Environmental Science

AN INTEGRATED ECOLOGICAL AND WATER QUALITY ASSESSMENT OF THE HEADWATERS OF THE NORTH FORK SHENANDOAH RIVER. Bryce D. Yoder, Jesse B. Parker, 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 establish baseline measurements for water quality parameters and determine relative contributions of tributaries to overall nutrient and sediment levels within the watershed. Storm events were found to cause spikes in nutrient, sediment, and bacteria levels. On average across sites, sediment levels increased from 10 mg/L to 285 mg/L, fecal coliform increased from 50 cfu/ 100ml to 372 cfu/ 100ml and nitrate levels doubled from 1.2 mg/L to 2.71 mg/L after storm events. This suggests that the streams in the study area are not able to manage the hydrologic stress of storm events, resulting in bank erosion and general stream instability as well as nutrient and bacteria input from runoff. Baseline total coliform levels averaged about 1500 cfu/ 100ml, a concentration far above the DEQ recommended amount of 235 cfu/ 100ml. Macroinvertebrate biotic indices, while overall indicating good to excellent conditions, were more stressed in reaches where livestock exclusion was not being implemented (VSCI of 65.75 compared to 83.94). Turtle surveys indicated relatively low wood turtle abundance and no evidence of a currently reproductive population. Continued baseline data collection and long-term monitoring will help evaluate the effectiveness of future stream restoration efforts and livestock exclusion practices.

BASELINE WATER MONITORING PROGRAM IN RESPONSE TO POTENTIAL HYDROFRACKING. Hannah M. Daley[1], Janaya M. Sachs[1], Tara Kishbaugh[1]& Douglas S. Graber Neufeld[2], [1]Dept. of Chemistry & [2]Dept. of Biology, Eastern Mennonite Univ., Harrisonburg VA. 22802. Stream and well water samples near a potential hydrofracking site in Bergton, VA. were collected from 2011 to present. Temperature, pH, conductivity, and TDS (Total Dissolved Solvents) data was used to determine a baseline sample dependent on seasonality. Barium and Strontium concentrations of the samples were measured through atomic absorption spectroscopy. It was found that, on average, Bergton, VA wells had 0.29 ppm and 0.23 ppm of Barium and Strontium, and Bergton, VA streams had 0.14 ppm and 0.05 ppm of Barium and Strontium, respectively. Barium in Bergton, VA. wells was significantly greater than in streams ($p < 0.05$). All of the samples measured, so far, have been well below the EPA limit for Barium and Strontium concentration of 2.0 g/mL and 4.0 g/ml, respectively. Barium in Bergton, VA was found to be significantly lower than other stream baseline samples in the Shenandoah Valley region ($p < 0.05$), which may be due to differences in geology, such as the presence of limestone. Strontium levels showed no significant difference throughout the Shenandoah Valley region. Bergton, VA

samples were also compared with samples in Doddridge County, WV, where hydrofracking is widespread, and although no significant differences were found in Barium and Strontium concentration, the Doddridge County samples appeared to have more variance. If hydrofracking began in Bergton, VA, the established baseline and observations from other areas could be used to indicate hydrofracking fluid leaking into the surrounding waters.

COMPARATIVE ANALYSIS OF NON-TIDAL, MITIGATED, FORESTED WETLANDS IN VIRGINIA PIEDMONT AND INNER COASTAL PLAIN. J.B. Radolinski & M.L. Bass, Department of Earth & Environmental Sciences, Univ. of Mary Washington, Fredericksburg, VA, 22401. Three constructed non-tidal palustrine forested wetlands (PFO) and one natural PFO were compared based on vegetative proliferation and soil physiochemical characteristics. Vegetation parameters included woody stem counts, a list of total wetland flora, Basal Area (BA), and Diameter at Breast Height (DBH) measurements. Soils were flooded using enriched freshwater and measured colorimetrically for N exchange/release and P sorption/desorption, in order to approximate biogeochemical nutrient cycling as a result of prolonged inundation. All wetland soils released N (2.65-13.6 mg NH_4-N/m^2). P sorption/desorption ranged from -4.35 mg PO_4-P/m^2 (desorption) to 16.6 mg PO_4-P/m^2 (sorption). The natural wetland (PNWL) supported significantly larger trees (DBH=13.1±1.29 cm) (BA=9.93 $cm^2 m^{-2}$) (ANOVA, $F_{3,12} = 9$, $p<0.0001$), the lowest density of woody stems (1102±440 ws ha^{-1}), the lowest species richness (S=14), while also containing the most soil organic matter and phosphorus through a depth of 30 cm. Overall, the 19 year old SMWL differed significantly from PNWL with a high density of smaller trees (4095±1951 ws ha^{-1}) (p=0.046) (DBH=0.99±0.43 cm) and sandy entisols showing a reduction in soil quality with depth. Underdeveloped, anthropogenically altered soils (udorthents) found in SMWL and beaver activity have likely limited success for this constructed PFO. Findings suggest that special attention be paid to initial soil conditions during construction. This study also underlines the complexity of flood-induced nutrient cycling in hydric soil, especially relevant as sea level rise and increased precipitation may result in more flood-prone wetlands in many transitional fluvial systems.

SEASONAL WATER QUALITY DEGRADATION, WILDLIFE, AND PROTECTED AREAS IN SOUTHERN AFRICA. J. Tyler Fox[1] & Kathleen A. Alexander[1,2], [1]Department of Fish & Wildlife Conservation, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061 & [2]CARACAL: Centre for Conservation of African Resources, Kasane, Botswana. Sustainable management of dryland river systems is often complicated by extreme variability of precipitation in time and space, especially across large catchment areas. Because of the extensive provision of ecosystem services and high subsistence value of southern African dryland rivers and wetland systems, there is a critical need to better understand the interdependent drivers of regional water quality changes. Using field transect data, GIS and remote sensing analysis, and spatiotemporal modeling, we examined seasonal variation of the fecal indicator

bacteria, *Escherichia coli,* and total suspended solids (TSS) in the Chobe River in relation to land use and hydrology. Our results suggest that direct deposition of fecal material in the Chobe River by wildlife, as well as accumulation feces in the landscape and subsequent flushing by rainfall and seasonal floods, are significant drivers of water quality declines in this dryland system. Park land use (p = 0.0009) and the presence of river floodplain (p = 0.016) were significantly associated with higher *E. coli* concentrations, and locations where *E. coli* was highest corresponded spatially with areas of high wildlife biomass.

DISTRIBUTION OF BACKGROUND TRACE INORGANIC MERCURY WITHIN TERRESTRIAL ECOSYSTEMS IN ROCKINGHAM CO., VA. Greg E. Mansour, Gail M. Moruza & Dean Cocking, Department of Biology, James Madison University. Despite the fact that there are no major anthropogenic sources of Hg in Rockingham County, there is still a presence of background mercury in A horizon soil, ~0.04 - 0.05 µg Hg•gdw^{-1}. and O horizon duff 0.02 µg Hg•gdw^{-1}. The overall study examines two sites located ~5 km NE and SW of Harrisonburg City for low-level Hg contamination within soil, duff, air, and various macro-invertebrate species. Both sites contain intermediate aged deciduous forest vegetation. Airborne Hg (dissolved, vapor, particulate and that in small organic matter fragments) was collected using passive samplers constructed from inverted plastic petri dishes containing a layer of TangleTrap®. Soil and duff samples were collected manually as were the macroinvertebrates discussed in the next paper. Soil, biotic tissue, and TangleTrap® gel were then digested in hot concentrated sulfuric and nitric acid and analyzed using a Perkin Elmer Flow Injection Atomic Absorption Spectrophotometer (FIMS). The NULL hypothesis was that there would be no difference in the Hg concentrations at the two sites. Detectable Hg was found at both and the NULL hypothesis was rejected for airborne Hg and accepted for the O and A horizon layers. These data were compared with a 2010-12 preliminary study and confirmed similar results for soil but differing results for the airborne sample. This is not unexpected because the years differed in many temporal aspects (e.g. weather) and Air Indices of µg Hg•m^2-surface•day^{-1} of exposure are expected to vary yearly. Detectable low level Hg is present as a potential source for biological uptake at both sites.

DISTRIBUTION OF TRACE INORGANIC MERCURY WITHIN INVERTEBRATE COMPONENTS OF TERRESTRIAL ECOSYSTEMS IN ROCKINGHAM CO., VA. Gail M. Moruza, Greg E. Mansour & Dean Cocking, Department of Biology, James Madison University. Ecosystems in the Shenandoah Valley of Virginia are not directly exposed to major known sources of mercury (Hg) contamination. Therefore, Harrisonburg, located in Rockingham County, was assumed to be suitable as a low level control site in comparison with locations in Waynesboro, VA (48 km distant), which were exposed to industrial Hg contamination in the mid-1900's. Subsequently, the presence of low level background Hg has been demonstrated in Rockingham County. This study examines the total Hg content associated with macroinvertebrate

taxa within the two successional forest sites located within Rockingham County described in the previous presentation. A variety of groups of organisms were digested in hot concentrated nitric and sulfuric acid and analyzed for total Hg concentrations using a Perkin Elmer flow Injection Spectrophotometer dedicated to Hg Analysis. The NULL hypothesis was that, where detectable Hg was present, it would not differ between the replicate sites. Several groups, including house flies, hornets, stink bugs, cockroaches, pill bugs, carion beetles, and hymenopterans contained 0.03 - 0.09 µg $Hg \bullet gdw^{-1}$ (ppm) and the NULL hypotheses were accepted for the Hg containing replicates. They were very similar for the individual species. Others, including Japanese beetles, ants and shield beetles, had concentrations from 0.1 - 0.4 µg $Hg \bullet gdw^{-1}$ and differed at the sites. Higher trophic level daddy long-legs and spiders, contained ~0.23 µg $Hg \bullet gdw^{-1}$. Hg is associated with these organisms, but this study does not confirm whether the association is superficial or internal.

USING STATE-OF-THE-ART MARK-RECAPTURE TECHNIQUES TO CREATE A CONSERVATION ACTION PLAN FOR ENDANGERED FRESHWATER MUSSELS. Alaina C. Esposito[1], Patrice M. Ludwig[1], Lihua Chen[2] & Christine L. May[1], [1]Department of Biology, James Madison University & [2]Deptartment of Mathematics & Statistics, James Madison University. The critically endangered James Spinymussel (*Pleurobema collina*) is a species of unionid freshwater mussel endemic to the James and Dan River basins. In the last 20 years *P. collina* has experienced a substantial decline and currently only occupies 10% of their original habitat, however little information is currently known about this species to assist in conservation. A 230-meter reach of transitional habitat in Swift Run was selected for repeat observations to estimate detection probabilities using a Capture-Mark-Recapture framework. In June 2014, visual scouting began to locate and tag *P. collina* (as well the as other mussel species found) with 12mm Passive Integrated Transponders tags. Repeat surveys were conducted on a bi-weekly basis to relocate all tagged individuals, record their current position and visibility on the surface, as well as relevant habitat characteristics that may have influenced their behavior or detectability. Results show that most *P. collina* are visually detectable <7% of the time, and that water depth, season, mussel size and community composition are significant predictors of detection probabilities. Additionally, modeling simulations have identified how to increase adult survival to 87.5% from manipulating glochidia and juvenile mortality rates. This information has been synthesized into field-usable information and helped create the backbone of a conservation action plan.

CONSERVING ENDANGERED FRESHWATER MUSSELS THROUGH COURSE-EMBEDDED RESEARCH. C. L. May, Department of Biology, James Madison University, MSC 7801, Harrisonburg, VA 22807. Freshwater mussels are among the most endangered animals in North America. Developing conservation strategies for them is complicated by the fact that they are cryptic, rare and poorly understood organisms. Our research team is integrating field studies and artificial stream channel

experiments with mathematical and statistical models to fill important knowledge gaps that can aid in their recovery. The novelty of our approach is using a series of linked courses that provide authentic research experience for both undergraduate and graduate students. Our presentation will use a case example of the federally endangered James Spinymussel and a team of students doing course-embedded research in Population Ecology, Mathematical Models in Biology, and independent research credits. Field studies are utilizing state-of-the art mark-recapture methods to quantify detection probabilities, population size and mortality rates. Artificial stream channel experiments are exploring environmental conditions that effect surface expression, and therefore the probability of detecting the species when it is present. Both approaches are integrating with mathematical and statistical models which are united into a conservation action plan.

Posters

MODELING HABITAT USE FOR THE ENDANGERED JAMES SPINYMUSSEL (*PLEUROBEMA COLLINA*): AN APPROACH FOR SETECTING RARE CRYPTIC ORGANISMS. Dorottya K. Boisen, Dakota M. Kobler, Katie M. Sipes, Alaina C. Esposito, Patrice M. Ludwig & Christine L. May, Department of Biology, James Madison University, Harrisonburg VA 22807. Freshwater mussels are keystone species in their ecosystems, and their filter feeding ameliorates water quality in downstream areas. Over 70% of freshwater mussel species worldwide are listed as vulnerable or more greatly threatened. The James Spinymussel (*Pleurobema collina*) is a species of top priority for conservation in Virginia. Due to limited research, cryptic appearance and behavior, and small population sizes, freshwater mussel conservation efforts have been hindered. A mark and recapture study has tracked approximately 20 James Spinymussels and 60 Notched Rainbow (*Villosa constricta*) mussels marked with Passive Integrated Transponder (PIT) tags at Swift Run in the summer of 2014. Multiple mussel recapture histories provide data about habitat use, stream-bed surface expression, and inform source sink models. We will present our work on this integrated approach to understanding rare cryptic organisms. This research is funded by the Jeffress Memorial Trust.

Medical Sciences

DESIGN AND SAR STUDY OF SMALL MOLECULE CTBP INHIBITORS. S. Korwar[1], B. L. Morris[2], S. R. Grossman[2] & K. C. Ellis[1,2], [1]Department of Medicinal Chemistry & [2] Massey Cancer Center, Virginia Commonwealth University. This project involves developing small molecule inhibitors of C-terminal Binding Protein (CtBP) which act as anti-cancer agents. CtBP is a transcriptional co-repressor of several tumor suppressor genes. It is over expressed in many colon, breast, and ovarian cancer tumors. CtBP has a catalytic site in which the co-factor NADH and substrate 4-