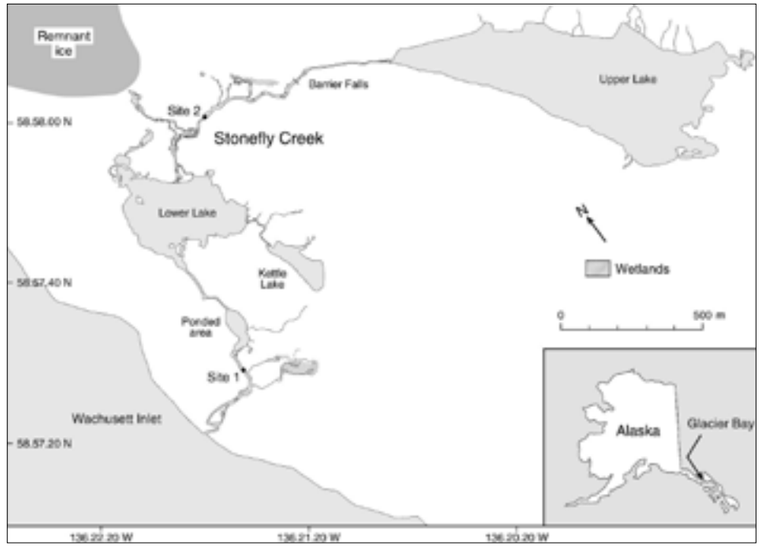
Glacial Melt

How deglaciation has allowed stream ecosystems to evolve

By: Elizabeth de la Reguera

The United States has a number of states with glaciers, with Alaska being the most well-known. However, glaciers in Alaska have slowly been retreating and thinning since the mid-eighteenth century. Due to the deglaciation in Alaska, streams have begun forming from the excess water in watersheds. For example, two streams that have been created from glacial melting are Wolf Point Creek and Stonefly Creek, both tributaries to Glacier Bay. Wolf Point Creek was not studied until 1977 but the stream began evolving in the 1940s. Wolf Point Creek was used as a reference for the evolution of a stream once Stonefly Creek began to form. Stonefly Creek began evolving in the late 1970s. Once the stream started to form, monitoring began right away in order to study the evolution of stream creation from the very beginning. The results of these studies found that the factor that seemed to affect the biological colonization of a new stream system initially was water temperature, but once temperatures began to rise, it appeared there were other factors.

The study focused on four hypotheses: 1) community assembly in streams following glacial recession follows deterministic pathways and tolerance model; 2) non-insects will be poorly represented in the stream community; 3) biological traits of the community will be different than other streams if trajectories of development are not similar; and 4) marine-derived nitrogen (MDN) will not be assimilated into the food webs because the geomorphological "simplicity" associated with young streams in Glacier Bay should prevent significant salmon-carcass retention (Ecology, 2011). The scientists used two sites for sampling invertebrates. Site 1 was the site that most closely related to Wolf Point Creek which is why it became the focus of the study. Sampling began in 1992 at Site 1 where the dominant substrate (the rock matter where organisms live) was predominantly cobble with a stream width of less than fivr meters and a depth of less than forty cm. The stream was relatively stable because of the close border of overhanging vegetation and in-stream habitat ruled by riffles (Ecology, 2011). Sampling continued in the summer months of 1997, 1999, 2000, and 2001. When invertebrates were collected, they were sorted from detritus and inorganic matter and then identified and numbered in the lab (Ecology, 2011).



Alexander M. Milner, Anne L. Robertson, Lee E. Brown, Svein Harald Sønderland, Michael McDermott, and Amanda J. Veal. 2011. Evolution of a stream ecosystem in recently deglaciated terrain. Ecology 92:1924–1935

In 1992 at Site 1, they reported that the five initial colonizers in the stream were chironomids (non-biting midges), blackflies, the mayfly Baetis, Orthocladiinae (non-biting midges), and Paratrichocladius (non-biting midges). By 1997, the richness of macroinvertebrates had increased to fifteen taxa (the scientific classification of a group or entity) resulting in a total mean macroinvertebrate abundance exceeding 4000 individuals/m^2. The mean macro abundance is significant because it helps to show the average number of total macroinvertebrates per square meter. By 2001, the richness had increased to thirty-one taxa with a total mean macro abundance exceeding 4,600 individuals/m^2. Over the years, some macroinvertebrates were no longer present due to change in water temperature and the stream ecosystem evolving over time, such as the Paratrichocladius, while some increased over the years such as Pagastia Partica, a different non-biting midge genus. The macroinvertebrate traits were compared between Stonefly Creek in 2001 and Wolf Point Creek in 1997 because those two years had approximately similar annual degree days. The changes in the macroinvertebrate community appeared to be linked to low water temperatures associated with remnant ice masses (Ecology, 2011).

This study has been able to show the evolution of a stream due to deglaciation and how the macroinvertebrate communities are affected. Initially, the low water temperatures seem to attract certain macroinvertebrates but once the water temperature begins to rise, a number of other factors impact the diversity and distribution of macroinvertebrates. This is significant because glacial recession is occurring across the world and this study can now provide insight into how a stream ecosystem will respond (Ecology, 2011).

Muir Glacier in Glacier Bay National Monument, Alaska, in August of 1941, 1950, and 2004.
http://www.sciencedaily.com/releases/2008/10/081006130550.htm

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Ecology, 2011. Alexander M. Milner, Robertson, A.L, Brown, L.E., Sonderland, S.H., McDermott, M., and Veal, A.J. "Evolution of a stream ecosystem in recently deglaciated terrain." Ecology, 92(10), 2011, pp. 1924-1935

You and Eutrophication

By: Joan Smedinghoff

Spring is here and with the beginning of baseball, grilling, and block parties comes the summer home maintenance staples of lawn and garden care. One thing that usually accompanies these activities is fertilizer, but unlike flowers and grass, fertilizers do not always remain in the yard. They frequently get washed away by rain and sprinklers into storm drains, which carry them to nearby streams and rivers. The transported fertilizers can contribute to eutrophication, a process that kills many aquatic organisms and ends up leading to the degradation of aquatic ecosystems.

Eutrophication leads to algal blooms.
http://www.chesapeakebay.net/issues/issue/nutrients

Eutrophication happens when an excessive amount of nutrients, particularly phosphates and nitrates, enter aquatic systems. Fertilizers, which contain these two chemicals, encourage plants to grow and photosynthesize faster. However, once they enter a stream this manufactured growth can have significant consequences. More specifically, they cause phytoplankton such as algae to grow and reproduce at an accelerated rate. This rapid population expansion creates a layer of algae on the top of the water, preventing sunlight from reaching the plants at the bottom. Without sunlight, those plants are no longer able to photosynthesize, and they die off. Decreasing the population of aquatic plants can then result in a decrease in food, habitat, and dissolved oxygen (produced by the plants during photosynthesis) in the water which other organisms need. Bacteria play a key role in decomposition, further depleting oxygen

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levels (Wright, 2008). The bacteria use oxygen in their respiration, and fish populations that require high levels of dissolved oxygen, such as trout and salmon, begin to suffer and decline (Muir, 2011). This feeds into a circle of continued ecological collapse: an increase in dead organisms leads to an increase in decomposing bacteria, meaning less dissolved oxygen for other aquatic organisms. Those organisms die off, allowing the population of bacteria to continue to thrive. Over time, the phytoplankton use up the fertilizers, and there are no longer enough nutrients in the water to support the large population, so they begin to die. The dead phytoplankton settle on the bottom of the water, adding to the organic material being decomposed. This positive feedback loop causes the water to become further depleted of oxygen, leading to the suffocation of fish and other aquatic animals (Wright, 2008). The biodiversity of the system decreases dramatically as any organisms that require dissolved oxygen find less and less available to them.

Eutrophication is a natural process for bodies of water, but it takes place over periods of hundreds or thousands of years. Cultural, or human triggered, eutrophication,is the addition of nutrients to the water via sewage treatment plants, poor farming practices, and urban runoff (Wright, 2008). Urban runoff is hard to combat because it is a nonpoint source of pollution. That is, the point from which the nutrients originated is either difficult or impossible to determine definitiveely (unlike pollution from an industrial source). Nonpoint source pollution is caused when rainwater picks up particles and chemicals from areas such as lawns or streets and carries them, usually through storm drains, to lakes, rivers, wetlands, coastal waters, and ground waters (EPA). This type of pollution is particularly hard to tackle because it cannot be solved by correcting the actions of one entity. It involves the vigilance of an entire area in order to cut down on the amount of nonpoint source pollution.

One of the main contributors to urban nonpoint source pollution is fertilizers. There are many misconceptions about fertilizers and their possible unintended effects. For instance, many believe that the water entering storm drains is filtered before entering waterways. However, that is not the case. The primary function of storm drains is to divert rainwater, which is theoretically the same composition as the water in streams and rivers and therefore, does not requiring filtration. Other misconceptions include the idea that a product that is good for plants cannot be harmful to water, or that organic fertilizer will not have the negative effects that synthetic fertilizers would have. However, as explained above, any excess of plant nutrients in water can lead to eutrophication, effectively starving a body of water of oxygen and killing both the plant and fish populations. Organic or not, fertilizers contain nitrate and phosphate which can lead to eutrophication.

Therefore, as homeowners, it is important to be mindful of how fertilizers are being applied. On average homeowners apply ten times the required amount for their lawns. It is essential to know when, where, and how to use fertilizers to minimize the chance that they will end up in nearby waterways. So, when you are prepping your lawn and garden for the spring and summer months, remember that what you do in your yard affects your waterways. Let this summer be one where you not only see your yard at its best, but your water too.

Rain washes lose debris, fertilizers, and pesticides into stormdrains.
http://www.nassaucountyny.gov/healthynassau/news/2007/HealthyWaterways.html

What Can You Do to Minimize Eutrophication?

http://www.lifespy.com/wp-content/uploads/2007/03/69637913x.jpg

Before Planting:

Test Your Soil: Get your soil tested to tell you how much fertilizer you need.

Choose Your Plants Wisely: Choose native plants for your garden because they are less likely to need excess fertilizer or water to stay healthy.

And Your Fertilizers: Choose fertilizer with low or no phosphorous. Also, select a slow-release fertilizer. Slow-release fertilizers have at least half the nitrogen in "water insoluble" form.

Let 'em Breathe: Aerate your lawn to promote better water infiltration and reduce the likelihood of runoff. There are many different aerators you can buy or rent, from attachments for your shoes all the way to power aerating machines.

http://sharpexblog.com/2011/08/beautiful-lawn/

After Planting:

Fertilizers: Apply ertilizers sparingly and always according to the directions. Keep fertilizer applications at least twenty feet away from lakes, streams, and storm drains. Never apply fertilizer to frozen ground or just before it is expected to rain, as it is more likely to be washed or blown away. Promptly clean up any fertilizer spilled on roads or sidewalks.

Yard Clippings: Sweep grass clippings back onto the lawn and compost other yard trimmings. This recycles nutrients back into the soil and reduces the amount of fertilizers needed. Compost also helps retain moisture, thus conserving water.

Mulch: Apply mulch to bare ground to help prevent runoff, erosion, and weed growth.

http://thatssomartha.blogspot.com/2010/05/i-have-been-very-busy-backyard-berm.html

Around Water:

Berm It: Construct and maintain a modified berm along the shoreline. This is best described as a slight hump in the ground that would run near and parallel to the shoreline. A berm serves as an obstacle to the nutrient-rich runoff into the water.

Let it Be: Leave a strip of unmanaged grass or natural vegetation to grow around the shoreline to remove and retain some of the nutrients that would otherwise enter the water.

Additional Resources:

Want to find out more about nonpoint source pollution in your area? Visit: http://www.epa.gov/reg3wapd/nps/

To find out how to get your soil tested, go to: http://www.aasl.psu.edu/Soils.html

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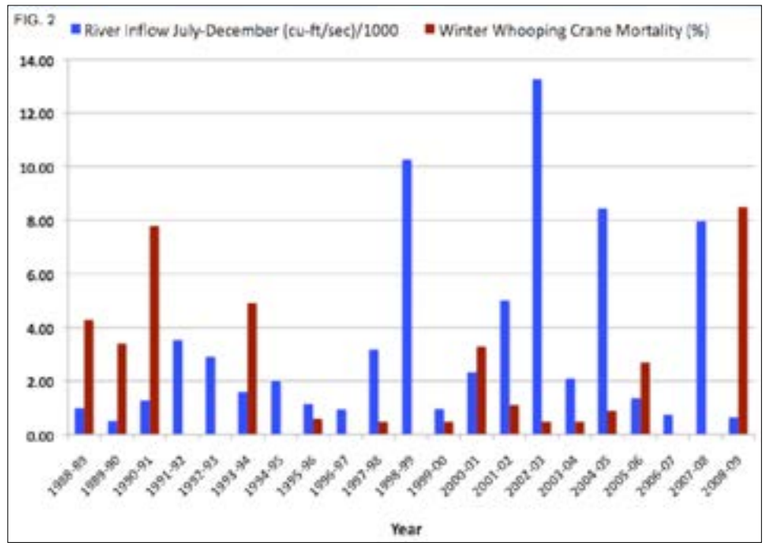
The Whooping Crane

Endangered species to determine future of Texas water rights

By: Katie Tomsho

What does it take to convince the people in an entire region that they must reduce their consumptive water use? That question is being debated in the Corpus Christie court of Southeastern Texas. The Guadalupe drainage basin is simultaneously one of the most ecologically important and rapidly developing regions in the United States. Now, it will determine the future of surface water withdrawals in Texas. The deciding factor will be the tallest bird in North America, the Whooping Crane.

http://thearansasproject.org/wp-content/uploads/2009/11/BasinMap.gif



Whooping crane mortality as compared to freshwater inflow.
http://www.texastribune.org/texas-environmental-news/texas-commission-on-environmental-quality-tceq/environmental-group-will-sue-tceq-in-federal-court/

Each year, the cranes fly 2,500 miles from their summer nesting spot in Northwestern Canada to the Aransas National Wildlife Refuge in Southeastern Texas. They stay in the refuge from November until March. This species of bird is on the Endangered Species List. In the 1940s, the use of the pesticide DDT, as well as habitat, loss slashed the population size to only fourteen birds. Since then, the flocks have been slowly rebounding. They numbered as many as 383 by 2010 (a remarkable increase, considering that couples parent only one chick per year).

The lawsuit went to trial beginning on December 2, 2011. The Aransas Project (TAP), an alliance dedicated to protecting the Guadalupe River Basin, accused the Texas Commission on Environmental Quality (TCEQ) of violating the Endangered Species Act. The argument was that the TCEQ had not adequately managed surface water flowing into the San Antonio Bay. The freshwater that flows from the Guadalupe is vital for the organisms, such as shrimp and blue crabs, living in the receiving Bay's estuarine habitat. However, large quantities of water in the Guadalupe are being appropriated to agriculture and industry at the expense of the downstream environment. The blue crabs, which are a primary source of food for the cranes, need the freshwater influx to create the brackish water in which they thrive. Insufficient flows of freshwater impact the crab populations, thus reducing the food supply for the cranes.

In the 2008-2009 season, a drought exacerbated the situation. TAP claims that tewnty-three Whooping Cranes died (compared to the usual one to two per year), citing a lack of adequate food as the cause of the deaths. TAP has not been able to locate the majority of the birds' bodies, though. The Guadalupe-Blanco River Authority (GBRA), the primary organization responsible for managing the water rights in the region, argued that the birds had lived through previous droughts that had reduced food reserves, and that the lack of incoming freshwater could not be definitively established as the cause of their deaths.

TAP has called upon Ron Sass, Professor of Natural Sciences at Rice University, to illustrate the Whooping Cranes' vital dependence on the freshwater flow. In order to do so, he compared the flow over six months from 1988 to 2009 to the observed yearly crane mortality rates. The study indicated that the years with the lowest flow were correlated with the years with the highest crane mortality rates.

At the heart of this debate lies a question: Industry versus the environment, which will receive priority towards water rights? TAP is asking that in years of drought, industry and agriculture reduce their outtake from the river, allowing enough water to reach the Bay to support the fragile environment. Judge Janis Graham Jack, who will make the final decision, is expected to do so in the summer of 2012. In the meantime, she encouraged the two sides to come up with a settlement. Though both groups have expressed an interest in this, the GBRA was quick to establish its limits to compromise. The general manager of the GBRA, Bill West, has already stated that they will not allow TAP to acquire senior water rights.

During Texas droughts, those with senior water rights are given priority over those holding junior rights. This means they are allowed to continue to withdraw as much water as they like, at the junior-right holders' expense. West's declaration has been perceived by some as a demonstration that the GBRA is more concerned about the potential impact on industry than on the environment.

The cranes are more than a dwindling species. They are an indication of what the future of this region may have in store if water allocation is not better managed. Loss of the cranes is an indication that there exists a deeper ecological threat to the entire region; the cranes are simply one of the more vulnerable and visible species. The loss of one of the most recognizable species would be tragic. To not address the management of Texas's surface water, though, would be devastating.

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ALLARM in Pictures

Katie Tomsho ('12) looks at a data sheet with a workshop participant.

Ben Mummert ('12), Kieran Avis ('14), and Elizabeth de la Reguera ('14) get tree mulch.

Kieran Avis ('14) sits by an ALLARM poster before the 25th Anniversary presentation.

Elise Minichiello ('14) readies macroinvertebrates for Harrisburg Academy.

No Child Left Inside

Getting the next generation ready to face environmental challenges

By: Elise Minichiello

http://notbuyinganything.blogspot.com/2010/04/nature-meditations-cure-nature-deficit.html\

The No Child Left Inside (NCLI) Act of 2011 is an amendment to the Elementary and Secondary Education Act of 1965, requiring all states to adopt K-12 environmental literacy plans involving hands-on experiential learning and teacher training (Sarbanes, 2011). It will also provide federal grants to groups that have environmental education services.

"Every child deserves the best education. Part of that education must be an understanding of the natural world and environmental issues," says NCLI coalition director, and vice president of education at the Chesapeake Bay Foundation, Don Baugh. "An environmentally literate child is more likely to achieve academically, be more motivated, and have a better chance at a job in the emerging green economy" (The Bay Net, 2011). Baugh, along with Senators Jack Reed (D-Rhode Island); Mark Kirk (R-Illinois) and author of the bill, Congressman John Sarbanes (D-Maryland), have been working together on this bipartisan bill since 2007, after testimony from educators, environmental advocates, public health figures, and researchers vocalized compelling arguments supporting how important it is for the next generations to have environmental education integrated into their schools (The Bay Net, 2011).

The term "environmental literacy" is a key component of the NCLI movement. An environmentally literate citizen is defined as one "able to demonstrate knowledge and understanding of the environment/circumstances affecting it, understand society's impact on the natural world, investigate and analyze environmental issues to make accurate conclusions about effective solutions, and take individual and collective action towards addressing environmental problems" (The Partnership for 21st Century Skills, 2011). While we do not know what new problems future generations will face, there is no doubt that those problems pertaining to the environment will be at the forefront. That being said, it is crucial that today's youth begin building the capacity to think critically about their environment (Environmental Literacy Council, 2008).

Before creating a curriculum focused on environmental literacy, it is important to assess the current situation in our country. Studies by the National Environmental Education and Training Foundation have shown that two-thirds of the American public fails a "simple environmental quiz" and 88% fails a quiz about basic energy resources. (Kenidel, 2008). What is even more concerning is these same studies produce statistics showing forty-five million Americans think the ocean is a source of fresh water and that only 27% of Americans know that most of our electricity is produced by burning coal and other flammable materials (Kneidel, 2008).

Luckily, there is still hope for students as the environmental movement continues to gain momentum. A key catalyst of increased interest in this field of study was the introduction of an Advanced Placement (AP) Environmental Science course for high school students in 1997. According to the College Board, the number of students taking this test has increased from about 5,000 students taking the first test May 1998, to almost 99,000 students taking the test in May 2011 (AP Central, 2012). Green charter schools and programs like the Green School Alliance also demonstrate how educational institutions are stepping up to meet the demand for environmental education.

Adding an environmental education graduation requirement for high schools is a good first step in the quest for environmental literacy. This "requirement" does not necessarily mean that each graduating student will need to take a specific class on environmental science; rather, environmental learning will be integrated into all disciplines representative of how environmental issues can be seen in all aspects of our society.

The main objectives of NCLI are to prepare students to analyze and understand environmental challenges facing their state and the U.S., provide field experience, and create opportunities for professional development in environmental science. Within one year of the bill's enactment, each state education agency will be required to submit an environmental literacy plan that must include state standards for how environmental literacy will be evaluated, how environmental education will be integrated into courses, a description of how teachers will improve their knowledge through environmental professional development, and how school systems will secure funding and support for their plans (Open Congress, 2011).

True environmental literacy will take time, but it is of paramount importance that our nation begins to critically asses the environmental literacy deficit and childhood disconnect with nature, so that the children of today can grow up to be strong environmental stewards and leaders set on improving our current, bleak situation.

Elise Minichiello ('14) teaches a student at a Carlise-area science night.
http://cumberlink.com/news/local/bellaire-elementary-school-holds-family-science-night/article_6c4db63c-1d67-11e1-935a-001871e3ce6c.html

While some critics say that the NCLI mission is spreading a political agenda to children, the countless benefits of environmental education and awareness outweigh the cons. "Robust environmental education is a down payment to grow the next generation of scientists, promote environmental stewardship, and encourage Americans to live healthier lifestyles," says Congressman Sarbanes. "Research shows that hands-on environmental education has a measurably positive impact not only on student achievement in science, but also in reading, math, and social studies" (Sarbanes, 2011).

I am interested in the environment because I spent countless hours enjoying nature with my family, friends, and classmates as a child. My personal experiences have led me to be very interested in educating the youth about our natural environment and upkeep. What happens if today's children do not have the kinds of outdoor experiences that I did? Will their lack of connection lead to indifference on environmental issues and sustainability? True environmental literacy will take time, but it is of paramount importance that our nation begins to critically asses the environmental literacy deficit and childhood disconnect with nature, so that the children of today can grow up to be strong environmental stewards and leaders set on improving our current, bleak situation.

A fifth grader once said to Richard Louv, author of *Last Child in the Woods*, "I like to play indoors better 'cause that's where all the electrical outlets are." Children have transitioned their play habits from tag and biking around their neigh-

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Elise (5th from left) on an Earth Day hike with her first grade class.

borhoods to Xboxes, cell phones, and other electronics. A "nature deficit disorder" has become quite the epidemic in the United States (Louv, 2007). Kids are not connecting with nature as much anymore which is very foreboding considering the state of our world. No Child Left Inside, along with other strong environmental education initiatives, needs to be prominent in all education systems. The more that those of the next generation know about their natural surroundings, the greater their capacity will be for coming up with solutions and creating effective policies, ensuring humans in the decades and centuries to come will still be able to play outside with their children.

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Carolyn Flower ('14) clears the area around a tree at the LeTort Service Day.

Morissa Glatman ('14) explains an activity to first graders at North Dickinson Elementry.

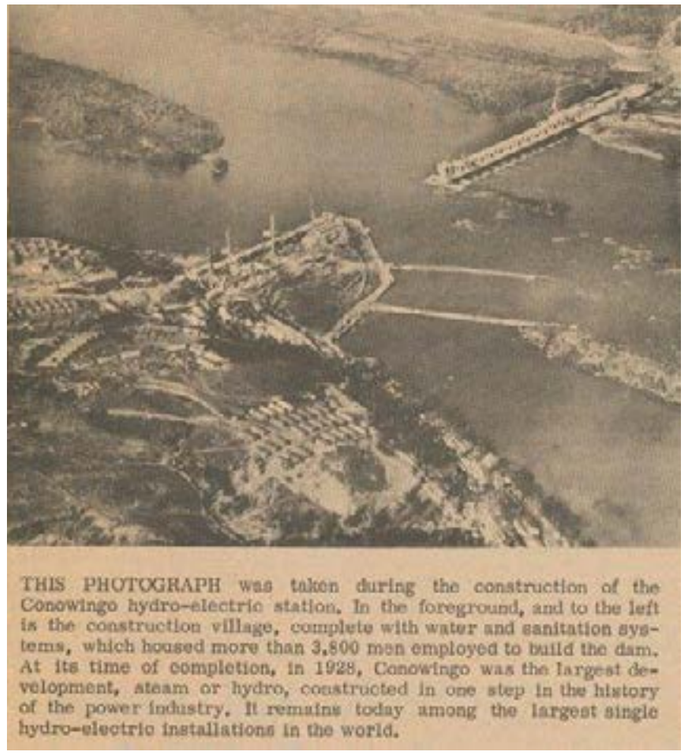
Taylor Wilmot ('13) practices a workshop activity during staff orientation.

Elizabeth de la Reguera ('14) assists with a hands-on activity at shale gas monitoring workshop.

The Conowingo Dam

The effects of sediment buildup behind the Conowingo Dam on the Chesapeake Bay

By: Carolyn Flower



THIS PHOTOGRAPH was taken during the construction of the Conowingo hydro-electric station. In the foreground, and to the left is the construction village, complete with water and sanitation systems, which housed more than 3,800 men employed to build the dam. At its time of completion, in 1928, Conowingo was the largest development, steam or hydro, constructed in one step in the history of the power industry. It remains today among the largest single hydro-electric installations in the world.

Construction of the Conowingo Dam hydro-electric station.
http://www.conowingolake.com/gpage4.html

In 2011, the Maryland Department of the Environment implemented a water quality assessment that determined the waters upstream from the Chesapeake Bay did not display signs of eutrophication. However, this does not account for the significant amount of phosphorus-contaminated sediment that will be released into the Bay once the Conowingo Dam reaches its storage capacity. Monitoring non-point source pollution is difficult for the Environmental Protection Agency since phosphorus, which adheres to suspended sediment, largely comes from agricultural run-off, especially in the Lower Susquehanna River Watershed. As a result, this issue still has far-reaching consequences for the Chesapeake Bay and its surrounding communities. Consequently, two distinct questions are being brought to the surface. Will this mean that the total maximum daily load (TMDL) for the Chesapeake Bay will need to be further assessed and re-designed? And are there viable solutions that can at least slow down the problem while effected counties work to lower their non-point source pollution?

The Conowingo Dam is part of a group of three dams that were used for hydroelectricity in the lower part of the Susquehanna River Basin (Langland, 1998). Built in 1928, the Conowingo Dam is the only dam located in northern Maryland, about ten miles upstream from the Chesapeake Bay. According to M.J. Langland, a scientist with the U.S. Geological Survey (USGS), because the other two dams (Safe Harbor and Holtwood) have reached their storage capacities, more suspended phosphorus-laden sediment is being collected behind the Conowingo Dam. A dam's storage capacity is its ability to continue holding sediment until it reaches a state of equilibrium and can no longer hold sediment. This creates a significant predicament because once the Conowingo Dam reaches its storage capacity, the entire load of phosphorus-contaminated sediment will reach the already impaired Chesapeake Bay. More recent studies from the USGS suggest that twenty-six million tons of sediment storage remain (Langland, 2009). Subsequently, the USGS has calculated that the Conowingo Dam will reach its storage capacity by the year 2025. Capturing 70% of the suspended sediment load and 40% of the phosphorus load, the Conowingo Dam is an integral part of making sure large amounts of phosphorus-contaminated sediment do not reach the Lower Susquehanna River and the Chesapeake Bay.

Although scouring events, which remove collected sediment from behind dams, can prolong a dam's carrying capacity, these events can only slow down sediment build up for a short amount of time. The short-term ecological impact on the Lower Susquehanna River and

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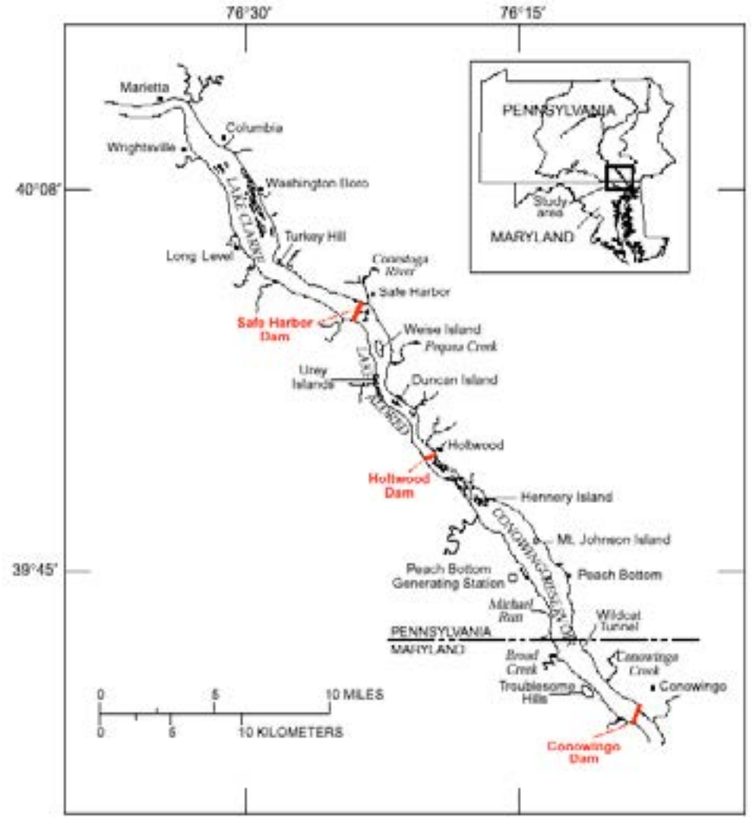

Map depicting the locations of the group of three dams of which the Conowingo Dam is a part.
http://pa.water.usgs.gov/reports/fs003-98.html

Sediment and phosphorus being scoured through the Conowingo Dam following Tropical Storm Lee in September 2011.
http://www.mdsg.umd.edu/CQ/V10N4/main2/

Chesapeake Bay depends on the season the scouring event takes place. Warmer summer months tend to have more biological activity, causing a deposit of sediment to be more detrimental to plant life. According to the Lower Susquehanna Riverkeeper Michael Helfrich, the most recent scouring event was Tropical Storm Lee in September 2011 (Helfrich, 2011). About 6.4 million tons of phosphorus-contaminated sediment were scoured from behind the dam, or about two years' worth of phosphorus removed in a week. Though this might sound like a significant amount of reacquired storage capacity, at the end of the day it is not that much. In 1972, the scouring event caused by Hurricane Agnes occurred in July when biological activity was thriving. The release of phosphorus-contaminated sediment caused grass beds to be smothered and produced algal blooms. These negative impacts on the Bay foreshadow the long-term problems the Bay will face once sediment is released from the dam constantly, not just during scouring events.

Since the dam will no longer be a buffer against phosphorus contamination in the future, regulation that mitigates the problem is needed before it gets worse. That is, instead of waiting for the dam to reach its storage capacity, studies done by the USGS and statements from both Helfrich and written on in the Chesapeake Bay Journal suggest solutions need to be found now in order to actually protect these significant watersheds from further eutrophication (Helfrich, 2011; Blankenship, 2007). According to a 2000 document from Resources for the Future, a new TMDL that takes into account the danger of higher levels of phosphorus and suspended sediment will support a more holistic approach to protecting the Chesapeake Bay from an influx of phosphorus-contaminated sediment due to agricultural runoff.

Despite the cost, Helfrich believes that dredging, a practice for removing bottom sediment is one of the best options (Helfrich, 2011). Furthermore, if products that use the sediment could be found that offset the price, it could become more cost effective. According to the EPA's Science Notebook, these products could include "ecomelt" which can be used in cement, gravel walkways, and floor tiles (EPA, 2011b). "Ecomelt" is produced by heating contaminated sediment and other materials to very high temperatures, either destroying or locking in contaminants. Treated sediment can also be mixed with other ingredients to create topsoil for green roofs or landscaping. According to the Chesapeake Quarterly, another method called sluicing could also divert sediment buildup (Brainard, 2011). During winter months when biological activity is low, sediment could be funneled past the dam through a pipe into the Upper Chesapeake Bay which needs sandy, large-grained sediment. However, funding these solutions remains inconclusive. According to the dam's owner, Exelon Corporation, sediment buildup behind the Conowingo Dam "is a watershed issue; it's not a Conowingo Dam issue" (Brainard, 2011). Although the Conowingo Dam is located in Maryland, it affects residents living upstream in other states. As a result, it is an issue that requires significant focus on collaboration between not only the EPA and local governments, but also of communities themselves. With a heavy focus on agriculture in the area, the farming lobby has an influential role in governmental decisions. Altering best management practices to decrease the agricultural runoff itself will also be important in mitigating this multi-faceted issue.

Additional Resources:

For more information about dredging visit: http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/AppendixTSusquehannaDams_final.pdf

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By: Christie Anderson

Fraser Island

The largest sand island in the world

Last fall while studying abroad in Brisbane, Australia, I had the privilege of studying and exploring Fraser Island—an island on the World Heritage List and the largest sand island in the world. The aboriginal name for the island is K'gari, which means paradise, and it truly is. The island is a unique environment and is home to amazing wildlife. It is the only place in the world where rainforest grows on sand dunes at elevations over 200 meters (UNESCO, 2012), and there are over forty freshwater lakes located on the island, including about half of the world's perched dune lakes (Lakes of Fraser Island, 2012).

Due to the high acidity and low nutrient levels of the lakes, they are poor habitats for fish. There are, however, some frog species as well as a few freshwater turtles that have adapted to tolerate the acidic conditions in the lakes and swamps (UNESCO, 2012). Plants on the island also need to tolerate the low nutrient content and relatively high acidity of the sand, and they gradually enrich the sand with nutrients as they die. Some of the plants on Fraser Island grow nowhere else in the world. One rare species that I saw on the island was the angiopteris fern, or King Fern, which has the largest fern fronds in the world (Flora on Fraser Island, 2012). Over 230 species of birds have been found on the island, as well as fifty species of reptiles including the goanna and Australia's purest population of dingoes, a breed of wild dog. Whales, dugongs, sea turtles, and dolphins can also be found in the waters around Fraser Island (Fraser Island,2010d).

During my four day stay on Fraser Island, I hiked through the rainforest and eucalypt forest to three of the freshwater lakes. Lake Wabby is the most famous barrage lake, a type of lake that is formed when moving sand dunes block a stream. There are twelve species of fish in this lake, which is unlike most of the other lakes (Fraser Island, 2010b). The second lake, Lake Boomanjin, is the world's largest perched dune lake, which is formed when organic matter, such as dead plants and leaves, builds up and hardens in depressions created by the wind. This hardened organic matter then allows the depression to fill with rainwater or be fed by streams (UNESCO, 2012). Lake Boomanjin is fed by three freshwater creeks and is stained a deep red-brown color by the tannins in tea trees (Fraser Island, 2010a). The final lake I hiked to was the crystal clear Lake McKenzie, another perched lake and the most popular lake for tourists.

Wild Dingo

Green Tree Frog

Fraser Island's resources used to be exploited by logging and sand mining, but the island is now protected from these threats thanks to campaigning by environmental activists. Now, the biggest threat to its environment is tourism (Fraser Island, 2010c). Lake McKenzie is most threatened by tourist activities because it is heavily advertised and also easily accessible. Some of the potential threats by tourists include the addition of nutrients and chemicals to the water, as well as physical disturbance of the sediment and vegetation. Lake McKenzie has the lowest nutrient content of all the Fraser Island lakes, and therefore may be more susceptible to eutrophication, or rapid algal growth in response to the addition of nutrients (Hadwen, Arthington, and Mosisch, 2003). Other waterways on the island, such as Eli Creek, are also visited by thousands of people a year. Boardwalks have been built along the creek to reduce trampling along the banks, but there are still stairs that lead down to the water. Another concern is subsidence of the sand and runoff into the lakes due to the heavy traffic of four-wheel drive vehicles that are used to drive around the island (Jacob, 2008). Many efforts to preserve the environment and protect it from some of these threats are easily visible. The campground that my class stayed at required that we use the biodegradable shampoo and soap that they provided, which breaks down more readily in the environment and does not contain nutrients such as phosphates. There were always toilet facilities available at the lakes for proper waste management, and Lake McKenzie also had fenced off areas around the lakes to prevent trampling through vegetation. These practices are meant to reduce the amount of nutrients and chemicals released into the environment, as well as protect vegetation that stabilizes the edge of lakes and streams. Fraser Island is one of the most beautiful places I have ever been, and I hope it can be properly protected for more generations to experience it as well.

Top: Lake McKenzie; bottom left: Lake Wabby; bottom right: Lake Boomanjin
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Unregulated Air Pollution

A new threat to Pennsylvania's streams

By: Taylor Wilmot

The state of Pennsylvania continues to receive the most acidic deposition than any other state (PA DCNRa, 2011). Acid deposition, commonly referred to as acid rain, is caused when the emissions from combustion of fossil fuels and other industrial processes undergo chemical reactions in the atmosphere and return to the earth as wet or dry deposition. Wet deposition includes rain, snow, cloud, or fog, while dry deposition is often in the form of dry particles or gas. The main emissions that can lead to acid deposition are sulfur dioxide and nitrogen oxides, which react in the atmosphere and result in the primary agents of acid deposition (ESA, 2000).

Acid deposition is known to degrade waterways such as lakes and streams, as well as forest ecosystems (ESA, 2000). More specifically, excessive nitrogen from atmospheric nitrate and ammonia deposition in ecosystems can lead to soil acidification, nutrient imbalances, and eutrophication (US EPA, 2011). In Pennsylvania, precipitation is monitored at stations throughout the state thanks to a cooperative with the Pennsylvania Department of Environmental Protection (DEP) and Penn State University (PA DCNRb, 2011). It has been found that the precipitation is not as acidic and is assumed to be the result of reduced air emissions due to regulations from the Clean Air Act (PA DCNRb, 2011). However, Pennsylvania still ranks in the top ten most polluted states for sulfur dioxide and nitrogen dioxide emissions, due to sources of atmospheric pollution both within and outside of its borders (PA DCNRa, 2011).

Recently, Pennsylvania has begun to experience a new industrial activity, unconventional shale gas extraction. The development of unconventional gas extraction in Pennsylvania began in 2005, and continues to expand rapidly throughout the state. As of October 2011, the Pennsylvania DEP stated that 4,342 wells have already been drilled in Pennsylvania (PA DEP, 2011). To date, the Marcellus shale is the most expansive shale gas play in the country, spanning across six states (US DOE, 2009). The increased development of natural gas has been supported in part because it is promoted as a bridge fuel for future energy consumption (Howarth, Santoro, Ingraffea, 2011). Although natural gas produces less pollution than coal when burned, combustion is not the only part of the process. Before natural gas can heat a home or generate electricity, wells are drilled and fracked, and gas must be extracted, processed, compressed, and transported (Osborne, 2011).

> There are multiple stationary sources of air pollution involved with the components of natural gas processes and operations.

Each stage of natural gas development produces emissions, including transportation, production, refining, and storage activities. There are multiple stationary sources of air pollution involved with the components of natural gas processes and operations (GASP, 2011). Natural gas-fired compressor engines and turbines; venting from storage, dehydrators, and condensate tanks; emissions from leaking pipes and valves; and emissions of raw gas during well completion are some of the main sources of emissions (Citizen's Marcellus Shale Commission, 2011). Collectively, there are many components that can result in significant emissions (US EPA, 2011). Atmospheric pollutants emitted by unconventional gas development include nitrogen oxide, carbon monoxide, volatile organic compounds, and particulate matter (Citizen's Commission, 2011). Nitrogen oxide and volatile organic compounds are two of the most significant pollutants associated with natural gas drilling (GASP, 2011). Volatile organic compounds, including benzene, ethyl benzene, toluene, and xylenes, and other hydrocarbons including fugitive (escaped) methane, can release into the atmosphere and mix with nitrogen oxides from the exhaust of diesel fuel. The combination of gases produces ground-level ozone (Colborn, et al., 2011). Many of these pollutants cause adverse human and environmental health effects. Ozone is not only a threat to the immediate region, but also for areas up to 200 miles beyond the original site of production (Colborn, et al., 2011).

http://www.isustainableearth.com/sustainable-living/fracking-may-be-poisoning-our-childrens-air

Volatile chemicals and other air pollutants can be carried in the atmosphere and deposited far from their original sources (Swackhamer et al., 2004). They can be deposited directly on ecosystems or fallout on the land and run off into waterways (Swackhamer,et al. 2004).Currently, there are legislative exclusions and exemptions for oil and gas exploration and production from a number of federal statutes, including the Clean Air Act (Colborn et al, p.1040). On a state basis, Marcellus Shale natural gas drilling has been exempt from Pennsylvania's Air Pollution Control Act by PA DEP, because it is considered a source of "minor significance." There has been little recognition of the impacts of air pollution emitted by this industry and the adverse effects this may have on Pennsylvania water quality. Citizen groups, such as the Citizen's Marcellus Shale Commission and the Group Against Smog and Pollution, have begun to raise concern about air pollutants emitted by the process of unconventional natural gas extraction. These citizen groups, along with others, recommend more studies conducted by DEP, air quality monitoring, and regulation. In December of 2011 the PA DEP issued "initial notifications" to the natural gas industry that the DEP now requires reporting of emissions data. This will allow the DEP to develop its first emissions inventory for the gas industry (PA DEP, 2011).

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Flooding along the Chesapeake Bay in Annapolis.
http://www.examiner.com/slideshow/flood-photos-maryland#slide=23600201

Floods, Floods, Floods

By: Benjamin Mummert

Floods are a powerful reminder of the relationship we share with waterways, and the Susquehanna River Basin Commission suggests that our watershed is nationally one of the most flood-prone. During last fall's storms, tiny streams swelled into brown rushing ribbons, compelling evacuation of 120,000 people in the Susquehanna River Basin. The flooding brought by Tropical Storm Lee was the capstone of a saturated summer that included Hurricane Irene just a week earlier. Flows at the Safe Harbor Dam in Lancaster were 286 million gallons of water each minute—compared to September's typical flow of six million gallons per minute. In parts of Pennsylvania the inundation topped records set by Hurricane Agnes in 1972.

Recently-completed levees spared Wilkes-Barre from an estimated three billion dollar damage related to the highest river level ever. However, more than one hundred sewage facilities on the Susquehanna were overwhelmed by flooding and released record amounts of sewage into the river, prompting Governor Corbett to call the waters toxic. Today's realities of technology and growth support a paradigm shift reversing perceptions of the relationship between man and water—floods' devastation is increasingly a result of man rather than nature.

Naturally, floods are an integral component of a moderate disturbance regime that maintains biological diversity and productivity. Occasional floods refresh stream channels, diversify habitat, fertilize the floodplain, and promote new growth in the riparian zone. Local trout anglers have eagerly anticipated a flood of the renowned LeTort Spring Run in expectation that it will flush silt accumulated from farming and thereby restore spawning habitat. Floods rarely became severe in the pre-colonial landscape because forests absorbed five times more precipitation than even turfgrass, while beaver dams and wetlands also buffered extremes.

In modern times, human activities make floods more frequent and severe. Predictions for Pennsylvania related to anthropogenic climate change suggest wetter weather and more extreme events like hurricanes. Landscape alteration that reduced infiltration, including agriculture and development, already has dramatic effects. Dominant management policies make runoff more efficient by constructing pipes that speed precipitation, called stormwater, into waterways. Overall, floods crest higher because more water finds its way into streams more quickly, making the streams "flashy." Pollution, including chemicals, nutrients, litter, and sediment also increase. Despite new control technologies, stormwater related to development is the only increasing source of pollution in the Susquehanna watershed. Management practices like retention basins are effective for frequent small rains but are not designed to mitigate heavy precipitation events. Though these approaches work day to day, they fundamentally fail during floods.

The traditional flood management approaches, moreover, create paradoxes. The transition from cities to less intensive suburbs exacerbates stormwater. By preventing groundwater recharge, approaches to control flooding even at low flows is challenging. Attempts to manage the associated human problems obliterate natural hydrology and habitat while moving the problem downstream. Instead of flushing sediment, today's floods dump more in, smothering aquatic life. Floods that used to improve fertility in waterways now exacerbate an existing problem with eutrophication. Because of human influence, floods that once restored waterways have the opposite effect of degrading them for years.

A storm in late May 2011 contributed to operating failures at the Carlisle Waste Treatment Plant and the discharge of thousands of gallons of untreated sewage, with solids mixed with chlorine, directly into the Conodoguinet Creek. Despite asking residents to refrain from water use, the treatment plant was overwhelmed with ten million gallons per day, driven up from the typical three million by illicit stormwater to sanitary sewer connections. This took place during the fish spawn, but consequences for aquatic life have not yet been studied. Such occurrences are common in Philadelphia and other cities where storm and sanitary sewers are combined, causing periodic combined sewer overflows, which the city must spend billions of dollars to reduce.

Clean water is something we're coming to appreciate, but water has been something to fear for thousands of years, and though the will to finance clean water can be murky, the costs of flooding are all too clear. Flooding demands a fundamental reevaluation of our approaches to how we alter landscapes and hydrology. Philadelphia has embraced some principles of green development, an alternative to traditional stormwater management, as a cost effective strategy to limit flooding and sewer overflows. It advocates a fundamental restoration of human balance with the hydrologic cycle and represents a paradigm shift from constructed practices by mimicking natural systems. It emphasizes on-site infiltration, such as rain gardens, and stream restoration in developed areas, best management practices on farms, and restrictions on development of greenfields to preserve natural hydrology. Rather than treating streams as somewhere to flush wastes, its principles include a fundamental respect for water and our ancient relationship with it, including all of creation's dependence on clean water.

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