Stream of Consciousness

Volume 45

May 2013

Stream of Consciousness (2013)

Alliance for Aquatic Resource Monitoring (ALLARM)
Dickinson College

Follow this and additional works at: http://scholar.dickinson.edu/stream_of_consciousness

Part of the Environmental Education Commons, Environmental Indicators and Impact Assessment Commons, and the Environmental Monitoring Commons

Recommended Citation
Available at: http://scholar.dickinson.edu/stream_of_consciousness/vol45/iss1/1

Stream of Consciousness is a publication of the Alliance for Aquatic Resources Monitoring (ALLARM) at Dickinson College. For more information, please contact allarm@dickinson.edu.
Nestled in the northwest corner of Pennsylvania, west of the Allegheny National Forest, Venango County has a long history with oil and gas. In 1859, the first successful oil well in the United States was drilled just outside of Titusville, PA, in Venango County. Oil pioneers including John D. Rockefeller capitalized on the oil-rich land in the county, erecting oil derricks all over the area. Most notably, the towns of Franklin and Oil City grew out of the oil boom. Historically Venango County, has been home to a number of strong environmental advocates. Investigative journalist and resident of Venango County, Ida M. Tarbell, knew firsthand the negative consequences of an oil boom and went on to publish, The History of the Standard Oil Company in 1904. Many historians credit her muckraking with contributing to the feelings of public sentiment against the company and its court-ordered break-up in 1911 (Weinberg, 2008).

Following in Tarbell’s footsteps, the Venango Pennsylvania Senior Environmental Corps (PASEC) is working to protect the area from any harmful effects of oil and gas drilling. The group was formed in 1999 to collect stream data from fourteen streams located in five different watersheds. Using the Environmental Alliance for Senior Involvement protocol, with help from the PA Department of Environmental Protection’s Citizens’ Volunteer Monitoring Program, they conducted rigorous chemical analyses of the streams every month, and conducted additional biannual studies. In 2003, the group began to hunt for abandoned, uncapped wells, from the oil boom (Kolojejchick, 2013). Since then, the volunteers have identified an impressive 830 orphan oil and gas wells (Venango PASEC, 2013). These wells could cause a number of environmental concerns; for example, abandoned wells may continue to release gas, oil, or brine which can contaminate nearby aquifers and vegetation.

When shale gas drilling moved into the region, the Venango PASEC became concerned and contacted ALLARM through the county conservation district (E. Kolojejchick, 2013). Because of the many unidentified old oil wells still in Venango County, the presence of shale gas drilling brings
ALLARM, founded in 1986, is a project of the Dickinson College Environmental Studies Department. Our team of students, professional staff, and faculty provides community groups with comprehensive technical support for locally-driven watershed assessments, protection, and restoration. For more information visit our website: www.dickinson.edu/allarm. Stream of Consciousness is published thanks to the generous support of the Charles Merrill Kurtz Fund, established by Betty Puzak in memory of her father, Charles M. Kurtz, Dickinson Class of 1907.

Contents

1 An ALLARM Partner Profile: Venango Pennsylvania Senior Environmental Corps
4 Partnering with New York Water Sentinels
5 Who is Kathryn Tomsho?
7 The Utica Shale and Point Pleasant Formation
9 Burning Up Atmospheric Effects of Methane from the Natural Gas Industry
11 Shale Gas Monitoring Three Years Later What Some of the Data are Telling Us
13 The Positive Influence of Environmental Education
14 Bringing Riparian Buffers Close to Home
16 Greywater Systems A Method for Water Conservation
18 Water Myths The Ghanaian Version of Events
19 Revitalizing the Los Angeles River
21 Woods Hole My Own Science Bootcamp
24 Exploring Water Resources on the World’s Largest Freshwater Island
27 A Semester in Italy
29 Senior Reflections
24 Exploring Water Resources on the World’s Largest Freshwater Island
19 Revitalizing the Los Angeles River
7 The Utica Shale/Point Pleasant Formation

facebook.com/AllianceForAquaticResourceMonitoring
allarm@dickinson.edu
www.dickinson.edu/allarm
an additional concern. Mark Schrope, writer for Environment Yale, warns that old pipes from these wells could become conduits for methane which could contaminate nearby aquifers. In neighboring Tioga County, an abandoned well is believed to have caused to a thirty-foot geyser of methane and water near hydraulic fracturing operations (Detrow, 2012).

As apprehension in the region mounted, ALLARM traveled to Venango County in the summer of 2012 to teach a workshop on stream monitoring for potential effects of shale gas drilling. Since then, ALLARM has had three follow up meetings with the group, and a data entry party to help the members become more comfortable with electronic data management. (Tomsho, 2013).

I spoke to chairman John Kolojejchick and his wife and fellow volunteer, Evelyn Kolojejchick, about their work in the organization. The two have been with the Venango PASEC for ten years, beginning in 2003. Both are retired high school biology teachers and have a passion for environmental science (E. Kolojejchick, 2013). Evelyn says that, “being part of the group is exciting. It feels like you are doing something concrete. If you pick up trash on the side of the road, it’s back to the way it was in a couple weeks. In the group, there is solid evidence of what we’ve accomplished. You can count the wells we’ve identified or the data from monitoring streams we’ve collected.”

Indeed, the Venango PASEC can boast many tangible accomplishments. In addition to stream monitoring and well hunting, the group provides educational programs to local schools and community members. Evelyn says they usually provide macroinvertebrate programs for school groups but they are “game for almost anything.” Once, they wore their “well-hunting vests” and fastened handmade wire dragonflies illuminated by strings of LED lights on their backs, in honor of the group’s logo, for the Franklin Light-Up Night parade. They walked beside their banner, also lit with LED dragonfly lights, and passed out candy, while waving to the crowd. “Our banner holder is a genuine antique Allis-Chalmers tractor complete with antique driver (Ivan is our oldest member)!”

The personal connections among members the Venango PASEC group are strong. “The fact that we come from diverse backgrounds but have this common interest really bonds us together. Our group is, for the most part, very sociable,” says Evelyn. The success of the group seems to stem from its passionate members and the relationships they have with each other. Instead of fading over time, they have grown. John says, “I think the group’s greatest accomplishment is that we have been able to increase our numbers and by that, increase awareness in the community.” The organization started out with seven eager volunteers in 1999 and has now grown to include around sixteen people (Kolojejchick, 2013). Each member brings a different perspective and passion. “Some members are very into the water testing; others have a passion for well hunting. One man organizes macroinvertebrate sampling twice a year, and that’s very fun,” Evelyn says.

Katie Tomsho, ALLARM’s Assistant Director of Outreach, praises the Venango PASEC, “They do an excellent job of documenting what they’ve done and how they’ve done it.” Indeed, the group makes superb use
of their website; on it they outline the group’s activities and display the data they collect from water monitoring. In fact, the Kolojejchicks say a volunteer joined the group after he found their website through a web search on abandoned oil wells. The Venango PASEC group shows no sign of slowing down. As the group continues its work with ALLARM, their enthusiasm and dedication to environmental stewardship only grows. We are excited for the future of the Venango PASEC and feel fortunate to be able to join them on a part of their journey.

Venango PASEC’s Website:
vpasec.org/aboutus.html

References:
Kolojejchick, Evelyn and John. Personal interview. 4 February 2013.
Tomsho, Katie. Personal interview. 1 February 2013.

ALLARM has recently extended its shale gas monitoring protocol in several ways, which include: working directly with other states in the Marcellus and Utica regions, as well as conducting research to apply ALLARM’s protocol to other shale gas plays in the United States. Among these relationships with surrounding states, ALLARM has developed a strong partnership with the New York Sierra Club Water Sentinels. The Sierra Club Water Sentinels have chapters in twenty-four states and their mission is to “protect, improve and restore our waters by fostering alliances to promote water quality monitoring, public education, and citizen action” (Sierra Club, 2013).

The partnership began in 2011 when volunteers, Arthur Kuypers and Jessica Helm, voiced a desire to collaborate. New York is in a unique position due to the current moratorium against unconventional gas drilling. This presents the opportunity to build a rich baseline dataset to establish stream health prior to drilling activity. When Arthur and Jessica saw a need for volunteer water monitoring in the southern tier of New York, they reached out to ALLARM for our existing infrastructure in shale gas monitoring workshops.

The first collaborative workshop with ALLARM and the Water Sentinels took place in December of 2011, in Cattaraugus County. The following summer, three students, Christie Anderson, Ruby Stanmyer, and myself, as well as Julie Vastine (ALLARM’s Director), conducted three workshops in the southern tier of New York. These three workshops took place in the small towns of Painted Post, Norwich, and Vestal. Portions of the shale gas monitoring protocol had to be adapted in order to align with New York legislation. The protocol updates included; finding wells through the Department of Environmental Conservation (DEC), updating contact information, and incorporating New York laws, rather than Pennsylvania laws, into the setup. These were all important steps for preparing for a set of workshops outside of our usual territory. The community members who attended these New York trainings were highly enthusiastic and engaged, which luckily has correlated directly to their current level of involvement as volunteers.

The network of volunteers from these four regions has developed into a model citizen-monitoring program, with about 105 volunteers covering nearly fifty monitoring sites. Arthur attributes many of these successes to their “super volunteers,” who

Arthur Kuypers, Courtney Blinkhorn (’13), Christie Anderson (’13), Ruby Stanmyer (’13), and Julie Vastine at a workshop in Norwich, New York
monitor multiple sites, and the strong communication between groups. The volunteers are given feedback based on the data they compile into a central database. There are established leaders for each of the four regions who hold conference calls every week in order to maintain communication and support one another. More impressively, each month the regional leaders meet with their volunteers to hear questions and concerns. Their colleague, Jake Mumm, developed an online database in which volunteers were able to house data from the start. The dynamic infrastructure of the group creates a strong sense of community around monitoring, which both Arthur and Jessica agree, seems to lead to their success.

Due to the moratorium on unconventional gas drilling, much of their data serves to establish a crucial baseline for the health of their streams. In March of 2012, a group of volunteers were able to catch a spill in a small tributary that flows into Olean Creek, in Cattaraugus County, New York. The area is still an active site for conventional drilling, and the spill was presumed to be an oil spill from one of these sites. The citizens reported the incident by contacting the DEC, the mayor, and health services, since the site was upstream from a drinking water inflow. The spill was responded to by the DEC and was cleaned up, but not to the standards of the Sierra Club. The story attracted media attention around the area and demonstrates the importance of volunteer monitoring and citizen action to protect local environments. The volunteers are still going strong and will hopefully be there to watch over the environment if and when drilling does take place in the state. Currently, ALLARM is partnering with the Water Sentinels to analyze their existing baseline dataset and help with plans for the future.

References:

Who is Kathryn Tomsho?
By: Shanice Grant

Franklin D. Roosevelt once said, “To reach a port we must set sail... Sail, not tie at anchor. Sail, not drift”. This year the Alliance for Aquatic Resource Monitoring (ALLARM) has set sail on a new course. The added program area of Shale Gas Monitoring has resulted in the need for additional staff time to provide communities with the necessary level of individualized assistance. The program provides communities with the technical and programmatic support needed for collecting baseline data where shale gas extraction is taking place. To this action, ALLARM was thrilled to open welcome arms to the newest Assistant Director of Outreach: Kathryn Tomsho.

At the age of twenty-two, Kathryn, or Katie as she is more commonly known, graduated from Dickinson College as a proud member of the class of 2012. During her college career Katie's love of the environment, and helping others, not only prompted her to major in Environmental Studies, but also to join the ALLARM family as a watershed coordinator her sophomore year where she continued working until her graduation.

As the new assistant director of outreach, Katie's job entails providing follow-up assistance to volunteers trained to monitor for impacts from shale-gas extraction. She travels throughout the state, meeting with monitoring groups to provide technical support, answer any questions, and to assist with data management and interpretation. Katie's goal is to ensure that volunteers are collecting the most robust data possible, and that it is being properly managed and utilized.

When asked why she applied for this job, Katie responded, “I loved the time I spent in my undergrad working here. It gave me exposure to people and issues in the field, which shaped my perspectives in a lot of my courses. The opportunity to apply for this position was ideal; working on an issue that I was close to and the chance to play a relevant role by helping others and continuing to make a difference.”

Katie was initially challenged on the job with defining and designing exactly what her job would entail, and how to proceed with connecting with groups, but she has met these issues, and more, head on. On a personal level, “I applied for this job in hopes of attaining more skills for communicating with different groups and facilitating meetings, and an independence that would help me grow professionally and personally. Helping people has always been a priority, and being
able to travel and stay connected to an issue that I have followed since my sophomore year of college means a great deal to me.” To this job, Katie brought her ability to communicate well with others, to take scientific and technical data and make it more readily accessible to others, her ability to think on her toes, and her background with the environmental field. She also brought her passion for the well-being of others, following one of her favorite quotes by Aesop, “no act of kindness, no matter how small, is ever wasted.” She understands what is expected of her in this position and strives to go beyond that on a daily basis.

When not at the office or in the field Katie spends her time submerging herself in a number of different projects, from painting and cooking to listening to music and playing a game of scrabble with friends. She stated, “I am also a very avid reader, the last book I read was ‘Eating Animals’ by Jonathan Safran Foer and I am currently waiting for another book to arrive in the mail. I also subscribe to Wired, Cooking Light and National Geographic.” Katie is well-rounded and capable of thinking outside of the box. When asked to list five different ways to use a pencil, other than writing of course, she quickly replied: “It can be used to hold up your hair, build things out of, entertain oneself (either by tapping out music or by mimicking the propeller movement on a helicopter)” or my personal favorite: “If you are a giant you can use it as a toothpick.”

ALLARM is expecting to see great things from Katie. Her lifelong dream to, “help others by providing the tools and knowledge needed [for individuals to empower themselves to be the difference, and change, they want to see in their personal lives, and in the world,” aligns with ALLARM’s vision. She is also destined to be a capable leader within the ALLARM family. Her leadership philosophy is to be liked rather than feared because, if a leader is feared those that are following him/her are acting for the wrong reasons.” Katies says, “In my eyes that makes a leader more of a coward.” Katie’s enthusiasm and passion has inspired great things within ALLARM.

Stream of Consciousness
The Utica Shale and Point Pleasant Formation

By: Carolyn Flower

New technologies, such as horizontal drilling and hydraulic fracturing (fracking), are making shale gas deposits more accessible. To date, the Marcellus Shale has been the primary focus of gas extraction in the Mid-Atlantic including Pennsylvania. However, the Utica Shale is another shale formation gaining recognition as a profitable source for natural gas. The Utica Shale is more extensive than the Marcellus Shale and underlies portions of Kentucky, Tennessee, Maryland, New York, West Virginia, Virginia, Pennsylvania, and Ohio.

Ohio has become the main focus of Utica Shale drilling. One reason is because of the relative depth of the shale. In central Pennsylvania, the Utica Shale can be up to 7,000 feet below the Marcellus Shale, but in eastern Ohio, it can be as shallow as 3,000 feet (King, 2011). The Utica Shale located within Ohio is also considered to be a valuable resource for the state because, so far, the lease prices have not been driven up by competition, and there is potential of refining the wet gas deposits. The location of the Utica is particularly auspicious because the Point Pleasant formation lies underneath the Utica Shale. More than 200 feet (61 m) thick, the Point Pleasant formation provides even more potential for production (Weeden, 2012).

As of November 2012, 457 Utica Shale horizontal drilling permits have been provided and 187 wells drilled in Ohio (ODNR, 2012). Chesapeake Energy Corporation had drilled 134 wells in the Utica Shale, with 34 of those wells in the production process, 37 wells awaiting pipeline construction, and another 65 wells in various stages of completion (Chesapeake Energy Corporation, 2012a). The opportunity of extracting wet gas from the region is also contributing to the Utica Shale’s popularity. Natural gas is characterized as being dry or wet based on how thermally mature it is and on its primary composition. Dry gas is more thermally mature than wet gas and contains very little natural gas liquids (NGLs) or oil. Wet gas is considered to be less thermally mature and contains valuable by-products (NGLs) such as ethane, butane, propane, and pentane.

On March 13, 2012, Chesapeake Energy announced a $900 million project for gathering, compressing, and processing natural gas and NGLs (Chesapeake Energy Corporation, 2012b). Chesapeake Energy, through its subsidiary company, Chesapeake Midstream Development, L. P., has entered into a partnership with two gas development companies, M3 Midstream LLC (Momentum) and EV Energy Partners, L. P. to develop the infrastructure that will process natural gas and NGLs from the Utica Shale. The processing facility will be located in Columbiana County and the NGLs will be delivered to a central NGL complex in Harrison County. According to Midstream Development, the system is expected to be in service during the second quarter of 2013.

The Ohio Department of Natural Resources’ Division of Oil and Gas Resources Management (ODNR-DOGRM) has primary authority in Ohio for well construction, design, permit approval, and operation. The ODNR also regulates the disposal of brine, considered to include, “all saline geological formation water resulting from, obtained from, or produced in connection to drilling, or production of oil or gas…” (OHEPA, 2011). The ODNR prohibits the direct discharge of brine or flowback water into state waters or municipal wastewater sewage plants. As a result, brine and flowback water are sent to ODNR permitted Class II injection wells. Class II injection wells reach to 13,000 feet below ground, and require three layers of protective steel piping and cement.

However, in recent news, the usage of Class II injection wells has been linked to seismic activity in Youngstown, Ohio, located in Mahoning County just north of Columbiana. According to the USGS’s (2011) records, a 4.0 magnitude earthquake occurred on December 31, 2011, following a 2.7 magnitude earthquake on December 24, 2011. The earthquake’s epicenter was shown to be located 2,454 feet below the Northstar 1 injection well. Northstar Disposal Services, LLC was required to halt operations until further research was completed. The ODNR seismic monitoring network documented ten small seismic events that occurred within two miles of the injection wells. Although these
earthquakes were not strong enough to cause significant damage, they are indicative of a possible problem with storing brine and flowback in deep injection wells. According to Leonardo Seeber, a seismologist, it is quite possible that fluid migrated into rock formations below the Utica Shale (Fountain, 2011). These older, deeper rock formations are referred to as the “basement” and contain a multitude of faults that could rupture. A subsequent news release from the ODNR in March 2012 discussed that, in response to these new reports on the seismic activity in Youngstown, the ODNR developed more specific regulations relating to seismic monitoring. Some of these new precautions include prohibiting wells from being drilled into the Precambrian basement rock formation, submission of information available on geological faults within a specified distance of a proposed well, and the submission of a plan to monitor potential seismic activity (LoParo, 2012).

The Expansion of Utica Shale Gas Extraction into PA

Utica Shale natural gas extraction has been gaining momentum in Pennsylvania as well. There is wet gas in four northwestern counties: Beaver, Lawrence, Mercer, and Crawford. Crawford possesses a long history of oil and gas extraction, beginning in 1859 when the county drilled its first oil well (Complete history, 2012). The first Pennsylvania Utica Shale deep well was drilled in Crawford County in summer 2012. The well, Lippert 1H, is located in the French Creek Watershed and was drilled into the Utica Shale to a depth of 7,236 feet (First deep-shale, 2012). Before Lippert 1H, the Utica Shale formations in the northwestern corner of Pennsylvania had been largely untapped. Range Resources laid the infrastructure for the well in July 2012, and began to frack in September 2012. There are now more Utica Shale wells that are planned to be drilled in the Shenango River Watershed, which also extends into Ohio.
There is a lot of controversy surrounding hydraulic fracturing (fracking), and whether it is actually a positive method of energy production or not. Those who support fracking cite the abundance of natural gas in the United States that can now be accessed inexpensively thanks to this method. They also cite that natural gas burns much cleaner than coal in terms of carbon dioxide emissions, emitting about half the carbon dioxide. Opponents of fracking note the environmental dangers to groundwater and other damages from events such as pipeline damage and increased truck emission pollution. They couldn’t find a match until they looked at air samples from nearby landfill and cow pastures. They couldn’t find a match until they looked at air samples from nearby landfill and cow pastures. They couldn’t find a match until they looked at air samples from nearby landfill and cow pastures. They couldn’t find a match until they looked at air samples from nearby landfill and cow pastures. They couldn’t find a match until they looked at air samples from nearby landfill and cow pastures. They couldn’t find a match until they looked at air samples from nearby landfill and cow pastures.

Methane, the primary component of natural gas, escapes from frack sites through flaring and leakages. Methane is a greenhouse gas that is frequently talked about because of its presence in fossil fuel emissions. Methane, although not as popular in the media as carbon dioxide, is a particularly serious greenhouse gas due to its Global Warming Potential (GWP). A GWP refers to how effectively a greenhouse gas can warm the earth over a 100 year period. It is based off of carbon dioxide, which has a GWP of 1. Methane has a GWP of 21, meaning that it is 21 times more effective at trapping heat than carbon dioxide (EPA 2012). Although natural gas is “cleaner” than coal in terms of carbon dioxide emissions, it is actually much worse in terms of GWP.

Methane made its way into the fracking debate in 2011 when researchers from Cornell published a paper finding that the greenhouse gas footprint of shale gas is “significantly larger than that from conventional gas, due to methane emissions with flow-back fluids...” The study concludes that 3.6% to 7.9% of methane is leaking into the atmosphere at various points of the shale gas production cycle (Howarth et. al 2011).

Gabrielle Pétron, an atmospheric scientist with the National Oceanic and Atmospheric Administration (NOAA) working in Colorado, published another study on methane and fracking. Pétron noticed high levels of methane in data from one of NOAA’s observation towers. The high methane levels were consistently accompanied by a mixture of other chemicals in the area. Pétron and colleagues went looking for the source of the methane-chemical mixture, getting air samples from a nearby landfill and cow pastures. They couldn’t find a match until they looked at air samples from nearby oil and gas fields. Pétron and her colleagues studied the fields to determine how much methane was leaking out (Shogren 2012). They published their findings in the Journal of Geophysical Research, reporting that actual methane emissions were higher than previous estimates. “The methane source from natural gas systems in Colorado is most likely underestimated by at least a factor of two,” the report states (Pétron et. al 2012).

In the fracking process, there is an additional amount of methane entering the atmosphere than just from leakages; in fact, some methane is intentionally released. After a well is fracked, the natural gas that comes to the surface is moving too quickly in such a great quantity that it is difficult to capture. Also, the current low prices of natural gas make it uneconomical to capture. Therefore, it is burned off in flares. This means that with each new well, more unwanted methane is escaping into the atmosphere. The increase in fracking around the country has led to a lot of flaring and a lot of wasted natural gas, so much so that it can even be seen from space (Makan 2012). The United States is notorious for gas flaring. It is among the countries that flare the most, coming in fifth only behind Russia, Nigeria, Iran, and Iraq.
Gas flares and methane emissions help put the Bakken shale formation in North Dakota on the map. (World Bank 2012). Natural gas and oil production has become the second biggest source of U.S. greenhouse gases, accounting for 224 million metric tons in 2011 (Drajem 2013).

This has led to a call for regulation on methane emissions from well sites. In April of 2012, the EPA drafted a rule giving drillers until 2015 to invest in methane-capturing equipment. The deadline had been set for much earlier, but upon review of 150,000 comments and the availability of the equipment, the EPA decided to phase in the requirements for new equipment (Gardner and Rascoe 2012).

It remains to be seen, though, how the methane problem from natural gas will play out. In his State of the Union address, President Obama praised the natural gas boom, noting that the price of natural gas is falling and that, “over the last four years, our emissions of the dangerous carbon pollution that threatens our planet have actually fallen” (New York Times 2013). While carbon emissions are a huge problem in the United States, methane emissions might become an even bigger one, if they are not already. Science has made its case about methane; politicians are another hurdle.

References:


Vigina Farley (‘13) gives a presentation on safety procedures at a Monitoring workshop.

Ruby Stanmyer (‘13) teaches at a Shale Gas workshop in New York.

Taylor Wilmot (‘13) trains a volunteer to test water quality at a Shale Gas Workshop in PA.
Shale Gas Monitoring Three Years Later
What Some of the Data are Telling Us

By: Christie Anderson

In 2010, ALLARM developed a volunteer-based protocol with the goal of monitoring small streams and their watersheds for early detection of the impacts from shale gas extraction in Pennsylvania. Between 2010 and early 2013, ALLARM conducted fifty shale gas monitoring workshops in Pennsylvania, New York, and West Virginia with over 1,100 volunteers in attendance.

Volunteers monitor their streams weekly. When they monitor they record visual observations, perform chemical analysis, and measure stage (the height of the stream at a standard location). The chemical parameters that volunteers test include conductivity and total dissolved solids (TDS). Conductivity measures the ability of water to carry an electrical current, based on the presence of ions in the water. Inorganic compounds such as dissolved salts and heavy metals are good conductors, so high levels of these substances will result in greater conductivity. TDS is directly related to conductivity, and measures the amount of ions in the water.

Chemical monitoring is important because a hydraulic fracturing liquid is pumped into the fracking well to fracture the shale and allow natural gas to escape. The fracking liquid is a water mixture that contains sand and chemicals. The frac water mixes with the natural salty brine in the shale. Some of this water returns to the surface as flowback water and contains high concentrations of salts and metals such as chlorides, sodium, barium, strontium, and cadmium (NYC DEC, 2009), which may allow chemicals to be released into the surrounding environment.

Since there are so many different chemicals associated with gas extraction, it is too expensive to test for each of them specifically, which is why ALLARM recommends conductivity and TDS as indicator tests for shale gas monitoring. A pollution event from flowback water could cause an increase in conductivity due to the high concentration of salts and metals. Stream stage is measured to determine if high conductivity values are a result of low flow conditions, a pollution event.

When stage is higher, conductivity is lower because the presence of more water dilutes the concentration of ions. Likewise, when flow is low, conductivity is higher because there is less water and ions are more concentrated.

Barium and strontium are the signature chemicals used to determine whether a pollution event is from flowback water since they are almost always present in high concentrations in flowback water. A study by the New York Department of Conservation found high median concentrations of barium (661 mg/L) and strontium (821 mg/L) in flowback water (NY DEC, 2009). It is important to obtain baseline data not only for conductivity and TDS, but also for barium and strontium in order to understand control levels in the stream prior to drilling.

In addition to weekly monitoring activities, volunteers must complete ALLARM’s quality assurance and quality control (QA/QC) program twice a year – once within the first month of monitoring, and again later in the year. Volunteers collect a sample while they are out monitoring and then send the sample as well as a corresponding data sheet with their chemical and stage values to ALLARM. QA/QC is essential to ensure the credibility of the data collected. It ensures that the monitors are using their meter properly, that the meter is functioning properly, and that they are getting good results. ALLARM tests the samples using the same equipment as the volunteers, and then compare the lab results to the monitor’s results. The water sample is also sent to a certified laboratory for barium and strontium analysis in order to provide baseline values for the stream. Volunteer monitors receive feedback letting them know whether they have passed or failed quality assurance/control and tips if they did not pass. Between 2010 and 2012, monitors sent in 375 samples, and 93% of them passed on the first time. 100% of monitors who failed the first time and submitted a new sample.
Between 2010 and 2012, AL-LARM has processed 375 stream water samples from volunteers throughout thirty-five counties in Pennsylvania and five in New York. The data tell us a lot and identifies areas for further research and investigation. Conductivity values show a clear trend, and are generally lower in the northern tier counties and higher in western counties (Figure 1). The highest conductivity values were found in southwest Pennsylvania; in Allegheny County and Westmoreland County. Conductivity fluctuates seasonally and the geology of the area has a large effect on the conductivity of a stream (US EPA, 2012). Bedrock made of limestone, dolomite, and marble are very prone to breaking down and dissolving, and do so relatively quickly. They contribute carbonate ions to the stream which results in an increase in TDS and conductivity. Streams running through areas with granite or quartz bedrock tend to have a lower conductivity because they do not readily ionize in water (US EPA, 2012). Stormwater discharge to streams can also raise the conductivity due to the presence of phosphate and nitrate in fertilizers, metals, or chloride from road salt (US EPA, 2012). Streams surrounded by heavily forested areas will likely have less inputs and a lower conductivity than those surrounded by agriculture. Headwater streams tend to have lower conductivities than streams further down in the watershed, simply because fewer things have an opportunity to dissolve in them. The conductivity of streams in the United States range from 15 – 500 µS/cm (microsiemens per centimeter) and rivers range from 50 – 1,500 µS/cm; by comparison, industrial waters can have concentrations as great as 10,000 µS/cm.

The distribution of strontium values was similar to conductivity –
values were higher in southwest Pennsylvania and lower in the Northern Tier region (Figure 2). Almost 40% of the stream samples contain concentrations of strontium greater than 0.05 mg/L. Twelve samples contained strontium concentrations greater than 0.5 mg/L. Further investigation is needed to determine why values are greater in these regions. A possible source is the geology; in areas with limestone bedrock, the groundwater that feeds these streams will have a more direct route to the stream because of karst geology typical of limestone bedrock. This means that the groundwater is not as filtered because it flows through channels dissolved in the limestone and has more interaction with ions underground, potentially including metals such as barium and strontium. Some of the samples with the highest concentrations of strontium are found in a region primarily containing limestone bedrock, but this is not the case for all samples.

In contrast, there are no clear trends in the distribution of barium concentrations, and further investigation is needed. Figure 3 highlights the top 5% of barium values. Many of the samples with high barium concentrations come from Allegheny County. Barium is used in some industrial processes, more so than strontium, which may explain why higher barium values have a more even distribution across the state. The presence of both barium and strontium metals may also vary in different types of geology.

There are a lot of areas for further research to try to explain some of the values we are seeing across the state. ALLARM continues to provide training to communities and QA/QC support to volunteer monitors, and will continue to investigate conductivity, barium, and strontium trends in the state.

References:


The Positive Influence of Environmental Education
By: Lizzie Harvey

Environmental education is a vital part of teaching today’s schoolchildren. Not only is environmental science a worthy academic subject, but studies have also shown that environmentally geared lessons improve student focus and allow students to connect all areas of learning to the real world. Behavioral benefits are a needed reminder of why this subject should be valued in schools.

The North American Association of Environmental Education defines environmental education as anything that “teaches children and adults how to learn about and investigate their environment and to make intelligent, informed decisions about how they can take care of it” (NAAEE, 2013). The environment does not just mean wooded or “natural” spaces. It refers to everything around us. It is something that influences learners of all ages, and it should be of the upmost value in today’s schools. In addition to the environment’s over-arching presence throughout everyday life, environmental education has numerous benefits to student learning. Its objectives aim to creating positive outcomes in awareness, knowledge, attitudes, skills, and participation (Athman, 2001). Each of these is an integral part of student growth and development. These objectives have proved successful when applied to well-designed environmental programs in and out of school.

The objectives of environmental education reveal themselves most strikingly in student behavior. Studies
have shown a correlation between improved social and behavioral skills and an increase in environmentally based education programs. Environmental education is a hands-on learning experience that helps with student engagement and focus. A genuine, tactile learning experience makes the student an active participant, ready to play an important role in his or her learning. Even when these lessons are held indoors, the content is based in subject matter that students have a clear visual image and understanding of. Theories about learning, such as Gardner’s theory of multiple intelligences, show that every individual has his or her own area of strength. Students who are visual or tactile learners, or have strong naturalistic intelligence, really benefit from being able to see what they are learning in the world around them. As a result, these students are more focused and engaged in their lessons (Coyle, 12-13).

Incorporating lessons with the environment can also break the confines of the traditional school setting. In a case study conducted by Alun Oliver, outdoor classroom time led to improvement in academics and behavior for a boy with concentration issues. Oliver cites the increased sense of freedom found outdoors as the reason for this young boy’s positive changes. Oliver is not the only educator to note the remarkable changes that structured outdoor learning can have on student behavior. According to a report by the National Wildlife Federation, 75% of teachers think that these activities improve both creativity and problem solving skills, and 78% think they lead to higher levels of concentration (Burnette, 2010). These advances are not limited to the environmental education classroom. Improvements are seen in every subject area.

Recently, high concern has been placed on outdoor education because of its health benefits. While these benefits are undeniable, focusing solely on this aspect of outdoor education neglects its potential for academic and behavioral growth. Outdoor time at school is often allocated to brief periods of play in recess or gym. What schools need is a system of outdoor education that fosters attitudes and behaviors conducive to learning from an early age. Environmental education programs accomplish this because they bring positive attitudes and academics together. If done well, these programs will create healthier, more environmentally aware students and improve academic success.

With today’s test-driven educational system, the focus in school is all too often on academics alone. Environmental education allows academics to be combined with the behavioral, social, and health benefits all children need. It provides a space for students of varied learning strengths and abilities to thrive. The value of environmental education should not be forgotten.


References:


Coyle, Kevin J. “Back to School: Back Outside! Creating High Performing Students.”
Close to home, in Boiling Springs and just south of the Dickinson College Farm, ALLARM and our various partners have the opportunity to design and implement a riparian buffer. The purpose of this buffer will be to reduce the impacts of the neighboring meadow and grazing lands on the Yellow Breeches Creek. Nutrients and sediment are important parameters to control in the greater Chesapeake Bay watershed, but also within the more local Yellow Breeches watershed. As stated in the Yellow Breeches Watershed Assessment and in reference to their nitrate and phosphorus testing, “all of these monitoring sites are subject to upstream agricultural influences, where runoff can wash animal waste [or phosphates from farm soils] into the stream as a result of poor vegetative protection and a minimal riparian buffer” (Yellow Breeches Watershed Association, 2005). Within this report, the importance and need for adequate riparian buffers was mentioned on numerous occasions, further illustrating how this project can benefit the overall health of the Yellow Breeches.

This riparian buffer project originated from the idea that the Dickinson College Farm could enhance both its production and educational opportunities by developing an agroforestry program on sections of the farm’s land. Sprouting from there, the college-owned land bordering the Yellow Breeches also presented itself as an area suitable for education along with other beneficial outcomes on the surrounding environment. During the summer of 2012, student researchers conducted assessments to provide some information about the current vegetation in the potential buffer zone.

This year, ALLARM students alongside the College Farm and other Dickinson departments, will develop and implement a long-term management plan for this riparian area. With great hopes for improving the health of our local waterways and creating opportunities for current and future students, ALLARM is thrilled to bring riparian buffers close to home.

References:


Although 70% of the Earth’s surface is covered in water, less than 1% is available for human use. Every day, each American uses on average one hundred gallons of this finite resource, whereas the United Nations suggests that humans need 5.3 to 13.2 gallons to meet daily needs (WaterSense EPA, 2012 and UN Water 2012). Where is all that extra water going? Water is allocated to many uses including irrigation and industry, but decreasing our personal daily water consumption is a good method to conserve this vital resource (WaterSense EPA, 2013). As population in the United States and worldwide continues to increase, managing our water resources more efficiently is imperative to ensuring that more people can have access to this liquid that is necessary for life.

A growing strategy to conserving water is to install greywater systems to reduce the use of potable, filtered water for non-drinking or cooking purposes. Greywater is generally untreated household water from bathtubs, showers, clothes washers, and wash bins. It does not include toilet water and sometimes not even water from kitchen sinks and dishwashers (Wickstead, 2011). Greywater can be used for outdoor purposes for watering non-edible landscape and lawns and washing cars and sidewalks (Paulo et al., 2009). Some systems cycle filtered greywater back into homes for uses such as flushing toilets. Systems vary in size and level of maintenance, ranging from merely sticking a bucket under a kitchen sink and reusing that water in a backyard, to underground filtering tanks capable of processing thousands of gallons of greywater.

Small-scale backyard systems are relatively simple to implement if they are set up to use gravity to get the graywater to plants and the lawn. The simpler a system (fewer components such as pumps, filters, and pipes), the less it costs and the longer it lasts without needing much maintenance (Greywater Action, 2013). Some piping may be necessary to connect greywater sources from a home to the desired endpoint (image to the left). Perhaps, the system flows directly on to plants and trees outside. This method requires an awareness of the amount of water being produced at a time so as to not overflow a backyard. An alternative option is to establish a storage tank to hold greywater until it is needed. Precautions should be taken to control the release of chemicals such as salts, dyes, and other nutrients (mainly in the form of detergents and cleaning products) into greywater that may affect soils and plants (Paulo et al., 2009). Taking these aspects into consideration will help make a small-scale system run more smoothly and effectively.

Some state governments, especially in western regions of the United States, are encouraging their residents to experiment with household greywater systems as ways to recycle water resources directly in their backyards. In Arizona, state law allows residents to use greywater without needing a special permit and has a rebate program to partially reimburse families that install systems in their backyards (City of Tucson, 2012). The Arizona Department of Environmental Quality also provides extensive resources, including brochures and manuals for people wishing to reuse their greywater. The state of Arizona serves as an example of how greywater reuse can be encouraged in citizens’ everyday lives as an effective way to decrease our water consumption.

In addition to individual household-size systems, many large
institutions and organizations have found creative ways to decrease their water consumption by recycling greywater. Some universities have included greywater systems in new buildings on their campuses, including Colorado State University, University of Georgia, Worcester Polytechnic Institute, University of Wisconsin-Milwaukee, and Oregon University (Jarvis, 2011). These complex systems usually include septic storage tanks and underground filtration spaces because of the large quantities of water they manage and are much more expensive than household systems because they require pumps and sand filters (Greywater Action 2013).

Bridgewater State University’s Marshall Conant Science Building includes a rainwater-catchring system of cisterns and filters that cleans and chlorinates water for non-potentable uses (Broberg, 2010). The University of Washington Center for Urban Waters facility has two 36,000-gallon tanks to collect rainwater and greywater that is used for irrigating plants and flushing toilets. This and other conservation design lets the facility use “46% less water than a conventional facility” (City of Tacoma, 2010). The Stroud Water Research Center in Pennsylvania has successfully constructed a wetland at their Moorhead Environmental Complex.

Designing a wetland with water-loving plants to filter out greywater nutrients will ideally improve the water quality before it sinks into the ground, and the Moorhead Environmental Complex has found this technique a viable way to manage this water (Moorhead Environmental Complex, 2013). Overall, these and other systems are examples of how greywater use can be an effective method for conserving our water resources.

As populations continue to increase, water conservation becomes increasingly pertinent. Using greywater systems for irrigation, cycling water back into flushing toilets, and creating constructed wetlands, are methods being used by many different organizations. These successful efforts to conserve potable water show that greywater use is a good way to conserve our finite water resources. So what are you waiting for? Why keep watering your lawn with water clean enough for you to be drinking? I assure you, your grass wouldn’t mind a little grey in their water.

References:


Greywater Action for a Sustainable Water Culture. About greywater reuse. http://www.greywateraction.org/content/about-greywater-reuse


As a girl growing up in the sprawling city of Accra, the capital of Ghana, I often heard stories from my family about the various aspects of nature and the mysterious forces behind it. Even though Christianity and Islam are the two major religions in Ghana, there is a certain connection with the spirits and nature that we as a people value. Water has always taken center stage when it comes to myths, traditions, and religion. Throughout local history there has always been a deep respect for water and the various gifts that it provides.

One of the most common water myths that I grew up hearing constantly, is that of Maame Water or Mami Wata (Yoruba Spelling). Mami here means woman, and Wata refers to water. References to her are found throughout most of West Africa as well as, among the African Diaspora (communities around the world that descended originally from Africa). In the Orisha tradition of Nigeria and some of South America she is still worshipped as a deity. Maame Water’s role in West African culture is that of a benevolent water goddess. She is presented as extremely beautiful whenever she is depicted and is often associated with snakes and shown with one wrapped around her body. She is said to dwell in the ocean, and often takes the form of a mermaid—half fish half woman—or with the tail of a serpent. In modern day Ghanaian movies her kingdom is depicted as an underwater town or city. In many of the tales surrounding her, people are dragged to the bottom of the ocean into her kingdom for a variety of reasons. Some say, they become her servants, and rarely return. If they do return though they are often altered physically and spiritually. Some are said to grow more beautiful and more prosperous after an encounter with her. She is viewed as a bad spirit, and is often associated with lust and sexual promiscuity and is blamed for illness or negativity in someone’s life. She may also be communicated with and asked for assistance through a shrine or juju man. Regardless of how people feel about her personally, as a deity she has remained a constant presence in Ghanaian culture and continues to do so to this day, often appearing in movies. She is a constant reminder of the power and mysteries of the ocean.

Another interesting water myth is a tale of two rivers. Near Dominase, my father’s village, there are two rivers that are connected to two separate lakes. There, rivers are said to run side by side, but the water from them never mixes, and the colors of the two rivers are also slightly different. These rivers are often referred to as sister rivers, with two separate bosoms or gods residing in them. One of the rivers is filled with fish and the other is filled with gold. The villagers are never to fish from the river containing gold, and only fish in the river containing fish. The river with the gold is considered sacred to the village, and they worship it. Legend has it that one day a fisherman from the city came and caught a fish from the river filled with gold. The fish that they caught had a crown of gold around its head. He warned the fishermen to release him to the river, as the fish was the daughter of the river god, but he did not listen and ate it instead. Less than five minutes after he ate the fish, the fisherman dropped dead.

Not too far from my father’s
village, is the famous Ashanti Kingdom. Within the Ashanti Kingdom there is another famous water body named Lake Bosomtwe. The name Bosomtwe comes from the legend of how the lake came into being. In Akan, Bosom refers to a god or spirit. The name of the lake means God's Antelope. The story of how the lake came into being is an interesting one and helps shed a little light on why the people revere it. Legend has it that a hunter from a nearby village went hunting one day. He spotted an injured antelope in the forest and chased it, but when he was close enough to shoot it the antelope entered a small lake. The lake was said to have saved the antelope, and the man realizing what had happened stayed by the lake and fished there instead. The god, or bosom that inhabited the lake, must have been a powerful one to save the antelope. The lake has grown in size since the story was told, but certain practices are still carried out in regards to the fishing methods used. You are only allowed to fish on the lake using wood, often raft like planks of wood are used to go on the lake. Additionally no steel is supposed to touch the lake. The villagers around the lake revere it.

These myths and legends are just some of the many that can be found in Ghana. The people of Ghana often regard water as a spirit; a part of nature and a part of what keeps us in harmony with it. These myths and legends are a constant reminder to keep nature in our lives, and are a reminder of how important nature was to our ancestors.

---

Revitalizing the Los Angeles River

By: Oscar Monge

When I was younger and people spoke about waterways, the one that came to mind was my hometown’s river, the Los Angeles River of southern California. The river is about a ten minute bike ride away from my home and it was not until I was a teenager that I realized it was neither natural nor sustainable. As a result of living near the L.A. River, an urbanized and human tamed river, my conceptions of rivers were detached from the natural environment. This misconception is merely an example of the failures of one of the most urbanized and developed cities of the country. Although infamous in Grease, Terminator 2, Drive, and T.I.’s “Live your Life” music video, the Los Angeles River is now known for its revitalizing initiative to mend some of the environmental and social problems it has created throughout its history (MilNeil, 2012).

The Los Angeles River, once known a Rio de Porciúncula (porciúncula means “little portion”), is a 51-mile long waterway channel of concrete that starts from the San Fernando Valley and drains into the Pacific (Figure 1). Geographer Blake Gumprecht called the river a joke. Truth is, the river is depressing. The river lacks life. It is fenced in with barbed wire and its environment is littered with graffiti, shopping carts, and discarded soda cans. If you can name it it is probably in the Los Angeles River (Gumprecht, 1997). However, it is most important to mention that the river has very little water flowing throughout the year, which makes it even more challenging for life to grow. As a frequent L.A. river

Figure 1: Los Angeles River; http://en.wikipedia.org/wiki/File:LARmap.jpg
goer, I can attest to what Christian MilNeil expressed in his 2012 environmental news report. He said that for most of the past century, most Angelinos have only "experienced the river (if at all) as a thin trickle of water running down the middle of a vast concrete channel, [which is] a potent example of the city's defiance and control of nature."

The Los Angeles River was the most important source of water for Los Angeles. Before it was encased by concrete, the river was a small stream that supported life. Although people might assume Los Angeles to have been treeless and deserted before it was occupied, the area in fact had cottonwoods and willows that grew as much as forty to fifty feet in height. The river supported sycamores, clumps of alder, hackberries, and native grapes. The Los Angeles River was a lively stream, but after several projects of urban development, such as the completion of a transcontinental railroad link to Los Angeles in 1876, the city was eventually forced to search for water elsewhere. The transcontinental railroad attracted more people to Los Angeles and also influenced agricultural growth of oranges. Although water demand increased, the river remained an important source of water for many Angelinos until the 1940s when the Colorado River Aqueduct was established (Gumprecht, 1997). By 1950, the Los Angeles population had reached 4.1 million people, which pushed for yet another water project. In 1960 the Construction of the State Water Project began and the California Aqueduct was completed in 1972 bringing water from northern California and the watershed of the western Sierra Mountains to the central valley and southern California (Watershed Wonders, 2009).

Although it was a significant source of water, the river also became a problem to the city's infrastructural development (Figure 2). The river was wild and needed taming. Its bedrock caused waters to remain shallow and without boundaries the stream was bound to shift. Furthermore, year-round flow was not consistent which caused additional problems to city dwellers in Southern Los Angeles. Dominguez Hills, for instance, regularly faced flooding from the river. The Los Angeles River shifted its channel several times in the early 1900s. In 1914, it shifted near Compton and created a flood discharge of 31,400 cubic feet per second. Floodwaters inundated 11,763 acres in Los Angeles County (Gumprecht 1997).

To prevent further financial and infrastructural losses the L.A. River underwent a ditching project. The project was a failure and flood problems continued. The U.S. Army Corps of Engineers was hired to carry on the project to control these unwanted floods. In 1936 and the twelve months that followed, more than $20 million

---

*Figure 2: A house falls into the Arroyo Seco near the confluence of the Los Angeles River below North Figueroa Street.*


---

**THE LOS ANGELES RIVER THROUGH DOWNTOWN LOS ANGELES**

**PAST**

**PRESENT**

**FUTURE**

Left to right: Los Angeles River near downtown, circa 1935; L.A. River from the First Street Bridge, 2006; Plan to revitalize the L.A. River downtown

was spent and 17,000 people were employed. Following this investment, after the establishment of the Flood Control Act of 1936, the Corps was authorized to spend $70 million for new construction. By 1960, the Army Corps of Engineers had completed the fifty-one mile storm drain costing $116.7 million to tame the river and protect Los Angeles against floods (Gumprecht 1997).

The organization known as Friends of the Los Angeles River has been leading the movement to renew the river and create a more natural environment. After much national attention in 1997, the city of Los Angeles released its first plan to create green spaces, bike lanes, and walkable paths along the river, between Griffith Park and Elysian Park (a total of seven of the fifty-one miles) (Gumprecht 1997). The L.A. River Revitalization project is currently working under four principles: revitalize the river, green the neighborhoods, capture community opportunities, and create value (L.A. River Revitalization Master Plan Vision). Under these principles, the Los Angeles River is bringing hope back to its communities and a healthier water stream.

Every time I go home, I look at the project and its efforts to bring green spaces to the Los Angeles River. I remember what it looked like a couple of years ago and I can sincerely say I was embarrassed. The river was dirty and empty of water and life. Now I can see the sunset, the trees, and even birds. It has definitely become a more welcoming environment for Angelinos and for wildlife. I am excited to go back home and see what’s up next for this river!

References:


---

**Woods Hole**

**My Own Science Bootcamp**

By: Elizabeth de la Reguera

Environmental science has been a field I wanted to enter since junior year of high school, but college has made me wonder, what comes after graduation? Are there internships or jobs in the field? Is there the availability of doing research? My friend, knowing I was an environmental science major, encouraged me to attend a meeting entitled, “Semester in Environmental Science at Woods Hole.” I was not planning on studying off campus my junior year but this seemed to be an opportunity I could not pass up, considering all the research and educational opportunities. The program director showed examples of students’ research and the one that caught my eye was a soil warming experiment at Harvard Forest. I decided to apply and was shortly there after accepted into the program. The program was at The Marine Biological Laboratory, a well-respected institution whose studies range from neurobiology to soil science.

Shortly after arriving on campus, the nerves kicked in and I was not sure if I was going to be able to survive.
I quickly realized that the program was truly a science boot camp: living, eating, and sleeping science. We were scheduled for classes and labs from 0830 to 1700 Monday through Friday, which did not include the readings we had each night and the lab reports we would spend all weekend completing. Even in our down time, my seventeen fellow students and I, discovered our discussions would always return to some kind of scientific topic.

Our lectures in the morning focused on either aquatic or terrestrial ecosystems. We were taught by the scientists who had written our textbooks and whose research we had reviewed for previous classes. Our lectures mainly looked at the ecosystem on a global scale with a biogeochemical focus. Biogeochemistry is the study of the, “chemical, physical, geological and biological processes, that govern the composition of the natural environment” (Wikipedia). Our labs had more of a local focus but still focused on biogeochemical processes in the ecosystem.

I also took a mathematical modeling class, which combined my knowledge of calculus and environmental issues in order to construct a model for my specific study. I decided to examine three parameters: various age classes of brown trout in a hypothetical Pennsylvanian stream, total dissolved solids, and methane pollution. I wanted to understand how total dissolved solids and methane pollution caused by Marcellus Shale fracking would affect the various age classes of brown trout, and both their birth and death rates. I was able to simulate pollution events that would discharge into the stream and then dilute based on the flow of the stream. This allowed me to examine the death rate of brown trout in various age groups at various stages in the stream both before, at, and after the discharge point.

The classes and group work were fun, but the independent research was the highlight of my experience at Woods Hole. My research allowed me to combine my interest in soil science with a global impact scope. My research was titled, “The effects of human management on urbanized lawns with respect to nitrous oxide.” I studied mowed and unmowed lawns. When the lawns were mowed I specified whether or not the clippings were left on the lawn or removed. I chose this topic because urbanized lawns have been increasing substantially within the past thirty years in New England and because nitrous oxide is believed to have a global warming potential that is 298 times greater than carbon dioxide on a 100-year timescale (Guillard, Kopp 2004 and Townsend-Small et al., 2011). I had initially not planned on looking at gas fluxes in soil, but my mentor Jim Tang explained that studying them helps to identify how much denitrification is taking place. This experience allowed me to design the entire experiment on my own. I needed to determine what materials I would need and what methods I would use. I also needed to conduct the lab analyses because my mentor was traveling the majority of the time for his own research.

I looked at four different management practices, three homes each practice: fertilizer and leave clippings, fertilizer and remove clippings, no fertilizer and leave clippings, no fertilizer and remove clippings. I also looked at a sandplain grassland at the Francis A. Crane Wildlife Management Area where there is no mowing or fertilization taking place. My results were contradictory of what I had anticipated. I expected a flux in nitrous oxide where lawns were fertilized and the grass clippings removed, because fertilizer increases ammonium and nitrate in soils and would result in an increase of denitrification. This is not the story my results were telling, it was the complete opposite. Lawns that are not fertilized and leave the grass clippings have the
The greatest nitrous oxide flux from their lawns, and the lowest value was from fertilized lawns that leave the grass clippings. This only raised more questions as to why this was occurring. After conducting all of my own research, I was able to present my findings at a scientific symposium held at the Marine Biological Laboratory. The symposium was an opportunity for me to practice public speaking as well as present data in an accessible way.

Through my time at the Marine Biological Laboratory, I have learned the value of research and what it takes to be prepared before being able to collect data. I also learned about the hardships that come with research such as; coordinating schedules with other scientists, machine breakdowns, and determining the parameters I would look at while accounting for all the confounding variables. My research also led me to more questions about urbanized lawns and their human management. I’ve learned that research is almost never definitive; you will always find more questions than answers. I learned not to be deterred by having results that were not anticipated. Woods Hole helped me to decide that I do eventually want to attend graduate school and that as long as I’m still passionate about research and science, I will never work a day in my life.

References:


While studying abroad in Costa Rica for three months with the School for Field Studies, I was able to take a weeklong trip to Nicaragua, Costa Rica’s northern neighbor. The program focused on sustainable development, especially the issues third world and tropical countries face regarding development. While Costa Rica has a well-established ecotourism sector and places great value on conserving biodiversity and the country’s ecosystems, Nicaragua is hard pressed to rapidly develop and bring its people out of poverty. Similar to Costa Rica, there is great potential in the beautiful country of Nicaragua to implement ecotourism and to preserve its land, however land and water resources are already being impacted. We saw examples of this in our first stop, and my personal favorite: la Isla de Ometepe.

We had taken a bus, from a small town in the central valley of Costa Rica, north through the border of Nicaragua. From there we continued to the lake town of Rivas to get on a ferry to our first destination. Stepping off the bus and entering the intense heat of Nicaragua, we were immediately “welcomed” by residents all determined to sell us random goods. I was offered plastic bags of water, juice, soda, trinkets, food, shoes, and other articles of clothing by desperate individuals. We all tried to politely but firmly refuse and continue walking. This was one of our first experiences with a country that, although located quite close to Costa Rica, made it seem as though we had stepped into a different time period and a different world. The group of forty or so of us boarded the ferry and then sat through a three-hour-long boat ride to Ometepe. With intense turbulent waters that felt more like the stormy ocean than a lake, multiple people became sick and spent the journey hanging off the back of the boat. During this rollercoaster ride across Lake Nicaragua, we had views of cloud tipped volcanoes, forest covered shores, small farms, and local fishing boats. We stayed at Hacienda Merida, a hotel/eco resort that also does educational and environmental work with children and residents of the island. From here, we spent the next three days hiking up volcanoes, and kayaking to “Monkey Island” where you ran the risk of being attacked by the local resident monkeys. We visited coffee farms, and Ojo de Agua, a swimming hole that shows some of the beginnings of developed tourism on the island.

Isla de Ometepe is an island composed of two volcanoes located on Lake Nicaragua (Ometepe, Nicaragua: A Travel Guide). It is the world’s largest island located in a body of freshwater. Of the two volcanoes, Concepción is still active while Maderas is dormant and contains a cloud forest and a lagoon in its crater (Ometepe, Nicaragua: A Travel Guide). We stayed on the Maderas volcano part of the island and were able to hike up the side and visit a waterfall just under the old dormant crater. The island was formed out of the two volcanoes and they essentially dominate the entire landmass. At any point on the island, you are able
to see the peak of either Concepción or Maderas looming above you.

Ometepe has a population of about 40,000 people (about double that of Carlisle, PA) and most live in rural areas (Hacienda Merida). Although it is becoming more of a tourist destination, the population is still extremely poor. Education on the island is similar to the rest of Nicaragua with only 2% of the population finishing high school and 30% of the population being illiterate. Lake Nicaragua is considered the most important surface water aquifer in Nicaragua and until very recently, the water was still of excellent quality (Hacienda Merida). However, several current situations are now negatively affecting the quality of Lake Nicaragua (US Army Corps of Engineers). The growth of cities, the increased use of agrochemicals, deforestation, and poor wastewater treatment systems all contribute to the degradation of Lake Nicaragua, as well as other surface bodies of water in Nicaragua. Additionally, the country is the second poorest in all of Latin America (with Haiti being number one), and as such there is a push to increase industry and agriculture in order to boost the economy. The Island of Ometepe relies upon the quality of Lake Nicaragua for drinking water, agriculture, and to maintain the special environments and communities on the island. The future development will affect the ecosystems on the island and the water quality of the lake for generations to come (Gunn). Why is this important? Why do we, and particularly the residents of Nicaragua, care about Ometepe and Lake Nicaragua?

The now famous site of Ometepe became a UNESCO Biosphere Reserve in 2010 (Fauna and Flora International). According to the United Nations Educational, Scientific and Cultural Organization, biosphere reserves are places established by countries to promote sustainable development based on community efforts and good science. It is an effort to promote conservation while also
improving economic development through a healthy relationship between people and nature. Therefore, biosphere reserves such as Ometepe are considered sites of excellence and places to put such sustainable practices into place (UNESCO). Along with this designation, Ometepe has a large range of altitude, topography, and climate, conditions which are unique on such a small area (107 mi²). There are humid cloud forests on the slopes of the island’s volcanoes. These forests are mostly intact despite Nicaragua’s rapid deforestation rate (Gunn). There is an incredible diversity of habitats and species on the island and its relative isolation in the middle of Lake Nicaragua means that it houses many endemic species: animals and plants that have evolved there and exist nowhere else on earth. It is an important site for bird migrations and contains rich archaeological remains from pre-colonial peoples in the form of petroglyphs and stone idols (Gunn).

Nicaragua is known as the “Land of Lakes and Volcanoes” due to its large numbers of both, but unfortunately the country actually has very little safe drinking water (Foundation for Sustainable Development). However, it is a country that amazed me, and my fellow travelers, with its people, culture, and environment. Ometepe especially is an incredibly beautiful and magical place with staggering biodiversity, a wide range of ecosystems, places for swimming, as well as, hiking, and is still amazingly undeveloped. Tourism is increasing on the island, yet the population is still mostly in poverty with low levels of education, high levels of subsistence farming, inadequate electricity, poor sewage systems, and a way of life that has not changed much in the past couple of decades. However, there is a strong possibility that this will change as tourism increases, bringing visitors and their accompanying development to the island. While I cannot claim to judge whether this is good or bad for the island and its residents, it is safe to say that the future developers must be careful to consider its designation as a Biosphere Reserve and maintain its natural beauty and unique ecological significance. Visitors should be willing to leave their personal lives and habits behind and be prepared to adjust to life as it is on Isla de Ometepe.

References:


A Semester in Italy

By: Kieran Avis

I spent the fall 2012 semester off campus in Bologna, Italy. I arrived in Bologna in mid-August and returned back home in late December. I had never been so far from home for such a long period of time and, needless to say I was a little nervous in the beginning. However, it was clear fairly quickly that there was no need for nerves as the semester turned out to be the most rewarding experience of my college time.

Bologna is an ancient city in the Emilia-Romagna region of northern Italy. It is located to the northeast of Florence and the southwest of Venice, forming a straight line between the three cities. The University of Bologna is the oldest university in the world, founded in 1088, which has given Bologna a long history of being a college city with students from across the globe. I was there with other Dickinson students but I was still able to meet many other students from all over the world. A typical day in Bologna usually involved waking up to a light breakfast, consisting of an espresso, which I grew to love, (usually having four to six a day), going to my morning classes, then going to my favorite pizza place to grab a cheap slice for a quick lunch. After lunch I would go to class, go exploring in the afternoon, study, and then either make myself some pasta and chicken for dinner or go out with friends to a restaurant.

Bologna is famous for its porticoes (porches/walkways) with roughly forty-five kilometers of porticoes and thirty-eight of those in the city center. In the 12th and 13th centuries Bologna was overwhelmed with tall towers. These towers were built by wealthy families for protection during war or revolts and also as a status symbol. Most of these towers are now gone and only a few remain. The most famous are the Due Torri or “Two Towers” near the center of the city. The two, Torre degli Asinelli and Torre degli Garisenda, are a famous landmark for the city. The towers are just one contribution to several Bolognese nicknames: la turrita meaning city of towers, la rossa literally meaning “the red,” la dotta literally meaning “the learned,” and la grassa which literally means “the fat.” These derive from the history of towers in the city, the abundance of red brick in the cities architecture along with the cities political history, the universites presence in the city, and the famous cuisine.

While abroad I was fortunate enough to travel extensively through Italy and Europe. My traveling consisted of weekend trips with friends or structured trips by our Dickinson program. One of my favorite trips was
to Cinque Terre, Italy. Cinque Terre is located on the Italian Riviera in the Liguria region of Italy, about 3 hours west of Bologna by car. Cinque Terre is a region made up of five small villages. From north to south they are: Monterosso al Mare, Vernazza, Corniglia, Manarola, and Riomaggiore.

Cinque Terre is unique in its beauty and history. The rugged coast, five quaint villages, and the surrounding terraced hillsides all make up the Cinque Terre National Park and also a UNESCO World Heritage Site. The terraced fields of grapes are indicative of the quality wine made in the area. It is fairly difficult to travel there because the area is highly protected and it is not reachable by car. In order to get there, we had to take a bus from Bologna to La Spezia, then walk to the ferry, because the bus was unable to get all the way down the road. We then took the ferry from La Spezia to Portovenere, then another ferry to the most northern village Monterosso al Mare. I spent the majority of my time in Cinque Terre cliff diving and swimming in the salty Ligurian sea. I ate plenty of the local cuisine. The Liguria region is famous for pesto, fresh seafood and Farinata, a chickpea based pancake snack that is especially common in Cinque Terre. The protected status of the area makes it a popular tourist destination. People come from far and wide, to appreciate the hiking trails and stunning views of the surrounding seascape and landscape. A lot of my time abroad was spent exploring and trying to learn as much as I possibly could about my surroundings. In the process of meeting new people and traveling, I was able to make new friends, as well as, learn a lot about myself. My experience abroad was extremely rewarding and I will always look back on it with fond memories.

References:

I have been fortunate enough to work for ALLARM for three years, as well as two summers, and my time here has provided me with invaluable experience in the environmental field. Working for ALLARM has allowed me to expand my knowledge on issues related to shale gas extraction and water quality, enhance my communication and presentation abilities, and build greater leadership and organizational skills. I have had the opportunity to engage in many different areas of our organization, from facilitating shale gas monitoring workshops, independent research, and environmental education presentations, to several different activities in the lab. I have taught both children and adults within the local community, as well as, in communities throughout Pennsylvania, which has been incredibly rewarding. ALLARM has made me so much more confident in my public speaking, which I am proud of and grateful for. I have also had an extremely valuable professional experience when I presented at the 2013 Watershed Congress. Throughout my time here I have gained knowledge and experience that I would never have gained solely in the classroom at Dickinson. I have worked alongside amazing and incredibly supportive colleagues who have come to be some of my best friends, and I will miss the ALLARM family. As I am graduating, I feel confident in the skills and professional experiences I will take with me from ALLARM, and I know that they will be useful for any path I choose in the future.

Christie Anderson

An ALLARM experience is hard to summarize in a brief senior reflection. Working at ALLARM encompasses such a diverse and robust array of experiences, skills, and knowledge—much more than what can be listed off here. Yet, one thing that is easy to assert is that my time at ALLARM has been one of the most defining components of my undergraduate education. I arrived at Dickinson with some inklings of following the environmental science path and my first year of courses was quick to confirm that. However, not included in my perception of what my four years at Dickinson would look like, was an employment opportunity that would so well pair with my academics. ALLARM had quickly appeared on the scene as an opportunity unlike any I had seen or heard of in a college atmosphere. These first impressions are synonymous with my final impressions as I leave ALLARM.

I can still recall my interview for an ALLARM position—I noted my goal for wanting to go beyond what was found within the classroom. This goal was met with incredible success. ALLARM provided a direct professional application for the skills and knowledge I learned throughout my undergraduate education. Similarly so, my experience with ALLARM paired flawlessly with what I achieved in the classroom. I am leaving ALLARM and Dickinson with professional experience, a large stock of new knowledge and skills, and a batch of wonderful relationships that shall continue well beyond these four years. I simply can’t imagine my time better spent.
Lizzie Harvey

My year at ALLARM was the perfect culminating experience for my final year in college. ALLARM has expanded my horizons for what I can do with a degree in English. I can get involved with environmental issues by using skills in reading, writing, and education as a means of connecting with people.

I designed lesson plans, wrote and edited newsletter articles, and worked with students of all ages, even adults. Before working here, I never thought I would be presenting at a workshop on water monitoring, teaching local communities how to test water, or playing an integral role in shale gas monitoring efforts.

I was also able to participate in the local community. The experience working with local school groups and children from the area was priceless. From first graders learning about wetlands to seniors in high school performing their own water monitoring, our environmental education programs were the most rewarding part of working at ALLARM. I was able to help students get excited about environment.

Oscar Monge

I came to Dickinson College knowing that I wanted to study the environment and the unfair stratification of people in society. Through my studies in environmental studies and sociology, I have done this. People in my hometown of Los Angeles, parents included, ask me why I’m studying this. Will I have a job after I graduate? I knew I wanted to serve as a facilitator and help empower underserved communities and I can sincerely say that ALLARM has added several valuable skills that will help me succeed.

When I was a high school senior, but I didn’t apply until my third year in college. Though I’m not sure why it took me so long, I became part of the ALLARM team my senior year. Since then, I have tried making the best of my time here. From working with our local Carlisle Stormwater Committee to the technical assistance and shale gas workshop I helped facilitate, my values in community empowerment have only grown. As I get ready to graduate, I see how ALLARM has helped me solidify my goals and passion with community work.
How do I possibly fit all of my wonderful experiences with ALLARM into one paragraph? Filling out my application to work here as a first year almost exactly three years ago, I thought I was applying to just another campus job, albeit one with an environmental focus. I could not have been more wrong. The two and a half years I have worked here, including two summers of full time work, have been full of pretty much every program that ALLARM has to offer. This began with environmental education, moved to lab work, technical assistance, shale gas, and finally to stormwater. Within these programs, I have been equipped with skills that I believe will enable me to succeed in any position I find myself in. It was not just these work experiences that have shaped me during the past couple years, it has also been working with my fellow ALLARM colleagues and with my fantastic supervisors, Julie, Jinnie, and Katie. Experiences such as driving thousands of miles throughout Pennsylvania, jamming out to countless playlists, bonding in questionable roadside motels, completing a stormdrain reconnaissance, and handling the full spectrum of audiences we have presented to, have turned my co-workers here at ALLARM into some of my biggest supporters, my mentors, and my best friends. In other words, ALLARM has become a family. Working here has been transformational for me and I have no idea where I would be headed without this organization.

Taylor Wilmot

Having the opportunity to work at ALLARM since my freshmen year is my most valuable experience at Dickinson College. My time working for ALLARM has greatly inspired and shaped my interests and direction during my time at Dickinson. ALLARM opened up my eyes up to the factors that contribute to a successful non-profit and the diverse methods that can be used to work with community members. Thanks to ALLARM I have discovered many passions in this field and will continue to work with organizations that are able to address community needs as successfully as ALLARM has done over the years. Working with the ALLARM staff, including the directors and students, are some of my most memorable moments at Dickinson. I feel very fortunate to have spent long car-rides, shale gas workshops, rain barrel events, conferences, and an ALLARM summer with the most passionate and hard-working people I have ever had the pleasure of working with. As I look forward to my future endeavors, I am excited to see new ALLARM staff begin their journey and experience opportunities to grow and learn with ALLARM as I have.