Environmental Science

ECOLOGICAL WATERSHED MONITORING IN THE HEADWATERS OF THE NORTH FORK OF THE SHENANDOAH RIVER USING MACROINVERTEBRATE AND TURTLE SURVEYS. Diana Mendoza, Sam Stoner, Ryan Keiner, Douglas S. Graber Neufeld & James M. Yoder, Department of Biology, Eastern Mennonite University, Harrisonburg Virginia 22802. This study is part of an ongoing collaborative project developed by Eastern Mennonite University and various partners to address watershed health in the primarily agricultural community of Bergton, Virginia. Short-term goals of this project are to collect baseline data of watershed health at future restoration sites in the German River and Crab Run watersheds using stream macroinvertebrate and wood turtle population surveys. Virginia Stream Condition Index (VSCI) values from samples collected in the fall and spring of 2014-2016 indicated primarily good to excellent conditions (>65) within both watersheds, although marginal (<65) and stressed (< 59) VSCI values were seen at two sites, particularly at the first proposed restoration site. Fall VSCI values were generally lower overall as well, likely due to lower stream levels leading in the summer and early fall, negatively affecting the macro community in this reach. Wood turtles are an excellent indicator of long-term overall watershed health and are species of concern in the state of Virginia. Biannual surveys in 2014-2016 indicated an established but relatively small population (25 individuals) within the watersheds, likely due to lack of quality in stream habitat. Only 1 out of 25 turtles were juvenile, indicating reduced reproductive success of the population. Monitoring will continue as restoration efforts at multiple sites are completed over the next 2 to 5 years. This study is supported by a grant from the National Fish and Wildlife Foundation.

NUTRIENT LOADING, SEDIMENTATION AND OVERALL WATERSHED HEALTHASSESSMENT IN THE HEADWATERS OF THE NORTH FORK OF THE SHENANDOAH RIVER. Jesse H. Reist, Tyler Brenneman, James Yoder & Doug Graber-Neufeld, Dept. of Biol., Eastern Mennonite University, Harrisonburg VA 22802. A two year integrated water quality study was conducted in Bergton, Virginia to assess chemical parameters of stream health in headwaters of the North Fork of the Shenandoah River. The Shenandoah River, consisting of mountain headwater streams, feeds the Chesapeake Bay – keeping its water healthy is of importance for downstream marine life and commercial activity. Nine chemical parameters were assessed, including turbidity, nitrate, phosphate, ammonium, dissolved oxygen, coliform bacteria, temperature, pH, and conductivity in two sub-watersheds (Crab Run and German River) feeding the North Fork of the Shenandoah River. Comprised of 88% forested cover, the

watersheds are categorized as primarily forested in the upper reaches, with agriculture dominating the remaining 12% of the land use. Results were collected periodically during bi-monthly sampling, as well as during storm events (5-6 per year) and showed that primary parameters of concern were high summer temperatures (>20^0 C), sediment and nutrient loading, and elevated bacteria colony county. Total sediment discharge for the watershed was estimated to be 1.4 million kg annually, and total phosphate and nitrate loading were estimated to be 365538 and 17326 kg/year, respectively. Impairment of all parameters of concern were higher in the Crab Run sub-watershed than in the German River sub-watershed. This study is supported by a grant from the National Fish and Wildlife Federation.

ENVIRONMENTAL FATE OF PIRLIMYCIN, A COMMONLY USED ANTIBIOTIC FOR DAIRY PRODUCTION. H. T. V. Le, K. M. Dayley & K. Xia, Department of Crop & Soil Environmental Sciences, Virginia Tech, Blacksburg VA 24060. A large amount of antibiotics have been used in livestock industry, which is of growing environmental concern since 40 to 95% of antibiotics administrated to animals are excreted in feces and urine and enter the environment via manure land application. Released antibiotics not only are bioactive but also have potentials to increase antibiotic resistance in the environment. In this study, the environmental fate of pirlimycin (PLY), a commonly used lincosamide antibiotic in dairy production, was investigated. Since sorption of antibiotics into soil components can reduce their mobility to surrounding environment, the sorption isotherms of PLY to a clay soil and a sandy soil were studied using the batch equilibrium experiment. Rainfall simulation study was conducted to monitor movement of PLY in fields receiving dairy manure amendment via surface application and subsurface injection. The sorption of PLY to the clay and sandy soils followed Langmuir and Freundlich sorption isotherms, respectively. Sorption coefficients (K_d) values were 124 and 67 L kg^{-1} for the clay and sandy soils, respectively, indicating PLY has higher mobility in sandy soils comparing to clay soils. Manure subsurface injection concentrated PLY in the injection slits with limited horizontal diffusion beyond 15 cm from the slit, while surface application evenly distributed PLY throughout the soil surface. However, rainfall after manure application increased vertical and horizontal movement of PLY from the injection slits, resulting in detection of PLY in up to 20 cm soil depth at a distance of 40 cm from the slits. Similarly, rainfall increased PLY levels in 5-20 cm depth of the surface application plots. Mass balance study showed that after the rainfall, 5% of PLY was carried in runoff for surface application plots, while only 0.18% of PLY was detected in the runoff for the subsurface injection plots. Comparing to surface application, higher percentage of applied PLY appeared in the deeper profile of the injection slits after rainfall. This study suggested

that subsurface manure injection in sandy soil might result in enhanced downward movement of PLY due to its limit sorption to sandy soils compared to clay soils.

WRECK ISLAND, VIRGINIA SHORELINE CHANGES SINCE 1999. James D. Haluska, Department of Ocean, Earth, and Atmospheric Sciences, Center for Coastal Physical Oceanography, Old Dominion University, Norfolk, VA. 23529. The Virginia barrier islands stretch from Assateague Island in the north to Fisherman Island in the south. These islands are subject to Atlantic extra-tropical storm and hurricane influence and sea level rise. Wreck Island changes were determined from satellite and aircraft images using ArcGIS software and the USGS Digital Shoreline Analysis System (DSAS). Transects every 300 meters alongshore were calculated for the island using DSAS. The resulting shoreline locations from the remote sensing image dates were used to construct time series of shoreline movement for each transect location. From 1999 to 2004, the island's shoreline was relatively stable. In 2004, a significant input of sand, possibly due to increased tropical storm activity, widened the island. Since 2004, the rate of shore loss at all locations has been much lower than other islands in the barrier island group. Significant shoreline gain coincides with exceptional events such as several hurricanes in a short period of time (12 to 18 months) in 2004-2005 and the El Nino of 2009-2010. Rates of shoreline change are a maximum gain of up to 54 meters/year at the southern end and a loss of up to 29 meters/year at the northern end. The gain/loss makes the island appear to be rotating counter-clockwise. The island has also shifted southward with an apparent increase in this shift post-2004.

VIRGINIA = FUTURE OF DROUGHT? Richard S. Groover, Former member of the Governor's Climate Change and Resiliency Update Commission, Mechanicsville, VA 23116. This presentation covers evidence supporting that critical drought may occur in some portions of Virginia in this century. The most affected areas may be in south central and central Virginia, northern Virginia and several other smaller regions. Numerous agencies in the Commonwealth of Virginia predict deleterious impacts from drought. As state population increases over the next 30 years, there will be 32% increase in water demand, raising questions if Virginia's freshwater supply will be enough, especially as increased evaporation due to climate change occurs and as water demand increases. The projected surface water demand may increase by 86%. Groundwater levels in SE Virginia are critically low, yet expected demand for water from aquifers is expected to increase by 14%. Eighty-two percent of current riparian removal of surface waters

are unregulated, and a reevaluation of water withdrawal regulation is needed. If persistent drought occurs and withdrawal increases, negative abiotic conditions would occur for aquatic system's biota. The Virginia Department of Environmental Quality recommends increased water storage; thus three new large state-owned reservoirs are recommended in this presentation.

PRESENCE OF *BORRELIA*, *RICKETTSIA*, AND *EHRLICHIA* IN FIELD-COLLECTED TICKS ON CANDLERS MOUNTAIN, VA. Lara E. Colombo & Heather E. Stanley, Department of Biology, Liberty University, Lynchburg VA, 24515. Tick-borne disease is found throughout the world. Tick collection is required for disease surveillance and depends on a comprehensive understanding of ticks' habitats, life cycles, and diseases they may carry. A tick field collection was begun in March of 2015 on Candlers Mountain in Lynchburg, Virginia to begin investigation of the tick population at that site and to obtain ticks for testing for three disease-causing agents. CO_2 traps were utilized in the capture of the ticks. To create the most efficient trap, the tapes used on the traps were experimentally tested with a force transducer in the lab. The goal was to use traps that would capture the greatest number of ticks. The results from the experiment identified colored lab tape and duct tape as the most efficient tapes to use for the CO_2 traps. From March 2015 through June 2015, three deer ticks (*Ixodes scapularis*) and 59 lone star ticks (*Amblyomma americanum*) were collected. Analysis will be done on the captured ticks, looking for disease-causing agents. The individual tick DNA will be extracted, purified, isolated, amplified, and run on gel electrophoresis. The agents tested for will include those that cause Lyme disease, Rocky Mountain spotted fever, and Ehrlichiosis in humans. This is a long-term ecological project. Tick collection has resumed in March 2016 to continue analysis of the tick population on Candlers Mountain.

AN EVALUATION OF SHORELINE STABILIZATION EFFORTS IN BACK BAY, VIRGINIA. Reece K. O'Donnell & Heather D. Harwell, Dept. of Environmental and Organismal Biology, Christopher Newport University, Newport News, VA 23606. Five shorelines at False Cape State Park and Back Bay National Wildlife Refuge in Virginia Beach, VA will be stabilized as part of a larger effort to design a regional network of effective adaptation projects to address the broad array of climate change impacts faced by human and wildlife populations. The purpose of this study is to evaluate the effectiveness of the living shorelines created to mitigate shoreline erosion. Analysis of vegetation communities pre- and post-construction and monthly erosion rate measurements will be performed to determine the effectiveness of each created living shoreline. We expect that the stabilization of these sites

using a living shoreline will drastically reduce erosion rates compared to reference sites, and will bring rise to a sustainable, native vegetation community that is different from the original composition of the site. This work will test the efficacy of living shoreline stabilization as a viable method of wetland restoration in Back Bay, and will contribute to the growing body of literature that supports this methodology.

A MILLENNIAL RECORD OF MARSH ACCRETION IN THE TIDAL REACHES OF THE POTOMAC RIVER. Megan K Clevenger[1], Neil E. Tibert[1], J.B. Hubeny[2], Tom Cronin[3], Tammy Prescott[1] & R.C. Lyle[1], [1]University of Mary Washington, [2]Salem State University, [3]United States Geological Survey. Tide gauge records in the Chesapeake Bay region, eastern US, indicate that relative sea-level rise over the last century is due to a combination of melting land ice, ocean thermal expansion, and subsidence, mainly due to glacio-isostatic adjustment. However, there has been little research to establish a millennial record of marsh accretion to quantify pre-20th century rates of Late Holocene sea level rise in the proximal-central estuary of the Potomac River downstream of Washington DC. Our primary objective is to establish a baseline physical, biological, and geochronological record of marsh deposits spanning the past three millennia. Three marsh cores were collected from Mattox Creek, Rosiers Creek, and Wilkerson Creek; tidal creeks adjacent to the Potomac River, Virginia. The cores range in thickness from 5.0-6.7 meters in length and comprise two primary lithofacies of basal grey clay and an upper organic-rich peat and clay. The grey clay lithology ranges in Total Organic Matter (TOM) from 4-20%and has highly variable magnetic susceptibility intensity peaks. In contrast, the alternating organic rich peat and clay ranges in TOM from 14-82% and has negligible variability with respect to magnetic susceptibility values. Microfossils extracted from the cores include an association of marsh and estuarine foraminifera that include *Ammoastuta inepta, Miliammina fusca, Trochammina inflata, Jadammina macrescens*, and *Ammobaculites*. Results of AMS^{14}C of woody matter, peat, and skeletal calcite yield a basal age of the cores as 3540 ybp at 5.01 meters below the marsh surface.

HEALTH ASSESMENT OF MASSAPONAX CREEK AND THE NI RIVER IN SPOTSYLVANIA COUNTY, VA IN 2015-2016. Cameron Stewart, Jessalyn Cockrell, Elizabeth Weast & Michael L. Bass, Department of Earth & Environmental Sciences, University of Mary Washington, Fredericksburg, VA 22401-5300. This research is a continuation of work starting in 2012 to compare the health of Massaponax Creek and the Ni River, in Spotsylvania County, VA, by benthic macroinvertebrate sampling and water quality analysis. Massaponax Creek flows through areas stabilizing after development.

The Ni River flows through a more rural area, though there is planned development of Ni Village community surrounding the river. Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) were determined by vacuum filtration and Fecal Coliform levels by MF technique. TSS were greater in the Ni River and TDS were greater in Massaponax Creek. Fecal Coliform concentrations were higher in Massaponax Creek in 2015. Massaponax Creek also had a higher average DO concentration and Conductivity. Aquatic insects were separated by order to calculate %EPT. The %EPT of both streams was just under 80%. Results from 2012 found greater variety of the EPT orders in the Ni River, whereas 2015 showed similar variation in both of the streams. Analysis of samples showed average Phosphate, Nitrate, Hardness and Alkalinity were higher in Massaponax Creek. In conclusion, Massaponax Creek appears to be recovering after the stabilization. Further research is necessary to determine if the pattern of recovery found in Massaponax Creek would be the result for the Ni River if the surrounding area were to be developed.